# မြိတ်ဒေသိယစကားရှိ အပြောစကားများလေ့လာချက်

နွယ်နွယ်စိုး[1]

## စာတမ်းအကျဉ်း

ဤစာတမ်းသည် မြိတ်ဒေသိယစကားရှိ အပြောစကားများကို လေ့လာတင်ပြထားသော စာတမ်းဖြစ်ပါသည်။ လေ့လာတင်ပြရာတွင် အခန်း(၁) လေ့လာမှုနယ်ပယ်နှင့် သုတေသနပြုပုံအဆင့်ဆင့်၊ အခန်း(၂) စံမြန်မာဘာသာစကားနှင့်အသုံးမတူသော မြိတ်ဒေသိယအပြော စကားများ၊ အခန်း(၃) မြိတ်ဒေသိယစကားရှိ အာမေဋိတ်အသုံးပါသောအပြောစကားများနှင့် လောကဝတ်အပြောစကားများ ဟူ၍ အခန်း (၃)ခန်းခွဲကာ လေ့လာ တင်ပြထားပါသည်။ အခန်း (၁) တွင် ဤသုတေသနစာတမ်းနှင့် ပတ်သက်၍ လေ့လာမှုနယ်ပယ် သတ်မှတ်ပုံနှင့် သုတေသနပြုလုပ်ပုံ အဆင့်ဆင့်ကို တင်ပြထားပါသည်။ အခန်း(၂) စံမြန်မာဘာသာစကား နှင့်အသုံးမတူသော မြိတ်ဒေသိအပြောစကားများတွင် "ဟထိုး" သံဖြုတ်၍ ပြောသော အပြောစကားများ၊ ရှေ့စကားလုံးဖြုတ်၍ပြောသော အပြောစကားများ၊ ဝါကျအဆုံးသတ် ပစ္စည်းအသုံးမတူသော မြိတ်ဒေသိယ အပြောစကားများ၊ စံမြန်မာဘာသာစကားနှင့် ဗျည်းသံ၊ သရသံအသုံးကွဲပြားသော အပြောစကားများ၊ စံမြန်မာဘာသာစကားနှင့် အခေါ် အဝေါ်အသုံး အနှုန်းကွဲပြားသော အပြောစကားများ ဟူ၍ခွဲခြားကာ လေ့လာတင်ပြထားပါသည်။ အခန်း (၃)တွင် စံမြန်မာဘာသာစကားနှင့် အာမေဋိတ်အသုံးမတူသော အပြောစကားများနှင့် လောကဝတ်အပြောစကားများကို လေ့လာတင်ပြထားပါသည်။ ဤစာတမ်းသည် မြိတ်ဒေသိယစကား လေ့လာလိုသူများအတွက် အထောက်အပံ့ဖြစ်စေနိုင်သော မြိတ်ဒေသအကျိုးပြု သုတေသနစာတမ်း တစ်စောင်ဖြစ်ပါသည်။

## နိဒါန်း

ဤစာတမ်းသည် စံမြန်မာဘာသာစကားနှင့်မတူသော မြိတ်ဒေသိယအပြောစကားများကို လေ့လာတင်ပြ ထားသော စာတမ်းဖြစ်ပါသည်။ **"ရိုးရာအမွေတည်တံ့ဖို့ ဘာသာစကားကိုလေ့လာစို့"** ဟူသောစကားအတိုင်း ဒေသကွဲပြားသောကြောင့် စံမြန်မာဘာသာစကားနှင့် အခေါ်အဝေါ် အသုံးအနှုန်း ကွဲပြားနေသည့် မြိတ် ဒေသိယအပြောစကားများကို ဖော်ထုတ်တင်ပြလိုသော ရည်ရွယ်ချက်ဖြင့် ဤသုတေသနစာတမ်းကို လေ့လာ ရခြင်းဖြစ်ပါသည်။

### ၁။ လေ့လာမှုနယ်ပယ်နှင့် သုတေသနပြုလုပ်ပုံအဆင့်ဆင့်

ဤစာတမ်းတွင် မြိတ်မြို့နယ်ကို လေ့လာမှုနယ်ပယ်အဖြစ် သတ်မှတ်လေ့လာထားပါသည်။ သုတေသန ပြုလုပ်ပုံအဆင့်ဆင့်မှာ စာတမ်းရှင်သည် မြိတ်တက္ကသိုလ်တွင် တာဝန်ထမ်းဆောင်စဉ် (၂ နှစ်ခွဲ) ကာလအတွင်း မြိတ်ဒေသိယစကားများကို လေ့လာသုတေသနပြုခဲ့ပါသည်။ မြိတ်တက္ကသိုလ်ရှိ ဝန်ထမ်းများ၊ ဆရာ၊ ဆရာမ များ၊ ကျောင်းသား၊ ကျောင်းသူများ၊ စားသောက်ဆိုင်များ၊ စီးပွားရေးလုပ်ငန်းရှင်များထံတွင် သိရှိလိုသော ဒေသိယစကားများကို မေးမြန်းစုဆောင်းခဲ့ပါသည်။ ဒေသိယစကားသံများကို အသံသွင်းယူခဲ့ပြီး သဒ္ဒဗေဒ အကွာရာဖြင့် အသံဖလှယ်ပါသည်။ ထို့နောက် သုတေသနပြုလုပ်လိုသောကဏ္ဍများအလိုက် ခွဲခြမ်းစိတ်ဖြာကာ စံမြန်မာဘာသာစကားနှင့် နှိုင်းယှဉ်လေ့လာ ခဲ့ပါသည်။

### ၂။ စံမြန်မာဘာသာစကားနှင့် အသုံးမတူသော မြိတ်ဒေသိယအပြောစကားများ

မြိတ်ဒေသိယစကားများတွင် စံမြန်မာဘာသာစကားနှင့် အသုံးမတူသော မြိတ်ဒေသိယအပြောစကား များကို လေ့လာတွေ့ရှိရပါသည်။ မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့် မတူဘဲ "ဟထိုးသံ" ဖြုတ်၍ပြောသောအပြောစကားများ၊ ရှေ့စကားလုံးဖြုတ်၍ပြောသောအပြောစကားများ၊

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[1] ဒေါက်တာ၊ ပါမောက္ခ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

ဝါကျအဆုံးသတ် ပစ္စည်းစကားအသုံးမတူသော အပြောစကားများ၊ အခေါ်အဝေါ်အသုံးအနှုန်းကွဲပြားသော အပြောစကားများ၊ ဗျည်းသံ၊ သရသံ အသုံးကွဲပြားသော အပြောစကားများကို တွေ့ရှိရပါသည်။

**၂၊ ၁။ "ဟထိုးသံ"ဖြုတ်၍ပြောသော အပြောစကားများ**

မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့်မတူဘဲ "ဟထိုးသံ"ဖြုတ်၍ ပြောသော အပြော စကားများကို လေ့လာတွေ့ရှိရပါသည်။ မြိတ်ဒေသိယစကားတွင် စံမြန်မာဘာသာစကား **"လှေ"** ကို "**လေ**"၊ **"ငှက်"** ကို "ငက်"၊ **"လှည်း"** ကို "**လည်း**"၊ **"မှောက်"** ကို "မောက်"၊ **"မှန်"** ကို "မန်"၊ **"မွှေး"** ကို "**မွေး**" ဟူ၍ "ဟထိုးသံ" မပါဘဲ ပြောဆိုသုံးနှုန်းလေ့ရှိကြပါသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
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| သာဓက ။ | ။ | (၁) ဒယ်ငက် လှဇမား။ | ဒီ**ငှက်**လှလိုက်တာ။ |
| | | (၂) ကမ်းနားမှာ **လေ**တွေ အားပဲ။ | ကမ်းနားမှာ **လှေ** တွေ အများကြီးပဲ။ |
| | | (၃) **မန်** ငယ်တစ်ချပ် ဝယ်ပေးလန်း။ | **မှန်**လေးတစ်ချပ် ဝယ်ပေးပါ။ |
| | | (၄) ဖက်ရယ်လေ **မောက်**ကျကုန်ဘီမား။ | လွှက်ရည်တွေ **မှောက်**ကျကုန်ပြီ။ |
| | | (၅) ဒယ်နပ်ခါး အား**မွေး**မား။ | ဒီသနပ်ခါး တအား**မွှေး**တယ်။ |

အထက်ပါသာဓကများအရ မြိတ်ဒေသိယအပြောစကားများတွင် "ဟထိုးသံ" ဖြုတ်၍ သုံးနှုန်းပြောဆို လေ့ရှိကြောင်း သိရှိရပါသည်။

**၂၊ ၂။ ရှေ့စကားလုံးဖြုတ်၍ပြောသော အပြောစကားများ**

မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့် အသုံးမတူသော ရှေ့စကားလုံး ဖြုတ်၍ ပြောသော အပြောစကားများကို လေ့လာတွေ့ရှိရပါသည်။ စံမြန်မာဘာသာစကား "ထမင်းငတ်သည်" ကို "မင်းငတ်"၊ "ငှက်ပျောသီး" ကို "ဗျောသီး"၊ "ငါးပိဖျော်" ကို "ပိဖျော်"၊ "သူငယ်ချင်း" ကို "ငယ်ချင်း"၊ "ဓနိရည်ချို" ကို "နိရယ်ချို"၊ "လွှက်ရည်" ကို "ဖက်ရယ်"၊ "ငရုတ်သီး" ကို "ရုတ်သီး"၊ "ခြောက်သွေ့သည်" ကို "သွေ့"၊ "စျေးသင့်သည်" ကို "သင့်"၊ "သနပ်ခါး" ကို "နပ်ခါး" ဟူ၍ ရှေ့စကားလုံးကို ဖြုတ်၍ သုံးလေ့ ရှိကြောင်း တွေ့ရပါသည်။

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| သာဓက ။ | ။ | (၁) ငှါဝို **ဗျောသီး**ငယ်တစ်လုံး ဝယ်ကျွေးလန်း။ |
| | | (ငှါကို **ငှက်ပျောသီး**လေးတစ်လုံး(လောက်) ဝယ်ကျွေးပါနော်။) |
| | | (၂) အာမိဝေး ဒါ **ရုတ်သီး** အားစပ်မား။ (အမလေး ဒီ**ငရုတ်သီး** အရမ်းစပ်တယ်။) |
| | | (၃) ရှမ်းချောင်းမှာ **နိရယ်ချို** သွားသောက်ဇို့လန်း။ |
| | | (စမ်းချောင်းမှာ **ဓနိရည်ချို** သွားသောက်ကြစို့နော်။ ) |
| | | (၄) နင် **ဖက်ရယ်** အားကြိုက်မား။ (နင်**လွှက်ရည်** အရမ်းကြိုက်တယ်။) |
| | | (၅) ဒယ်**ပိဖျော်** စားကောင်းဇမား။ (ဒီ**ငါးပိဖျော်** အရမ်းစားကောင်းတယ်။ ) |

အထက်ပါသာဓကများအရ မြိတ်ဒေသိယအပြောစကားများတွင် "ရှေ့စကားလုံး" ဖြုတ်၍ သုံးနှုန်း ပြောဆိုလေ့ရှိကြောင်း သိရှိရပါသည်။

၂။ ၃။ ဝါကျအဆုံးသတ်ပစ္စည်း အသုံးမတူသော အပြောစကားများ

မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့် ဝါကျအဆုံးသတ်ပစ္စည်းအသုံးမတူသော အပြောစကားများကို လေ့လာတွေ့ရှိရပါသည်။ စံမြန်မာဘာသာစကား၌ မရှိသော “ဇ၊ ဇမား၊ ဝမား၊ ဇလန်း၊ လန်း၊ ဝ့ဲလန်း၊ ဝ့ဲနား၊ နား၊ ရယ်” စသော ဝါကျအဆုံးသတ်ပစ္စည်းစကားများကို သုံးနှုန်းပြောဆိုနေကြကြောင်း တွေ့ရှိရပါသည်။

စိတ်ခံစားမှုကို ဖော်ညွှန်းသည့်သဘောကိုဆောင်သည့် ဝါကျများတွင် စံမြန်မာဘာသာစကားရှိ ဝါကျအဆုံးသတ်ပစ္စည်းစကား“တယ်”အစား “ဇ”ကို ကြိယာ၏နောက်တွင်ထား၍ သုံးလေ့ရှိပြီး သာမန်ထက်ပိုမိုလွန်ကဲသည့်သဘောကို ဖော်ပြလိုလျှင် “ဇမား” ဟူသော အဆုံးသတ်ပစ္စည်းစကားကို သုံးလေ့ရှိကြောင်း တွေ့ရပါသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|
| သာဓက။ | ။ | ၁။ နင့်ဝို အားနာ**ဇ**။ | နင့်ကို အားနာ**တယ်**။ |
| | | ၂။ ငါစိတ်ညစ်**ဇ**။ | ငါစိတ်ညစ်**တယ်**။ |
| | | ၃။ ငါနင့်ဝိုလွမ်း**ဇ**။ | ငါနင့်ကို လွမ်းတယ်။ |
| | | ၄။ ငါနင့်ဝိုလွမ်း**ဇမား**။ | ငါနင့်ကို အရမ်းလွမ်းတယ်။ |
| | | ၅။ နင့်ဝို ချစ်**ဇ**။ | နင့်ကို ချစ်တယ်။ |
| | | ၆။ ငါနင့်ဝို ချစ်**ဇမား**။ | ငါနင့်ကို အရမ်းချစ်တယ်။ |

ယဉ်ကျေးသည့်အသုံးကို သုံးလိုသောအခါ စံမြန်မာဘာသာစကားတွင် “နော်” ဟု အဓိပ္ပာယ်ရသည့် ဝါကျအဆုံးသတ်ပစ္စည်းစကားများအဖြစ် “နား၊ ဝ့ဲနား၊ လန်း” တို့ကို သုံးနှုန်းလေ့ရှိကြောင်း တွေ့ရသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|
| သာဓက။ | ။ | ၁။ မိုးလင်းသောဇ့ဲ**နား**။ | မနက်ဖြန်သွားစို့**နော်**။ |
| | | ၂။ ဒယ်ဇာ စျေးကြီး**ဇ** သောမကိုင်နဲ့**နား**။ | ဒီဟာစျေးကြီးတယ် သွားမကိုင်နဲ့**နော်**။ |
| | | ၃။ ပုဂံဟန်တွေလာမလုပ်ဝ့ဲ**နား**။ | ရန်ကုန်ဟန်တွေ လာမလုပ်နဲ့**နော်**။ |
| | | ၄။ မိုးလင်းဘုရားအတူသောဇ့ဲ**လန်း**။ | မနက်ဖြန် ဘုရားအတူသွားစို့**နော်**။ |
| | | ၅။ အသံကောင်း**ဇလန်း**။ | အသံကောင်းတယ်**နော်**။ |

ထို့ပြင် မြိတ်ဒေသိယအပြောစကားများတွင် ငြင်းဆန်မှုသဘောကို ဖော်ပြလိုသောအခါ “ဝ”၊ “ရ”၊“ဝမား” (ဘူး) ဟူသော ဝါကျအဆုံးသတ်ပစ္စည်းစကားများကို သုံးလေ့ရှိကြောင်း တွေ့ရပြီး တစ်ခါတစ်ရံတွင်မူ အငြင်းပစ္စည်းစကား “မ” ကိုဖြုတ်၍ “မဟုတ်ဝ”၊ အစား “ဟုတ်ဝ” (ဟုတ်ဘူး) ဟူ၍ သုံးကြောင်းလည်း တွေ့ရှိရပါသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|
| သာဓက။ | ။ | ၁။ ငါရန်ကုန်မာ မပျော်ဝမား | ငါရန်ကုန်မှာ မပျော်ဘူး |
| | | ၂။ ဒယ်ဇာ ငါမသိရ | ဒီဟာ ငါမသိဘူး |
| | | ၃။ မဟုတ်ဝ | မဟုတ်ဘူး |
| | | ၄။ ငါမပြောရ | ငါမပြောဘူး |
| | | ၅။ ငါမလုပ်ဝ | ငါမလုပ်ဘူး |

စံမြန်မာဘာသာစကားတွင်သုံးသည့် အည္ဆန်းပစ္စည်းစကားအသုံး "ဒီဟာ"ကို မြိတ်ဒေသိယစကားတွင် "ဒယ်ဇာ"၊ "ဒယ်ဟာ"၊ "ဒုတ်ဇာ"၊ "ဒါ" ဟုအမျိုးမျိုး ကွဲပြားစွာ ပြောဆိုသုံးနှုန်းနေကြောင်း တွေ့ရသည်။ ထို့ပြင် အမေးပစ္စည်းစကား "ဘာလဲ" ကို မြိတ်ဒေသိယစကားတွင် "ဘုတ်ဇာ"ဟု သုံးနှုန်းသည်ကိုလည်း တွေ့ရပါသည်။

| | | |
|---|---|---|
| သာဓက။ ။ | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
| | ၁။ ဒုတ်ဇာ ဘုတ်ဇာ | ဒီဟာ ဘာလဲ |
| | ၂။ ဒယ်ဇာတစ်ခုတော့ ဂုဏ်ယူဝို့လန်း | ဒီဟာတစ်ခုတော့ ဂုဏ်ယူစို့နော် |
| | ၃။ ဒယ်ဇာမျိုးဆို မကြိုက်ရ | ဒီလိုမျိုးဆို မကြိုက်ဘူး |

အထက်ပါသာဓကများအရ မြိတ်ဒေသိယအပြောစကားများရှိ ဝါကျအဆုံးသတ်ပစ္စည်းစကားများသည် စံမြန်မာဘာသာစကားနှင့် မတူညီဘဲ ကွဲပြားစွာ သုံးနှုန်းနေကြောင်း လေ့လာတွေ့ရှိရပါသည်။

**၂၊ ၄။ စံမြန်မာဘာသာစကားနှင့် ဗျည်းသံ၊ သရသံ အသုံးကွဲပြားသောအပြောစကားများ**

မြိတ်ဒေသိယစကားနှင့် စံမြန်မာဘာသာစကားတို့သည် အသံထွက်တူညီမှုများရှိသကဲ့သို့ ကွဲပြားသောစကားသံများလည်းရှိကြောင်း လေ့လာတွေ့ရှိရပါသည်။ ဗျည်းသံ၊ သရသံကွဲပြားမှုများတွင် အများအားဖြင့် စံမြန်မာဘာသာစကားနှင့် သရသံကွဲပြားမှု ပိုမိုများပြားကြောင်း တွေ့ရှိရပါသည်။

**၂၊ ၄၊ ၁။ ဗျည်းသံအသုံးကွဲပြားသော မြိတ်ဒေသိယအပြောစကားများ**

မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့် မတူသော ဗျည်းသံအသုံးကွဲပြားမှုများကိုတွေ့ရှိရပါသည်။ စံမြန်မာဘာသာစကားရှိ ဝါကျအဆုံးသတ်ပစ္စည်းစကား "တယ်" ကို မြိတ်ဒေသိယစကား တွင် "ရယ်"၊ စံမြန်မာဘာသာစကား "တဲ့" ကို မြိတ်ဒေသိယစကားတွင် "ရဲ့" ဟူ၍ စံမြန်မာဘာသာစကား "တ" ဗျည်း သံကို မြိတ်ဒေသိယစကားတွင် "ရ" ဗျည်းသံနှင့် ရွတ်ဆိုလေ့ရှိကြောင်း တွေ့ရှိရပါသည်။ ထို့ပြင် စံမြန်မာဘာသာစကားတွင်သုံးသည့်"ကို" ကို မြိတ်ဒေသိယအပြောစကား "ဝို"ဟူ၍ သုံးကြောင်း တွေ့ရသည်။ စံမြန်မာဘာသာတွင်သုံးသော "က" ဗျည်းအသုံးကို မြိတ်ဒေသိယစကားတွင် "ဝ"ဗျည်းသံအဖြစ် အသုံး ကွဲပြားသည့် သဘောပင်ဖြစ်သည်။

စံမြန်မာဘာသာစကားတွင်သုံးသည့် အည္ဆန်းပစ္စည်းစကားအသုံး ''ဒီဟာ''ကို မြိတ်ဒေသိယအပြောစကားတွင် ''ဒယ်ဇာ'' ဟူ၍ ''ဟ'' ဗျည်းအစား '' ဇ'' ဗျည်းကို အသုံးပြုပြောဆိုနေကြောင်း တွေ့ရပါသည်။ ထို့ပြင် စံမြန်မာဘာသာစကားတွင်အသုံးပြုသည့် သံပြင်းဗျည်း "ဘ" ကို မြိတ်ဒေသိယအပြောစကားတွင် သံတင်းဗျည်း "ဖ" ဖြင့် သုံးနှုန်း ပြောဆိုနေကြောင်း တွေ့ရပါသည်။ သာဓကအားဖြင့် "ဘယ်"ကို "ဖယ်"၊ "ရင်ဘတ်" ကို "ရင်ဖတ်" စသည်ဖြင့် အသုံးကွဲပြားမှုမျိုး ဖြစ်ပါသည်။

သာဓက။ ။(၁) ငါပြောဇာ<u>ဝို</u> နင်မမေ့ရဲ့နား (ဝို > ကို ) (ဝ> က)

(ငါပြောတာ<u>ကို</u> မမေ့နဲ့နော်)

(၂) ဒယ်<u>ဇာ</u> စျေး ရှု ဝယ်လာ<u>ရယ်</u> (ဇာ> ဟာ) (ဇ> ဟ) ।(ရ> က)। (ရယ်> တယ်) (ရ> တ)

(ဒီ<u>ဟာ</u>စျေး<u>က</u> ဝယ်လာ<u>တယ်</u>)

(၃) ငါ့မာ ကြီးပြားစု<u>ဟား</u>ရယ် (ဟား> ထား) (ဟ> ထ)

(ငါ့မှာ ကြီးပြား စု<u>ထား</u>တယ်) (ရယ်> တယ်) (ရ> တ)

**၂။ ၄၊ ၂။ သရသံအသုံးကွဲပြားသော မြိတ်ဒေသိယအပြောစကားများ**

မြိတ်ဒေသိယစကားနှင့် စံမြန်မာဘာသာစကားတို့သည် အသံထွက်တူညီမှုများရှိသကဲ့သို့ ကွဲပြားမှုများလည်း ရှိပါသည်။ စံမြန်မာဘာသာစကားနှင့် သရသံကွဲပြားမှုသည် ဗျည်းသံကွဲပြားမှုထက် ပိုမိုများပြားကြောင်း တွေ့ရှိရပါသည်။ စံမြန်မာဘာသာစကားတွင် "အီ" /i/ သရသံ၊ "အေ" /e/သရသံဖြင့် ပြောဆိုသုံးနှုန်းသည်ကို မြိတ်ဒေသိယတွင် "အယ်" /ɛ/ သရသံဖြင့်လည်းကောင်း၊ စံမြန်မာစကားတွင် "အား" /á/ သရသံဖြင့် ပြောဆို သုံးနှုန်းသည်ကို မြိတ်ဒေသိယတွင် "အော" /ɔ/ သရသံဖြင့်လည်းကောင်း စံမြန်မာဘာသာစကားတွင် "အက်" /ɛʔ/သရသံဖြင့် ပြောဆို သုံးနှုန်းသည်ကို မြိတ်ဒေသိယတွင် "အစ်" /iʔ/ သရသံဖြင့် ကွဲပြားစွာ သုံးနှုန်းနေကြ ကြောင်း တွေ့ရသည်။

| | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|
| | ၁။ <u>**အယ်**</u> /ɛ/ | <u>**အေ**</u> /e/ |
| | **မယ်** | **မေ** |
| | ၂။ <u>**အယ်**</u> /ɛ/ | <u>**အီ**</u> /i/ |
| | **ရယ်** | **ရီ** |
| | ဒယ်နေ့ | ဒီနေ့ |
| | စယ် | စည် |
| သာဓက။ | (၁) <u>**မယ်မယ်**</u>ဆီ သွားဝို့လန်း | |
| | (<u>**မေမေ**</u>ဆီ သွားစို့နော်) | (အယ် > အေ) /ɛ/ > /e/ |
| | (၂) ငါဝို မ<u>ရယ်</u>ဇားနဲ့လန်း | |
| | (ငါ့ကိုမရီနဲ့နော်) | (အယ် > အီ) /ɛ/ > /i/ |
| | (၃) <u>**ဒယ်**</u>နေ့ ဘုရားမှာ လူတွေ **စယ်**နေလန်း | |
| | (<u>**ဒီ**</u>နေ့ ဘုရားမှာ လူတွေ စည်နေတယ်) | (အယ် > အီ) /ɛ/ > /i/ |
| | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
| | ၃။ <u>**အော**</u> /ɔ/ | <u>**အား**</u> /á/ |
| | သော | သွား |
| သာဓက။ | (၁) ငါဈေး<u>**သော**</u>ဝို့ ။ | ငါဈေး<u>**သွား**</u>ဖို့။ (အော >အား) /ɔ/ > /á/ |
| | (၂) မိုးလင်း ရန်ကုန်<u>**သော**</u>ဝို့။ | မနက်ဖြန် ရန်ကုန်<u>**သွား**</u>ဖို့။(အော >အား)/ɔ/ >/á/ |
| | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
| | ၄။ <u>**အစ်**</u> /iʔ/ | <u>**အက်**</u> /ɛʔ/ |
| | မျစ်နာ | မျက်နှာ |
| | နစ် | နက် |
| | ခစ် | ခက် |

| | | |
|---|---|---|
| သာဓက။ (၁) | **ဒယ်**ဇာလုပ်ရ**ခစ်**ဇ။ | **ဒီ**ဟာလုပ်ရ**ခက်**တယ်။ (အစ် > အက်) /iʔ / > /ɛʔ / |
| (၂) | **ဒယ်**ရေကန် **နှစ်**ဇနား။ | **ဒီ**ရေကန် **နှက်**တယ်နော်။ (အစ်> အက်) /iʔ / > /ɛʔ / |

စံမြန်မာဘာသာစကားတွင် စကားလုံးနှစ်လုံးကို တစ်ဆက်တည်း ရွတ်ဆိုသည့်အခါ သံညင်းသံမှ သံပြင်းသံသို့လည်းကောင်း၊ အသံပြည့်မှ မတြာဝက်သရသံသို့လည်းကောင်း ပြောင်းလဲသွားလေ့ရှိပါသည်။ မြိတ်ဒေသိယစကားတွင်မူ အသံပြည့်မှ မတြာဝက်သရသံသို့ ပြောင်းလဲသွားခြင်းမရှိဘဲ အသံပြည့်ဖြင့်သာ ပြောဆိုသုံးနှုန်းလေ့ရှိကြောင်း တွေ့ရပါသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|
| သာဓက။ | ။ | ကြမ်းပိုး/ ကြမ်းပိုး/ | ကြမ်းပိုး / ဂျတိုး/ |
| | | ငါးခြောက် / ငါးခြောက်/ | ငါးခြောက် /ငခြောက်/ |
| | | ဝါးလုံး/ ဝါးလုံး / | ဝါးလုံး /ဝလုံး/ |
| သာဓက။ | (၁) | အယ့်ဝါးလုံး ငှါဇာလန်း။ | ဒီဝါးလုံး ငှါဟာနော်။ |
| | (၂) | မိုးလင်း ငါးခြောက် ဟင်းချက်လာလန်း။ | မနက်ဖြန် ငါးခြောက်ဟင်းချက်လာနော်။ |
| | (၃) | အိမ်မာကြမ်းပိုး အားပေါလန်း။ | အိမ်မှာကြမ်းပိုး တအားပေါတယ်။ |

အထက်ပါသာဓကများအရ မြိတ်ဒေသိယအပြောစကားများတွင်ရှိသော သရသံအသုံးများသည် စံမြန်မာစကားနှင့် မတူဘဲ ကွဲပြားစွာ ပြောဆိုသုံးနှုန်းနေကြောင်း လေ့လာတွေ့ရှိရပါသည်။

**၂၊ ၅။ စံမြန်မာဘာသာစကားနှင့် အခေါ်အဝေါ်**အသုံးအနှုန်း**ကွဲပြားသော အပြောစကားများ**

မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့် အခေါ်အဝေါ်အသုံးအနှုန်းမတူသော အပြော စကားများကို လေ့လာတွေ့ရှိရပါသည်။ "ပိုက်ဆံ" ကို "ကြေးပြား"၊ "ဆန်ပြုတ်" ကို "မင်းဖြုတ်"၊ "မနက် မိုးလင်း" ကို "ကြက်တွန်"၊ "စျေးကြီးသည်" ကို "စွန်သည်"၊ "သကြီန်ထမင်း" ကို "မင်းရေဒိမ်"၊ "မနက်ဖြန်" ကို "မိုးလင်း"၊ "ကျောက်ပုဇွန်" ကို "ဗဂဲ"၊ "မိတ်" ကို "ချွေးဗျောသီး"၊ "စိတ်ဆိုးသည်" ကို "စိတ်ပေါက်သည်"၊ "သေးသေးလေး" ကို "နည်းနည်းငယ်"၊ "မြင်းခွာရွက်" ကို "ရိုးငယ်ရွက်"၊ "အထက်ဆင်" ကို "ဂဒင်"၊ "ကျွဲကောသီး" ကို "တာအိုးသီး"၊ "သီဟိုဠ် သီး" ကို "ခရုသီး"၊ "ထမင်းဆာသည်" ကို "ဝမ်းဟာသည်"၊ "အရမ်း" ကို "ဒတ်ဆိုး"၊ "ပြူးတူးပြဲတဲ" ကို "အောလီအောလစ်"၊ "ရီသည်" (ပျက်ရယ်ပြုသည်) ကို "ရယ်ဇားသည်" ဟူ၍ စံမြန်မာဘာသာစကားနှင့် အခေါ်အဝေါ် အသုံးအနှုန်းများ ကွဲပြားလျက်ရှိကြောင်း တွေ့ရပါသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|
| သာဓက ။ | ။ (၁) | **ဗဂဲ**လေ စျေးကြီးဇ။ | **ကျောက်ပုဇွန်**တွေ စျေးကြီးတယ်။ |
| | (၂) | **မိုးလင်း** ဘုရားသောဇို့။ | **မနက်ဖြန်** ဘုရားသွားစို့။ |
| | (၃) | သူငှါကို **စိတ်ပေါက်**နေရယ်လန်း။ | သူငှါကို **စိတ်ဆိုး**နေတယ်။ |
| | (၄) | ငှါမှာ **ကြေးပြား**မရှိရ။ | ငှါမှာ **ပိုက်ဆံ** မရှိဘူး။ |
| | (၅) | ဒယ်**မင်းဖြုတ်** အားစားကောင်းဇမား။ | ဒီ**ဆန်ပြုတ်** အရမ်းစားကောင်းတယ်။ |
| | (၆) | **ကြက်တွန်** မြို့ဝို သောဇို့ | **မနက်** မြို့ကို သွားစို့။ |

မြိတ်ဒေသိယအပြောစကားများတွင် “ငယ်” ဟူသောစကားလုံးကို ထည့်သွင်းပြောဆို လေ့ရှိကြောင်း ထူးခြားစွာတွေ့ရပါသည်။

| | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|
| သာဓက ။ ။ | (၁) ဒယ်အက်ျီ**ငယ်**လှဇမား။ | ဒီအင်္ကျီ**လေး** လှလိုက်တာ။ |
| | (၂) ဒယ်သားကင်း**ငယ်**လေ ဆိုးဇ။ | ဒီကလေး**လေး** သိပ်ဆိုးတယ်။ |
| | (၃) ဒယ်သီချင်း**ငယ်** နားထောင်ကောင်းဇ။ | ဒီသီချင်း**လေး** နားထောင်ကောင်းတယ် ။ |

ထို့ပြင် “ယူဆောင်သည်”၊ “သယ်ဆောင်သည်” “ကိုင်ဆောင်သည်” “ဝယ်ဆောင်သည်” “ခေါ်ဆောင်သည်” ဟူသောအသုံးကို စံမြန်မာဘာသာစကားတွင် “ယူ”၊ “သယ်”၊ “ကိုင်”၊ “ဝယ်” “ခေါ်” ဟူ၍ လုံးချင်းကြိယာစကားလုံးများကိုသာ သုံးလေ့ရှိပါသည်။ မြိတ်ဒေသိယစကားတွင်မူ အဓိပ္ပာယ် ပိုမိုလေးနက်ပြည့်စုံစေလိုသောသဘောဖြင့် “ယူဆောင်သည်”၊ “သယ်ဆောင်သည်” “ကိုင်ဆောင်သည်” “ဝယ်ဆောင်သည်” “ခေါ်ဆောင်သည်” ” ဟူ၍ ''ဆောင်'' ဟူသော စကားလုံးကို ထည့်သွင်းပြောဆိုလေ့ရှိကြောင်း တွေ့ရပါသည်။

| | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|
| သာဓက ။ ။ | (၁) ဒယ်ပစ္စည်း **<u>သယ်ဆောင်</u>သော**ဝို့လန်း။ | ဒီပစ္စည်း <u>သယ်</u>သွားဖို့(လား)။ |
| | (၂) ဒယ်ဟာဝို **<u>ယူဆောင်</u>**သောဝို့လန်း။ | ဒီဟာကို <u>ယူ</u>သွားဖို့ (လား)။ |
| | (၃) ဒယ်မုန့်ဝို **<u>ဝယ်ဆောင်</u>**သောဝို့။ | ဒီမုန့်ကို <u>ဝယ်</u>သွားဖို့။ |

အထက်ပါသာဓကများအရ မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့် အခေါ်အဝေါ် အသုံးအနှုန်းများ ကွဲပြားသော အပြောစကားများရှိကြောင်း လေ့လာတွေ့ရှိရပါသည်။

**၃။ မြိတ်ဒေသိယစကားရှိ အာမေဋိတ်အသုံးပါသောအပြောစကားများနှင့် လောကဝတ်အပြောစကားများ**

မြိတ်ဒေသိယအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့်မတူသော **အာမေဋိတ်အသုံးများနှင့် လူတစ်ဦး** နှင့်တစ်ဦး ဆုံတွေ့ကြသောအခါ လောကဝတ်တာဝန်အရ ပြောဆိုနှုတ်ဆက်ကြသော လောကဝတ်အပြော စကားများကို လေ့လာတွေ့ရှိနိုင်ပါသည်။

**၃၊ ၁။ အာမေဋိတ် အသုံးပါသော အပြောစကားများ**

လူမှုကိစ္စအဝဝအတွက် တစ်ဦးနှင့်တစ်ဦး ပြောဆို ဆက်သွယ်နေကြသော ဘာသာစကားများတွင် စိတ်ခံစားမှုနှင့် ယှဉ်သော အာမေဋိတ်စကားသည်လည်း တစ်ခုအပါအဝင်ဖြစ်ပါသည်။ လူတို့သည် မိမိခံစားရသော ခံစားမှုနှင့် အညီ နှုတ်မှအာမေဋိတ်အသုံးအမျိုးမျိုးကို ပြောဆိုလေ့ရှိကြသည်။ စိတ်ကျေနပ်နှစ်သက်ဖွယ်၊ ဝမ်းသာ ပျော်ရွှင်ဖွယ်၊ စိုးရိမ်ထိတ်လန့်ဖွယ်၊ ဝမ်းနည်းဖွယ်စသော စိတ်ခံစားမှုများနှင့် ကြုံတွေ့ကြရသည့်အခါများတွင် အာမေဋိတ်စကားများကို ရေရွတ်ပြောဆိုလေ့ရှိကြပါသည်။

မြန်မာအဘိဓာန်တွင် အာမေဋိတ်ကို အနက်ဖွင့်ဆိုရာ၌ “အာမေဋိတ်သည် ပါဠိစကား “အာမေဋိတ” မှ ဆင်းသက်လာသည်။ ထိတ်လန့်ခြင်း၊ အံ့သြခြင်း၊ ဝမ်းသာခြင်း စသည့် တစ်စုံတစ်ခုသော အကြောင်းကြောင်းကြောင့် ပြင်းပြင်းထန်ထန် စိတ်လှုပ်ရှားကာ ရုတ်တရက်ထွက်ပေါ် လာသော အသံ” (မြန်မာအဘိဓာန်၊ ၁၉၉၁၊ ၄၂၉) ဟူ၍ ဖွင့်ဆိုထားပါသည်။

ထို့ပြင် ဆရာမောင်ခင်မင် (ဓနုဖြူ)ကလည်း “ထိတ်လန့်ခြင်း၊ အံ့သြခြင်း၊ ဝမ်းသာခြင်း စသည့်အကြောင်းများကြောင့် စိတ် လှုပ်ရှားပြီး နှုတ်က ရုတ်တရက်ပွင့်ထွက်လာသော စကားလုံးလေးများ

ရှိတတ် ပါသည်၊ အာမေဋိတ်ဟုခေါ်ပါသည်။ အာမေဋိတ်စကားများကို စကားတစ်ခု အစချီရာတွင်ဖြစ်စေ၊ စကားအဆုံးသတ်ရာတွင်ဖြစ်စေ ထည့်သုံးလေ့ရှိပြီး ခံစားမှု ထင်ဟပ်သည့် စကားလေးများ ဖြစ်သည်။" (ခင်မင်၊ မောင်၊ ၂၀၀၁၊ ၇၄) ဟူ၍ ဖွင့်ဆိုထားပါသည်။

ထို့ကြောင့် အာမေဋိတ်စကားများကို စကားအစချီရာတွင်ဖြစ်စေ၊ စကားအဆုံးသတ်ရာတွင် ဖြစ်စေ ထည့်သွင်းပြောဆိုလေ့ရှိကြောင်း သိရှိရပါသည်။ ထို့ပြင် လက်တွေ့လူမှုဝန်းကျင်ရှိ လူ့အဖွဲ့အစည်းတွင် စိတ်ခံစားမှုတစ်ခုခုနှင့် ကြုံတွေ့ရသည့်အခါ မိမိတို့၏ ဘုရားကို တ၍ "ဘုရား"၊ "အနိစ္စ"၊ "ဘုရား၊ ဘုရား" ဟူ၍ အာမေဋိတ်ပြုလေ့ရှိကြသည်ကို တွေ့ရပါသည်။ မြိတ်ဒေသိယအပြောစကားများတွင်လည်း စံမြန်မာ ဘာသာစကားကဲ့သို့ အာမေဋိတ်အသုံးများကို တွေ့နိုင်ပါသည်။ မြိတ်ဒေသိယအပြောစကားများတွင် အာမေဋိတ်အသုံးများအဖြစ် "အာမိဝေး"၊ "မိဝေး"၊ "အာချေအေး"၊ "အာလန်း"၊ "မိဝေး ဘုရား ဘုရား" တို့ကို ပြောဆိုသုံးနှုန်းနေကြကြောင်း တွေ့ရပါသည်။

| | | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|---|
| သာဓက ။ | ။ | (၁) | **မိဝေး** အားလှမား | အမလေး တအားလှလိုက်တာ |
| | | (၂) | **အာမိဝေး** နင်တော်ဇမား | အမလေးနင်သိပ်တော်လိုက်တာ |
| | | (၃) | **မိဝေးဘုရားဘုရား** တော်သေးရိ | အမလေး**ဘုရားဘုရား** တော်သေးတယ် |
| | | (၄) | **အာလန်း** နာဆိုးဘဲ(ဝဲ) | အမလေး နာလိုက်တာ |
| | | (၅) | အာချေအေး စိတ်ညစ်ဆိုး | အမလေး သိပ်စိတ်ညစ်တယ် |

အထက်ပါသာဓကများအရ မြိတ်ဒေသိယအပြောစကားများတွင် အာမေဋိတ်အသုံးများကို အသုံးပြုလေ့ရှိကြောင်း လေ့လာတွေ့ရှိရပါသည်။

**၃၊ ၂။ လောကဝတ်အပြောစကားများ**

လူမှုဆက်ဆံရေးနယ်ပယ်တွင် တစ်ဦးနှင့်တစ်ဦးဆုံတွေ့ကြသောအခါ လောကဝတ်စကားများနှင့် နှုတ်ခွန်းဆက် လေ့ရှိကြပါသည်။ လောကဝတ်စကားဟူသည် လူတစ်ဦးနှင့်တစ်ဦး ဆက်သွယ်ပြောဆိုရာ၌ ဆက်ဆံရေး ပြေပြစ်ချောမွေ့ လွယ်ကူစေရန်အတွက် အသုံးပြုပြောဆိုသော စကားများဖြစ်သည်။

မြန်မာအဘိဓာန်တွင် "လောကဝတ်" ကို လောကွတ် – / လောဝွတ်/ နာ – ဖော်ရွေပျူငှာမှု ဟူ၍ ဖွင့်ဆိုထားသည်ကို တွေ့ရပါသည်။ လူတစ်ဦးနှင့်တစ်ဦး တွေ့ဆုံကြသောအခါ "နေကောင်းလား"၊ "ထမင်းစားပြီးပြီလား"၊ "ဘယ်သွားမလို့လဲ" စသည်ဖြင့် မေးမြန်းခြင်းသည် အမှန်တကယ် နေကောင်း မကောင်း၊ ထမင်းစားပြီး၊ မပြီး သိလို၍မေးမြန်းခြင်းမဟုတ်ဘဲ လူ့လောက၏လောကဝတ်တာဝန်အရ မေးမြန်းကြသော စကားများဖြစ်သည်။

"လောကဝတ်များပြောဆိုရာတွင် အကြောင်းအရာသည် ပဓာနမဟုတ် ပြောဆိုသူ၊ တုန့်ပြန်သူတို့၏ အမူအရာ၊ လေယူလေသိမ်း၊ အသံအနိမ့်အမြင့်၊ အတက်အကျ တို့သည်သာ ပဓာနဖြစ်သည်။" (ခင်ခင်အေး၊ ဒေါ်၊ ၁၉၆၆၊ ၁၆၃)

မြိတ်ဒေသိယအပြောစကားများတွင်လည်း လောကဝတ်အပြောစကားများကိုတွေ့ရသည်။

လောကဝတ် စကားများကို

(၁) ပြောသူကို အခြေခံသော လောကဝတ်စကား

(၂) နာသူကို အခြေခံသော လောကဝတ်စကား

(၃) အခြေအနေအဆက်အစပ်နှင့်သက်ဆိုင်သောလောကဝတ်စကား

ဟူ၍(၃)မျိုး ခွဲခြားနိုင်သည်။

**၃၊ ၂။ ၁။ ပြောသူကို အခြေခံသော လောကဝတ်စကား**

ပြောသူကိုအခြေခံသောလောကဝတ်စကားသည် မိမိတစ်ဦးတည်းဖြစ်နေသည့်အခိုက်၌ မိမိ၏ စိတ်ခံစားချက်၊ ဖြစ်လိုသောဆန္ဒများကို မိမိတစ်ဦးတည်း ပြောဆိုရေရွတ်မိသော စကားဖြစ်သည်။ ထိုကဲ့သို့သော အပြော စကားများကို စံမြန်မာဘာသာစကားတွင်သာမက မြိတ်ဒေသိယစကားတွင်လည်း တွေ့ရှိနိုင်ပါသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|
| သာဓက ။ | ။ | (၁) ဒယ်နေ့ ပျင်းဆိုးပဲ | ဒီနေ့ (နေရတာ) ပျင်းလိုက်တာ |
| | | (၂) ဒယ်နေ့ စောစောငယ် အိပ်ဇို့လန်း | ဒီနေ့ စောစောအိပ်ရအောင်နော် |
| | | (၃) ငါဈေးသောချင်ဆိုး | ငါဈေးသွားချင်လိုက်တာ |
| | | (၄) ရှပ်သီကင်ငယ် ငတ်ခဲ့ဆိုး | ရှပ်သီကင်လေး စားချင်လိုက်တာ |

**၃၊ ၂။ ၂။ နာသူကိုအခြေခံသော လောကဝတ်စကား**

လူမှုဆက်ဆံရေးနယ်ပယ်တွင် လူတစ်ဦးနှင့်တစ်ဦး တွေ့ဆုံဆက်ဆံကြရာ၌ ဆက်သွယ်မှုလမ်းကြောင်း အဆင်ပြေချောမွေ့ကြစေရန်အတွက် နာသူကိုအခြေခံသော လောကဝတ်စကားများကို အသုံးပြုလေ့ရှိကြပါ သည်။ နာသူ (သို့မဟုတ်) နားထောင်သူကို အခြေခံသော လောကဝတ်စကားများကို မြိတ်ဒေသိယအပြောစကား များတွင်လည်း တွေ့ရှိရပါသည်။

| | | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|---|
| သာဓက ။ | ။ | (၁) ဘယ်သောဝို့ | ဘယ်သွားမလို့လဲ။ |
| | | (၂) တစ်ခုခုလိုဝါပြော | အကူအညီလိုရင် ပြောနော်။ |
| | | (၃) မတွေ့ဇာကြာဘီမား | မတွေ့တာကြာပြီနော်။ |
| | | (၄) မင်းစားပြီးဘီလား | ထမင်းစားပြီးပြီလား။ |
| | | (၅) ငါ့နင့်ကို လွမ်းရိ တတ်မနိုင်ဘီ | ငါနင့်ကို သိပ်လွမ်းတယ်။ |

**၃၊ ၂၊ ၃။ အခြေအနေအဆက်အစပ်နှင့် သက်ဆိုင်သော လောကဝတ်စကား**

မြိတ်ဒေသိယနေ့စဉ်သုံး အပြောစကားများတွင် အခြေအနေအဆက်အစပ်ကိုမူတည်၍ ပြောသူ၊ နာသူ (၂)ဦး စလုံးနှင့် သက်ဆိုင်သော လောကဝတ်စကားများကို တွေ့နိုင်ပါသည်။လောကဝတ်စကားများ ပြောဆိုရာ၌ စကားတွင်ပါသောအဓိပ္ပာယ်ကို အဓိကရည်ညွှန်းလိုသည်မဟုတ်ဘဲ ဆက်ဆံရေးချောမွေ့စေရန်အတွက် ဆက်သွယ်ပြောဆိုသော စကားများဖြစ်သည်။

| | **မြိတ်ဒေသိယစကား** | **စံမြန်မာဘာသာစကား** |
|---|---|---|
| သာဓက။ | (၁) ဒယ်နေ့ မင်းစားရ အဆင်ပြေဝ့ဲလန်း | ဒီနေ့ထမင်းစားရတာ အဆင်ပြေရဲ့လား |
| | (၂) ဒယ်နေ့ မိုးကောင်းဆိုး | ဒီနေ့ မိုးကောင်းလိုက်တာ။ |
| | (၃) တွေ့ရဇာ ဝန်းသာဆိုးဝ့ဲ | တွေ့ရတာ ဝမ်းသာပါတယ်။ |
| | (၄) ဒယ်မျိုးညနေဆိုမြိတ်ကမ်းနားလမ်းမှာအားလှဆိုးဝ့ဲ | ဒီလိုညနေဆိုမြိတ်ကမ်းနားလမ်းက သိပ်လှတာပဲ။ |
| | (၅) ဒယ်ချိန်မျိုးဆို ရေစာတွေ အားပေါရယ် | ခုလိုအချိန်ဆိုပင်လယ်စာတွေ အရမ်းပေါတယ်။ |

## ခြုံငုံသုံးသပ်ချက်

ဤစာတမ်းသည် မြိတ်ဒေသိယအပြောစကားများကို စံမြန်မာဘာသာစကားနှင့် နှိုင်းယှဉ်လေ့လာ တင်ပြထား သောစာတမ်းဖြစ်ပါသည်။ ဒေသကွဲပြားသည်နှင့်အမျှ အခေါ်အဝေါ်ကွဲပြားတတ်သည့် သဘောသဘာဝအတိုင်း မြိတ်ဒေသိယစကားသံများတွင် "ဆေးကုလားမ" ကို "ငွေလရောင်"၊ "တို့စရာ" ကို "ပိရှာ"၊ "မီးပျက်" သည်ကို "မီးသေ" သည် "အလှပြင်သည်" ကို "ဟန်လုပ်သည်"၊ "ပြူးတူးပြဲတဲ" ကို "အောလီအောလစ်"၊ "စိတ်ဆိုး သည်" ကို "စိတ်ပေါက်သည်"၊ "မနက်ဖြန်" ကို "မိုးလင်း"၊ "မိုးလင်း"ကို "ကြက်တွန်"၊ "ပြက်ရယ်ပြုသည်" ကို "ရယ်ဇားသည်"၊ "ပိုက်ဆံ" ကို "ကြေးပြား" ဟူ၍ စံမြန်မာဘာသာစကားနှင့် လုံးဝကွဲပြားနေသော အသုံး များကို တွေ့ရပါသည်။

ထို့ပြင် စံမြန်မာစကားတွင် "ထမင်းငတ်"သည်ကို "မင်းငတ်"၊ "ငရုတ်ဆုံ"ကို "ရုတ်ဆုံ"၊ "နှုတ်ခမ်းနီ" ကို "ခမ်းနီ"၊ "ငှက်ပျောအူ" ကို "ဗျောအူ"၊ "ငါးခွေးလျှာ" ကို "ခွေးလျှာ" ဟူ၍ ရှေ့စကားလုံးဖြုတ်၍ သုံးသောအသုံးများ ၊ စံမြန်မာစကား "လေ" ကို "လေ"၊ "ငှက်ဆိုး" ကို "ငက်ဆိုး"၊ "နှမ်း" ကို "နမ်း"၊ "မှန်" ကို "မန်" ဟူ၍ "ဟထိုးသံ" ဖြုတ်၍ပြောသော အသုံးများကိုလည်း တွေ့ရသည်။ စံမြန်မာဘာသာစကားတွင် မတွေ့ရသော "မား၊ ဇမား၊ ဝမား၊ နား၊ ဝ့ဲနား၊ လန်း၊ ဝ့ဲလန်း၊ ရိုလန်း" စသော ဝါကျအဆုံးသတ် ပစ္စည်းစကားများကိုလည်း ကွဲပြားစွာသုံးနှုန်းနေကြောင်းလည်း လေ့လာသိရှိရပါသည်။ သာမန်သမရိုးကျကိစ္စ များနှင့် ချစ်ခြင်း၊ မုန်းခြင်း၊ လွမ်းခြင်းဟူသော စိတ်ခံစားချက်တို့ကို ဖော်ပြရာ၌ "ဈေးကြီးဇ၊ ချစ်ဇ၊ မုန်းဇ၊ လွမ်းဇ" ဟူ၍ ဝါကျအဆုံးသတ် ပစ္စည်းစကား "ဇ" ကို သုံးလေ့ရှိပြီး သာမန်ထက် ပိုလွန်သော သဘောကို ဖော်ပြလိုလျှင် "ချစ်ဇမား (အရမ်းချစ်တယ်)၊ ချောဇမား (အရမ်းချောတယ်) "ဟူ၍ "ဇမား" (အရမ်း)ကို ဝါကျအဆုံးသတ်စကားအဖြစ် သုံးလေ့ရှိကြောင်း တွေ့ရသည်။

ယဉ်ကျေးသည့်သဘောကို ဖော်ပြလိုလျှင် ဝါကျအဆုံးသတ်စကားအဖြစ် "လန်း၊ ဝ့ဲနား၊ နား" (နော်) တို့ကို သုံးလေ့ရှိပြီး ငြင်းဆန်မှုသဘောကို ဖော်ပြလိုလျှင် "ဝ"၊ "ဝမား"၊ "ရ" (ဘူး) တို့ကို သုံးလေ့ရှိပါသည်။ ထို့ပြင် အငြင်းပစ္စည်းစကား "မ" ကို ဖြုတ်၍ ဟုတ်ဝ (မဟုတ်ဘူး) ဟူ၍လည်း သုံးလေ့ရှိကြောင်း တွေ့ရှိရ သည်။

မြိတ်ဒေသိယအပြောစကားများတွင် "သီချင်းငယ်"၊ "သားကင်းငယ်"၊ "နည်းနည်းငယ်" ဟူ၍ "ငယ်" ဟူသော စကားသုံးကို ချစ်စဖွယ် ထည့်သွင်းပြောဆိုသုံးနှုန်းနေကြောင်း တွေ့ရပါသည်။ ထို့ပြင် အဓိပ္ပာယ် ပိုမို လေးနက်ပြည့်စုံစေလိုသော သဘောဖြင့် "သယ်ဆောင်"၊ "ယူဆောင်"၊ "ဝယ်ဆောင်"၊ "ခေါ်ဆောင်" ဟူ၍ "ဆောင်" ဟူသော စကားလုံးကို ထည့်သွင်းသုံးနှုန်းနေကြောင်း တွေ့ရပါသည်။ စံမြန်မာဘာသာစကားတွင်မူ "သယ်"၊ "ယူ"၊ "ဝယ်"၊ "ခေါ်" ဟူ၍ လုံးချင်းကြိယာအသုံးကိုသာ သုံးနှုန်းလေ့ရှိပါသည်။

စံမြန်မာဘာသာစကားနှင့် မြိတ်ဒေသိယအပြောစကားများတွင် ဗျည်းသံ၊ သရသံ အသုံးများသည် တူညီမှုများရှိသကဲ့သို့ ကွဲပြားမှုများလည်း ရှိကြောင်းတွေ့ရပြီး ကွဲပြားမှုများတွင် သရသံအသုံး ကွဲပြားမှုသည် ပိုမိုများပြားကြောင်း တွေ့ရှိရပါသည်။ မြိတ်ဒေသိယစကားတွင် မတြာဝက်သရသံအသုံးထက် အသံပြည့်ကို သုံးလေ့ရှိပြီး စံမြန်မာဘာသာစကားရှိ ကိန်းဂဏန်းအရေအတွက် "နှစ်" ကို မြိတ်ဒေသိယစကားတွင် အခြား စကားလုံးတစ်ခုခုနှင့် တွဲဖက်ရွတ်ဆိုသည့်အခါ "အဲ" /ɛ̀/သရသံကို ပြောင်းလဲအသံထွက်၍ ရွတ်ဆိုလေ့ရှိ ကြောင်း ထူးခြားစွာ တွေ့ရပါသည်။ (လူနှစ်ယောက် > လူနဲ့ယောက်)

စိတ်ခံစားမှုတစ်ခုခုနှင့် ကြုံရသောအခါတွင် သုံးသည့် "မိဝေး"၊ "အာမိဝေး"၊ "အာလန်း" စသော အာမေဋိတ်စကားများအပြင် ကိုးကွယ်ယုံကြည်ရာကို တမ်းတရွတ်ဆိုသော "မိဝေးဘုရား၊ ဘုရား" ဟူသော အာမေဋိတ်စကား၊ အားမလို အားမရဖြစ်သောအခါတွင် သုံးသည့် "အာချေအေး" ဟူသော အာမေဋိတ်စကား အသုံးများကိုလည်းတွေ့ရှိရပါသည်။ စံမြန်မာစကားနှင့်မတူသော အာမေဋိတ်အသုံးများအပြင် လောကဝတ် စကားအသုံးများကိုလည်း လေ့လာတွေ့ရှိရပါသည်။

## နိဂုံး

ဤစာတမ်းသည် မြိတ်ဒေသိယအပြောစကားများကို လေ့လာတင်ပြထားသော သုတေသနစာတမ်းတစ်စောင်ဖြစ်ပါသည်။ မြိတ်ဒေသိယအပြောစကားများကို လေ့လာခြင်းအားဖြင့် တိမ်မြုပ်ပျောက်ကွယ်လုဖြစ်နေသော မြိတ်ဒေသိယစကားများကို ထိန်းသိမ်းစောင့်ရှောက်ရာလည်း ရောက်ပေသည်။ ဒေသိယစကားတစ်ခုမပျောက်ပျက်အောင် ထိန်းသိမ်းခြင်းသည် ဒေသအမှတ်လက္ခဏာတစ်ခုကို မပျောက်ပျက်အောင် ထိန်းသိမ်းခြင်းပင်ဖြစ်ပြီး အဖိုးမဖြတ်နိုင်သော ရိုးရာအခြေအနေတစ်ရပ်ကို ထိန်းသိမ်းခြင်းပင်ဖြစ်သည်။ **"ညီနောင်သွေးချင်းရင်းနှီးဖို့၊ ဘာသာစကားကိုလေ့လာစို့"** ဆိုသည့်အတိုင်း ဒေသကွဲပြားသောကြောင့် အခေါ်အဝေါ်ကွဲပြားကြသော တိုင်းရင်းဘာသာစကားများကို လေ့လာခြင်းအားဖြင့် တိုင်းရင်းသားအချင်းချင်းချစ်ကြည်ရင်းနှီးမှုကို ခိုင်မြဲစေနိုင်မည်ဖြစ်သည်။ ဤစာတမ်းသည် မြိတ်ဒေသိယစကား လေ့လာလိုသူများအတွက် တစ်ထောင့်တစ်နေရာမှ အထောက်အပံ့ပေးနိုင်သော ဒေသအကျိုးပြု သုတေသနစာတမ်းတစ်စောင်ဖြစ်သည်ဟု ထင်မြင်ယူဆမိပါသည်။

## ကျမ်းကိုးစာရင်း


ခင်ခင်အေး၊ ဒေါ်။ (၁၉၆၆)။ *ဘာသာဗေဒအခြေခံ*၊ တက္ကသိုလ်ပညာပဒေသာစာစောင်၊ အတွဲ (၁)၊ အပိုင်း (၄)၊ ရန်ကုန်။

ခင်မင်၊ မောင် (ဓနုဖြူ)။ (၁၉၉၀)။ *မြန်မာစကား၊ မြန်မာ့စာရုပ်ပုံလွှာ*။ စာပေဗိမာန်ပုံနှိပ်တိုက်၊ ရန်ကုန်။

ခင်မင်၊ မောင်၊ ဓနုဖြူ။ (၂၀၀၁)။ *တစ်သံနှစ်သံသုံးလေးသံ*။ ရန်ကုန်၊ ရူပံပုံနှိပ်တိုက်။

ခင်အေး၊ ဒေါက်တာ။ (၂၀၀၈)။ *အတ္ထဗေဒနိဒါန်း*၊ ဒုတိအကြိမ်။ ရန်ကုန်၊ ပညာတန်ဆောင်ပုံနှိပ်တိုက်။

တင်ဇ၊ ဦး။ (၁၉၇၅)။ *မြန်မာဘာသာစကား၏ ဒေသိယစကားများလေ့လာမှု*။ မြန်မာနိုင်ငံသုတေသနအသင်းဂျာနယ်၊ အတွဲ (၅၈) အပိုင်း (၂)၊ ရန်ကုန်။

ထွန်းမြင့်၊ ဦး။ (၁၉၉၆)။ *သဒ္ဒဗေဒ* ၊ ရန်ကုန်၊ တက်လမ်းစာပေ။

နုနုကြည်၊ဒေါ်။(၂၀၀၃)။*မျက်မှောက်ခေတ် မြန်မာအပြောဘာသာစကား၌ အာမေဋိတ်စကားများ*၊ မြန်မာစာဌာန၊ မန္တလေးတက္ကသိုလ်။

မြန်မာအဘိဓာန်။ (၁၉၉၁)။ မြန်မာစာအဖွဲ့ဦးစီးဌာန၊ ရန်ကုန်။

အောင်မြင့်ဦး၊ ဒေါက်တာ။ (၂၀၀၃)။ *လူမှုဘာသာဗေဒမိတ်ဆက်* ။ ရန်ကုန်၊ ပညာတန်ဆောင်ပုံနှိပ်တိုက်။

အောင်မြင့်ဦး၊ ဒေါက်တာ။ (၂၀၀၆)။ *အင်းလေးဒေသိယစကား*။ ရန်ကုန်၊ ရူပံစာအုပ်တိုက်။


## နောက်ဆက်တွဲ

### အမေးခံပုဂ္ဂိုလ်များ

| စဉ် | အမည် | အလုပ်အကိုင် |
|---|---|---|
| ၁။ | ဒေါ်ဇင်မာယု | လ/ထ ကထိက၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၂။ | ဒေါ်ခတ္တာ | နည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၃။ | ဦးရှိုင်းမောင်မောင် | နည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၄။ | ဒေါ်ချောယုနှင်း | အချိန်ပိုင်းနည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၅။ | ဒေါ်မေသူစိုး | အချိန်ပိုင်းနည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၆။ | ဒေါ်မြမဋ္ဌာ | အချိန်ပိုင်းနည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၇။ | ဒေါ်အိန္ဒယ်ထွန်း | အချိန်ပိုင်းနည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၈။ | ဒေါ်အေးသန္တာဇော် | အချိန်ပိုင်းနည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၉။ | ဒေါ်ချောစုဝေ | (နေ့စားဝန်ထမ်း) မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။ |
| ၁၀။ | မောင်ညီညီလျှမ်းထက်စိုး | ပထမနှစ်၊ မြိတ်ကွန်ပျူတာတက္ကသိုလ်။ |
| ၁၁။ | ဦးစိုးလှိုင်ဝင်း | Mergui Plus Travel Services Travel & Tour Co.ltd |
| ၁၂။ | ဦးစိန်လှိုင် | (ဥယျာဉ် လုပ်သား) ရွှေဒူးကျေးရွာ။ |

# ကယန်း (ပဒေါင်) ဘာသာစကား၏ စကားလုံးဖွဲ့ပုံ လေ့လာချက်

မြမြဝင်း[၁]


## စာတမ်းအကျဉ်း

ဤစာတမ်းသည် ကယန်း (ပဒေါင်) တိုင်းရင်းသား အခေါ်အဝေါ်မျိုးနွယ်စုနှင့် နေထိုင်ရာ ဒေသ၊ စကားလုံးသတ်မှတ်ချက် ကယန်း (ပဒေါင်) ဘာသာစကား၏ စကားလုံးဖွဲ့ပုံ၊ စကားရိုး၊ စကားရော၊ စကားပေါင်းစနစ်များကို လေ့လာဖော်ထုတ် တင်ပြထားပါသည်။

သော့ချက်ဝေါဟာရ ။ စကားလုံးဖွဲ့ပုံ၊ စကားလုံး၊ စကားရိုး၊ စကားရော၊ စကားပေါင်း။


## နိဒါန်း

ဤစာတမ်းသည် ကယန်း (ပဒေါင်) ဘာသာစကား၏ စကားလုံးဖွဲ့ပုံများကို ခွဲခြမ်းစိတ်ဖြာလေ့လာဖော်ထုတ် ထားပါသည်။ ကယန်း (ပဒေါင်) တိုင်းရင်းသားတို့၏ အများသုံးကြားခံ ဘာသာစကား (Lingua tranca) အဖြစ် ဖယ်ခုံမြို့နယ်သုံး ကယန်းစကား၏ စကားလုံးဖွဲ့ပုံရှိ စကားရိုး၊ စကားရော၊ စကားပေါင်းများကို စိစစ်ဖော်ထုတ်တင်ပြထားပါသည်။

### ၁။ ကယန်း (ပဒေါင်) တိုင်းရင်းသား

### ၁၊ ၁။ ကယန်းနှင့် ပဒေါင်အခေါ်အဝေါ်

ကယန်းတိုင်းရင်းသားများကို ပဒေါင်လူမျိုးဟု လူသိများကြပါသည်။ ကယန်း (ပဒေါင်) တိုင်းရင်းသားတို့သည် မိမိတို့ကိုယ်မိမိတို့ ကယန်းလူမျိုးဟု ဂုဏ်ယူစွာခေါ်ကြပါသည်။ အမေးခံ ကယန်းတိုင်းရင်းသားတို့၏ ပြောဆို ချက်အရ "ကမ်းယံ" ဖြစ်သည်ဟု ဆိုပါသည်။ တိဗက်ကုန်းပြင်မြင့်တွင် နေထိုင်ခဲ့ကြသော "ကမ်းယံ" ဟူသော မျိုးနွယ်စုမှ ဆင်းသက်လာပြီး ရှမ်းပြည်နယ်သို့ ရောက်ရှိခဲ့ကြသည်ဟု ဆိုပါသည်။ "ကမ်းယံ" သည် "ကမ်းယန့်" မှ "ကမ်းယံ" ဖြစ်လာခြင်းဖြစ်သည်။ "ကမ်း" ဟူသည် "မြေမာ" ဟု အဓိပ္ပာယ်ရပြီး "ယန့်" မှာ "တိုင်းပြည်" ဟု အဓိပ္ပာယ်ရပါသည်။ ထို့ကြောင့် "ကမ်းယန့်" ၏ အဓိပ္ပာယ်မှာ "မြေမာတွင် နေသူ" ဟု ဖြစ်ပြီး "ကမ်းယန့်" မှ ကမ်းယံဖြစ်လာပြီး ကမ်းယံမှ "ကယန်း" လူမျိုးဟု ခေါ်ခဲ့ကြသည်။ ထို့အပြင် ကယန်း ဆိုသည်မှာ "ပထမလူမျိုး" (တင်နွယ်မောင်၊ ၂၀၀၂၊ ၁၈)ဟု အဓိပ္ပာယ်ရသည် ဟုဆိုပါသည်။

"ကယန်း" လူမျိုးများကို "ပဒေါင်"ဟူ၍ ခေါ်ကြခြင်းမှာ ကယန်းအမျိုးသမီးများကို ရှမ်းတိုင်းရင်းသားများက ရွှေဝါရောင်ကြေးကွင်းပတ်၍ အလှဆင်ကြသည့်အတွက် "ပတ်တောင်း" ဟု ရှမ်းစကားဖြင့် ခေါ်ဆိုကြပါသည်။ "ပတ်" ဟူသည် "ရစ်ပတ်သည်" ၊ "တောင်း" မှာ "ကြေး" ဟု အဓိပ္ပာယ်ရပါသည်။ ထို့ကြောင့် "ပတ်တောင်း" သည် "ကြေးကွင်းစွပ်ထားသူများ" ဟု အဓိပ္ပာယ်ဖြစ်ပါသည်။ ထိုမှ "ပဒေါင်" ဟူသော အမည် ဖြစ်လာပါသည်။ ကယန်းမျိုးနွယ်စုတွင် (၁) ကယန်းလဝီ (ပဒေါင်)၊ (၂) ကယန်း (ကငန်း) (ယင်းဘော်)၊ (၃) ကယန်း ကဓူး (ဂေဘား)၊ (၄) ကယန်းလထာ (လထ) (ခေါ်) ခေါင်းတို (ခေါ်) ဇယိမ် ဟူ၍ အဓိက မျိုးနွယ်စု (၄)မျိုးဖြင့် စုစည်းခဲ့ကြပါသည်။

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[၁]ဒေါက်တာ၊ တွဲဖက်ပါမောက္ခ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

**၁၊ ၂။ ကယန်း (ပဒေါင်) တိုင်းရင်းသားတို့၏ မျိုးနွယ်စုနှင့် နေထိုင်ရာဒေသ**

ကယန်း (ပဒေါင်) လူမျိုးစုများသည် ကရင်မျိုးခွဲဖြစ်သော ကယားမျိုးနွယ်တွင်ပါဝင်ပြီး ၁၉၈၃ခု၊ သန်းခေါင် စာရင်းအရ လူဦးရေ (၄၀, ၉၀၀) ခန့်ရှိသည်။ ကယန်းတိုင်းရင်းသားတို့သည် ကယားပြည်နယ်၊ ရှမ်းပြည်နယ် တောင်ပိုင်း မိုးဗြဲ၊ ဖယ်ခုံဒေသ၊ တောင်ငူ၏ အရှေ့တောင်ကုန်း သံတောင်၊ မန္တလေးတိုင်း ပျဉ်းမနားနှင့် ထိုင်းနိုင်ငံရှိ ရွာအနည်းငယ်တွင် နေထိုင်ကြလေသည်။

**၂။ စကားလုံးဖွဲ့ပုံ**

ဘာသာစကားတစ်ခု၏ သဒ္ဒါကို လေ့လာရာတွင် အဓိကကျသည့်အဆင့် (၂)ဆင့် ရှိပါသည်။ ယင်းတို့မှာ **ဝါကျဖွဲ့ပုံ**[1] နှင့် **စကားလုံးဖွဲ့ပုံ**[2] တို့ဖြစ်ပါသည်။ စကားလုံးဖွဲ့ပုံသည် **သဒ္ဒါ၏ဘာသာခွဲ**[3]တစ်ခု ဖြစ်သည်။ စကားလုံး၏ **တည်ဆောက်ပုံ**[4] (သို့မဟုတ်) **စကားလုံးပုံသဏ္ဌာန်များ**[5]ကို လေ့လာသည်။ အခြေခံအားဖြင့် **ရုပ်ရင်း အဖွဲ့အစည်း၏အသုံး**[6]ကို လေ့လာခြင်းဖြစ်သည်။ ယေဘုယျအားဖြင့် လေ့လာမှုနယ်ပယ် (၂)ခုရှိသည်။ ယင်း(၂)ခုမှာ **ရုပ်ပြောင်းမှု**[7]ကို လေ့လာခြင်း (**ရုပ်ပြောင်းစကားလုံးဖွဲ့ပုံ**)[8] နှင့် **စကားလုံးဖွဲ့ထုံး**[9] (**ဝေါဟာရသို့– စကားလုံးပွား– စကားလုံးဖွဲ့ပုံ**)[10] ကို လေ့လာခြင်းတို့ဖြစ်သည်။

**၂၊ ၁။ စကားလုံးသတ်မှတ်ချက်**

စကားလုံးနှင့် ပတ်သက်၍ သတ်မှတ်ချက် အမျိုးမျိုးရှိခဲ့ပါသည်။ ဤကျမ်းအတွက်မူ သဒ္ဒါကို အခြေခံသော **စကားလုံးသတ်မှတ်ချက်**[11] ကို အခြေခံထား၍ သတ်မှတ်ပါမည်။ ထိုသတ်မှတ်ချက်မှာ–

" စကားလုံးဟူသည် သီးခြားရပ်တည်နိုင်သော **အသေးဆုံးအစိတ်အပိုင်း**[12]ဖြစ်သည်"

ဟူသော သတ်မှတ်ချက်ဖြစ်ပါသည်။

စကားလုံးသည် ဘာသာဗေဒယူနစ်များအနက် တည်ငြိမ်မှုအရှိဆုံး ယူနစ်တစ်ခုဖြစ်ပါသည်။ ဤအဆိုမှာ **အတွင်းတည်ဆောက်ပုံ**[13]ကို မူတည်၍ ဆိုခြင်းဖြစ်ပါသည်။ စကားလုံးသည် ရုပ်ရင်းတစ်ခု (သို့မဟုတ်) တစ်ခုထက်ပိုသော ရုပ်ရင်းတို့ဖြင့် ပေါင်းစပ်ဖွဲ့စည်း ယူသော ယူနစ်မျိုးဖြစ်သည်။ အခြားစံတစ်ခုမှာ **ကြားမထိုးနိုင်မှု**[14] ဖြစ်ပါသည်။ (သို့မဟုတ်) **စကားလုံးတို့၏ ပူးကပ်မှု**[15]ဖြစ်ပါသည်။ ပုံမှန် စကားပြောမှုတွင် စကားလုံးတို့၏ အတွင်းသို့ အစိတ်အပိုင်းအသစ်များ ဝင်ရောက်မဖြစ်ပေါ်နိုင်ခြင်းကို ဆိုလိုပါသည်။ ထိုစံ တို့ဖြင့် စကားလုံးကို သတ်မှတ်ဖော်ထုတ်တင်ပြပါမည်။

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[1] syntax
[2] morphology
[3] the branch of grammar
[4] structure
[5] form of words
[6] the use of morpheme
[7] inflection
[8] inflectional morphology
[9] word formation
[10] lexical or derivational morphology
[11] grammatical definition of the word
[12] minimal free form
[13] internal structure construction
[14] uniterruptibility
[15] cohesiveness of words

**၂၊ ၂။ ဖွဲ့စည်းပုံအရ စကားလုံးအမျိုးအစား ခွဲခြားခြင်း**

ကယန်း (ပဒေါင်) စကားရှိ အလေ့လာခံ ဘာသာစကားတို့ကို ဖွဲ့စည်းပုံအရ အောက်ပါအတိုင်း ခွဲခြားကြည့်နိုင် ပါသည်။

(၁) စကားရိုး

(၂) စကားရော

(၃) စကားပေါင်း

ဟူ၍ ခွဲခြားနိုင်ပါသည်။

**၂၊ ၂၊ ၁။ စကားရိုး**

**စကားရိုး**[1]ဆိုသည်မှာ **ရုပ်သီး**[2]တစ်ခုတည်းဖြင့် တည်ဆောက်ထားသည့် စကားလုံးမျိုးကို ဆိုလိုပါသည်။ စကားရိုးတွင် နာမ်သော်လည်းကောင်း၊ ကြိယာသော်လည်းကောင်း ဖြစ်နိုင်ပါသည်။ စကားရိုးသည် **ဧကဝဏ္ဏ စကားလုံး**[3]ဖြစ်နိုင်သကဲ့သို့ **ဗဟုဝဏ္ဏစကားလုံး**[4]လည်း ဖြစ်နိုင်ပါသည်။ ဧကဝဏ္ဏစကားလုံးများကို **အတွင်း တည်ငြိမ်မှုစံ**[5]နှင့် စမ်းသပ်ရန် မလိုသော်လည်း ဗဟုဝဏ္ဏစကားလုံးကိုမူ ကြားမထိုးနိုင်မှုစံနှင့်ရော အတွင်း တည်ငြိမ်မှုစံနှင့်ပါ စမ်းသပ်ကြည့်နိုင်ပါသည်။ စကားရိုးဖွဲ့စည်းပုံကို ပုံသေနည်းဖြင့် ပြရလျှင်-

စကားရိုး ⟶ ရုပ်သီးတစ်ခု

နာမ် / ကြိယာ

ဖော်ပြပါ ပုံသေနည်းကို သင်္ကေတပြရသော်

S.W ⟶ FF

$N_{free}$ / $V_{free}$

**နာမ်စကားရိုး**[6]တွင် **ဧကဝဏ္ဏနာမ်စကားရိုး**[7]၊ **ဒွိဝဏ္ဏနာမ်စကားရိုး**[8]နှင့် **တြိဝဏ္ဏနာမ်စကားရိုး**[9] ဟူ၍ ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ရှိပါသည်။

ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ဧကဝဏ္ဏနာမ်စကားရိုးများရှိကြောင်းကို အောက်ပါသာဓကများအရ သိနိုင်ပါသည်။

သာဓက။ ။ နာမ်စကားရိုးပုံစံများ

S. W ⟶ $N_{free}$

< pĩ >

အဖွား

---

[1] simple word

[2] free morpheme

[3] monosyllabic word

[4] polysyllabic word

[5] criterion of internal stability

[6] simple noun

[7] monosyllabic- simple noun

[8] disyllabic- simple noun

[9] trisyllabic – simple noun

< h̆ɥ̆ >

မြေ

< sʰɯ̄ >

ရေ/ ကြက်

< sʰɛ̱i̱ >

တောင်ယာ

< sʰăɥ̆ >

တောင်

< b̆ɛ̣ >

လယ်တော

စသည်တို့ဖြစ်ပါသည်။

ထို့အပြင် ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ဒွိဝဏ္ဏနာမ်စကားရိုးများရှိကြောင်းကိုလည်း အောက်ပါ သာဓကများတွင် ပါသည်။

သာဓက။ ။ S. W ⟶ N free

< θə gū >

လေ

N free

< bə jā̃ >

ကောက်ညှင်း

N free

< gə lɥ̣ >

ဆံပင်

N free

< gə deị̄ >

လက်

N free

< gə bɥ̣ >

ပါး

N free

< gə d̪ɥ̣ >

ပေါင်

အထက်ဖော်ပြပါသာဓကများသည် ဒွိဝဏ္ဏ နာမ်စကားရိုးများဖြစ်ပါသည်။ ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ကိုယ်ခန္ဓာနှင့် ပတ်သက်သော စကားလုံးများသည် ဒွိဝဏ္ဏနာမ်စကားရိုးများစွာရှိပါသည်။

ထို့နောက် ကယန်း (ပဒေါင်) ဘာသာစကားတွင် တြိဝဏ္ဏနာမ်စကားရိုးရှိကြောင်း အောက်ပါ သာဓကတွင် တွေ့နိုင်ပါသည်။

သာဓက။ ။ S.W ⟶ N free

< hɑ̃ˌ bə ʔɛ̨>

ရွှံ့

ထို့ကြောင့် ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ဧကဝဏ္ဏနာမ်စကားရိုး၊ ဒွိဝဏ္ဏနာမ်စကားရိုးနှင့် တြိဝဏ္ဏ နာမ်စကားရိုးများရှိပါသည်။ သို့သော် တြိဝဏ္ဏနာမ်စကားရိုးမှာ အရေအတွက် နည်းပါးသည်။

ကယန်း (ပဒေါင်) ဘာသာစကားရှိ **ကြိယာစကားရိုး**[1]တွင် **ဧကဝဏ္ဏကြိယာ စကားရိုး**[2]၊ **ဒွိဝဏ္ဏကြိယာစကားရိုး**[3]နှင့် **တြိဝဏ္ဏကြိယာစကားရိုး**[4]များလည်းရှိပါသည်။ ဧကဝဏ္ဏကြိယာစကားရိုးကို အောက်ပါသာဓကများတွင် တွေ့နိုင်ပါသည်။

သာဓက။ ။ S.W ⟶ V free

< mà >

လုပ်(သည်)။

V free

< tʃwˌe >

ဆွဲ (သည်)။

V free

< n̪ɔ̄>

ပုန်း (သည်)။

V free

< phī>

ယူ (သည်)။

ဖော်ပြပါ သာဓကများသည် ကယန်း (ပဒေါင်) ဘာသာစကားရှိ ဧကဝဏ္ဏကြိယာစကားရိုးများဖြစ်ပါသည်။

ထို့နောက် ဒွိဝဏ္ဏကြိယာစကားရိုးများကိုလည်း အောက်ပါသာဓကများအရ သိနိုင်ပါသည်။

သာဓက။ ။ S.W ⟶ V free

< pə sʰaḭ̃ >

ဆင်းရဲ (သည်)။

V free

< pə rɛ̨i>

ဝယ် (သည်)။

V free

[1] simple verb

[2] monosyllabic simple verb

[3] disyllabic simple verb

[4] trisyllabic – simple verb

< $k^h$ə loṵ>

ချမ်း/ အေး(သည်)။

ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ကြိုဝဏ္ဏကြိယာစကားရိုးများလည်းရှိပါသည်။

သာဓက။ ။ S.W ⟶ V $_{free}$

< ʔṵ sù ṭù>

မုန်း(သည်)။

V $_{free}$

< ʔauʔ jā zù>

ခင်မင် (သည်)။

V $_{free}$

< bwɛ̰ bə loū>

ပေါင်း (သည်)။

စသည်ဖြင့် စကားရိုးများရှိပါသည်။

**၂။ ၂။ ၂။ စကားရော**

**စကားရော**[1]တွင် **ရုပ်သီး**[2]နှင့် **ရုပ်မှီး**[3]များ ပါဝင်ပါသည်။ အရေအတွက် အကန့်အသတ်မရှိ ပါဝင်နိုင်သော်လည်း အနည်းဆုံးရုပ်သီးတစ်ခုနှင့် ရုပ်မှီးတစ်ခုပါဝင်ရပါသည်။ စကားရောသည် ဗဟုဝဏ္ဏများသာဖြစ်ကြပြီး နာမ် စကားလုံးရောနှင့် ကြိယာစကားရော နှစ်မျိုးလုံးတွေ့ရပါသည်။ စကားရောကိုလည်း စကားလုံးတစ်ခု ဟုတ် မဟုတ် အတွင်းတည်ငြိမ်မှုနှင့်ရော ကြားမထိုးနိုင်မှုစံနှင့်ပါ စမ်းသပ်ကြည့်နိုင်ပါသည်။ စကားရောတွင် နာမ် (သို့မဟုတ်) ကြိယာ၏ ရှေ့တွင် **ရှေ့ဆက်**[4] (ရုပ်မှီး) တစ်ခုထည့်၍ ဖွဲ့စည်းထားသည်ကို တွေ့ရပါသည်။ စကားရောဖွဲ့စည်းပုံကို ပုံသေနည်းဖြင့်ပြရလျှင် အောက်ပါအတိုင်း ဖြစ်ပါသည်။

| | | | |
|---|---|---|---|
| စကားရော | ရုပ်မှီးတစ်ခု | + | ရုပ်သီးတစ်ခု |
| | ရှေ့ဆက် | + | နာမ် |
| | ရှေ့ဆက် | + | ကြိယာ |

အထက်ပါ ပုံသေနည်းကို သင်္ကေတပြုရသော် –

| | | | |
|---|---|---|---|
| CPL. W | BF | + | FF |
| | PREF | + | N $_{free}$ |
| | PREF | + | V $_{free}$ |

ဟူ၍ဖြစ်ပါသည်။

---

[1] complex word

[2] free form

[3] bound form

[4] prefix

ရှေ့ဆက်နှင့် နာမ်ပေါင်းထားသော စကားရောပုံစံများကို အောက်ပါသာဓကများတွင် တွေ့နိုင်ပါသည်။

| | | | | | | |
|---|---|---|---|---|---|---|
| သာဓက။ | ။ | CPL. W | ⟶ | BF | + | FF |
| | | | | PREF | + | N $_{free}$ |
| | | | | < phū | + | pra̱ > |
| | | | | တိုင်း | | လူ |
| | | | | | လူတိုင်း | |
| | | | | PREF | + | N $_{free}$ |
| | | | | < phū | + | d̪aũ̀ > |
| | | | | တိုင်း | | နေ့ |
| | | | | | နေ့တိုင်း | |

ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ရှေ့ဆက်နှင့် ကြိယာပေါင်းစပ်ထားသော စကားရောများကိုလည်း အောက်ပါသာဓကများတွင် တွေ့နိုင်ပါသည်။

| | | | | | | |
|---|---|---|---|---|---|---|
| သာဓက။ | ။ | CPL. W | ⟶ | PREF | + | V $_{free}$ |
| | | | | < ə | + | l̀ ã > |
| | | | | အ | + | ဆင်း |
| | | | | | အဆင်း | |
| | | | | PREF | + | V $_{free}$ |
| | | | | < ə | + | t$^{h}$ɑ̃̀ > |
| | | | | အ | + | တက် |
| | | | | | အတက် | |
| | | | | PREF | + | V $_{free}$ |
| | | | | < ə | + | p$^{h}$ei̱ > |
| | | | | စရာ | + | ပေး |
| | | | | | ပေးစရာ | |
| | | | | PREF | + | V $_{free}$ |
| | | | | < ə | + | t̪aĩ̀ > |
| | | | | စရာ | + | ပြော |
| | | | | | ပြောစရာ | |
| | | | | PREF | + | V $_{free}$ |
| | | | | < ə | + | krā > |
| | | | | အ | + | လှ (သည်) |
| | | | | | အလှ | |
| | | | | PREF | + | V $_{free}$ |
| | | | | < kə lã̄ | + | t$^{h}$ɑ̃̀ > |
| | | | | အ | + | ထွက် |
| | | | | | အထွက် | |

**၂။ ၂။ ၃။ စကားပေါင်း**

**စကားပေါင်း**[1]တွင် အနည်းဆုံးရုပ်သီးနှစ်ခုပါဝင်သည်။ ရုပ်သီးအရေအတွက် အကန့်အသတ်မရှိ ပါဝင်နိုင် သော်လည်း ကယန်း (ပဒေါင်) ဘာသာစကားတွင် ရုပ်သီးနှစ်ခုမှ သုံးခုအထိ ပေါင်းစပ်ထားသည်ကို တွေ့ရပါ သည်။ စကားပေါင်းတို့သည် ဗဟုဝဏ္ဏများသာဖြစ်ကြပါသည်။ ယင်းတို့ကို စကားလုံး တစ်ခုတည်းဖြစ်ကြောင်း အတွင်းတည်ငြိမ်မှုစံနှင့် စမ်းသပ်ကြည့်နိုင်ပါသည်။ စကားပေါင်းအချို့တွင် နာမ်နှင့် နာမ်အချင်းချင်း ပေါင်းစပ် ထား၍ အချို့တွင်မူ နာမ်နှင့် ကြိယာပေါင်းစပ်သည်ကို တွေ့ရပါသည်။ စကားပေါင်း ဖွဲ့စည်းပုံကို ပုံသေနည်း ဖြင့်ပြရလျှင်-

| | | | | | |
|---|---|---|---|---|---|
| စကားပေါင်း → | ရုပ်သီး (၂-၃) | | | | |
| | နာမ် | + | နာမ် | | |
| | နာမ် | + | ကြိယာ | | |
| | နာမ် | + | ကြိယာ | + | ကြိယာ |
| | နာမ် | + | ကြိယာ | + | နာမ် |

ဟူ၍ ဖြစ်ပါသည်။ အထက်ပါပုံသေနည်းကို သင်္ကေတဖြင့်ပြရသော်-

| | | | | | |
|---|---|---|---|---|---|
| CPD. W → | FF (2–3) | | | | |
| | $N_{free}$ | + | $N_{free}$ | | |
| | $N_{free}$ | + | $V_{free}$ | | |
| | $N_{free}$ | + | $V_{free}$ | + | $V_{free}$ |
| | $N_{free}$ | + | $V_{free}$ | + | $N_{free}$ |

ဟူ၍ ဖြစ်ပါသည်။ ရုပ်သီးနှစ်ခုပါဝင်သော စကားပေါင်းကို အောက်ပါသာဓကများတွင် တွေ့နိုင်ပါသည်။

| | | | |
|---|---|---|---|
| CPD. W → | $N_{free}$ | + | $N_{free}$ |
| | < phaũ | + | θa̰ > |
| | ပန်း | + | သီး |
| | | ပန်းသီး | |
| | $N_{free}$ | + | $N_{free}$ |
| | < $s^{h}$ũ | + | ja̰ > |
| | ကြက် | + | အသား |
| | | ကြက်သား | |
| | $N_{free}$ | + | $N_{free}$ |
| | < $s^{h}$ṵ̃ | + | phɔ̰ > |
| | ကြက် | + | ကလေး |
| | | ကြက်ကလေး | |

အထက်ပါစကားပေါင်းတွင် နာမ်နှင့် နာမ်ပေါင်းစပ်ထားခြင်းဖြစ်သည်။

ထို့အပြင် နာမ်နှင့် ကြိယာပေါင်းစပ်ထားသော စကားပေါင်းကိုလည်း အောက်ပါသာဓကများအရ သိနိုင်ပါသည်။

[1] compound word

CPD. W ⟶ $N_{free}$ + $V_{free}$

< θà + Noū >

ငါး + ကြော် (သည်)

ငါးကြော်

$N_{free}$ + $V_{free}$

< jạ + Noū >

အသား + ကြော် (သည်)

အသားကြော်

$N_{free}$ + $V_{free}$

< bṵ̃ + sɯ̰ >

မျှစ် + ချဉ် (သည်)

မျှစ်ချဉ်

ကယန်း (ပဒေါင်) ဘာသာစကားတွင် နာမ်၊ ကြိယာ၊ ကြိယာပေါင်းစပ်ထားသော ရုပ်သီး (၃)ခုပါသော စကားပေါင်းနှင့် နာမ်၊ ကြိယာ၊ နာမ်ပေါင်းစပ်ထားသည့် ရုပ်သီး(၃)ခုပါ စကားပေါင်းကိုလည်းတွေ့ရှိရပါသည်။ သာဓကပြရလျှင်-

သာဓက။ ။ CPD. W ⟶ $N_{free}$ + $V_{free}$ + $V_{free}$

< bṵ̀ + sɯ̰ + shěĩ >

မျှစ် ချဉ် ခြောက်

မျှစ်ချဉ်ခြောက်

$N_{free}$ + $V_{free}$ + $N_{free}$

< $s^{h}$ɯ̄ + la̱ + pū̱>

ရေ နွေး အိုး

ရေနွေးအိုး

$N_{free}$ + $V_{free}$ + $N_{free}$

< θà + ðei̱ + $s^{h}$ɯ̄>

ငါး သိပ်/ ဖိ ရည်

ငါးပိရည်

## ခြုံငုံသုံးသပ်ချက်

ဤစာတမ်းသည် ကယန်း (ပဒေါင်) ဘာသာစကား၏ စကားလုံးဖွဲ့ပုံကို လေ့လာထားခြင်း ဖြစ်ပါသည်။ ကယန်း (ပဒေါင်) တိုင်းရင်းသားတို့၏ အဓိပ္ပာယ်၊ အခေါ်အဝေါ်၊ ကယန်း (ပဒေါင်) တိုင်းရင်းသားတို့၏ မျိုးနွယ်စု၊ နေထိုင်ရာဒေသများကို စိတ်ဝင်စားဖွယ် တွေ့ရှိရပါသည်။ ကယန်း (ပဒေါင်) တိုင်းရင်းသား ဘာသာ စကား၏ စကားလုံးဖွဲ့ပုံကို လေ့လာဖော်ထုတ်ရာတွင် စကားရိုး၊ စကားရော၊ စကားပေါင်းများ ဟူ၍ ခွဲခြား သတ်မှတ်နိုင်ပါသည်။ မြန်မာဘာသာစကား၏ စကားလုံးဖွဲ့ပုံနှင့် အမျိုးအစားတူကြောင်း လေ့လာဖော်ထုတ် နိုင်ပါသည်။ ကယန်း (ပဒေါင်) ဘာသာစကား၏ စကားရိုးတွင် ဧကဝဏ္ဏစကားလုံးနှင့် ဗဟုဝဏ္ဏစကားလုံး ဟူ၍ရှိပြီး နာမ်စကားရိုးတွင် ဧကဝဏ္ဏနာမ်စကားရိုး၊ ဒွိဝဏ္ဏနာမ်စကားရိုးနှင့် တြိဝဏ္ဏနာမ်စကားရိုးဟူ၍ ရှိပါ သည်။ သို့သော် တြိဝဏ္ဏနာမ်စကားရိုးမှာ အရေအတွက်နည်းပါးပါသည်။ ကြိယာစကားရိုးတွင်လည်း ဧကဝဏ္ဏ ကြိယာစကားရိုး၊ ဒွိဝဏ္ဏကြိယာစကားရိုးနှင့်

ကြိဝဏ္ဏကြိယာစကားရိုးဟူ၍ရှိပါသည်။ စကားရောသည် ဗဟုဝဏ္ဏ များသာဖြစ်ကြပြီး နာမ်စကားရောနှင့် ကြိယာစကားရောဟူ၍ ရှိရာတွင် နာမ် (သို့မဟုတ်) ကြိယာ၏ ရှေ့တွင် ရှေ့ဆက်(ရုပ်မှီး)ပေါင်းစပ်သည် ကိုတွေ့ရသည်။ ကယန်း (ပဒေါင်) ဘာသာစကား၏ စကားပေါင်းတွင် ရုပ်သီး နှစ်ခုမှ သုံးခုအထိ ပေါင်းစပ်ထားပြီး နာမ်နှင့်နာမ်ပေါင်းစပ်ခြင်း၊ နာမ်နှင့် ကြိယာပေါင်းစပ်ခြင်း၊ နာမ်နှင့် ကြိယာနှစ်လုံး ပေါင်းစပ်ခြင်းနှင့် နာမ်၊ ကြိယာနှင့် နာမ်ပေါင်းစပ်သည့် ရုပ်သီး (၃)ခု ပါဝင်သော စကားပေါင်း များကိုလည်း တွေ့ရှိရပါသည်။

## နိဂုံး

ကယန်း (ပဒေါင်) ဘာသာစကား၏ စကားလုံးဖွဲ့ပုံကို လေ့လာဖော်ထုတ်ရာတွင် စိတ်ဝင်စားဖွယ် ပေါင်းစပ်မှု များကို တွေ့ရှိနိုင်ပါသည်။ မြန်မာဘာသာစကား၏ စကားလုံးဖွဲ့ပုံနှင့် အမျိုးအစားခွဲခြားခြင်း တူညီသည်များ လည်းရှိကြောင်းတွေ့ရပါသည်။ ဤစာတမ်းသည် ဖယ်ခုံမြို့နယ်သုံး ဘုံစကားကို အဓိကထားသုတေသနပြု ဖော်ထုတ်ထားပါသည်။

## တွေ့ဆုံမေးမြန်းသူများ

| | | |
|---|---|---|
| ၁။ မောင်နေလင်း | အသက် (၂၄)နှစ် | ဖယ်ခုံမြို့ |
| ၂။ ဦးလွန်းမောင် | အသက် (၅၃)နှစ် | ဖယ်ခုံမြို့ |
| ၃။ ဒေါ်မူးကွံး | အသက် (၅၃) နှစ် | ဖယ်ခုံမြို့ |
| ၄။ ဥူးဇင်း ဦးဣန္ဒက | အသက် (၃၀)နှစ် | (နာယက) (ကယန်းစာပေနှင့် ယဉ်ကျေးမှု ဗဟိုကော်မတီ အဖွဲ့ဝင်) မိုးဗြဲဒေသ |
| ၅။ ဦးကထန့် | အသက် (၄၇)နှစ် | ဖယ်ခုံမြို့ |
| ၆။ ဒေါ်မူနယ် | အသက် (၆၃)နှစ် | မိုးဗြဲကျေးရွာ |

## ညှိနှိုင်းကိုးကားသည့်ကျမ်းကိုးစာရင်း


### မြန်မာဘာသာ

ခင်မင်၊ မောင် (ဓနုဖြူ)။ (၁၉၉၀)။ *မြန်မာစာ မြန်မာစကားရုပ်ပုံလွှာ*၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

ခွန်နွယ်၊ မောင် (အင်းလေး)။ (၁၉၉၂)။ *ပအိုဝ်း*။ ရန်ကုန်၊ ဗဟိုပုံနှိပ်တိုက်။

ဂျင်းဖောမယ် (ယုဝတီ)။ (၂၀၀၀)။ *တိုင်းရင်းသားမဂ္ဂဇင်း*။

စင်ကြယ်၊ မောင်။ (၁၉၆၀)။ *ကရင့်ဘဝဓလေ့*။ ရန်ကုန်၊ သီတာထွန်းပုံနှိပ်တိုက်။

ထွန်းမြင့်၊ ဦး။ (၁၉၉၆ က)။ *ဘာသာဗေဒ*။ ရန်ကုန်၊ ဂျီအီးစီ (ပညာရေး) သမဝါယမလီမိတက်၊ ရန်ကုန်တက္ကသိုလ်။

ဖေမောင်တင်၊ ဦး။ (၁၉၅၈)။ *ဘာသာလောကကျမ်း*။ ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

မင်းနိုင်၊ ဦး၊ (၁၉၆၀)။ *တို့တိုင်းရင်းသားပြည်ထောင်စုဘွား*။ ရန်ကုန်၊ ပြည်ထောင်စုမြန်မာနိုင်ငံတော် ယဉ်ကျေးမှုဝန်ကြီးဌာန။

မောင်သောင်း၊ ခွန်။ (၁၉၇၃- ၇၄)။ *ရှမ်းပြည်တောင်ပိုင်း ပအိုဝ်းတိုင်းရင်းသားများ၏ လူမှုပထဝီဝင်စာတမ်း*၊ ပုသိမ်ကောလိပ်။

မြန်မာ့ဆိုရှယ်လစ်လမ်းစဉ်ပါတီ။ (၁၉၆၇)။ *တိုင်းရင်းသား ယဉ်ကျေးမှုဓလေ့ထုံးစံများ (ကယား)*။ ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

မြန်မာ့ဆိုရှယ်လစ်လမ်းစဉ်ပါတီ။ (၁၉၆၇)။ *တိုင်းရင်းသားယဉ်ကျေးမှုဓလေ့ထုံးစံများ (ကရင်)*။ ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

သျှင်ထွေးယဉ် (မနုဿ) (၂၀၀၅)။ *"ကယန်း (ပဒေါင်)"* ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

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# ပုလောဒေသိယစကားမှ နာမ်စကားလုံးဖွဲ့ပုံကို ဘာသာဗေဒအမြင်ဖြင့် လေ့လာခြင်း

ချိုချိုနွယ်[1], ဇော်ဝင်း[2]

## စာတမ်းအကျဉ်းချုပ်

ဤစာတမ်းသည် ပုလောဒေသိယစကားမှ (နာမ်) စကားလုံးဖွဲ့ပုံကို (ဘာသာဗေဒ) ရှုထောင့်မှ လေ့လာတင်ပြထားပါသည်။ ဘာသာဗေဒရှုထောင့်ဆိုရာတွင် ဒေသိယစကား လေ့လာမှု ဘာသာဗေဒရှုထောင့်ဖြစ်ပါသည်။ လေ့လာတင်ပြရာတွင် ပုလောမြို့နယ် တည်နေရာ အကျယ်အဝန်း နယ်နိမိတ်၊ ဒေသိယစကား ဖွင့်ဆိုသတ်မှတ်ချက်၊ နာမ် ဖွင့်ဆိုသတ်မှတ်ချက်၊ စကားလုံးဖွဲ့မှုဖွင့်ဆိုချက်၊ ရုပ်ရင်းဖွင့်ဆိုချက်နှင့် စကားရိုး၊ စကားရော၊ စကားပေါင်း၊ စကားလုံးအမျိုးအစားများကို ခွဲခြားသတ်မှတ်ကာ လေ့လာတင်ပြထားပါသည်။ ထိုသို့လေ့လာခြင်းဖြင့် ပုလောဒေသိယစကား စကားလုံးဖွဲ့ပုံနှင့် ဓလေ့ထုံးစံ၊ အတွေးအခေါ် အယူအဆတို့ကို သိမြင် နိုင်ပါသည်။

**သော့ချက်ဝေါဟာရများ။** ။ဒေသိယ၊ နာမ်၊ ရုပ်ရင်း၊ စကားလုံး၊ စကားရိုး၊ စကားရော၊ စကားပေါင်း။

## နိဒါန်း

ပုလောဒေသိယစကား၊ နာမ်စကားလုံးဖွဲ့ပုံကို သုတေသနပြုရာတွင် သက်ဆိုင်ရာမြို့နယ်ရှိ ဒေသိယ အပြောစကားတို့ကို အလေ့လာခံအဖြစ်ထား၍ ပုလောမြို့မှ ရပ်မိရပ်ဖများနှင့် မိတ်ဆွေ သူငယ်ချင်းများ၊ မြိတ်တက္ကသိုလ်၊ မြန်မာစာဌာနမှ ဆရာ၊ ဆရာများ၊ ဝန်ထမ်းများနှင့် ကျောင်းသား၊ ကျောင်းသူတို့ကို မေးမြန်းကာ တိုက်ဆိုင် စိစစ်မှုများ ပြုခဲ့ပါသည်။ ဤသုတေသနစာတမ်းသည် မြန်မာဘာသာစကား ဆိုင်ရာ မြန်မာ့ဝေါဟာရများ တည်တံ့မှုအတွက် အရေးပါမှုရှိမည်ဟု ယုံကြည်ပါသည်။

### ၁။ ပုလောမြို့နယ်၏ တည်နေရာ၊ အကျယ်အဝန်းနယ်နိမိတ်

တနင်္သာရီတိုင်းဒေသကြီးတွင် ထားဝယ်ခရိုင်၊ မြိတ်ခရိုင်နှင့် ကော့သောင်းခရိုင်တို့ပါဝင်သည်။ မြိတ်ခရိုင်တွင် ပုလောမြို့နယ်၊ မြိတ်မြို့နယ်၊ တနင်္သာရီမြို့နယ်နှင့် ကျွန်းစုမြို့နယ်တို့ပါဝင်ပါသည်။ မြန်မာ့ ပင်လယ်ကမ်းရိုးတန်းတွင် တစ်ခုအပါအဝင်ဖြစ်သော ပုလောမြို့နယ်သည် မြောက်လတ္တီကျူ ၁၂° ၁၂' နှင့် ၁၃° ၂၈' အကြား၊ အရှေ့လောင်ဂျီကျူ ၉၈° ၅၀' အကြားတွင် တည်ရှိသည်။ ရေပြင်အပါအဝင် စတုရန်း (၁၃၀၀) မိုင်၊ ရေပြင်မပါ ကုန်းမြေစတုရန်းမိုင် (၁၀၁၇) မိုင်၊ မြို့အကျယ်မိုင် (၂.၇၃) မိုင်၊ မြောက်မှ တောင်စွန်းအထိ ၅၆ မိုင်၊ အရှေ့မှ အနောက်စွန်းအထိ (၂၆) မိုင်၊ အရှေ့ဘက်တွင် တနင်္သာရီ မြို့၊ အနောက်ဘက်တွင် ပင်လယ်ကမ်းခြေ၊ တောင်ဘက်တွင် မြိတ်မြို့နယ်၊ မြောက်ဘက်တွင် သရက်ချောင်း မြို့နယ်တို့နှင့် နယ်နိမိတ်ချင်း ထိစပ်နေသည်။ (ကိုလတ်နှင့်အဖွဲ့၊ ၂၀၀၈၊ ၁၀)

ပုလောမြို့၏ ပထဝီအနေအထားကို လေ့လာခြင်းဖြင့် ပုလောဒေသိယစကား ဖြစ်ပေါ်လာခြင်းကို သတိပြုစေနိုင်ပါသည်။ ပုလောမြို့သည် တနင်္သာရီတိုင်းဒေသကြီး ကမ်းရိုးတန်းဒေသတွင် တည်ရှိပြီး မြန်မာမင်းတို့၏ထီးနန်းအုပ်ချုပ်ရာဒေသနှင့် ဝေးကွာလွန်းခြင်းတို့ကြောင့်လည်း ပုလောဒေသိယစကားသည် မြန်မာဘာသာစကားပင်ဖြစ်သော်လည်း အသံထွက်နှင့် ဝေါဟာရအသုံးအနှုန်း အချို့မတူ ကွဲပြားမှု ရှိနေခြင်းဖြစ်သည်။

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[1] ချိုချိုနွယ်၊ ကထိက၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

[2] ဒေါက်တာ၊ ပါမောက္ခ၊ ဌာနမှူး၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

**၂။ ဒေသိယစကားဖွင့်ဆိုသတ်မှတ်ချက်များ**

ဒေသိယစကားနှင့်ပတ်သက်၍ ပညာရှင်များက အမျိုးမျိုးဖွင့်ဆိုခဲ့ကြသည်။ ဒေသိယစကားကို မြန်မာအဘိဓာန်တွင်-

"ဒေသအလိုက်ပြောဆို သုံးနှုန်းသောစကား" (မြန်မာစာအဖွဲ့၊ ၁၉၉၁၊ ၁၇၈) ဟူ၍ ဖွင့်ဆိုထားပါသည်။

ဆရာကြီး မောင်ခင်မင် (ဓနုဖြူ)က ဒေသိယစကားကို ဘာသာဗေဒပညာရှင်များက တစ်ချိန်က "ဒေသန္တရစကား" ဟူ၍ ခေါ်တွင်ခဲ့ကြသည်ဟူ၍ ဖော်ပြထားသည်။ (ခင်မင်၊ မောင် (ဓနုဖြူ)၊ ၂၀၀၄)

လူမှုဘာသာဗေဒမိတ်ဆက်စာအုပ်တွင် ဒေါက်တာအောင်မြင့်ဦးက-

"ဘာသာစကားသုံးစွဲသူတို့၏ ဒေသအလိုက်လည်းကောင်း၊ အသက်အရွယ်အလိုက်သော်လည်း ကောင်း၊ လူမှုအခြေအနေအရသော်လည်းကောင်း၊ လုပ်ငန်းအလိုက်သော်လည်းကောင်း ဖြစ်နိုင်သည်။ ထိုဘာသာစကား၏အသွင်ကွဲကို ဒေသိယစကားဟုခေါ်သည်။ ထို့ကြောင့် ဒေသိယဟူသည် ဘာသာ စကား၏ အသွင်ကွဲဖြစ်သည် ဟုဖွင့်ဆိုနိုင်သည်။" (အောင်မြင့်ဦး၊ ဒေါက်တာ၊ ၂၀၀၃၊ ၃၄) ဒေသိယ ဟူသော ဝေါဟာရသည် ပါဠိစကား "ဒေသ" နှင့် "ဣယ" ဟူသော စကားနှစ်လုံးကို ပေါင်းစပ်ထားခြင်း ဖြစ်သည်။ ဒေသိယစကားဟူသည် "မူလဘာသာစကားတစ်ခုနှင့် အမျိုးအစားတူသော ဘာသာစကား တစ်ခုပင်ဖြစ်သည်။" (အောင်မြင့်ဦး၊ ဒေါက်တာ၊ ၂၀၀၃၊ ၃၄)

**၃။ နာမ်ဖွင့်ဆိုသတ်မှတ်ချက်**

နာမ်ကို အစဉ်အလာသဒ္ဒါဆရာတို့က "လူပုဂ္ဂိုလ်၊ နေရာ၊ အရာဝတ္ထုတစ်ခုခု၏အမည်" ဟု ဖွင့်ဆိုခဲ့ကြသည်။ အစဉ်အလာသဒ္ဒါအရ နာမ်ကို ဖွင့်ဆိုသတ်မှတ်ရာတွင် အားနည်းချက်များရှိနေ၍ ယင်းဖွင့်ဆိုသတ်မှတ်ချက်ထက် ပိုမိုကောင်းမွန်သော အများလက်ခံနိုင်သော ဖွင့်ဆိုချက်များကို ဘာသာဗေဒပညာရှင် တို့ ဖွင့်ဆိုခဲ့ကြသည်။ နာမ်၏ ပုံသဏ္ဌာန်နှင့် ဝါကျအတွင်း အလုပ်တာဝန်ကို ဖော်ပြ သတ်မှတ်သော ဖွင့်ဆိုချက်မျိုးဖြစ်သည်။ ယင်းဖွင့်ဆိုချက်မျိုးကို မန်းနှင့် စတော့ဘို့၏ ဘာသာစကားနှင့် ဘာသာဗေဒ အဘိဓာန်တွင်-"နာမ်သည် အနည်းကိန်းနှင့် အများကိန်းကို ခွဲခြားပြနိုင်သည်။ (ဥပမာ- Table, tables) ပိုင်ဆိုင်မှုကိုလည်း ပြနိုင်သည်။ (ဥပမာ- man's) ၎င်းအချက်များကို မပြသော်လည်း နာမ်၏ လုပ်ဆောင်ချက်များကို ထမ်းဆောင်နိုင်သော ပုဒ်မျိုးကို နာမ်ဟု သတ်မှတ်သည်။" (Richards, 1992)

**၄။ စကားလုံးဖွဲ့မှုဖွင့်ဆိုချက်**

စကားလုံးဖွဲ့မှုဟူသည် စကားလုံး၏ အတွင်းတည်ဆောက်ပုံကို လေ့လာခြင်းဖြစ်သည်။ ဆိုလိုသည်မှာ စကားများဖြစ်အောင် တည်ဆောက်ရာ၌ အစိတ်အပိုင်းများအဖြစ် ရုပ်ရင်းများ ပါဝင်ရသည်။ ပါဝင်သော ရုပ်ရင်းတို့၏ သဘောသဘာဝ၊ စည်းကမ်း၊ အနေအထား၊ အစီအစဉ်၊ နေရာ စသည်တို့အား လေ့လာ ခြင်းကို စကားလုံးဖွဲ့မှုဟု ခေါ်ပါသည်။ ထို့ကြောင့် ရုပ်ရင်း၏ သဘောသဘာဝကို လေ့လာတင်ပြပါမည်။ (ခင်မင်၊ မောင် (ဓနုဖြူ)၊ ၂၀၀၄)

၄၊ ၁။ ရုပ်ရင်းဖွင့်ဆိုချက်

ရုပ်ရင်းသတ်မှတ်ချက်နှင့် စပ်လျဉ်း၍ ပညာရှင်များ အမျိုးမျိုးဖွင့်ဆိုခဲ့ကြသည်။ ဗလွန်းဖီး၏ ရုပ်ရင်းသတ်မှတ်ချက်မှာ " ရုပ်ရင်းဆိုသည်မှာ အခြားမည်သည့် ဘာသာဗေဒယူနစ်နှင့်မျှ အသံချင်းရော အဓိပ္ပာယ်ချင်းပါ တစ်စိတ်တစ်ဒေသမျှ ဆင်တူမှုမရှိသော ယူနစ်ဖြစ်သည်။" (ထွန်းမြင့်၊ ဦး၊ ၂၀၀၇) ဟု ဖွင့်ဆိုထားပါသည်။ တစ်နည်းအားဖြင့် "အဓိပ္ပာယ်ရှိသော အသေးဆုံးယူနစ်ဖြစ်သည်"ဟု ဖွင့်ဆိုထားပါသည်။

ဤစာတမ်းတွင် ရုပ်ရင်းသတ်မှတ်ချက်မှာ ရုပ်ရင်းသည် ဘာသာဗေဒယူနစ်များအနက် အသေးဆုံးယူနစ်တစ်ခုဖြစ်ပါသည်။ အဘိဓာန်အနက်ကိုလည်း ဖော်ဆောင်နိုင်သည်။ သဒ္ဒါအနက်ကိုလည်း ဖော်ဆောင်နိုင်သည်။ အဘိဓာန်အနက်ကို ဖော်ဆောင်ရာတွင် အနက်တစ်ခုမက ဖော်ဆောင်နိုင်သည်။

၄၊ ၂ ။ ရုပ်ရင်းအမျိုးအစား

ရုပ်ရင်းအမျိုးအစား (၂)မျိုးရှိသည်။ ယင်းတို့မှာ-

(၁) ရုပ်သီးရုပ်ရင်း

(၂) ရုပ်မှီးရုပ်ရင်း တို့ဖြစ်ကြပါသည်။

၄၊ ၂။ ၁။ ရုပ်သီးရုပ်ရင်း

ရုပ်သီးရုပ်ရင်းဆိုသည်မှာ ရုပ်ရင်းတစ်ခုအနေနှင့်သာမက စကားလုံးတစ်ခုအနေနှင့်လည်း သီးခြားစွာ ရပ်တည်နိုင်သော ရုပ်ရင်းမျိုးဖြစ်ပါသည်။ ရုပ်သီးရုပ်ရင်းတစ်ခုသည် စကားလုံးတစ်ခုအသွင်ဖြင့် တည်ဆောက်ထားသောကြောင့် ရုပ်သီးတစ်ခုရှိသော စကားလုံးဟုလည်း ခေါ်ဆိုသည်။

သာဓကအားဖြင့် -

သွီး / θwì / (သွေး) (n)

fm

၄၊ ၂။ ၂။ ရုပ်မှီးရုပ်ရင်း

ရုပ်မှီးရုပ်ရင်းဆိုသည်မှာ အခြားရုပ်ရင်းရုပ်သီးကို ဖြစ်စေ၊ ရုပ်မှီးကို ဖြစ်စေ၊ တစ်ခုခုနှင့်အတူ စကားလုံး တစ်ခုတည်းတွင် ဝင်ရောက်ဖြစ်ရသည့် ရုပ်ရင်းမျိုးကို ခေါ်သည်။ ရုပ်မှီးရုပ်ရင်းသည် မိမိဘာသာ စကားလုံး တစ်ခုအသွင်ဖြင့် သီးခြားရပ်တည်နိုင်စွမ်းမရှိပေ။

သာဓကအားဖြင့်-

အဗွာ / ə bwā/ (အမြွှာ) (n)

bm + fm

**၅။ စကားလုံးဖွင့်ဆိုချက်**

ဘာသာဗေဒပညာရှင်များသည် ဘာသာစကားများကို လေ့လာရာတွင် ဘာသာဗေဒအစိတ်အပိုင်းယူနစ်များကို ဝါစဉ်အလိုက် စဉ်ကြသည်။ ယင်းတို့အနက် အကြီးဆုံးမှစ၍ ဝါကျ၊ ဝါကျခွဲ၊ ပုဒ်၊ စကားလုံး၊ ရုပ်ရင်းတို့ပါဝင်ကြပါသည်။ စကားလုံးသည် ဘာသာဗေဒအစိတ်အပိုင်းယူနစ်တစ်ခုဖြစ်ပါသည်။ စကားလုံး သတ်မှတ်ချက်နှင့် စပ်လျဉ်း၍ ဘာသာဗေဒပညာရှင်များ အမျိုးမျိုး သတ်မှတ်ခဲ့ကြပါသည်။

စကားလုံးသတ်မှတ်မှုနှင့် ပတ်သက်၍ တင်ပြကြရာတွင် “စကားလုံးဆိုသည်မှာ သီးခြား လွတ်လပ်စွာ ရပ်တည်နိုင်သော အသေးဆုံးယူနစ်တစ်ခုဖြစ်သည်။” (Bloom field, 1976, 118) ဟု လည်းကောင်း၊ “စကားလုံးဆိုသည်မှာ မည်သည့်ဘာသာဗေဒယူနစ်တို့၏ ကြားတိုးမှုကိုမျှ လက်မခံသော ပုံသေဖွဲ့စည်းမှုရှိသော ဘာသာဗေဒယူနစ်တစ်ခုဖြစ်သည်။ (David crystal, 1969, 190) ဟုလည်းကောင်း စသည်ဖြင့် အသီးသီး သတ်မှတ်ခဲ့ကြပါသည်။

စကားလုံးသည် သီးခြားရပ်တည်နိုင်သော အသေးဆုံးအစိတ်အပိုင်းဟုသတ်မှတ်လျှင် စကားလုံး၏ အောက်အဆင့်ရှိ ရုပ်ရင်းနှင့်သဘောချင်း ထပ်တူဖြစ်နေမည်။ ရုပ်ရင်းသည်လည်း သီးခြားရပ်တည်နိုင်သော သဘောရှိသည်။

သာဓကအားဖြင့်-

ဝါးဖူး (n) = ဝါး + ဖူး

/wà + phù /

fm + fm

စကားလုံးထက်ငယ်သော ရုပ်ရင်းကို အခြေပြု၍ စကားလုံးသတ်မှတ်ခြင်းဖြစ်သောကြောင့် ရုပ်ရင်းအခြေပြု စကားလုံးဖွဲ့မှုဟု ဆိုနိုင်ပါသည်။ ဤစာတမ်းတွင် ရုပ်ရင်းအခြေပြုစကားလုံးဖွဲ့မှု လေ့လာနည်းကို အသုံးပြုပါမည်။

၅၊ ၁။ စကားလုံးအမျိုးအစားခွဲခြင်း

ဘာသာဗေဒပညာရှင်များသည် စကားလုံးနှင့် ပတ်သက်ပြီး အမျိုးအစားခွဲခြားရာတွင် သတ်ပုံကို အခြေခံ၍လည်းကောင်း၊ အသံကို အခြေခံ၍လည်းကောင်း၊ သဒ္ဒါကို အခြေခံ၍လည်းကောင်း အမျိုးအစားခွဲပြီး နောက် ဖွဲ့စည်းတည်ဆောက်ပုံကို အခြေခံ၍လည်း အမျိုးအစားခွဲခြားပါသည်။ စကားလုံးတို့၏ ဖွဲ့စည်းပုံအရ အောက်ပါအတိုင်း (၃)မျိုး ခွဲခြားထားပါသည်။ (ထွန်းမြင့်၊ ဦး၊ ၂၀၀၇) ယင်းတို့မှာ -

(၁) စကားရိုး

(၂) စကားရော

(၃) စကားပေါင်း တို့ဖြစ်ကြသည်။

**၅၊ ၁၊ ၁။ နာမ်စကားရိုး**

စကားရိုးဆိုသည်မှာ ရုပ်သီးရုပ်ရင်းတစ်ခုတည်းဖြင့် ဖွဲ့ထားသော စကားလုံးမျိုးကို ခေါ်သည်။ (ထွန်းမြင့်၊ ဦး၊ ၂၀၀၇) ရုပ်သီး တစ်ခုတည်းဖြင့် ဖြစ်နေသည့် စကားရိုးကို ပုံသေနည်းဖြင့်ပြရလျှင်-

စကားရိုး → ရုပ်သီးရုပ်ရင်း

ကွဲ (n) → / kwɛ̀ / ကျွဲ

သားလွန် (n) → / θà -lũ/ လုံချည်

စကားရိုးသည် ရုပ်သီးရုပ်ရင်းတစ်ခုတည်း ရှိသော်လည်း ဝဏ္ဏအရေအတွက်အရမူ ဧကဝဏ္ဏ (အသံတစ်ခု) နှင့် ဗဟုဝဏ္ဏ (တစ်ခုမကသော အသံ) လည်းဖြစ်နိုင်သည်။ (ထွန်းမြင့်၊ ဦး၊ ၂၀၀၇၊ ၃၃၃) ပုလောဒေသိယ စကားတွင်လည်း စကားရိုး နာမ်စကားလုံး များစွာရှိသည်ကို လေ့လာတွေ့ရှိရပါသည်။

**နာမ်စကားရိုး**

| **ဒေသိယစကား** | **စံစကား** | **စံအရေး** |
|---|---|---|
| ဘဲ့ ˊbɛ́ˊñ<br>fm | ဆိတ် ˊsheiʔˊˋñ<br>fm | ဆိတ် |
| မန်း ˊmàãˊñ<br>fm | ထမင်း ˊthə mìˊñ<br>fm | ထမင်း |
| ပဒီး ˊpə d`iˊñ<br>fm | ဆွဲကြိုး ˊshwɛ̀ dʒóˊñ<br>fm | ဆွဲကြိုး |

| | | |
|---|---|---|
| ခမောက်´khə mauʔ˝ñ<br>fm | ဦးထုပ်´ú thouʔ˝ñ<br>fm | ဦးထုပ် |
| ဂုတ်´gouʔ˝ñ<br>fm | လည်ဂုတ်´lɛ̄ gouʔ˝ñ<br>fm | လည်ဂုတ် |
| ပိ´pi´˝ñ<br>fm | ငါးပိ´ŋə pi´ ˚ñ<br>fm | ငါးပိ |
| နွန် ´-nũ´ ˚ñ<br>fm | အကို´ə kō´ ˚ñ<br>fm | အစ်ကို |
| ဖငယ်´phá ŋɛ̄˝ñ<br>fm | ပထွေး´pə thwè˝ñ<br>fm | ပထွေး |
| ဖဂီး´phá g`i˝ñ<br>fm | ဘကြီး´bá dʒ`í ˚ñ<br>fm | ဘကြီး |
| မိငယ်´mi´ ŋɛ̄˝ñ<br>fm | မိထွေး´mi´ dwè˝ñ<br>fm | မိထွေး |
| မျဉ်းတံ ´mj ̀ ̀i -dã˝ñ<br>fm | ပေတံ´pē -dã˝ñ<br>fm | ပေတံ |

**၅၊ ၁၊ ၂။ နာမ်စကားရော**

စကားရောဆိုသည်မှာ တစ်ခု (သို့မဟုတ်) တစ်ခုထက်ပိုသော ရုပ်သီးနှင့် တစ်ခု (သို့မဟုတ်) တစ်ခုထက်ပိုသော ရုပ်မှီးရုပ်ရင်းများဖြင့် ပေါင်းစပ်တည်ဆောက်ထားသော စကားလုံးမျိုးဖြစ်သည်။ (ထွန်းမြင့်၊ ဦး၊ ၂၀၀၇) ပုံသေနည်းဖြင့် ပြရလျှင်-

စကားရော → ရုပ်မှီး + ရုပ်သီး + ရုပ်မှီး
Cpl.w bm + fm + bm
ရုပ်သီး + ရုပ်မှီး ...
fm + bm
ရုပ်သီး + ရုပ်မှီး ...+ ရုပ်သီး
fm + bm + fm

သာဓကအားဖြင့် -

အသီးအပွင့် - အ + သီး + အ + ပွပ်
/ ə θ̀ i ə pwaʔ /
bm + fm+ bm+ fm

စားစရာ - စား + ဇာ
/ sà zā/
fm + bm

ဟူ၍ဖော်ပြထားသည်။ စကားရောတစ်ခုတွင် တစ်ခု (သို့မဟုတ်) တစ်ခုထက်ပိုသော ရုပ်မှီး နှင့် တစ်ခု (သို့မဟုတ်) တစ်ခုထက်ပိုသော ရုပ်သီး များထည့်၍လည်း တည်ဆောက်နိုင်သည်။ တစ်ခု (သို့မဟုတ်) တစ်ခုထက်ပိုသော ရုပ်သီး၏နောက်တွင် တစ်ခု (သို့မဟုတ်) တစ်ခုထက်ပိုသော ရုပ်မှီးတို့ ပေါင်းစပ်၍ လည်း တည်ဆောက်နိုင်သည်။ ရုပ်သီး ရုပ်ရင်း၏အလယ်တွင် ရုပ်မှီးတစ်ခုထည့်၍လည်း တည်ဆောက် နိုင်သည်ဟု ဆိုလိုပါသည်။ (ထွန်းမြင့်၊ ဦး၊ ၂၀၀၇၊ ၃၃၄-၃၃၅) ပုလောဒေသိယစကားတွင်လည်း စကားရောအဖြစ် တည်ဆောက်ထားသော နာမ်များကို တွေ့ရှိရပါသည်။

**နာမ်စကားရော**

| ဒေသိယစကား | စံစကား | စံအရေး |
|---|---|---|
| အိမ်အကူ-eì ə kũ<br>fm ˣ bmˣ fm | အိမ်ဖော်၊ အိမ်စေ-eì phɔ̄ ʕ-eì zē<br>fmˣ fm | အိမ်ဖော်၊ အိမ်စေ |
| အပျိုဇွန် ə pjō -zũ<br>bmˣ fmˣ fm | အပျိုရံ ə pjō -jã<br>bmˣ fm | အပျိုရံ |
| အဝတ်လန်းဒန်း ə wuʔ lˋã dˋã̄<br>bmˣ fmˣ fm | အဝတ်လှန်းစင် ə wuʔ hlˋã -zì<br>bmˣ fmˣ fm | အဝတ်လှန်းစင် |
| အစိမ်းယွန် ə sèì -jũ<br>bmˣ fmˣ fm | အစိမ်းရောင် ə sèì -jaũ<br>bmˣ fmˣ fm | အစိမ်းရောင် |
| အကွန်းအကန်း ə kˋũ ə kˋã<br>bmˣ fmˣ bmˣ fm | အကောင်းအကန်း ə kàũ ə kˋã̄<br>bmˣ fmˣ bmˣ fm | အကောင်းအကန်း |
| အမွီး ə mẁí<br>bmˣ fm | အမွေး ə mẁe<br>bmˣ fm | အမွေး |

**၅၊ ၁၊ ၃။ နာမ်စကားပေါင်း**

စကားပေါင်းဆိုသည်မှာ တစ်ခုထက်မကသော ရုပ်သီးရုပ်ရင်းတို့ဖြင့် ပေါင်းစပ် ဖွဲ့စည်းထားသည့် စကားလုံးမျိုးဖြစ်သည်။ (ထွန်းမြင့်၊ ဦး၊ ၂၀၀၇) ပုံသေနည်းဖြင့် ပြရလျှင်-

စကားပေါင်း ⟶ ရုပ်သီး + ရုပ်သီး ...
Cpd.w ⟶ fm ... + fm ...

သာဓကအားဖြင့်

ခွေးခေါင်း - ခွီး + ခွန်း
/ khẁi khẁũ/
fm + fm

ဟူ၍ပြရပါသည်။ ဆိုလိုသည်မှာ စကားပေါင်းတစ်ခုလျှင် ရုပ်သီးရုပ်ရင်းနှစ်ခု (သို့မဟုတ်) နှစ်ခုထက် ပိုသော ရုပ်သီးရုပ်ရင်းများဖြင့် တည်ဆောက်သည်ဟု ဆိုလိုပါသည်။ ပုလော ဒေသိယစကားတွင်လည်း စကားပေါင်းနှင့် ပတ်သက်သည့် နာမ်စကားလုံးများကို လေ့လာ တင်ပြပါမည်။

**နာမ်စကားပေါင်း**

| ဒေသိယစကား | စံစကား | စံအရေး |
|---|---|---|
| ရွှေရင်အေး ɕwē -jì ɛ̀<br>fm + fm + fm | ကျောက်ကျော tɕauʔ tɕɔ́<br>fm + fm | ကျောက်ကျော |
| ကြစ်တွန်မွီး tɕiʔ -tũ mẁí<br>fm + fm + fm | ကြက်မွေး tɕiʔ mwè<br>fm + fm | ကြက်မွေး |
| မုန့်ပါတစ်ကား mouʔ pā taʔ kā<br>fm + fm + fm+ fm | ကြက်ဥခေါက်မုန့် tɕiʔ ú khauʔ mouʔ<br>fm + fm + fm+ fm | ကြက်ဥခေါက်မုန့် |
| ကွဲဒတ်ကီး kwè daʔ kˋí<br>fm + fm + fm | ကျွဲသိုးကြီး tɕwè θò dʒ̀í<br>fm + fm + fm | ကျွဲသိုးကြီး |

| | | |
|---|---|---|
| ဆီးဒွန်းလုံး sh`i d`ũ lòũ<br>fm + fm + fm | ခါးတောင်းကျိုက် gə dàũ tɕiʔ<br>fm + fm + fm | ခါးတောင်းကျိုက် |
| ဖဲဖွန်းသီး phè ph`ũ θ`í<br>fm + fm + fm | ငွေးသီး gwè ð`í<br>fm + fm | ငွေးသီး |
| ငါးဖွန်းဆံ ŋà ph`ũ -shã̀<br>fm + fm + fm | ငါးစည်းဖောင်း ŋə sì bàũ<br>fm + fm + fm | ငါးစည်းဖောင်း |
| ရုန်းဒေါ်ဗျန် jòũ dɔ̄ -bjã́<br>fm + fm + fm | စိန်ပန်း -seɪ̀ b`ã<br>fm + fm | စိန်ပန်း |
| ငွေလယွန် ŋwē lá -jṹ<br>fm + fm + fm | ဆေးကုလားမ shè kə ká má<br>fm + fm | ဆေးကုလားမ |
| ရေမြီးသီး jē mʷì θ`í<br>fm + fm | နှင်းသီး -hnì ð`í<br>fm + fm | နှင်းသီး |
| ပိုက်ခွန်းအုံး pai? kh`ũ òũ<br>fm + fm + fm | ဖက်လုံး phɛʔ lòũ<br>fm + fm | ဖက်လုံး |
| အိမ်တတ်ပွဲ -eɪ̀ taʔ pwè<br>fm + fm + fm | မင်္ဂလာပွဲ -mɪ̀ gə lā bwɛ̀<br>fm + fm | မင်္ဂလာပွဲ |
| မုန့်ခွပ်သား moũ khwaʔ θã́<br>fm + fm + fm | မုန့်လင်မယား moũ -lì mə jà<br>fm + fm + fm | မုန့်လင်မယား |
| ပဲထွန်းမုန့် pè th`ũ moũ<br>fm + fm + fm | မြေပဲလိပ် mjē pè leiʔ<br>fm + fm + fm | မြေပဲလိပ် |
| ပဇင်းရေသော် pə ʑì jē θɔ̀<br>fm + fm + fm | သက်တံ θɛʔ -tã<br>fm + fm | သက်တံ |
| အုန်းခြစ်ကျွန် òũ tɕhiʔ -tɕũ<br>fm + fm + fm | အုန်းခြစ် òũ tɕhiʔ<br>fm + fm | အုန်းခြစ် |

ပုလောဒေသိယစကားမှ နာမ်စကားလုံးဖွဲ့ပုံကို လေ့လာရာတွင် စကားရိုးနှင့် စကားရော အသုံးနည်းပြီး စကားပေါင်းအသုံးများသည်ကို တွေ့ရသည်။ စံဘာသာစကားမှ စကားလုံးများနှင့် ဝေါဟာရအသုံး ကွဲပြားမှုကိုကြည့်လျှင် အနည်းငယ် ကွဲပြားသည်များရှိသကဲသို့ လုံးလုံးလျားလျား ကွဲပြားသည်များလည်း ရှိသည်။ အချို့မှာ စကားသံကွဲပြားမှုကြောင့် ဝေါဟာရ ကွဲပြားသကဲ့သို့ ဖြစ်နေခြင်းဖြစ်သည်။ အနက် အဓိပ္ပာယ်မှာ စံမြန်မာစကားနှင့် အတူတူပင်ဖြစ်သည်။

## ခြုံငုံသုံးသပ်ချက်

ဤသုတေသနစာတမ်းတွင် ပုလောဒေသိယစကားမှ စကားလုံးဖွဲ့ပုံကို အမျိုးအစားခွဲကာ လေ့လာတင်ပြထားပါသည်။ စကားလုံးတို့၏ ဖွဲ့စည်းတည်ဆောက်ပုံအရ စကားရိုး၊ စကားရော၊ စကားပေါင်း ဟူသော စကားလုံးအမျိုးအစား သတ်မှတ်ချက်များကို အခြေခံ၍ လေ့လာခဲ့ရာ စကားရိုးနှင့် စကားပေါင်း အသုံးများပြီး စကားရော အသုံးနည်းသည်ကို လေ့လာတွေ့ရှိရပါသည်။

စကားရောနှင့် စကားပေါင်းကို ခွဲခြားရာတွင် စကားရောဥပဒေသအရ ခွဲခြားရာ ခက်ခဲပါသည်။ အနည်းဆုံး ရုပ်သီးရုပ်ရင်းတစ်ခုနှင့် ရုပ်မှီးရုပ်ရင်းတစ်ခု ပေါင်းစပ်ခြင်းကို စကားရောဟု ဆိုသော်လည်း ပုလောဒေသိယစကားရှိ အချို့သော စကားရောများတွင် အဆက်ပစ္စည်းများကို မြှုပ်သုံးလေ့ရှိပါသည်။ သာဓကအားဖြင့် အရောင်းအဝယ် / ə jàũ ə wɛ̄ /၊ ကို ယွန်းဝယ် / j`ũ wɛ̄ / ဟု သုံးခြင်းကြောင့် ဖြစ်ပါသည်။

အချို့သော စကားရောများတွင် “အ” အဆက်ကို မြှုပ်သုံးလေ့မရှိပုံကိုလည်း သတိပြုမိပါသည်။ သာဓကအားဖြင့် “အရွက်” / ə jwiʔ / ကို “အဝပ်” / ə waʔ / ဟု “အ” အဆက်ကို မြှုပ်မသုံးသည်ကို တွေ့ရှိရ

ပါသည်။ သို့သော် “အ”ရှေ့ဆက်ပါသောစကားရိုးနှင့် အခြားနာမ်စကားလုံးတစ်ခုတို့ ပေါင်းစပ်လိုက် သောအခါ “အ” ကို မြှုပ်သုံးလေ့ရှိပါသည်။ သာဓကအားဖြင့် “ဝက်အသား” / wɛʔ ə θà/ ကို “ဝပ်သား” / wɛʔ θà /၊ “ဆိတ်အသွေး” / sheiʔ ə θwè / ကို “ဘဲ့သွီး” / bɛ̀ θwï / ဟု “အ” ကို မြှုပ်သုံးလေ့ရှိပါသည်။

ပုလောဒေသိယစကားရှိ စကားပေါင်းများကို လေ့လာသည့်အခါ စကားပေါင်းများ ဖွဲ့စည်းရာ၌ စံမြန်မာစကားနှင့် မတူသော စကားလုံးများရှိပါသည်။ သာဓကအားဖြင့် “သားအဖ” / θà ə phá / ကို “ဖ့ဲသား” / phá θà / ၊ “သားအမိ” / θà ə mí / ကို “မိသား” / mí θà / ဟု ဖွဲ့စည်းထားပါသည်။ အချို့သော စကားလုံးများတွင် ဝဏ္ဏမြှုပ်သုံးကြောင်း တွေ့ရပါသည်။ အထူးသဖြင့် ရှေ့ဝဏ္ဏနှင့် အလယ်ဝဏ္ဏကို မြှုပ်သုံး လေ့ရှိပါသည်။ သာဓကအားဖြင့် “ငါးပိ” / ŋə pí / ကို “ပိ” / pí /၊ “ဂုန်နီအိတ်” / -goũ nì eiʔ / ကို “ဂုန်အိတ်” / -goũ eiʔ / ဟု ဝဏ္ဏများကို မြှုပ်၍ သုံးလေ့ရှိသည်ကို တွေ့ရပါသည်။

မျက်မှောက်ခေတ်ဘာသာဗေဒနယ်ပယ်တွင် ဘာသာဗေဒသုတေသီများသည် ဒေသိယစကားများ၏ စကားလုံးဖွဲ့မှုကို စနစ်တကျ စူးစမ်းလေ့လာနေကြရာ ပုလောဒေသိယစကား စကားလုံးဖွဲ့မှု လေ့လာ ခြင်းသည် စံမြန်မာစကားရှိ အသွင်ကွဲဒေသိယစကားရှိ စကားလုံးဖွဲ့မှုလေ့လာခြင်းကို တစ်စိတ်တစ်ဒေသ အားဖြင့် အထောက်အကူ ပြုလိမ့်မည်ဟု တွေးရှုမိပါသည်။

## နိဂုံး

ဤစာတမ်းသည် ပုလောဒေသိယစကားရှိ နာမ်စကားလုံးဖွဲ့ပုံကို လေ့လာ သုတေသနပြုခြင်းဖြင့် ဒေသ၏ ထူးခြားသော အမှတ်လက္ခဏာတစ်ရပ်ဖြစ်သော ပုလောဒေသိယစကားကို တစ်ဖက်တစ်လမ်းမှ မှတ်တမ်းတင် ထိန်းသိမ်းရာ ရောက်စေပါသည်။ ထို့ပြင် ပုလောဒေသခံတို့၏ ဘိုးဘွား ရိုးရာယဉ်ကျေးမှု အမွေအနှစ်တစ်ရပ်ဖြစ်သော ဒေသိယစကားများကို အနာဂတ်မျိုးဆက်သစ် လူငယ်များ စိတ်ဝင်စားစွာ လေ့လာလိုသူများအတွက် အထောက်အပံ့ဖြစ်မည်ဟု မျှော်လင့်မိပါသည်။

## ကျမ်းကိုးစာရင်း


**မြန်မာဘာသာ**

ကိုလတ်နှင့် အဖွဲ့တက္ကသိုလ်။ (၂၀၀၈)။ *တနင်္သာရီတိုင်းစစ်အစိုးရ၏ ဖွံ့ဖြိုးတိုးတက်ဆောင်ရွက်မှု*။

ခင်ခင်ယု၊ ဒေါက်တာ။ (၂၀၁၂)။ *မြိတ်နှင့် ပုလောဒေသိယဝေါဟာရများ နှိုင်းယှဉ်လေ့လာမှု*။

ခင်မင်၊ မောင် (ဓနုဖြူ)။ (၁၉၉၀)။ *မြန်မာစကား၊ မြန်မာရုပ်ပုံလွှာ*။ ရန်ကုန်၊ စာပေဗိမာန်။

ခင်မင်၊ မောင် (ဓနုဖြူ)။ (၁၉၉၇)။ *စကားသမ္ဘရာ*။ ရန်ကုန်၊ မြကန်စာအုပ်တိုက်။

ခင်မင်၊ မောင် (ဓနုဖြူ)။ (၂၀၀၄)။ မတ်လ။ *စကားပြေသဘောတရား စကားပြေအတတ်ပညာ* ။

တနင်္သာရီတိုင်း၊ မြိတ်ခရိုင်။ (၁၉၆၉)။ *ပုလောမြို့နယ် ဖြစ်စဉ်မှတ်တမ်း*။

တင်ဇ၊ ဦး။ (၁၉၅၈)။ *မြန်မာဘာသာစကား၏ ဒေသိယစကားများ လေ့လာမှုမှတ်တမ်း*။

ထွန်းမြင့်၊ ဦး။ (၂၀၀၇)။ *ဘာသာဗေဒ* (တတိယအကြိမ်)။ ရန်ကုန်၊ ရာပြည့်စာအုပ်တိုက်။

ထွန်းမြင့်၊ ဦး။ (၂၀၀၇)။ *သဒ္ဒဗေဒ* (တတိယအကြိမ်)။ ရန်ကုန်၊ ရာပြည့်စာအုပ်တိုက်။

မြန်မာစာအဖွဲ့။ (၁၉၉၁)။ *မြန်မာအဘိဓာန်*။ ရန်ကုန်၊ ဖိုတိုလစ်သိုပုံနှိပ်စက်ရုံ။

အောင်မြင့်ဦး၊ ဒေါက်တာ။ (၂၀၀၃)။ *လူမှုဘာသာဗေဒမိတ်ဆက်* ။ ရန်ကုန်မြို့၊ ဓူဝံစာအုပ်တိုက်။

အောင်မြင့်ဦး၊ ဒေါက်တာ။ (၂၀၀၆)။ *အင်းလေးဒေသိယစကား*။ ရန်ကုန်မြို့၊ ဓူဝံစာအုပ်တိုက်။

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# ဓမ္မတေးဂီသမိုင်းကြောင်းလေ့လာချက်

ယဉ်မာအေး[1], ဇော်ဝင်း[2]

## စာတမ်းအကျဉ်း

ဤစာတမ်းသည် ဓမ္မတေးသီချင်းများ ပေါ်ပေါက်လာပုံကို လေ့လာတင်ပြထားသော စာတမ်းဖြစ်သည်။ မြန်မာစာပေတွင် ဓမ္မတေးသီချင်းများသည် အခန်းကဏ္ဍတစ်ရပ်မှ ပါဝင်လျက်ရှိသည်။ တေးသီချင်း များ၏ နယ်ပယ်တွင် ဓမ္မပူဇောတေးသီချင်းများသည် ကာလပေါ်ခေတ်တစ်လျှောက်လုံးတွင် ထင်ရှား ကျော်ကြား ခဲ့သည်။ ဘုရားရှင် သက်တော်ထင်ရှား ရှိစဉ်ကပင် ဂီတတေးသံတို့ကြောင့် အကျွတ်တရား ရရှိကြသော သာဓကများစွာ ရှိခဲ့သည်။ ထိုအကြောင်းကို လေ့လာတင်ပြရာတွင် ဂီတစာပေ၏ သဘောသဘာဝ၊ ဓမ္မတေးဂီတများ ပေါ်ပေါက်လာပုံ၊ဓမ္မပူဇော တေးသီချင်းအမျိုးအစားတို့ကို တင်ပြထားပါသည်။ ဓမ္မစာပေ၊ ဓမ္မကဗျာ၊ ဓမ္မတေးသီချင်းများသည် ဘုရားရှင်၏ ဂုဏ်တော်တို့ကို ရည်မှန်းကာ ဖွဲ့နွဲ့ကြသည်။ ဂီတစာပေ၏ အဆင့်အတန်းသာမက လေးမြတ်အပ်သော ဘုရားမြတ်စွာ၏ ဂုဏ်ရည်တို့ကိုပါ မြင်တွေ့ရမည်ဟု ယုံကြည်ပါသည်။

**သော့ချက်စေါ်ဟာရ။** ။ ဓမ္မတေး၊ဂီတ၊သုတ္တန်၊အဘိဓမ္မာ၊ဂါထာ။

## နိဒါန်း

မြန်မာစာပေလောကတွင် ဂီတတေးသီချင်းများသည် အရေးပါသော အခန်းကဏ္ဍမှ ပါဝင်နေသည်။ ထိုဂီတသီချင်းများတွင် ဗုဒ္ဓဘုရားရှင်၏ ဘဝဖြစ်တော်စဉ်၊ တရားတော်တို့၏ ဂုဏ်ရည်၊ ဘုရားသမိုင်း များကို စပ်ဆိုထားသော ဓမ္မပူဇောတေးသီချင်းများသည်လည်း အပါအဝင်ဖြစ်သည်။ ကိုလိုနီခေတ်တွင် ဓမ္မပူဇောတေးသီချင်းများ အများဆုံးထွက်ပေါ်ခဲ့သည်။ ဓမ္မတေးဂီတ လမ်းကြောင်းတွင် တခမ်းတနား ရပ်တည်ခဲ့ခြင်း ဖြစ်သည်။ ဘုရားရှင်တားမြစ်ထားသော သီလတွင် နစ္စ၊ ဂီတတည်း ဟူသော ပညတ်တော် ပါဝင်သော်လည်း လူတို့၏ စိတ်နှလုံးအတွင်းသို့ အလွယ်တကူ စိမ့်ဝင်စီးဆင်းစေသည့် ဓမ္မတေးဂီတများ၏ အခန်းကဏ္ဍသည် ယခုထက်တိုင် ကျယ်ပြန့်တိုးတက်ထွန်းကားလျက် ရှိပေသည်။

### ၁။ ဂီတစာပေသဘော

ရသစာပေများတွင် ဂီတစာပေ၏ ထူးခြားချက်မှာ စကားအသုံးအနှုန်း ဖွဲ့နွဲ့မှုတို့ဖြင့် အနုပညာဂုဏ် မြောက်အောင် ရေးခဲ့ရုံသာမက အနုပညာရှင်များ၏ အသံအနေအထား၊ ဂီတသံစဉ်တေးသွားများ၊ သီဆိုမှုအတတ်ပညာများ ပေါင်းစပ်ပါဝင်နေသည်။ ဂီတနှင့်ပတ်သက်၍ မြန်မာအဘိဓာန်တွင်

"ဂီတသည် ပါဠိစကားဖြစ်ပြီး သီချင်း" (မြန်မာစာအဖွဲ့၊ ၂၀၀၈၊ စာ ၇၆။)

ဟု ဖွင့်ဆိုထားသည်။ သီခြင်း၊ ဆိုခြင်း၊ သီဆိုကီးမှုတ်ခြင်းဟု ဆိုထားပေသည်။ သီချင်းသည် အကြောင်းအရာတစ်ရပ်ကို ဖွဲ့သီထားခြင်း ဖြစ်သော်လည်း ဂီတအသံနှင့် ပေါင်းစပ်ရာတွင် သာယာနာ ပျော်ဖွယ် သံစဉ်တေးသွားဖြစ်ရမည် ဖြစ်သည်။

မြန်မာ့တေးဂီတ အနုစာပေသမိုင်း (ပုဂံခေတ်မှ ကုန်းဘောင်ခေတ်အဆုံး) စာအုပ်တွင် နိဒါန်း၌ ဆရာကြီးဦးမြင့်ကြည်က

"တေးဂီတအနုစာပေဆိုသည်မှာ သံချိုသံသာတီးကွက် တီးလက်တို့ဖြင့် စည်းကိုက် ဝါးကိုက် မွမ်းမံဖွဲ့နွဲ့ထားသော၊ ဂုဏ် ရသရှိရှိနှင့် ထိမိစွာ ရေးသားထားသည့် လူ့ဘဝ၊ လူ့လောက၊ သရုပ်ပြစာများပင်တည်း" (မြင့်ကြည်၊ ဦး၊ ၂၀၀၁၊ စ။)

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[1]ဒေါက်တာ၊ ကထိက၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်။

[2]ဒေါက်တာ၊ ပါမောက္ခ၊ ဌာနမှူး၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

ဟု ဖွင့်ဆိုထားပါသည်။ ဆရာကြီး၏ အဆိုအမိန့်သည် တေးဂီတစာပေ၏ သဘောကို ပေါ်လွင် နားလည်စေပါသည်။ တေးဂီတစာပေသည် စကားပြေ၊ ဝတ္ထု၊ ကဗျာတို့ကဲ့သို့ ဘာသာစကားကို အသုံးချရုံမျှနှင့် ပြီးပြည့်စုံခြင်းမရှိပေ။ တီးလုံး၊ တီးကွက်၊ သီဆိုသံတို့နှင့် လိုက်ဖက်ရမည်။ စည်းဝါးကျအောင် သီဆိုနိုင်ရန်အတွက် ဖွဲ့နွဲ့ထားရမည်ဟု ဆိုလိုပါသည်။

စန္ဒရားလှထွတ်ကမူ "ဂီတ" နှင့်ပတ်သက်၍ "မြန်မာ့ဂီတရေစီးကြောင်း" စာအုပ်တွင်

"ဂီတသည် သီချင်းဟုအနက်ရသော ပါဠိစကားဖြစ်သည်။ သီဆိုခြင်းဟူ၍လည်း ဖြစ်သည်။ သီချင်းဟူသည်မှာ ယနေ့အများနားလည်နေကြသည့်အတိုင်း သီဆိုရ လျှင် စာသားနှင့် အသံပေါင်းစပ်ထားသော ဂီတအဖွဲ့အစပ်ဖြစ်သည်။ "သီဆိုသည်" ဆိုသည်မှာ စာသားပါသော ဂီတသံအဖွဲ့ အစပ်ကို နူတ်ဖျားမှ ထုတ်လုပ်ခြင်း၊ မြည်တမ်းခြင်း၊ ရွတ်ဆိုခြင်းဖြစ်သည်။" (လှထွတ်၊ စန္ဒရား၊ ၁၉၉၆၊ စာ ၃။)

ဟု ဖွင့်ဆိုထားသည်။ သီချင်းသည် အကြောင်းအရာတစ်ရပ်ကို ဖွဲ့သီထားခြင်းဖြစ်သော်လည်း ဂီတအသံနှင့် ပေါင်းစပ်ရာတွင် သာယာနာပျော်ဖွယ် သံစဉ်တေးသွား ဖြစ်ရမည် ဖြစ်ပါသည်။

သီချင်းကို မြန်မာအဘိဓာန်တွင်

"သီဆိုရန်သံစဉ်အမျိုးမျိုးဖြင့် ဖွဲ့နွဲ့ထားသော အဖွဲ့အနွဲ့" (မြန်မာစာအဖွဲ့၊ ၂၀၀၈၊ စာ ၃၇၂။)

ဟု ဖွင့်ဆိုထားသည်။

မြန်မာ့ဂီတစာပေသည် ခေတ်အဆက်ဆက် ပေါ်ထွန်းခဲ့ရာ ယခုတိုင်အောင် အခိုင်အမာ ရပ်တည်နေပေသည်။ သရေခေတ္တရာလက်ထက် ပျူလူမျိုးတို့ တရုတ်ပြည်သို့ သွားရောက်ဖျော်ဖြေခဲ့ကြသည်ဟူသော အထောက်အထားအရ ရှေးနှစ်ပေါင်းများစွာကတည်းက ဂီတသည် စည်ပင်ပေါက်ဖွားနေပေသည်။ ပုဂံခေတ်မှစ၍ ကုန်းဘောင်ခေတ်အထိ တေးသီချင်းများ ပေါ်ပေါက်ခဲ့သည်။ ကုန်းဘောင်ခေတ်တွင် တေးသီချင်းများစွာအနက်မှ ထူးမခြားနားသီချင်းခံတစ်ပုဒ်သည်သာလျှင် ဘုရားရှင်၏ ဂုဏ်တော်ကို ဖွဲ့နွဲ့ထားသော ဓမ္မတေးတစ်ပုဒ် ဖြစ်ခဲ့သည်။ ကိုလိုနီခေတ်တွင် ခေတ်၏ လိုအပ်ချက်အရ အမျိုး၊ ဘာသာ၊ သာသနာကို မမေ့မလျော့အောင် အားပေးလှုံ့ဆော်ခဲ့သည့် ဓမ္မဂီတ တေးသီချင်းများ များစွာပေါ်ပေါက်ခဲ့ပေသည်။

**၂။ ဓမ္မတေးဂီတသမိုင်းကြောင်း**

ဗုဒ္ဓဘုရားရှင်၏ ဂုဏ်တော်၊ ဟောတော်မူသည့်တရားတော်၊ ဖြည့်ကျင့်ခဲ့သည့် ဘဝအဆက်ဆက် ပါရမီတော်တို့ကို ရေးသားဖွဲ့စပ်သီကုံးသည့် စာပေများစွာရှိပေသည်။ ဓမ္မစာပေ၊ ဓမ္မကဗျာ၊ ဓမ္မတေးသီချင်းများ စုံလင်လှပေသည်။

ဓမ္မတေးဂီတကို အဓိပ္ပာယ်တွဲစပ်ဖွင့်ဆိုထားခြင်း မရှိသော်လည်း မြန်မာအဘိဓာန်တွင်

"ဓမ္မ – ဟုတ်မှန်သောသဘော။ ဗုဒ္ဓ၏ တရားတော်" (မြန်မာစာအဖွဲ့၊ ၂၀၀၈၊ စာ ၁၈၆။)

ဟု လည်းကောင်း၊

"တေး – သီချင်း" (စာ ၁၄၇)

ဟု လည်းကောင်း၊

"ဂီတ – သီချင်း" (စာ ၇၇)

ဟု လည်းကောင်း ဖွင့်ဆိုထားသည်။ သို့ဖြစ်၍ ဓမ္မတေးဂီတဟူသည် ဟုတ်မှန်သော သဘော၊ ဗုဒ္ဓ၏ တရားတော်များကို ဖွဲ့နွဲ့ထားသော သီချင်းများဟု ဖွင့်ဆိုရပေမည်။ ဗုဒ္ဓမြတ်စွာ၏ ဟောပြည့်ဆွန်ပြ တော်မူသော တရားတော်များ၊ ဖြစ်တော်စဉ်များ၊ ဂုဏ်တော်များကို အမှီပြု၍ ပူဇော်ရေးဖွဲ့ထားကြ သည်။

ဓမ္မဂီတဟူသော အသုံးနှင့်ပတ်သက်၍ ဦးသုခက ဓမ္မဂီတဆောင်းပါးတွင် စတင်ဖော်ပြထား သည်ကို တွေ့ရသည်။ ထို့အပြင် ဓမ္မဂီတ၏ အစကို ဆောင်းပါးတွင်

“ကျင့်အပ်သော သီလတရားတွင်မူ ကခြင်း၊ သီဆိုခြင်း၊ တီးမှုတ်ခြင်း၊ ကိုယ်တိုင် ပြုခြင်း၊ သူတစ်ပါးအား ပြုစေခြင်း၊ နားထောင်သာယာကြည့်ရှုခြင်း စသော အကျင့် တို့ကို ရှောင်ကြဉ်အပ်သည်ဟု ဆိုထားပေသည်။ မည်သို့ပင်ဆိုစေကာမူ ဓမ္မဂီတ သံစဉ်များသည် အကျွတ်တရား နိဗ္ဗာန်ရောက်ပို့ဆောင်ပေးသော သာဓကများစွာ ရှိပေသည်။ ထိုအကြောင်းရင်းတို့သည် ဓမ္မဂီတ၏ အစ” (သုခ၊ ၁၉၉၃၊ စာ ၂၂၅။)

ဟုပင် ယူဆကြောင်းဖော်ပြထားသည်။

ဘုရားလောင်း သိဒ္ဓတ္တမင်းသားပင်လျှင် ဂီတဟူသော အသံကို ကြားရသောအခါ သတိတရား ဝင်တော်မူ၍ ဆင်ခြင်သုံးသပ်ကာ တောထွက်တော်မူကြောင်း ဖော်ပြထားသည်။ ဘုရားလောင်း သိဒ္ဓတ္တမင်းသား ဥယျာဉ်တော်မှ ရွှေနန်းတော်သို့ဝင်ချိန်တွင် ရှုမြင်လိုက်ရသော ကိသာဂေါတမီသည် နှစ်လိုချစ်ခင်သောစိတ်ဖြင့် ဥဒါန်းကျူးရင့်ဖွဲ့သီလိုက်သော ဂါထာကို ဘုရားလောင်း သိဒ္ဓတ္တမင်းသား ကြားတော်မူလေသည်။ ထိုအကြောင်းကို ဓိနတ္ထပကာသနီတွင်

“နိဗ္ဗုတာ နူန သာ မာတာ၊

နိဗ္ဗုတာ နူန သာ ပိတာ၊

နိဗ္ဗုတာ နူန သာ နာရီ၊

ယသယံ ဤဒိသော ပတိ” (ကျီးသဲလေးထပ်ဆရာတော်၊ ၂၀၀၈၊ စာ ၃၀။)

ဟူ၍ ဥဒါန်းကို ဖော်ပြထားသည်။ ကိသာဂေါတမီရင့်ကျူးသော ဂါထာသီချင်း၏အနက်မှာ

“အိုခင်ပွန်းမတို့ လောကဤရှာဝယ် ဘုန်းပညာ အသရေအခြွေအရံတို့ဖြင့် စံပယ်တင့်တယ် အပ်ခြင်းအမှုဌ် အတုမရှိ အသဒိသဖြစ်သော သားတော်မြတ်၏ မိခင်ဖခင်သည် အလွန်သာလျှင် ကြည်လင်ငြိမ်းချမ်း ရွှင်လန်းပေအံ့သည်တကား၊ ဤကဲ့သို့သော လင်ကောင်းမယား ညာထားငယ်ကြင်သည် အလွန်သာလျှင် ရှုမြင်မရဲ ယှဉ်နွဲ့ပျော်မြန်း ငြိမ်းချမ်းလေအံ့သည်တကား ဟူလိုသည်” (ကျီးသဲ လေးထပ်ဆရာတော်၊ ၂၀၀၈၊ စာ ၃၀။)

ဟု ဖော်ပြထားသည်။ ထိုရင့်ကျူးသောအသံကို ဘုရားလောင်းသိဒ္ဓတ္တ ကြားတော်မူသောအခါ ဉာဏ်တော်ဖြင့်ယှဉ်၍ အတွေးအမြင် ဖြစ်ပေါ်လာပုံကို ဓိနတ္ထပကာသနီကျမ်းတွင်

“ပုထုဇဉ်သာ ဖြစ်သေးသော ဤလူ၏ အတ္တဘောကို မြင်သဖြင့် မိခင်ဖခင် ငယ်ကြင်မယားတို့အား ငြိမ်းချမ်းခြင်းဖြစ်၏ ဆိုသည်မှာ အသို့ဖြစ်နိုင်အံ့နည်း။ ရာဂ ဒေါသ မောဟ ဟူသော မီးငြိမ်းမှသာလျှင် ဇာတိ ဇရာ မရဏ ဒုက္ခကင်းဝေးစေလျက်

ဘေးအပေါင်းမှ ငြိမ်းအောင် ဆောင်သော သားမှ နိဗ္ဗုတာ မည်ရာသည်တကား” (ကျီးသဲလေးထပ်ဆရာတော်၊ ၂၀၀၈၊ စာ ၃ဖ၀။)

ဟု ဖော်ပြထားသည်။ ကိသာဂေါတမီဥဒါန်းကျူးသော ဂီတ၏ အသံကြောင့် ဘုရားလောင်း၏ စိတ်တို့ သည် တောထွက်ရန် ပိုမိုပြတ်သားခိုင်မာလာလေသည်။ ဤသည်ကား ဓမ္မဂီတအစဟုပင် ဆိုရပေမည်။

ဘုရားရှင်လက်ထက်တွင် ဇေတဒဂ်ရတော်မူသော ခေမာထေရီသည် ဂီတကိုမှီ၍ ဘုရားရှင် ထံတော်ပါးသို့ ရောက်ခဲ့ရသည်။ ကျွတ်တမ်းဝင်ခဲ့ရသေးသည်။ ရုပ်အဆင်းကို အပြစ်တင်ဖွဲ့ကဲ့ရဲ့တော် မူသော ဘုရားရှင်၏ တရားတို့ကို ကြားရသောကြောင့် ရုပ်အဆင်းကို ဖက်တွယ်ယစ်မူးနေသော ခေမာမိဖုရားသည် ဝေဠုဝန်ကျောင်းတော်သို့ မရောက်ချေ။ ဗိမ္ဗိသာရမင်းကြီးကလည်း မိမိ၏ မိဖုရား ဖြစ်လျက် ဘုရားရှင်ကို မဖူးတွေ့ဘဲနေသည်ကို မသင့်လျော်ဟု တွေးမြင်ကာ ပရိယာယ်ဖြင့် ကျောင်းတော်သို့ ပို့လေသည်။ ထိုသို့ ပို့ရာတွင် မင်းအမိန့်မဟုတ်ဘဲ ရတုကဗျာလင်္ကာ သီချင်းဖွဲ့သီ တတ်သူတို့အား ဝေဠုဝန်ကျောင်းတော်၏ သာယာတင့်တယ်ပုံကို စပ်ဆိုကာ ခေမာမိဖုရားကြီးကြား စေသည်။ ဂီတ၏ အသံကိုကြားသော ခေမာမိဖုရားကြီးသည် ကျောင်းတော်သို့ ရောက်ရှိလေတော့သည်။ သီချင်းဂါထာသည်က

“ရာဇပုညေန နိဗ္ဗတ္တံ၊ ဗုဒ္ဓပုညေန ဘူသိတံ

ကာဝတ္တာ တသနိဿသံ၊ ဝနသ ဂုဏသဗ္ဗယံ” (ကျီးသဲလေးထပ်ဆရာတော်၊ ၂၀၀၈၊ စာ ၃၆၁။)

ဟူ၍ ဆိုသံကို ကြားရသောအခါ ခေမာမိဖုရားကြီးသည် ဝေဠုဝန်ကျောင်းတော်သို့ ဗုဒ္ဓမရှိဟူသော အမှတ်ဖြင့် ရောက်လေသည်။ ဘုရားရှင်လည်း ခေမာမိဖုရား ကျွတ်တမ်းဝင်တော်မူမည်ကို သိသဖြင့် ကျောင်းတော်၌ပင် သီတင်းသုံးကာ ရုပ်နာမ်အဖြစ်အပျက်ကို ကိုယ်တိုင်ရှုမြင်စေပြီးမှ တရားဟော တော်မူသည်။ ပညာရှိအရာ၌ ဇေတဒဂ်ရတော်မူသည့် ခေမာထေရီဟူသော အဂ္ဂသာဝိကာအရာ ရတော်မူသည်။ ဤသည်ကား ဂီတတေးသံ၏ အကျိုးတို့ပင်ဖြစ်သည်။

လွန်ခဲ့သော နှစ်ပေါင်း (၂၅၀၀) ခန့်က ကဝေဒိယက္ခတောင် ဣဠာသာလဂူအတွင်း၌ ဘုရားရှင်သီတင်းသုံးတော်မူစဉ် ပဠာသိန်နတ်သားသည် ဗေလုဝနတ်စောင်းတီးခတ်၍ မြတ်စွာဘုရား ၏ သံဃာတော်ဂုဏ်ကို ချီးကျူးသောအခါ သိကြားနတ်ဗြဟ္မာတို့ ပူဇော်ကြသည်ဟု ပုသိမ် ဒေါ်တင်တင်၏ ဂီတသုတေသန စာတမ်းတွင် ဖော်ပြထားပါသည်။ ဗုဒ္ဓဘုရားရှင် လက်ထက်တွင် ပုဗ္ဗာရုံကျောင်းအမကြီး ဝိသာခါသည် ရဟန်းသံဃာတို့ကို ဝါဆိုရာတွင် ဆွမ်းကပ်သည့် ကုသိုလ်ကို ပြုပြီးသည့်နောက် ဗိုက်ကို ဖြောအမှတ်ဖြင့် တီးခတ်ခဲ့သည်။ သဒ္ဓါစိတ်၊ ကြည်နူးစိတ်တို့မှ ပွင့်အန်ကျ လာသော ခံစားမှုတွင် ဂီတသဘောပါခဲ့သည်။ ထိုသို့ ပြုခဲ့သော်လည်း ဘုရားရှင်က အပြစ်တော် မယူခဲ့ကြောင်းကို နန်းတော်ရှေ့ ဆရာတင် ရေးစပ်ခဲ့သော ပဠာသိန်သီချင်းတွင်

“(ဂီတ…ဂီတပညာ….တေးသီချင်းများကို..ဘုရားတောင်ပယ်တော်မမူ…
ပုဗ္ဗာရုံ…ကျောင်းအမပြုရတဲ့..ကုသလ..ကြည်ဖြူ)

ဗိုက်ကိုပင်…ဖြောအမှတ်နှင့်တီးကာ…ရွှင်ပျော်..

အတောမသတ်ပေါင်…လောကဤဇမ္ဗူ..စေတနာလွန်ကဲသူ..

ရဟန်းမြတ်တို့..ဝါဆိုဝါကပ်ယူ…ကျောင်းအမကြီး..ဖြောတီးသမားကို

ဘုရားတောင်…အပြစ်မယူ” (ခေတ်ဟောင်းတေးသီချင်းများ၊ ၂၀၀၂၊ စာ ၃၀။)

ဟု ရေးဖွဲ့ခဲ့ပါသည်။

ပဠာသိန်နတ်သားသည် ဘုရားရှင်ရှေ့မှောက်တွင် မလျော့မတင်း စောင်းတီးပြခြင်းဖြင့် တေးဂီတနှင့် ပူဇော်ခဲ့သည်။ ထိုအကြောင်းကို နန်းတော်ရှေ့ဆရာတင်က

“ပဠာသိန်..နတ်ဒေဝါ..ထံတျာ..တေးသံကျူ

မြတ်စွာဘုရားရှေ့…မိန့်တော်မမူ..

မလျော့မတင်း..စောင်းသံကို…ညင်းကာယူ

လျှော့လိုက်ဦးလို့..မိန့်တော်မမူ..

မကြည်အောင်…တေးဂီတ…ဖရုဿဝါစာ…မပါဘဲနဲ့…

အသုံးခံသူ..၎င်းနည်းတူ..အကြောင်းသိမူ..ဘုရားတောင်..အပြစ်တော်မူ” (ခေတ်ဟောင်းတေးသီချင်းများ၊ ၂၀၀၂၊ စာ ၃၀။)

ဟု ရေးဖွဲ့ခဲ့သည်။ ပဉ္စသိခ်ံနတ်သား၏ မလျော့မတင်း စောင်းကြိုးညှင်းသံကို တားမြစ်ခြင်းမပြုဘဲ ဘုရားရှင်သည် တီးခတ်စေခဲ့သည်။ ဘုရားမြတ်စွာပင်လျှင် တေးဂီတအသံကို တားမြစ်ခြင်းမရှိဘဲ ကောင်းမွန်သောအဖွဲ့အနွဲ့ကို လက်ခံကြောင်း ဖော်ပြထားသည်။

ဘုရားရှင်လက်ထက် ရာဇဂြိုဟ်ပြည်တွင် သာကေတရွာသူ မက္ခလိက သဘင်သည်မသည် ဘုရားမြတ်တို့အား တေးသီချင်းအဆိုအကတို့ဖြင့် လှူဒါန်းခဲ့သည်။ နန်းတော်ရှေ့ဆရာတင်၏ သီချင်း တွင်

“စာတရားကိုယ်ညီမျှ…ရာဇဂြိုဟ်ပြည်မက…သာကေတရွာသူ…

မက္ခလိက…သဘင်သည်မမှာ…စေတနာစင်ကြယ်လှလို့….

အသံရော…အကရော…အပြောပါလှူ….

ရဟန်းမြတ်တို့၏…ရောင်ခြည်တော်…ကြွမြန်းအဆူဆူ…

အရဟတ္တဖိုလ်…ရဖူးသူ…တီးလုံးဆန်းထွင်…ပါရဂူ…

နန်းတော်အရှေ့ကရေးတဲ့…တေးသွားယူ” (ခေတ်ဟောင်းတေးသီချင်းများ၊ ၂၀၀၂၊ စာ ၃၀။)

ဟု ရေးဖွဲ့ခဲ့ပါသည်။ ထိုသို့အားဖြင့် ဂီတစာပေသည် ဗုဒ္ဓ၏ ဖြစ်စဉ်တော်များ၌လည်း ပါဝင်လျက် ရှိသည်ကို တွေ့ရပါသည်။ ဗုဒ္ဓလက်ထက်တော် ကတည်းကပင် ဓမ္မဂီတကို တားမြစ်တော်မမူဘဲ လက်ခံတော်မူခဲ့သည်ဟု ယူဆမိပါသည်။

ဓမ္မဂီတ၏ အနှစ်သာရနှင့် ပတ်သက်၍ ဦးသုခ၏ ဓမ္မရသအလှမျိုးစုံဆောင်းပါးစာအုပ်တွင် ဥပမာမျိုးစုံဖြင့် ဖွင့်ဆိုခဲ့သည်။ မိဘမေတ္တာကို အသိတတ်ဆုံး၊ အလေးစားဆုံး၊ အတုယူရဆုံးသော ဦးသုခပင်လျှင် အမေ့ကို မေ့ခဲ့သည်။ ဘုရားဟောဇာတ်နောက်ခံတေးသီချင်းတစ်ပုဒ်ကို ကြားမှသာ သတိရ၍ အမေ့မေတ္တာကို ပြန်လည်ရှုမြင်ခံစားမိသည်ဟု ဆိုခဲ့သည်။ ရွှေတိုင်ညွှန့်၏ ဝိစိတြ ကာလပေါ်သီချင်း ကြားရသောအခါမှ အမေ့မေတ္တာကို သတိရကာ မျက်ရည်ကျဖူးသည်ဟု ဆိုထား သည်။ ထိုသည်ကား ဓမ္မနွယ်သော တေးဂီတ၏ အနှစ်သာရပေဟု ဆိုရပါမည်။

ဓမ္မဂီတတို့သည် ခံစားသူတို့၏ စိတ်အစဉ်ကို အသိတရား၊ သတိတရား ထည့်သွင်းပေးသည် ဟု ထင်မြင်မိပါသည်။ ဘဝသံသရာသီချင်းသည် မူလဇစ်မြစ်တေဘုမ္မာက ဆင်းသက်လာသည်ဟု ဆိုထားသည်။ ဂီတတစ်ပုဒ်မှ နောက်ထပ်ဂီတတစ်ပုဒ်၊ ဓမ္မတရားအနှစ်မှ နောက်ထပ်ဓမ္မတရား အသစ်သို့ ပို့ဆောင်ပေးသည်ဟု ဆိုရပေမည်။

ခေတ်အဆက်ဆက် ဖန်တီးလာသော တေးသီချင်းတို့တွင် ဓမ္မဂီတတို့သည်လည်း စာပေ၏ နေရာတစ်ခုကို ယူထားသည်ဟု ထင်မြင်မိပါသည်။ ပုဂံခေတ် ဘုရားပုထိုးများကို ပသာသည်၊ ခွက်ခွင်းသည်၊ ပန်တျာသည်တို့ လှူခဲ့ပါသည်။ ဆွမ်း၊ ရေချမ်း ကပ်လှူချိန်တွင် ဓမ္မဂီတတို့ကို တီးမှုတ် ပူဇော်ကြပေမည်။ အမတ်ကြီး သိဃ်သူကျောက်စာ၌ “စည်ညှင်းဖြင့်နိုးထထသော စည်းစိမ်ကို လိုရကား” ဟူသော အလှူပြုရခြင်းအကြောင်း ဖော်ပြချက်သည်လည်း ဆွမ်း၊ ရေချမ်း ကပ်လှူစဉ်၌ သီဆို တီးမှုတ်သော ဓမ္မဂီတကို ရည်ရွယ်ဟန်တူသည်။ အင်းဝခေတ်စာပေနယ်တွင် ကဗျာ၊ လင်္ကာ၊ ပျို့ တို့တွင် ဓမ္မဂီတများ ပါဝင်နေပါသည်။ တောင်ငူခေတ် ဘုရားတိုင်ရတုတို့တွင် ဘုရား၏ ကြည်ညို သပ္ပာယ်ပုံတို့ကို ဖွဲ့ရာ၌လည်း

ဓမ္မဂီတစာပေ၏ သဘောပါဝင်နေပါသည်။ ကုန်းဘောင်ခေတ်တွင် 'အထင်ရှားဆုံးဖြစ်သည့် ထူးမခြားနားသီချင်းခံသည် ဘုရားရှင်၏ ရောင်ခြည်တော်ကို ကွန့်မြူးပုံကို ကြည်ညိုဖွယ်ဖြစ်အောင် ရေးဖွဲ့ထားသည်။ ကိုလိုနီခေတ်တွင်မူ ဓမ္မပူဇောတေးသီချင်းများစွာပေါ်ထွက်ခဲ့သည်။ နယ်ချဲ့လက်အောက်တွင် ကျရောက်နေစဉ် ပြည်သူတို့စိတ်နှလုံးကို တက်ကြွလာအောင် ဘုရားဆေးဖြင့် ကုသ ကြရသည်။ ဘုရားရှင်၏ ဂုဏ်တော်၊ တရားတော်၏ဂုဏ်ရည်တို့ကို ပွားများရင်း စိတ် နှလုံးထက်မြက် လာကာ နယ်ချဲ့ကို အနိုင်ယူတွန်းထုတ်လာစေသည်အထိ အမျိုးသားရေးပါလှုံ့ဆော်ပေးသော ဓမ္မပူဇော တေးများ ဖြစ်လာသည်။

**၃။ ဓမ္မပူဇောတေးဂီတအမျိုးအစား**

ဓမ္မပူဇောတေးဂီတသီချင်းများကို အမျိုးအစားခွဲရာတွင် (၁) ဘုရားရှင်၏ ရောင်ခြည်တော်ကို ဖွဲ့သော သီချင်းများ၊ (၂) ဘဝဖြစ်တော်စဉ်ဆိုင်ရာ ဇာတ်တော်နောက်ခံသီချင်းများ၊ (၃) ဘုရားရှင် ဟောကြားတော်မူခဲ့သော တရားတော်များကို ဖွဲ့သောသီချင်းများ၊ (၄) ဗုဒ္ဓပရိဘောဂ စေတီတော် မြတ်တို့၏ သမိုင်းကြောင်းကိုဖွဲ့သော သီချင်းများတို့ဟူ၍ ခွဲခြားလေ့လာတင်ပြထားပါသည်။

ဘုရားရှင်၏ရောင်ခြည်တော်ဖွဲ့သော သီချင်းများတွင် ကုန်းဘောင်ခေတ်တွင် မြဝတီမင်းကြီး၏ ထူးမခြားနားသီချင်းခံ၊ ကိုလိုနီခေတ်တွင် နန်းတော်ရှေ့ဆရာတင်၏ ရောင်ခြည်တော်ဘွဲ့ကြိုး၊ ရွှေတိုင် ညွှန့်၏ ရောင်တော်ဖွင့်၊ အေဝမ်းဆရာညှာ၏ ခြောက်သွယ်ရောင်ခြည်သီချင်းတို့ ဖြစ်သည်။ ထိုသီချင်း တို့သည် ယခုထက်တိုင် အထင်ရှားဆုံးနှင့် တေးဂီတတွင် ဖန်တီးမှုအကောင်းဆုံးသီချင်းအဖြစ် ယခုတိုင် ရပ်တည်လျက် ရှိသည်။

ဘဝဖြစ်တော်စဉ်ဆိုင်ရာ ဇာတ်တော်နောက်ခံသီချင်းများတွင် ငါးရှဉ်ငါးဆယ်ဇာတ်တော် နောက်ခံပြုရေးသားထားသော သီချင်းများနှင့် ဓမ္မပဒလာသီချင်းများ ပါဝင်သည်။

တရားတော်ဆိုင်ရာ သီချင်းများတွင် သုတ္တဆိုင်ရာသီချင်း၊ အဘိဓမ္မာဆိုင်ရာသီချင်းများ၊ ဂါထာ ဆိုင်ရာ သီချင်းများ ဟူ၍ ခွဲခြားလေ့လာနိုင်သည်။ သုတ္တန်ဆိုင်ရာတေးသီချင်းများသည် ဘုရားရှင် သက်တော်ထင်ရှားရှိစဉ် ဖြစ်ပျက်ခဲ့သော၊ဟောတော်မူသော တရားတော်များအကြောင်းကို ဖွဲ့နွဲ့ထား သည်။သာဓကအားဖြင့် ဗောဓိပင်နှင့် ရွှေပလွင်၊ ဓမ္မစက္ကြာ၊ မေတ္တာဂုဏ်တော်၊ ငါးပါးပဋ္ဌသီ၊ သီတာရတနာ၊ ဂုဏ်တော်ဖွင့်စသော သီချင်းများဖြစ်သည်။

အဘိဓမ္မာနှင့်ပတ်သက်သော တေးသီချင်းများတွင် တေဘုမ္မာသီချင်း၊ မဂ္ဂင်ရှစ်ပါးသီချင်းနှစ်ပုဒ် သာရှိသည်ကို တွေ့ရှိရပါသည်။

ဂါထာတော်ဆိုင်ရာတေးသီချင်းများစွာ ကိုလိုနီခေတ်တွင် ပေါ်ထွက်ခဲ့သည်။ သာဓက အားဖြင့် အန္တရာယ်ကင်းသီချင်း၊ အောင်ခြင်းရှစ်ပါးသီချင်း စိန္တာမဏိသီချင်း၊ သမ္မုဒ္ဓေသီချင်းစသော တေးသီချင်း များစွာ ပေါ်ထွက်ခဲ့သည်။

ဗုဒ္ဓ၏ပရိဘောဂစေတီတော်မြတ်တို့၏သမိုင်းကြောင်းတို့ကိုဖွဲ့သော သီချင်းများစွာရှိပေသည်။ အထူးထင်ရှားသော တေးသီချင်းများ ဖြစ်သည့် ရွှေတိဂုံသမိုင်းသီချင်း၊ မြတ်ဘုရားရွှေတိဂုံသီချင်းနှင့် မဟာမြတ်မုနိသီချင်းတို့သည် ယခုတိုင် ထင်ရှားသောတေးသီချင်းများ ဖြစ်သည်။

ဓမ္မပူဇောတေးသီချင်းများတွင် ဓမ္မဂီတစစ်စစ်အဖြစ် ''ကျိုက်လတ်ဦးပြုံးချို၏ တေဘုမ္မာသီချင်း" တစ်ပုဒ်ကိုသာ တွေ့ရှိရသည်ဟု ဆိုရပေမည်။

ထိုဓမ္မပူဇောတေးဂီတသီချင်းများ၏ နောက်ခံအကြောင်းအရာများ၊ အဖွဲ့အနွဲ့များသည် တေးသီချင်း၏ ရေးသားဖွဲ့နွဲ့ဟန်သာမက တရားဓမ္မဆိုင်ရာ အသိပညာများကို တိုးပွားစေသည်။ စာဆိုတေးပြုသူတို့၏ ဓမ္မဂီတများသည် အသိ၊ သတိ ကင်းနေသော ဗုဒ္ဓဘာသာဝင်တို့၏စိတ်ကို တရားဓမ္မဘက်သို့

စိတ်ညွှတ်လာအောင် လှုံ့ဆော်ရာပင် ဖြစ်သည်ဟု ယူဆမိသည်။ ဓမ္မဂီတတေးများ သည် နားဆင်သူတို့၏ စိတ်နှလုံးကို သာယာကြည်ရွှင်စေပြီးလျှင် တရားဓမ္မအသိများဖြင့် ငြိမ်းချမ်း စေပါသည်။

## ခြုံငုံသုံးသပ်ချက်

ဓမ္မတေးဂီတသည် ဘုရားရှင်လက်ထက်တော်မှစ၍ သန္ဓေတည်အစပျိုးကာ ရှင်သန်ခဲ့ရာ ကိုလိုနီခေတ်တွင် အထူးစည်ပင်ဝေဆာလာခဲ့သည်။ ဖြတ်သန်းခဲ့ရသော ခေတ်အဆက်ဆက်၏ ပုံရိပ်များသည် ဓမ္မဂီတများအပေါ်တွင် လွှမ်းမိုးလျက်ရှိသည်။ တေးသီချင်းကဏ္ဍမှ ဖျော်ဖြေရေး သဘောအပြင် ဘုရားရှင်၏ ဂုဏ်တော်၊ ဘဝဖြစ်စဉ်တို့ကို သိရှိနားလည်ခံစားစေပြီး တရားတော်၏ ဂုဏ်တော်၊ တေးသီချင်း၏ အနှစ်သာရ၊ ခေတ်အဆက်ဆက်၏ ဓမ္မပူဇောတေးသီချင်းများ အစပျိုးလာ ပုံတို့ကို လေ့လာ တွေ့ရှိရပါသည်။

## နိဂုံး

ဓမ္မတေးဂီတစာပေဟူသော လမ်းကြောင်းသည် မြန်မာ့အနုပညာခရီးတွင်လည်းကောင်း၊ မြန်မာ့စာပေ လောကတွင်လည်းကောင်း ခမ်းနားထည်ဝါစွာ အခိုင်အမာရပ်တည်လျက် ရှိသည်။ လူ့ဘောင်အဖွဲ့အစည်းတွင် ကျင့်ကြံလိုက်နာအပ်သော၊ ဆင်ခြင်တုံတရား ထားအပ်သော၊ သတိဉာဏ်ပညာနှင့် ယှဉ်အပ်သော အတွေးအမြင်များ ပွားများလာစေသည်။ ဓမ္မတေးဂီတ လမ်းကြောင်းတွင် အထွန်းတောက်ဆုံး၊ အအောင်မြင်ဆုံးခေတ်မှာ ကိုလိုနီခေတ် ဖြစ်ခဲ့သည်။ တွေ့ကြုံမြင်တွေ့ရသော ခေတ်အခြေအနေတွင် စိတ်နှလုံးကို ကောင်းမွန်စွာ ရပ်တည်စေပြီး နိုင်ငံအတွက် အင်အားဖြစ်ခဲ့သည် ဟု ဆိုချင်ပါသည်။

## ကျမ်းကိုးစာရင်း


ကျီးသဲလေးထပ်ဆရာတော်။ (၂၀၀၈)။ ဓိနတ္ထပကာသနီကျမ်း။ ရန်ကုန်၊ ခင်ချိုထွန်းစာပေ။

တေးရေးပညာရှင်ကြီးများ။ (၂၀၀၂)။ ခေတ်ဟောင်းကာလပေါ်တေးသီချင်း(အတွဲ-၅)။ ရန်ကုန်၊ ပြန်ကြားရေးဝန်ကြီးဌာန။

မြင့်ကြည်၊ ဦး။ (၂၀၀၁)။ မြန်မာ့တေးဂီတအနုစာပေသမိုင်း။ ရန်ကုန်၊ လူ့စွမ်းအားအရင်းအမြစ် ဖွံ့ဖြိုးရေးဌာန၊ ယဉ်ကျေးမှုဝန်ကြီးဌာန။

မြန်မာစာအဖွဲ့။ (၂၀၀၈)။ မြန်မာအဘိဓာန်။ ရန်ကုန်၊ မြန်မာစာဦးစီးဌာန။

မြန်မာစာအဖွဲ့။ (၁၉၇၉)။ မြန်မာ့စွယ်စုံကျမ်း(အတွဲ-၅)။ ရန်ကုန်၊ မြန်မာစာဦးစီးဌာန။

လှထွတ်၊ စန္ဒယား။ (၁၉၉၆)။ မြန်မာ့ဂီတရေစီးကြောင်း။ ရန်ကုန်၊ နေရီဦးစာအုပ်တိုက်။

သုခ။ (၁၉၉၃)။ ဓမ္မရသအလှမျိုးစုံစာမျိုးစုံ။ ရန်ကုန်၊ ပါရမီစာပေ။

# ကချင်ဘာသာစကားရှိစကားထာများမှ ရိုးရာဓလေ့

Mဆိုင်းဘူ[၁], ဇော်ဝင်း[၂]


## စာတမ်းအကျဉ်း

ဤစာတမ်းသည် မြန်မာနိုင်ငံမြောက်ပိုင်း၊ မြစ်ကြီးနားမြို့တွင်နေထိုင်ကြသော ကချင်ဘာသာစကားရှိ စကားထာများမှ ရိုးရာဓလေ့ကို သုတေသနပြုထားသော စာတမ်းဖြစ်ပါသည်။ စကားထာများမှတစ်ဆင့် တိုင်းရင်းသားမျိုးနွယ်စုတို့၏ ရိုးရာ ဓလေ့ကို တွေ့မြင်နိုင်ပါသည်။ စကားထာ၏သဘောကပင် စကားကို ပရိယာယ်ဖြင့် ပြောဆိုရသည့်အတွက် ဆိုလိုချက်ကိုဖော်ထုတ်နိုင်ရန် ခဲယဉ်းလှပါသည်။ ထိုသို့ ဖော်ထုတ်နိုင်ခြင်း မရှိပါက ယင်းစကားများသည် ပျောက်ကွယ်သွားနိုင်ပါသည်။ ထိုစကားထာများပျောက်ကွယ်သွားလျှင် ရိုးရာဓလေ့ပါ ပျောက်ကွယ် သွားနိုင်ပါ သည်။ ထို့ကြောင့် ကချင်ဘာသာစကားရှိစကားထာများမှ ရိုးရာဓလေ့ကို စာပေရှုထောင့်မှ စနစ်တကျသုတေသနပြုထားခြင်း ဖြစ်ပါသည်။ ဤသို့လေ့လာခြင်းဖြင့် ကချင်တိုင်းရင်းသား တို့၏ စာပေဖွံ့ဖြိုးမှုနှင့် ဘာသာစကားအကျိုးဖြစ်ထွန်းမှုတို့ အတွက် ရည်ရွယ်ပါသည်။


**သော့ချက်ဝေါဟာရများ-** ကချင်၊ ဂျိန်ဖော့၊ ဘာသာစကား၊ နေ့စဉ်သုံးစကား၊ စကားထာ၊ ရိုးရာဓလေ့၊ တိုင်းရင်းသား။

## နိဒါန်း

ဤစာတမ်းသည် မြန်မာနိုင်ငံမြောက်ပိုင်း၊ မြစ်ကြီးနားမြို့နယ်တွင်နေထိုင်ကြသော ကချင်ဘာသာစကား ရှိ စကားထာများမှရိုးရာဓလေ့ကို သုတေသနပြုထားသောစာတမ်း ဖြစ်ပါသည်။ စကားထာသည် ဘာသာ စကားတိုင်း၌ ရှိသည်။ ထိုစကားထာများမှတဆင့် လူမျိုးတို့၏ရိုးရာဓလေ့များနှင့် ယဉ်ကျေးမှုများကို တွေ့မြင်နိုင်ပါသည်။ ယခု တင်ပြသောစာတမ်းတွင် ကချင်ဘာသာစကားရှိစကားထာများမှတစ်ဆင့် ၎င်း တို့၏ရိုးရာဓလေ့များကို ဗဟုသုတဖြစ်ဖွယ်၊ စိတ်ဝင်စားဖွယ်အဖြစ် လေ့လာတင်ပြထားခြင်း ဖြစ်ပါသည်။ ဤသို့လေ့လာခြင်းဖြင့် တိုင်းရင်းသားတို့၏ရိုးရာဓလေ့၊ ယဉ်ကျေးမှုများနှင့် ၎င်းတို့၏ဘာသာစကား အကျိုးဖြစ်ထွန်းမှုတို့ကို ရည်ရွယ်ပါသည်။

### ၁။ ကချင်လူမျိုးနှင့် နေထိုင်ရာဒေသ

''ကချင်လူမျိုးတို့သည် ရှေးယခင်ကာလက မြန်မာနိုင်ငံမြောက်ပိုင်းဒေသအနှံ့အပြားနှင့် ရှမ်းပြည်နယ် မြောက်ပိုင်းဒေသအနှံ့အပြား၊ စစ်ကိုင်းတိုင်း၊ အိန္ဒိယအာသံပြည်နယ်တို့တွင် ပျံ့နှံ့နေထိုင်လာခဲ့ကြသည်။ '' ဟု ဦးမင်းနိုင်က သွေချင်းတို့ပျော်သည့်မြေ (၁၉၆၃)စာအုပ်တွင် ဖော်ပြထားပါသည်။ (စာ ၁) ကချင်လူမျိုးတို့သည် တိဗက်မြန်မာအနွယ်ဝင်များဖြစ်ကြပြီး သီးခြားဘာသာစကား၊ ယဉ်ကျေးမှုအစဉ် အလာဖြင့် အခြားသောတိုင်းရင်းသားများနှင့်အတူ အေးအတူပူအမျှ နေထိုင်လျက်ရှိသော တိုင်းရင်းသား လူမျိုးတစ်မျိုး ဖြစ်ပါသည်။

မြန်မာ့ဆိုရှယ်လစ်လမ်းစဉ်ပါတီဗဟိုကော်မတီမှ ထုတ်ဝေသော ပြည်ထောင်စုမြန်မာနိုင်ငံ တိုင်းရင်းသားယဉ်ကျေးမှု ရိုးရာဓလေ့ထုံးစံများ (၁၉၆၇) စာအုပ်တွင်

''သက္ကရာဇ် (၁၄၄၂)ခုနှစ်ခန့်က ရေးထိုးခဲ့သော မြန်မာကျောက်စာများတွင် ကချင်တောင်တန်း ဒေသ၌ နေထိုင်ကြသော တိုင်းရင်းသားများကို ခခွေးရရစ်ငသတ်ဖြင့် ရေးထိုးထားသည်။ ''ကခြင်''ဟူ၍ ခေါ်ဝေါ်ခဲ့ကြသည်။ ဤနောက်ပိုင်းတွင် မြန်မာစာပေများ၌ ''ကချင်" ဟူ၍ လည်းကောင်း၊ ''သိန်းဖော'' ဟူ၍လည်းကောင်း ဆက်လက်ခေါ်ဝေါ်ခဲ့ပြန်သည်။ ၁၉ရာစုပိုင်းသို့ ရောက်သောအခါတွင်လည်း မြန်မာ

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[၁] ကထိက၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

[၂] ဒေါက်တာ၊ ပါမောက္ခ၊ ဌာနမှူး၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

များသာမက ဥရောပတိုက်သားများကပါ ကချင်တောင်တန်းများအားလုံးကို ''ကချင်'' ဟူ၍ ခေါ်ဝေါ်သုံး စွဲခဲ့ရာ (၁၈၉၁)ခုနှစ်အထိ ဖြစ်သည်။ သက္ကရာဇ် (၁၉၀၀)ပြည့်နှစ်နောက်ပိုင်းတွင် ပေါ်ပေါက်လာသော ဘာသာစကားဆိုင်ရာ ပညာရှင်များက ကချင်တောင်တန်းဒေသရှိ တိုင်းရင်းသားများကို ယင်းတို့ပြောဆို သုံးနှုန်းသော စကားအလိုက် ခွဲခြားရာတွင် ဂျိန်ဖော့စကားပြောသူများသာ ကချင်အဖြစ်ကျန်ရစ်၍ အခြား မရူစကား၊ ရဝမ်စကား၊ လီဆူစကား ပြောသူများနှင့် ထိုစကားအုပ်စုတွင် ပါဝင်သောသူအားလုံးမှာ လူမျိုး တစ်မျိုးစီ ဖြစ်ခဲ့ရလေသည်။ ထိုသို့ ကွဲပြားလာခြင်းကိုပင် အချို့သောပညာရှင်များက လက်ခံခဲ့သဖြင့် ဒုတိယကမ္ဘာစစ်အပြီးတွင် ပေါ်ပေါက်ခဲ့သော မြန်မာစာပေကျမ်းများ၌ ဂျိန်ဖော့နှင့် သိန်းဖောကိုသာ ကချင်အဖြစ် လက်ခံခဲ့ကြသည်။'' (စာ ၆၁၊ ၆၂)

ဟူ၍ ဖော်ပြထားပါသည်။ ဦးမင်းနိုင်၏သွေးချင်းတို့ပျော်သည့်မြေ (၁၉၆၃)စာအုပ်တွင်

''ကချင်ဟူသော ဝေါဟာရမှာ မြေပြန့်မြန်မာများက ခေါ်ဝေါ်သောအမည် ဖြစ်သည်။ ကချင် လူမျိုးများကမူ ယင်းတို့ကိုယ်ကို ယင်းတို့ 'ဂျိန်ဖော့' ဟူ၍ ခေါ်ဝေါ်သုံးစွဲကြသည်။ တရုတ်များကမူ 'ယေဂျင်' ဟူ၍ ခေါ်ဆိုကြသည်။ အချို့တရုတ်များက 'ရှန်ထို' ဟူ၍ ခေါ်ဝေါ်ကြသည်။ မြန်မာရာဇဝင် သမိုင်းများ တွင် 'သိမ်းဖော' ဟူ၍ ခေါ်ဝေါ်ကြသည်။ အာသံနယ်ဖက်တွင် ကချင်အနွယ်ဝင်တို့ကို 'စင်းဖိုး' ဟူ၍ ခေါ်ဝေါ်ကြသည်။ ရှမ်းများက ကချင်အနွယ်ဝင်တို့ကို 'ခန်ဂ' ဟူ၍ ခေါ်ဆိုကြသည်။ လူအများစုက ဂျိန်ဖော့များကို 'ကချင်' လူမျိုးများဟူ၍ သိရှိနားလည်ထားကြသည်။'' (စာ ၃၈)

ဟူ၍ ဖော်ပြထားသည်ကို တွေ့ရသည်။

ဦးဖဂါယော်၏ ကချင်ဓလေ့နှင့် စကားပြောနည်းစာအုပ်တွင် ဂျိန်ဖော့စကားအုပ်စု၏ ခံယူချက် အရ ဂျိန်ဖော့ဟူသောစကား၏အဓိပ္ပာယ်မှာ 'လူ' ဟူ၍ ဖြစ်သည်။ ယင်းတို့၏စကားဖြင့် 'မရှ' ဖြစ်သည်။ ဂျင်းဆိုင်ဖော့ဆိုင် ဟူ၍လည်း ခေါ်သည်။ အဓိပ္ပာယ်မှာ အတည်တကျဖြစ်ပြီး အမြင်ကျယ်လာသည်ဟု ဆိုသည်။ ထို့ကြောင့် ဂျိန်ဖော့ဟူသည် အတည်တကျဖြစ်ပြီး အမြင်ကျယ်လာသောလူများဟု အဓိပ္ပာယ် ကောက်နိုင်သည်။

ထို့ပြင် ကချင်ဘာသာစကားဖြင့် ကချင်လူမျိုးကို 'ဂျိန်ဖော့' ဟုခေါ်သည်။ 'ဂျိန်'ဟူသည် 'အိုးအိမ် အတည်တကျနေထိုင်၍ ကြွယ်ဝချမ်းသာခြင်း' ဖြစ်၍ 'ဖော့'ဟူသည် 'အသိပညာ ဗဟုသုတပွင့်လင်းခြင်း' ဖြစ်သည်။ ထို့ကြောင့် 'ဂျိန်ဖော့' ဟူသည့်စကားမှာ 'အိုးအိမ်အတည်တကျနေထိုင်၍ ချမ်းသာကြွယ်ဝပြီး၊ အသိပညာထွန်းကားသော လူမျိုး' ဟု အဓိပ္ပာယ်ရပါသည်။ (စာ ၅)

ကချင်ပြည်နယ်တွင် တိုင်းရင်းသားလူမျိုးပေါင်း (၁၀)မျိုးခန့်ရှိရာ ဂျိန်ဖော့တို့သည် လူဦးရေ အများဆုံးဖြစ်၍ အတိုးတက်ဆုံးလည်း ဖြစ်သည်။ မြစ်ဖျားအထက်ဖက် (မြောက်ဘက်)တွင် နေထိုင်သော ဂျိန်ဖော့များကို ခရူးဟု ခေါ်ဆိုကြပြီး အောက်ဖက်( တောင်ဘက်)တွင် နေထိုင်ကြသော အနွယ်များကို ဂျိန်ဖော့ ဟုခေါ်ဆိုကြသည်။

အထက်တွင် ဖော်ပြခဲ့သော အကြောင်းအရာများမှာ ကချင် ဟူသော ဝေါဟာရ၊ ထိုမှ ဂျိန်ဖော့ ဟူသော အဓိပ္ပာယ်နှင့် ကချင်တိုင်းရင်းသားတို့၏နေထိုင်ရာဒေသတို့ကို ဖော်ပြထားခြင်း ဖြစ်ပါသည်။

**၁၊ ၁။ ကချင်ဘာသာစကားနှင့် ရိုးရာဓလေ့**

ကချင်ပြည်နယ်တွင်နေထိုင်ကြသော ကချင်တိုင်းရင်းသားတို့၏ဘာသာစကားကို သေချာဆန်းစစ်လိုက် ပါက ရှေးဟောင်းတိဗက်လူမျိုးတို့၏ ဘာသာစကားမှ ဆင်းသက်ပေါက်ဖွားလာသည်ဟု ဆိုသည်။

စာပေဗိမာန်က ထုတ်ဝေသော ဦးဖေမောင်တင်(၁၉၅၈)၏ ဘာသာလောကကျမ်းတွင် 'တိဗက် မြန်မာမူလမျိုးရိုးမူကား တောင်တန်းကြီးများမှ ဗြဟ္မပုတြမြစ် ထွက်ပေါ်လာသော နေရာသို့ရောက်သော် သုံးစုပြား၏။ တစ်စုသည် ဗြဟ္မပုတြမြစ်ကို ဆန်တက်ပြီးလျှင် တိဗက်ပြည်သို့ ရောက်၏။ ဒုတိယအစုကား

ယင်းမြစ်ကို စုန်ဆင်းရ၍ အာသံပြည်သို့ ရောက်၏။ တတိယအစုကား ချင်းတွင်းမြစ်၊ ဧရာဝတီမြစ်တို့ကို စုန်ဆင်းရ၍ မြန်မာပြည်သို့ ရောက်၏။' ဟူ၍ ဖော်ပြထားပါသည်။ (စာ ၁၄)

မြန်မာဆိုရှယ်လစ်လမ်းစဉ်ပါတီဗဟိုကော်မတီကဦးစီးထုတ်ဝေသော ပြည်ထောင်စုမြန်မာနိုင်ငံတိုင်းရင်းသားယဉ်ကျေးမှု ရိုးရာဓလေ့ထုံးစံများ(၁၉၇၁)စာအုပ်တွင် ကချင်စကားမှာ မြန်မာစကားနှင့် လည်း အလွန်နီးစပ်နေပြန်သည်။ အခြေခံစကားလုံးများအနက် လေးပုံတစ်ပုံခန့်မှာ မြန်မာစကားလုံးများ နှင့် ကိုက်ညီနေသည့်အပြင် သဒ္ဒါမှာလည်း မြန်မာသဒ္ဒါအတိုင်း ဖြစ်နေပြန်သည်။ ကချင်စကားတွင် မရှိ သော ဝေါဟာရများကိုလည်း မြန်မာဝေါဟာရအတိုင်း သုံးစွဲနေ ပြန်သည်။ ထိုသို့ဖြစ်ခြင်းကြောင့် ကချင် စကားသည် တိဗက်စကားနှင့် မြန်မာစကားကို ဆက်စပ်ပေးရာ ပေါင်းကူးတံတားဖြစ်သည်ဟု ဆိုနိုင် သည်။

ကချင်လူမျိုးတို့ ပြောဆိုသုံးနှုန်းသော စကားများမှာ နေရာဒေသ၊ အမျိုးအနွယ်နှင့် စကားအုပ်စု ကိုလိုက်၍ ကွဲပြားခြားနားတတ်ရာ တစ်ခါတစ်ရံတွင် တောင်တစ်တောင်၌ စကားတစ်မျိုးထွန်းသည်ဟု ဆိုရ လောက်အောင်ပင် သုံးနှုန်းသောစကားများ ပေါကြွယ်လှသည်။ ဂျိန်ဖော့စကားတစ်မျိုးတည်းကိုပင် အာသံနယ်စပ်နှင့် ဟူးကောင်းချိုင့်ဝှမ်းဒေသများတွင် တစ်မျိုး၊ မေခ၊ မလိခမြစ်ဝှမ်းတွင် တစ်မျိုး၊ အရှေ့ ဘက် တရုတ်ပြည်နယ်စပ်တစ်လျှောက်တွင် တစ်မျိုးပြောဆိုသည်ကို တွေ့ရသည်။ သို့သော် အခြေခံအားဖြင့် ကချင်လူမျိုးတို့၏ဘာသာစကားကို လေးမျိုး ခွဲခြားနိုင်သည်။ ယင်းတို့မှာ ဂျိန်ဖော့စကား၊ မရူစကား၊ ရဝမ်စကားနှင့် လီဆူစကား တို့ဖြစ်သည်။

ဂျိန်ဖော့စကားမှာ ကချင်ပြည်နယ်တွင် လူသုံးအများဆုံးသော ဘာသာစကား ဖြစ်သည်။ (၁၈၉၅)ခုနှစ်လောက်ကစ၍ ဟင်ဆန်ဆိုသူ အမေရိကန်သာသနာပြုဆရာကြီးက ရောမအက္ခရာများကို အသုံးပြု၍ ဂျိန်ဖော့စာကို တီထွင်ပေးခဲ့သည်။ အခြားစာပေမရှိသေးသော လူမျိုးများကလည်း ဂျိန်ဖော့ စာပေကို သင်ကြားလေ့လာခဲ့ကြရာမှ ဂျိန်ဖော့စာတတ်သူများ ပေါများလာကာ ဂျိန်ဖော့စကားမှာ လူသုံး များသောစကားရပ် ဖြစ်လာခဲ့သည်။ သို့ရာတွင် ဂျိန်ဖော့စကားမှာ နေရာဒေသကိုလိုက်၍ လေယူ လေသိမ်း၊ အသံအနေအထား ကွဲပြားကြသည်။ သာမန် ဂျိန်ဖော့၊ ခရူးဂျိန်ဖော့၊ ဂေါင်ရီဂျိန်ဖော့၊ ဟူးကောင်း ဂျိန်ဖော့၊ ဒူရင်ဂျိန်ဖော့နှင့် ထိန်နိုင်းဂျိန်ဖော့တို့သည် ဂျိန်ဖော့စကားတစ်မျိုးတည်းကို သုံးစွဲကြသော်လည်း အသံအနေအထားတို့သည် အနည်းအကျဉ်းစီ ကွဲပြားကြသည်။ (စာ ၃၉)

မဂ္ဂယ်ရှိန်ရာစာပေကထုတ်ဝေသော မရန်ဘောက်လာ (မဟာဝိဇ္ဇာဂုဏ်ထူး) (၂၀၁၃)၏ ခေတ် အမြင်နှင့် ကချင်ယဉ်ကျေးမှုစာအုပ်တွင် ကချင်လူမျိုးတို့၏ ရိုးရာဓလေ့ထုံးစံများအရ ကျင်းပသောပွဲလမ်း များမှာ မနောပွဲ၊ ကောက်သစ်စားပွဲ၊ အိမ်သစ်တက်ပွဲ၊ အသုဘပွဲ၊ ကလေးကင်ပွန်းတပ်ပွဲ စသည့်ပွဲများကို ကျင်းပလေ့ရှိသည်။ ထိုပွဲများအနက် မနောပွဲမှာ အကြီးကျယ်ဆုံး အခမ်းနားဆုံးဖြစ်သည်။ ရှေးအကျဆုံး ရိုးရာပွဲလည်း ဖြစ်သည်။ မနောပွဲသည် ထိုနယ်မြေဒေသအတွင်းရှိသော ကျေးရွာသားအားလုံးနှင့်တကွ အနွယ်အားလုံးနှင့်လည်း သက်ဆိုင်သောပွဲဖြစ်၍ အနည်းဆုံး လေးရက်မှရှစ်ရက်အထိကြာမြင့်တတ်သည်။ မနောပွဲမှာ မဒိုင်နတ် ခေါ် ကောင်းကင်နတ်ကို မူတည်၍ ကျင်းပသောနတ်ပွဲတစ်ရပ်ဖြစ်သော်လည်း ကောင်းကင်နတ်နှင့်တကွ ပူဇော်ပသရသောအခြားနတ်များမှာ အလွန်များပြားလှပါသည်။ မနောပွဲပြီးလျှင် ကောက်သစ်စားပွဲသည် အခမ်းနားဆုံး ဖြစ်သည်။ ကချင်ယဉ်ကျေးမှုတွင် အရေးပါသော ရိုးရာပွဲ တစ်မျိုး ဖြစ်ပါသည်။ ကောက်သစ်စားပွဲကို အိမ်ထောင်စုအလိုက် ကျင်းပသကဲ့သို့ တစ်ရွာလုံးစုပေါင်း၍လည်း ကျင်းပသည်။ သားငါး၊ အရက်ခေါင်ရည်စသော စားသောက်ဖွယ်ရာများကို ဦးစွာစုဆောင်းပြီး ရွာလုံးကျွတ် ကောက်သစ်စားပွဲနေ့တစ်နေ့သတ်မှတ်၍ တခမ်းတနား ကျင်းပလေ့ရှိသည်။ (စာ ၇၉)

ယခုအချိန်အခါတွင် ကောက်သစ်စားပွဲကို ကျေးဇူးတော်ချီးမွမ်းရာနေ့ (THANK GIVING DAY) အဖြစ် နိုဝင်ဘာလတွင် ကျင်းပနေဆဲ ဖြစ်ပါသည်။ ကျန်ရှိသော ရိုးရာပွဲတော်များကိုလည်း အချိန်အခါအလိုက် ကျင်းပလေ့ရှိပါသည်။

**၂။ စကားထာ**

စကားထာဟူသည် လူမျိုးတစ်မျိုး၏နေထိုင်ရာဒေသပတ်ဝန်းကျင်၊ စားသောက်မှုဓလေ့၊ စရိုက်၊ အတွေး အခေါ်နှင့် ရိုးရာဓလေ့ယဉ်ကျေးမှု စသည်တို့ကိုအခြေပြု၍ ပေါ်ပေါက်လာသော ဉာဏ်စမ်းမေးခွန်း ဖြစ် သည်။ မိမိတို့ပတ်ဝန်းကျင်၌ တွေ့မြင်ရသည့်အရာများကို အနက်အဓိပ္ပာယ်ဝှက်ကာ တစ်ဦးနှင့်တစ်ဦး မေးမြန်း ကြသည်။ စကားထာ၏အဓိပ္ပာယ်ဖွင့်ဆိုချက်နှင့် ပတ်သက်၍ အမျိုးမျိုး ဖွင့်ဆိုခဲ့ကြသည်ကို တွေ့နိုင်ပါ သည်။

မြန်မာစာအဖွဲ့က ဒုတိယအကြိမ်ထုတ်ဝေသော မြန်မာအဘိဓာန်စာအုပ်(၂၀၀၈)တွင်

စကားထာ/ဇဂထာ/ နာ- အနက်အဓိပ္ပာယ်ကို မြှုပ်ထားသော ဉာဏ်စမ်းစကား။ ပဟေဠိ။
(သွားတော့ခွေခွေ၊ နေတော့စင်းစင်း။)

စကားထာဝှက် /ဇဂထာဝှက်/ ကြိ- ဖြေဆိုရန် စကားထာတစ်ခုခုကို ဆိုသည်။ (စာ ၉၁)

ဟု ဖွင့်ဆိုထားပါသည်။ မြန်မာနိုင်ငံဘာသာပြန်စာပေအသင်းမှထုတ်ဝေသော မြန်မာ့စွယ်စုံကျမ်းအတွဲ(၃) (၁၉၅၆)တွင်

'စကား၏အနက်အဓိပ္ပာယ်ကို ကွယ်ဝှက်၍ ပုစ္ဆာထုတ်ခြင်းသည် စကားထာ ဖြစ်သည်။ ဤသို့ ပုစ္ဆာထုတ် ခြင်းကို စကားထာဝှက်သည်' (စာ ၂၉၅)

ဟု ဆိုထားပါသည်။

ကြည်ဦးက စကားထာဟူသောဝေါဟာရကို မြန်မာ့ရိုးရာစကားထာများစာအုပ် (၂၀၀၃)တွင်

'မြန်မာစကားထာဟူသည်မှာ ရှေ့တွင်ဖော်ပြလတ္တံ့သော မဟောသဓာဝတ္ထု၊ ဓမ္မပဒဝတ္ထု စသည့် ပါဠိစာပေများမှ အခြေခံ၍လာသည်မှာ မှန်သော်လည်း မြန်မာနိုင်ငံ၏ ရေမြေသဘာဝ၊ မြန်မာ့ စားဝတ်နေမှုဘဝ၊ မြန်မာ့ယဉ်ကျေးမှုအလေ့အထများနှင့် ဆီလျော်စွာ နှစ်ပေါင်းများစွာက စတင် ၍ အသုံးတွင်လာခဲ့သော ရိုးရာမြန်မာမှုစစ်စစ်တစ်ခု ဖြစ်သည်' (စာ ၁၄)

ဟုဆိုထားပါသည်။

ထို့ကြောင့် စကားထာဆိုသည်မှာ မိမိဆိုလိုသည့်အနက်အဓိပ္ပာယ်ကို ဝှက်ကာမေးမြန်းပြီး ဖြေဆို မည့်သူကလည်း ထိုအဖြေကို သေသေချာချာစဉ်းစားပြီး ဖြေဆိုရသည့် ဉာဏ်စမ်းကစားနည်း တစ်မျိုးပင် ဖြစ်သည်။

မြန်မာမှုတွင်တွေ့ရသော စကားထာအမျိုးအစားများကို မြန်မာ့စွယ်စုံကျမ်း အတွဲ(၃) တွင်

(၁) ကာရန်အားဖြင့်ဝှက်သောစကားထာ

(၂) ဥပမာအားဖြင့်ဝှက်သောစကားထာ

(၃) အနက်အားဖြင့်ဝှက်သောစကားထာ

(၄) စကားလိမ်အားဖြင့်ဝှက်သောစကားထာ

(၅) သရီ်ဂအားဖြင့်ဝှက်သောစကားထာ

ဟူ၍ ခွဲခြားဖော်ပြထားသည်ကို တွေ့ရပေသည်။ မှားသည်ဟူ၍ကား မဆိုလိုပါ။ သို့ရာတွင် အမျိုးအစား ခွဲခြားပုံ မရှင်းလင်းဘဲ ထွေးရောယှက်တင်ဖြစ်၍ နေပေသည်။ ထို့ကြောင့် မြန်မာစကားထာများကို အမျိုး အစားအားဖြင့် (၆)မျိုးခွဲခြား ဖော်ပြထားသည်။ ယင်းတို့မှာ

၁။ စကားထာရိုးရိုး

၂။ စကားလိမ်

၃။ စကားဝှက်

၄။ ပုစ္ဆာစကားထာ

၅။ သန်္ဂျာစကားထာ

၆။ ပုံပြင်စကားထာ

တို့ဖြစ်ပါသည်။ (စာ ၁၆)

ထို့ကြောင့် စကားထာဟူသည်မှာ ဆိုလိုသည့်အနက်အဓိပ္ပာယ်ကို ဝှက်ကာမေးမြန်းသော ဉာဏ်စမ်းကစားနည်းဖြစ်သည်ဟု ဆိုနိုင်ပါသည်။

၂၊ ၁။ ရိုးရာဓလေ့

မြန်မာစာအဖွဲ့ကထုတ်ဝေသော မြန်မာအဘိဓာန် (၂၀၀၈) တွင် ရိုးရာ ဟူသောဝေါဟာရ၏အဓိပ္ပာယ်ကို

ရိုးရာ၊ နဝ- ၁၊ မိဘအစဉ်အဆက်။ ၂၊ မိဘအစဉ်အဆက် ကိုးကွယ်ခဲ့သောနတ်။ ၃၊ မိဘစဉ်ဆက် ကျင့်သုံးခဲ့သော အလေ့အထ။ (စာ ၃၁၁)

ဟူ၍ လည်းကောင်း၊ ဓလေ့ကို

ဓလေ့၊ နဝ- ထုံးစံ။ အလေ့။ (စာ ၁၈၄)

ဟူ၍ လည်းကောင်း ဖွင့်ဆိုထားပါသည်။

ထို့ကြောင့် ရိုးရာဓလေ့ဆိုသည်မှာ လူမျိုးစုတစ်စုတွင် မျိုးရိုးစဉ်ဆက်အလိုက် ကျင့်သုံးခဲ့သော ဓလေ့ထုံးစံများ ဖြစ်သည်။ ထိုကဲ့သို့ အစဉ်အလာရှိခဲ့သော ရိုးရာဓလေ့များကို ကချင်ဘာသာစကားရှိ စကားထဲများတွင် လေ့လာတွေ့ရှိရပါသည်။

**၃။ ကချင်တိုင်းရင်းသားတို့၏ နေ့စဉ်သုံးစကားမှ စကားထာများတွင် တွေ့ရသော ရိုးရာဓလေ့**

လူတို့သည် သာမန်အားဖြင့် ဝေါဟာရတို့၏အနက်ကို အလေးမထား အာရုံမစိုက်ဘဲ အမှုမဲ့အမှတ်မဲ့ ပြောဆိုတတ်ကြသည်။ ခက်ခဲသောအရာတို့ကို လွယ်ကူအောင် လုပ်တတ်ကြသကဲ့သို့ စကားလုံးများကို လည်း အခါအားလျော်စွာ လွယ်ကူအောင် သုံးစွဲတတ်ကြသည်။ ရာစုနှစ်ပေါင်းများစွာကပင် ရှိနေသည့် ဘိုးဘေးဘီဘင်ဘာသာစကားများမှ ဖွံ့ဖြိုးတိုးတက်လာခြင်း ဖြစ်သည်။ ထို့ပြင် ကချင်ဘာသာစကား တွင်လည်း ဖန်တီးပြောဆိုသုံးစွဲသော စကားလုံးများရှိသကဲ့သို့ အခြားဘာသာစကားများမှ မွေးစားထား သောစကားလုံးများလည်း များစွာရှိပါသည်။ ယင်းစကားလုံးများကို လူတို့က နေ့စဉ်သုံးစကားအဖြစ် သုံး စွဲနေကြသည်။ ထို့ကြောင့် နေ့စဉ်သုံးစကားဆိုသည်မှာ လူအများနေ့စဉ်သုံးစကားအဖြစ် ပြောဆိုသုံးနှုန်း နေသောစကားဟု သာမန်အားဖြင့် ဖွင့်ဆိုနိုင်ပါသည်။ (http://en.m.wikipedia.org) နေ့စဉ်သုံးစကား များကို သာမန်အားဖြင့် ခွဲခြား ကြည့်လျှင်

၁။ ဥပစာအဖြစ် ပြောဆိုသုံးစွဲနေကြသော ဥပစာစကားများ

၂။ လူမှုကိစ္စအမျိုးမျိုးကို အခြေပြုပြီး ပေါ်ပေါက်လာသော ဓလေ့သုံးစကားများ

၃၊ ခေတ်ကာလအလျောက် ပေါ်ပေါက်လာသော ဗန်းစကားများ

၄။ သက်ဆိုင်ရာ 'စံ' ဘာသာစကားမှ သွေဖည်သော ဒေသိယစကားများ

၅။ ပုံခိုင်းနှိုင်း၍ ပြောဆိုသော စကားပုံများ

၆။ ရှေးယခင်မှစ၍ ပြောဆိုခဲ့သော မှတ်သားဖွယ်ရာ ဆိုရိုးစကားများနှင့်

၇။ ဆိုလိုသည့်အဓိပ္ပာယ်ကို ဝှက်ကာပြောဆိုသော စကားထာများ

ဖြစ်ကြပါသည်။

ယခု ဤစာတမ်းတွင် ကချင်ဘာသာစကားရှိစကားထာမှ ရိုးရာဓလေ့ကို ထင်ဟပ်စေသော စကားထာများကိုသာ တင်ပြထားခြင်း ဖြစ်ပါသည်။

N dum mai bau sa gaw hpa – lagat tsip

/nə dũ´ mai¯ baū shā gɔ¯ phā // – / lə ga? si?//

တီးလို့မရတဲ့မောင်း – ပျားအုံ

ကချင်လူမျိုးတို့၏ ရိုးရာယဉ်ကျေးမှုတွင် မောင်းသည် မရှိမဖြစ်အရေးပါသော တူရိယာပစ္စည်းတစ်ခုဖြစ်ပါသည်။ မင်္ဂလာအခမ်းအနားတွင်လည်းကောင်း၊ ပျော်ပွဲရွှင်ပွဲအဖြစ်ကျင်းပသောအခမ်းအနားတွင် လည်းကောင်း၊ နာရေးအခမ်းအနားတွင်လည်းကောင်း အသုံးပြုရသောပစ္စည်း ဖြစ်ပါသည်။

မင်္ဂလာအခမ်းအနားဟုဆိုရာတွင် တစ်အိုးတစ်အိမ် ထူထောင်ရေးမှာ ကချင်လူမျိုးတို့အဖို့ အရေးကြီးသည်နှင့်အမျှ အခမ်းအနားအဆောင်ယောင်ကလည်း ကျယ်ဝန်းများပြားလှပါသည်။ ဒူဝါမျိုးဖြစ် သော ကချင်အမျိုးသားတစ်ဦးသည် အမျိုးတူဖြစ်သော ကချင်အမျိုးတစ်ဦးကိုသာ အိမ်ထောင်ဖက်အဖြစ် ရွေးချယ်ရသည်။ အမျိုးသမီးသည် မယုမျိုး(ယောကျ္ဍမမျိုး) မဟုတ်ဘဲ အခြားသွေးသားမတော်စပ်သည့် အန္တယ်ထဲမှဖြစ်နေလျှင် မယုမျိုး(ယောကျ္ဍမမျိုး)ထံသို့ ဖဂါပစ္စည်းတစ်ခုခုပေး၍ အကျိုးအကြောင်း အခြေအနေကို ပြောကြားရသည်။ ထိုအခါ ယောကျ္ဍမမျိုးက သဘောတူသည့်အနေနှင့် မောင်းတစ်လုံးကို အထိမ်းအမှတ်ပြု၍ ပေးလိုက်သည်။ ထိုမောင်းကို သက်သေခံပစ္စည်းအဖြစ်ထားကာ မိန်းကလေးရှင်ထံ တွင် မူလ မယုမျိုးနှင့် ကင်းရှင်းပြီဖြစ်ကြောင်း ပြောကြားရသည်။ မယုမျိုးထံတွင်ပင် သမီးတောင်းရမည် ဆိုပါက ထိုကိစ္စမျိုး မလိုတော့ပေ။

ကချင်အမျိုးသားသည် မိမိနှစ်သက်သောအမျိုးသမီးကို စေ့စပ်ကြောင်းလမ်းရာတွင် မိန်းကလေး၏မိဘများထံသို့ သွားရောက် စကားကမ်းလှမ်းရသည်။ ထိုသို့ စေ့စပ်ရာတွင် ယောက်ျားလေးဘက်မှ ဦးလေး၊ ဘကြီး စသော ညီအစ်ကိုများကို တိုင်ပင်ကာ ကဆာ ခေါ် အောင်သွယ်နှစ်ဦးကို လက်ဆောင်ပစ္စည်းများနှင့်အတူ မိန်းကလေးနေထိုင်ရာ ကျေးရွာသို့ စေလွှတ်ရသည်။ ဤသို့ စေလွှတ်ရာတွင် လက်ဆောင်ပစ္စည်းအဖြစ်ပေးသော ပစ္စည်းများတွင် မောင်းပါသည်ကို တွေ့ရသည်။

မင်္ဂလာအခမ်းအနား ကျင်းပသောနေ့တွင် သတို့သားအိမ်၌ မင်္ဂလာအခမ်းအနားနှင့်ဆိုင်သော ရိုးရာပူဇော်ပွဲအတွက် နတ်ဆရာအဟောထွက်သည့်အတိုင်းလိုအပ်သော ယဇ်ကောင်များကို အသင့်ပြင်ထားရသည်။ ထို့နောက် သတို့သမီးနှင့်အဖွဲ့အား တည်းခိုရာအရပ်မှ သတို့သားအိမ်သို့ ခေါ်ဆောင်လာရ သည်။ ထိုသို့ သတို့သမီးအားခေါ်ဆောင်လာသည့်အခါတွင် တည်းခိုရှင်နှင့် သတို့သမီးကို လိုက်ပို့သော ဆွေးမျိုးများအား မောင်းနှင့် တောင်ရှည်ပုဆိုး အစရှိသောပစ္စည်းများကို လက်ဆောင်အဖြစ် ပေးခဲ့ရ သည်။

ယနေ့ခေတ်အချိန်အခါတွင် နတ်ကိုးကွယ်မှု နည်းပါးသွားသော်လည်း မောင်းပေးရခြင်းမှာ ဆက်လက်တည်ရှိနေဆဲ ဖြစ်ပါသည်။

ပျော်ပွဲရွှင်ပွဲအခမ်းအနားဟုဆိုရာတွင် ကချင်လူမျိုးတို့၏ရိုးရာဓလေ့ထုံးစံအရ ကျင်းပသောပွဲ များတွင် မနောပွဲမှာ အကြီးကျယ်ဆုံး၊ အခမ်းနားဆုံး ဖြစ်သည်။ မနောပွဲမှာ ကြီးကျယ်ခမ်းနားသည်နှင့် အမျှ ဆောင်ရွက်ဖွယ်ရာလုပ်ငန်း အစီအစဉ်လည်း များပြားလှပါသည်။ မနောပွဲကျင်းပတော့မည်ဆိုလျှင်

ကျင်းပမည့် ကွင်း၏အလယ်ဗဟိုတွင် မနောတိုင် လေးတိုင် စိုက်ထူရသည်။ မနောတိုင်လေးတိုင် အနက် နှစ်တိုင်မှာ မနောကသည့်အခါတွင် နှစ်ဖက်ပိတ်စည်ကြီးတစ်လုံးနှင့် မောင်းကြီးသုံးလုံး တပ်ဆင်ရန် ဖြစ်သည်။ ထိုကဲ့သို့ ပျော်ပွဲရွှင်ပွဲ အခမ်းအနားတွင်လည်း မောင်းသည် မပါမဖြစ်အရေးပါသော ပစ္စည်းဖြစ်သည်ကို တွေ့ရပါသည်။

ကချင်လူမျိုးတို့သည် တမလွန်ဘဝကို ယုံကြည်ကြသူများ ဖြစ်သည်။ လူတစ်ယောက် သေဆုံးသည်နှင့်တစ်ပြိုင်နက် အိမ်နီးနားချင်းများ သိရှိစေရန် သေနတ်သုံးချက် ဖောက်ရသည်။ အသုဘမောင်း ထုနည်းဖြင့် မောင်းကို ထုရသည်။ သေဆုံးသူသည် အသက်အရွယ်ကြီးရင့်မှသာလျှင် မောင်းကို တီးခတ်၍ လူငယ်လူရွယ်များ သေဆုံးလျှင်မူ မောင်းကို မသုံးချေ။ ထိုသို့ အသုဘပွဲကျင်းပမည့်အကြောင်းကို သေသူ၏ဝိညာဉ်အားနတ်ဆရာက ပထမအကြောင်းကြားပြီးနောက် ချိတ်ဆွဲထားသော မောင်းနှင့်ဗုံရှည်ကို တီးကာ ကပွဲကို အိမ်တွင်းမှစ၍ ကကြသည်။ အသုဘအခမ်းအနားတွင် ကလေ့ရှိသောအကကို ကဗုံဒွန် အကဟု ခေါ်သည်။

ထိုသို့သော အသုဘအခမ်းအနားကျင်းပပုံနှင့် ကဗုံဒွန်အကကိုယနေ့ခေတ်အခါတွင် ပြုလုပ်သူ နည်းပါးသွားသည်ကို တွေ့ရသည်။ အသက်အရွယ်ကြီးရင့်သူများ သေဆုံးလျှင်မူ မောင်းတီးခြင်းကို ယနေ့ခေတ်တွင်လည်း ပြုလုပ်လေ့ရှိပါသည်။ ယနေ့ခေတ်အချိန်တွင် အသုဘပို့ဆောင်သည့်အခမ်းအနား တွင် ဒူဝါမျိုးနွယ်နှင့် အသက်ကြီးရင့်သူများကို ဘင်ခရာတီးဝိုင်းဖြင့် လမ်းတစ်လျှောက်တီးမှုတ်ကာ ပို့ဆောင်လာသည်ကိုလည်း တွေ့ရပါသည်။

ထိုကြောင့် ကချင်လူမျိုးတို့သည် မိမိတို့၏ရိုးရာဓလေ့အခမ်းအနားများတွင် အသုံးပြုလေ့ရှိသော မောင်းကို ''တီးလို့မရတဲ့မောင်း'' ဟူသော စကား၏အနက်အဓိပ္ပာယ်ကိုဝှက်ကာ တစ်ဦးနှင့်တစ်ဦး မေးမြန်းပြောဆိုလာကြသည်။ ထိုစကားထာမှတစ်ဆင့် ကချင်လူမျိုးတို့၏ရိုးရာဓလေ့ကို စိတ်ဝင်စား ဖွယ်၊ ဗဟုသုတဖြစ်ဖွယ် မှတ်သားသိရှိရပါသည်။

Yi ya magwi hpa – Yi wa

/ jí jā mə gwī phā // – / jí wā//

တောင်ယာထဲကဆင် – တောင်ယာတဲ

မြန်မာနိုင်ငံမြောက်ပိုင်းတွင် နေထိုင်ကြသော ကချင်တိုင်းရင်းသားတို့သည် တောင်ပေါ်ဒေသတွင် နေထိုင်ကြပြီး တောင်ယာစိုက်ပျိုးရေးကို အဓိကထားလုပ်ကိုင်ကြသည်။ ထိုသို့ လုပ်ကိုင်ရာတွင် တစ်နှစ်နှင့် တစ်နှစ် စိုက်ပျိုးသည့်မြေနေရာမတူညီဘဲ ရွှေ့ပြောင်းလုပ်ဆောင်ကြသည်ကို တွေ့ရသည်။ ထိုသို့ လုပ်ဆောင်ရာတွင် တောင်ယာအဖြစ်လုပ်ကိုင်မည့်နေရာမှ တောသစ်ပင်များကို ခုတ်ထွင်ရှင်းလင်းရ သည်။ ထိုသို့ တောင်ယာခုတ်သွားလျှင် နေအိမ်သို့ပြန်ရန် အလွန်ဝေးသောကြောင့် တောင်ယာထဲတွင် တဲထိုးကာ နေထိုင်ကြသည်။ ထိုတဲတွင် တောင်ယာခုတ်ချိန်မှစ၍ တောင်ယာစပါးရိတ်သိမ်းပြီးချိန်ထိ နေထိုင်ကြသည်ကို တွေ့ရသည်။ ထိုတဲသည် တောင်ယာထဲတွင် ထီးထီးကြီးတစ်လုံးတည်း တည်ရှိနေ သည်။

ဤအခြင်းအရာကို ကြည့်ပြီး ကချင်လူမျိုးတို့သည် ''တောင်ယာထဲကဆင်''ဟူသော အနက်အဓိပ္ပာယ်ကို ဝှက်ကာမေးမြန်းသော စကားထာ ဖြစ်လာသည်။ ဤစကားထာမှ ကချင်တိုင်းရင်းသား တို့၏ တောင်ယာလုပ်ငန်းဖြင့် အသက်မွေးခြင်းသည် ၎င်းတို့၏ရိုးရာဓလေ့အဖြစ်တွေ့မြင်ရပါသည်။

Bum n tsa kaw hka wan taw nga ai lapu hpa – Bum Hkaw

/ -bũ nə sā kɔ´ khə wã´ tɔ¯ ŋā aī lpū phā // – / -bũ khɔ´//

တောင်ပေါ်မှာ ခွေနေတဲ့ မြွေ – ခေါင်းပေါင်း

ဝတ်စားဆင်ယင်မှုနှင့် ပတ်သက်လျှင် လူမျိုးတိုင်း၊ နိုင်ငံတိုင်းတွင် မိမိတို့၏နေရာဒေသနှင့် လိုက်လျော ညီထွေသော၊ ကျန္ဆေသိက္ခာရှိသော၊ လုံခြုံသော ဝတ်စားဆင်ယင်မှုမျိုးကိုသာ ဆင်မြန်းကြသည်။ မြန်မာ နိုင်ငံတွင် မှီတင်းနေထိုင်သော တိုင်းရင်းသားလူမျိုးများသည်လည်း မိမိတို့၏ရိုးရာဝတ်စုံများကို အမြတ် တနိုးဝတ်စားဆင်မြန်းကြပါသည်။ ကချင်တိုင်းရင်းသားများသည်လည်း မိမိတို့၏ရိုးရာဝတ်စုံကို အမြတ် တနိုးတန်ဖိုးထားဝတ်ဆင်ကြသည်။ ပြည်ထောင်စုမြန်မာနိုင်ငံ တိုင်းရင်းသားယဉ်ကျေးမှု ရိုးရာဓလေ့ထုံးစံ များ(ကချင်) (၁၉၆၇)စာအုပ်တွင် ကချင်လူမျိုးတို့တွင် တစ်နေရာနှင့်တစ်နေရာ၊ စကားအုပ်စုတစ်စုနှင့် တစ်စု၊ ဝတ်စားဆင်ယင်ပုံချင်း ကွာခြားမှုရှိသည်။ ရဝမ်တို့က အဖြူရောင်ကို ဝတ်ဆင်ကြ၍ အခြားကချင် တို့က အမည်းရောင်ကို ဝတ်ဆင်ကြသည်။ အဇီးနှင့်လီဆူအမျိုးသားတို့က ခေါင်းပေါင်းကို ထူထူ ထည်းထည်း ပေါင်းထုပ်သဖွယ်ပေါင်း၍ ဂျိန်ဖော့နှင့် မရူအမျိုးသားတို့က ခေါင်းပေါင်းကို ပါးပါးပေါင်းကြ သည်။ (စာ ၆၁)

ဦးနောင်ဘ စုဆောင်းတင်ပြသော မြန်မာနိုင်ငံကချင်လူမျိုးများ စာအုပ်(၁၉၂၉)တွင် ကချင် အမျိုးသားများသည် ခေါင်းပေါင်းကို ပေါင်းကြသော်လည်း မြန်မာတို့ကဲ့သို့ ခေါင်းပေါင်းခြင်း မဟုတ်သည့် အပြင် ပိုးခေါင်းပေါင်းလည်း မဟုတ်ပေ။ ကချင်အမျိုးသားတို့၏ ခေါင်းပေါင်းသည် အဝါနုရောင်၊ အညိုရောင်ဖြစ်ပြီး အနက်ရောင်လိုင်းများ ဖောက်ထားလေ့ရှိသည်။ ထိုခေါင်းပေါင်းများကို ပူတာအိုနှင့် မြစ်ကြီးနားတွင် ရရှိနိုင်သည်။ ထိုခေါင်းပေါင်းကို ဝက်အူချောင်းကဲ့သို့ ရစ်ပတ်ပြီး အစွန်း တစ်ဖက်ကို ဦးခေါင်းထိပ်တွင် အထုံးပြုလုပ်ထားသည်။ အခြားတစ်ဖက်စွန်းကို ဦးခေါင်းပေါ်၌ ရစ်ပတ်ထားရာ ဆံပင် အချို့ပေါ်ထွက်နေစေရန် ပေါင်းလေ့ရှိသည်။ (စာ ၁၆)

ကချင်တို့သည် သူတို့၏ဦးခေါင်းကို အမြတ်တနိုးတန်ဖိုးထားကြောင်း မှတ်သားသင့်သည်။ ကချင် တစ်ယောက်သည် သမင်သားများကို စစ်ရဲကင်းစခန်းသို့ ရောင်းချရန် ယူဆောင်သွားသည်။ အရပ်မြင့်မြင့် ဆစ်(ခ်)လူမျိုး စစ်ရဲတစ်ယောက်က သမင်သားအတွက် ငွေအနည်းငယ်ပေးသည်ကို ကချင်အမျိုးသားက လက်မခံဘဲ ငြင်းပယ်လိုက်သည်။ ထိုအခါ ဆစ်(ခ်)လူမျိုးစစ်ရဲက ကချင်အမျိုးသား၏ဦးခေါင်းကို လက်ဝါး ဖြင့်ရိုက်ချလိုက်ရာ ကချင်၏ဦးခေါင်းမှ ခေါင်းပေါင်းပြုတ်ကျသွားသည်။ ဤအပြုအမူမှာ ဆိုးဝါးသော လုပ်ရပ်ဖြစ်သည်။ စစ်ရဲက ထိုမျှဖြင့် ရပ်တန့်ခြင်းမရှိသေးဘဲ ကချင်အမျိုးသားအား ခေါင်းပေါင်းကို ကောက်ယူပြီး ကင်းစခန်းမှ ထွက်ခွာသွားရန် အမိန့်ပေးလိုက်သည်။ သို့သော် ကချင်အမျိုးသားက စစ်ရဲ ကိုယ်တိုင် ခေါင်းပေါင်းကိုကောက်ယူပေးမှသာ ကင်းစခန်းမှ ထွက်ခွာသွားမည်ဖြစ်ကြောင်း၊ ခေါင်းပေါင်း ကို စစ်ရဲကကိုယ်တိုင်ကောက်ယူမပေးလျှင် ထွက်ခွာမသွားနိုင်ကြောင်း ငြင်းဆိုလိုက်သည်။ ထိုအခါ စစ်ရဲ က ကချင်အမျိုးသားအား ကင်းစခန်း စစ်ရေးပြကွင်းမှ ထွက်ခွာသွားအောင် တွန်းထိုးရန် ပြုလိုက်သည်။ ကချင်အမျိုးသားသည် သူ့မားကိုဆွဲထုတ်ကာ စစ်ရဲ၏ဦးခေါင်းကို လည်ပင်းမှခုတ်ပိုင်းဖြတ်ချလိုက်သည်။ ဖြစ်ရပ်က လျင်မြန်လှသောကြောင့် မည်သူမျှမသိလိုက်မီ ဆစ်(ခ်)လူမျိုးစစ်ရဲသည် လည်ပင်းပြတ်သွားခဲ့ ရလေသည်။ (စာ ၈၅၊ ၈၆)

ထိုအဖြစ်အပျက်ကို ကြည့်ခြင်းဖြင့် ကချင်တိုင်းရင်းသား အမျိုးသားများသည် မိမိတို့ဦးခေါင်းကို မြတ်တနိုးတန်ဖိုးထားကာ ခေါင်းပေါင်း ပေါင်းလေ့ရှိကြကြောင်းတွေ့ရသည်။ ထိုသို့ အမြဲခေါင်းပေါင်း ပေါင်းခြင်းဖြင့် မိမိတို့နေ့စဉ်လုပ်ဆောင်နေသောအရာကို တစ်ဦးနှင့်တစ်ဦး အနက်အဓိပ္ပာယ်ဝှက်ကာ မေးမြန်း ပြောဆိုရာမှ ''တောင်ပေါ်မှာခွေနေတဲ့မြွေ'' ဟူသော စကားထာဖြစ်လာသည်။ ဤစကားထာမှ ကချင်တိုင်းရင်းသားတို့၏ရိုးရာဓလေ့ကို စိတ်ဝင်စား ဖွယ် လေ့လာတွေ့ရှိရပါသည်။

## ခြုံငုံသုံးသပ်ချက်

မြန်မာနိုင်ငံမြောက်ပိုင်း၊ ကချင်ပြည်နယ် မြစ်ကြီးနားမြို့တွင်နေထိုင်ကြသော ကချင်တိုင်းရင်းသား တို့၏ ဘာသာစကားရှိ စကားထားများမှ ရိုးရာဓလေ့ထင်ဟပ်နေသော စကားထာများကို လေ့လာတင်ပြထား

ခြင်းဖြစ်ပါသည်။ ''တီးလို့မရတဲ့မောင်း''ဟူသော စကားထာတွင် ကချင်လူမျိုးတို့၏ ရိုးရာယဉ်ကျေးမှု ဓလေ့ထုံးစံတွင် မောင်းသည်အရေးကြီးသောပစ္စည်းဖြစ်သည်ကို လည်းကောင်း၊ ''တောင်ယာထဲကဆင်'' ဟူသော စကားထာတွင် ကချင်လူမျိုးတို့သည် တောင်ယာစိုက်ပျိုးခြင်းကို အဓိကထားလုပ်ကိုင်ကြသည့် ဓလေ့ကို လည်းကောင်း၊ ''တောင်ပေါ်မှာခွေနေတဲ့မြွေ'' ဟူသော စကားထာတွင် ကချင်တိုင်းရင်းသား အမျိုးသားတို့သည် မိမိတို့၏ခေါင်းပေါင်းကို အမြတ်တနိုးတန်ဖိုးထားကြသည့်ဓလေ့ကို လည်းကောင်း စသည်ဖြင့် ကချင်တိုင်းရင်းသားတို့၏ စကားထာများမှ ၎င်းတို့၏ရိုးရာဓလေ့များကို စိတ်ဝင်စားဖွယ် လေ့လာတွေ့ရှိရပါသည်။ ယခု လေ့လာတင်ပြထားသော စကားထာများသည် အနက်အဓိပ္ပာယ်ကို ဝှက်ကာမေးမြန်းသော စကားထာရိုးရိုးများသာ ဖြစ်ပါသည်။

## နိဂုံး

ကချင်လူမျိုးတို့၏ဘာသာစကားရှိ စကားထာများမှ ရိုးရာဓလေ့ထင်ဟပ်နေသော စကားထာအချို့ကို လေ့လာတင်ပြထားခြင်း ဖြစ်ပါသည်။ အချို့သော စကားထာများနှင့်ပတ်သက်၍ ကွင်းဆင်းလေ့လာမှုပြုကာ မှတ်တမ်းများစုဆောင်းပြီး ဖော်ပြထားခြင်းဖြစ်ပါသည်။ ထိုသို့ လေ့လာတင်ပြခြင်းဖြင့် ကချင်တိုင်းရင်းသား တို့၏ စာပေဖွံ့ဖြိုးမှုနှင့် ဘာသာစကားအကျိုးဖြစ်ထွန်းမှုကို ရည်ရွယ်၍ ဤစာတမ်းကို ပြုစုရခြင်း ဖြစ်ပါသည်။

## ကျမ်းကိုးစာရင်း


၁။ ကြည်ဦး။ (၂၀၀၃)။ မြန်မာ့ရိုးရာစကားထာများ။ ရန်ကုန်၊ ချိုတေးသံစာပေ။

၂။ ဖဂါယော်၊ ဦး။ ကချင်ဓလေ့နှင့် စကားပြောနည်း။ မြစ်ကြီးနားမြို့၊

၃။ ဖေမောင်တင်၊ ဦး။ (၁၉၅၈)။ ဘာသာလောကကျမ်း။ ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

၄။ ဘီဇက်ဇော်လီ။ (၂၀၁၆)။ WUNPAUNG လို့ခေါ်တဲ့ကချင်လူမျိုး။ ရန်ကုန်၊ ပန်းလက်ဆောင်စာပေ။

၅။ မနမ်ဖန်၊ ဦး။ (၂၀၀၂)။ Kachin– English Dictionary ။ ရန်ကုန်၊ ပုံနှိပ်တိုက်။

၆။ မနမ်ဖန်၊ ဦး။ (၂၀၁၄)။ Myanmar– Kachin– English Dictionary ။ ရန်ကုန်၊ မြင့်ပုံနှိပ်တိုက်။

၇။ မရန်ဘောက်လာ။ (၂၀၁၃)။ ခေတ်အမြင်နှင့် ကချင်ယဉ်ကျေးမှု။ မြစ်ကြီးနားမြို့၊ မဂ္ဂယ်ရှိန်ရာစာပေ။

၈။ မဲဇာ။ (၁၉၆၃)။ ကချင်ရိုးရာသုတပဒေသာ။

၉။ မင်းနိုင်၊ ဦး။ (၁၉၆၃)။ သွေးချင်းတို့ပျော်သည့်မြေ။ ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

၁၀။ မြတ်ဝေတိုး။ (၂၀၁၁)။ ဂျိန်ဖော့သွေးချင်းတို့၏အလှ။ ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

၁၁။ မြန်မာစာအဖွဲ့။ (၂၀၀၈)။ မြန်မာအဘိဓာန်။ ရန်ကုန်၊ နေလင်းပုံနှိပ်တိုက်။

၁၂။ မြန်မာနိုင်ငံဘာသာပြန်စာပေအသင်း။ (၁၉၅၆)။ မြန်မာ့စွယ်စုံကျမ်း၊ အတွဲ(၃)။ ရန်ကုန်၊ စာပေဗိမာန် ပုံနှိပ်တိုက်။

၁၃။ မြန်မာ့ဆိုရှယ်လစ်လမ်းစဉ်ပါတီ။ (၁၉၇၁)။ ပြည်ထောင်စုမြန်မာနိုင်ငံတိုင်းရင်းသား ယဉ်ကျေးမှုရိုးရာ ဓလေ့ထုံးစံများ(ကချင်)။ ရန်ကုန်၊ စာပေဗိမာန်ပုံနှိပ်တိုက်။

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# ရခိုင်ရိုးရာစကားထာများကို လူမှုဘာသာဗေဒရှုထောင့်မှ လေ့လာခြင်း

ခင်စောဦး[1]


## စာတမ်းအကျဉ်း

ဤစာတမ်းသည် ရခိုင်ရိုးရာစကားထာများကို လူမှုဘာသာဗေဒရှုထောင့်မှ လေ့လာ တင်ပြထားသော စာတမ်းဖြစ်ပါသည်။ လေ့လာတင်ပြရာတွင် ကောက်ယူထားသော စကားထာများမှ စံမြန်မာစကားထာနှင့် ရခိုင်စကားထာများ၏ အသံထွက်ကွဲပြားမှု၊ စံမြန်မာစကားထာနှင့် ရခိုင်စကားထာများ၏ ဝေါဟာရကွဲပြားမှု၊ စံမြန်မာစကားထာနှင့် ရခိုင်စကားထာများ၏ အနက်အဓိပ္ပါယ်တူညီမှု စသည့်တို့ကို လေ့လာဖော်ထုတ်ထားပါသည်။ စကားထာများကိုလေ့လာခြင်းဖြင့် စကားလုံးကြွယ်ဝမှု၊ ဝေါဟာရ ကြွယ်ဝမှု၊ ဖြတ်ထိုးဉာဏ်အားကောင်းမှု၊ ရခိုင်တိုင်းရင်းသားတို့၏ ရိုးရာဓလေ့များကို သိရှိစေကာ တိုင်းရင်းသားချစ်ကြည်ရင်းနှီးမှု၊ စကားထာဝှက်ခြင်းအလေ့မှာ တစ်စတစ်စ တိမ်ကောလုနီးပါးဖြစ်လာပေရာ ရိုးရာယဉ်ကျေးမှုတစ်ရပ် မတိမ်ကောမပျောက် စေလိုမှု၊ နောင်လာနောက်သားတို့က ရိုးရာစကားထာများကို စိတ်ပါဝင်စားလာစေမှု တို့ကိုရည်ရွယ်၍ ရခိုင်ရိုးရာစကားထာများကို လူမှုဘာသာဗေဒရှုထောင့်မှ လေ့လာ ဖော်ထုတ်ထားပါသည်။


**သော့ချက်ဝေါဟာရများ–စကားထာ၊ အသံထွက်၊ ဝေါဟာရ၊ စံမြန်မာဘာသာစကား၊ ရခိုင်ဘာသာစကား၊ စကားသံ၊ အနက်အဓိပ္ပါယ်**

## နိဒါန်း

ဤစာတမ်းသည် ရခိုင်ရိုးရာစကားထာများကို စံမြန်မာစကားထာနှင့်နှိုင်းယှဉ်၍ လူမှုဘာသာဗေဒရှုထောင့်မှ လေ့လာတင်ပြထားသော စာတမ်းဖြစ်ပါသည်။ ရခိုင်တိုင်းရင်းသားတို့၏ စကားကို ဘာသာဗေဒပညာရှင်အချို့က ဒေသိယအဖြစ်မှတ်ယူပြီ ရခိုင်တိုင်းရင်းသားတို့က ဘာသာစကားအဖြစ် သတ်မှတ်ကြသည်။ (အောင်မြင့်ဦး၊ ၂၀၀၃၊ ၃၆)၊ ရခိုင်တိုင်းရင်းသားတို့သည် ရခိုင်ဘာသာစကားနှင့် မြန်မာဘာသာစကားကိုအများဆုံးအသုံးပြုကြသည်။ ရခိုင်ဘာသာစကားသည် မြန်မာဘာသာစကားနှင့် အရင်းအမြစ်တူသည်ဟုဆိုကြသည်။ (စက္ကိန္ဒ၊ ၁၉၉၄၊ ၁၅)၊ ရခိုင်ဘာသာစကားနှင့် စံမြန်မာဘာသာစကားသည် အပြောစကားတွင်ရော၊ စာပေအရေးအသားတွင်ပါအတော်များများတူညီသည်ကို တွေ့ရပါသည်။ စကားထာများ ကို လူမှုဘာသာဗေဒရှုထောင့်မှ လေ့လာခြင်းဖြင့် ဘာသာစကားတို့၏ တူညီမှု၊ ကွဲပြားမှုတို့ကို သိရှိပြီး အသုံးချနိုင်သဖြင့် လူမှုစီးပွားဆက်သွယ်မှုများ ပိုမိုကောင်းမွန်ပြီး ဘာသာစကား ဝေါဟာရတိုးပွားမှုတို့ကို အထောက်အကူဖြစ်စေနိုင်ပါသည်။ ရခိုင်ရိုးရာစကားထာများကို လေ့လာစုဆောင်းရာတွင် ရခိုင်ရိုးရာ စာပေ၊ ယဉ်ကျေးမှု၊ ဗဟုသုတများကို ရေးသားဖော်ပြထားသော စာအုပ်စာတမ်းများ၊ အင်တာနက်လူမှုစာမျက်နှာများနှင့် ရခိုင်ဘိုးဘွားတို့အား တွေ့ဆုံမေးမြန်းခြင်းများစသည်ဖြင့် စုဆောင်း ကောက်ယူ ခဲ့ပါသည်။

### ၁။ စကားထာဟူသည်

စကားထာ၏ ဝေါဟာရအနက်ကို “စကား+ အတ္ထ= စကတ္ထမှ “စကားထာ”ဟူ၍ဖြစ်လာကြောင်း ဆိုသည်။ အချို့ကလည်း “စကား”နှင့် “ထပန”ဟူသော ပုဒ်နှစ်ခုပေါင်း၍ “စကားထာပနာ”၊ ထိုမှအတို ကောက်စကား “စကားထာ”ဟုဆိုကြောင်း ကြံဆကြသည်။ စကားထာသည် “စကားဓာရ”မှ “စကားဓာ” “စကားထာ”ဟူ၍ ဖြစ်လာသည်ဟုလည်းဆိုကြသည်။ (ကြည်ဦး၊ ၂၀၁၁၊ ၂၃) “ဓာရ”သည် “ဆောင်သည်”ဟူသော အနက်ရှိသဖြင့် ဆောင်ထားအပ်သော စကားဟူ၍ဖြစ်နိုင်သည်။ တစ်ဖန်ပါဠိဘာသာ “ဌာပန”၊ သက္ကတဘာသာ “သ္ထာပန”၊ မြန်မာဘာသာ “ထားခြင်း”အနက်ကိုဆောင်သည်။ မုန့်ကိုဌာပနာ သက္ခဲသို့ စကားကိုလည်း ဌာပနာသည်ဟု သုံးစွဲရာမှ “စကားဌာပနာ၊ စကားထာ” ဖြစ်လာလေသည်ဟု ကြံဆကြသေးသည်။ (မြန်မာဝိုကီပီဒီးယား) ခရီးဆောင်မြန်မာအဘိဓာန်တွင် စကားထာကို “အနက်

[1] ကထိက၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

အဓိပ္ပာယ်မြုပ်ထားသော ဥာဏ်စမ်းစကား။ ပဟေဋ္ဌိ” (၂၀၁၄၊ ၈၀-၈၁) ဟု ဖွင့်ဆိုထားသည်။ အနက်အဓိပ္ပာယ်ကို တိုက်ရိုက်မပြော လိုသောကြောင့် လည်းကောင်း၊ လူတစ်ယောက်၏ဥာဏ်ပညာ ဗဟုသုတကို စမ်းသပ်လိုသောအခါ၌လည်း ကောင်း စကား ထာဝှက်လေ့ရှိသည်။

ဥာဏ်စမ်းသည့်အနေဖြင့် စကားထာဝှက်တမ်းကစားကြခြင်းသည် မြန်မာနိုင်ငံအရပ်ဒေသများ တွင်ရှိသော မြန်မာ့ရိုးရာဓလေ့တစ်ခုပင်ဖြစ်သည်။ ဇာတ်ကြီးဆယ်ဘွဲ့ဇာတကများ၊ မြန်မာ့ရိုးရာပုံပြင်များ စာပေများတွင်လည်း စကားထာများကိုတွေ့ရသည်။ စကားထာဝှက်ရာတွင် ဖြေဆိုသူကမဖြေနိုင်လျှင် “ပန်းပေးပြီ” ဟုဆိုကာ အရှုံးပေးရသည်။ ထိုအခါ စကားထာဝှက်သူက အဖြေမှန်ပေးရသည်။ စကား ထာ၏အဖြေမှန်ကို မဖော်နိုင်လျှင် စကားထာဝှက်သူက အနိုင်ရပြီး ဖြေသူကရှုံးသည်။ စကားထာ၏ အဖြေမှန်ကို ဖြေသူကဖော်နိုင်လျှင် ဖြေဆိုသူက အနိုင်ရသည်။ စကားထာကို ဝှက်သူကအသစ်ဖန်တီး ခြင်းမဟုတ်ပါ။ ခေတ်အဆက်ဆက်ပြောဆိုခဲ့သော စကားထာများကို မှတ်သား၍ပြန်လည်ပြောဆိုခြင်း သာဖြစ်ပါသည်။

ရခိုင်လူမျိုးတို့တွင်လည်း စကားထာဝှက်သောအလေ့ ရှေးကပင်ရှိခဲ့သည်။ အများအားဖြင့် စပါး ပေါ်စ တပို့တွဲလ၊ တပေါင်းလများ၏ လပြည့်ညများတွင် စကားထာဝှက်တမ်း ကစားလေ့ရှိကြသည်။ အသက်(၁၁)နှစ်မှ (၂၀)ကျော်ထိ လူငယ်များသည် ရွာရှိလူပျိုခေါင်းအိမ်၊ အပျိုခေါင်းအိမ်များတွင် စု၍အိပ် ကာ အပျော်သဘောဖြင့် စကားထာဝှက်လေ့ရှိကြသည်။ နောင်တွင် လူပျို၊ အပျို၊ တစ်ခုလပ်၊ မင်းကျွန်၊ မင်းကျွန်မ၊ မုဆိုးမကြီး ငယ်တို့ပါ ကစားလာခဲ့ကြသည်။ (စက္ကိန္ဒ၊ ၁၉၉၄၊ ၁၂၀) အားလပ်ချိန်များတွင် လည်းကောင်း၊ အိမ်မှုဗာဟီရလုပ်ငန်းများလုပ်ရင်းလည်းကောင်း၊ ရက္ကန်းရက်၊ ဗိုင်းငင့်လုပ်ကိုင် နေရင်းလည်းကောင်း၊ ပန်းဝှက်ကစားလေ့ရှိခဲ့ကြသည်။ အိမ်ပါးနီးချင်း တစ်အိမ်နှင့် တစ်အိမ်အော်ဟစ် ၍ပင် ပန်းဝှက်တမ်းကစားလေ့ရှိကြသည်။ (ယင်း) စကားထာဝှက်ရာတွင် အနက်အဓိပ္ပာယ်ဝှက်၍ အမေးအဖြေပြုသည်။ ဖြေဆိုသူက အဓိပ္ပာယ်ဖော်နိုင်လျှင် ဖြေဆိုသူအနိုင်ရသည်။ ဖြေဆိုသူက မဖြေနိုင် လျှင် စကားထာဝှက်သူကို ပန်းပေး(အရှုံးပေး)ရသည်။ ထိုအခါ စကားထာဝှက်သူက အဖြေမှန်ကို ပြောပြ သည်။ ရခိုင်ဒေသတွင် စကားထာဝှက်သည်ကို “ပန်းဝှက်သည်”၊ စကားထာအဖြေပေးသည်ကို “ပန်းဖော် သည်” ဟုဆိုပါသည်။ ရခိုင်စကားထာများသည် ရခိုင်လူမျိုးတို့၏ အတွေ့အကြုံ၊ ထုံးဓလေ့အစဉ်အလာ၊ လူမှုအခြေအနေ၊ တီထွင်မှုဥာဏ်ရည်များအရ အစဉ်အလာပြောဆိုအသုံးပြုခဲ့သော အကြောင်းအရာများ ပင်ဖြစ်ပေမည်။ စကားထာများသည် မည်သည့်ခေတ်၊ မည်သည့်ကာလတွင် မည်သို့ပေါ်ပေါက်ခဲ့သည် ကို သေချာစွာဖော်ထုတ်နိုင်ခြင်းမရှိသေးပါ။ ဆက်လက်လေ့လာသုတေသနပြုရန်လိုအပ်ပါသည်။

မြန်မာမှုတွင်ရော ရခိုင်ရိုးရာတွင်ပါ စကားထာ အမျိုးမျိုးရှိသည်။ ကာရန်အားဖြင့် ဝှက်သော စကားထာ၊ ဥပမာအားဖြင့်ဝှက်သောစကားထာ၊ အနက်အားဖြင့်ဝှက်သောစကားထာ၊ စကားလိမ်အား ဖြင့်ဝှက်သောစကားထာ၊ သင်္ချာအားဖြင့်ဝှက်သော စကားထာဟူ၍အမျိုးမျိုးရှိသည်။ ယခုစာတမ်းတွင် စကားထာ၏အဖြေကို စကားထာ၏ဥပမာနှင့်ကိုက်ညီအောင် ရှာရသော၊ စကားထာ၏အဖြေကို အနက် အဓိပ္ပာယ်ဆက်စပ်၍ ရှာရသော ဥပမာအားဖြင့် ဝှက်သောစကားထာ၊ အနက်အားဖြင့်ဝှက်သော စကား ထာများကို လေ့လာတင်ပြထားပါသည်။

**၁၊ ၁။ သုတေသနပြုသည့် စကားထာများ။**

၁။ ဆင်ပြောင်ကြီး ငါးရာ **ရီ**သောက်လာ၊ **ခြီ**ရာလည်းပျောက်၊ **ရီ**လည်းနောက်

အဖြေ= ဆန်**ဆီး**သည်

၂။ အိမ်တိုင်းအိမ်တိုင်း၊ ဒိုင်းတစ်ချပ်

အဖြေ= စံဂိုး

၃။ အ**ခြီ**ရှစ်ချောင်း၊ အဂေါင်းမပါ၊ သန်ညှပ်ကြီးကိုထမ်းလို့လာ

အဖြေ= ကဏန်း

၄။ **ရှိ**မှာလည်းမ**နီ**၊ နောက်ကလည်းမလိုက်၊ ဘေးမှာမျှောင်ဇိမ်**နန့်**လိုက်

အဖြေ= လွယ်အိတ်

၅။ မင်းသားမောင်ဖြူထွက်တော်မူ၊ ရန်သူငါးယောက်ဖမ်းဖို့ရောက်

အဖြေ= နှပ်**ညှိပ်** သည်။

၆။ ငှါနွားတစ်ကောင် ဘို့တစ်ထောင်

အဖြေ= ဂြင့်ခါးသီး

၇။ အ**ခြီ** ဝါဝါလှသန္တာ၊ အလှမျိုးစုံ ဂေါင်းမြီးခြုံ၊ နာရီသိတတ် ယောကျ်ားမြတ်

အဖြေ= ကြက်ဖ

၈။ တောင်ကြိုတောင်ကြား၊ **လှီ**ယှေတစ်စင်း**လား**

အဖြေ= ရက်ကန်းလွန်း

၉။ အ**ခြီ**လေးချောင်းသတ္တဝါ၊ ဆီမစားရမ**လား**ပါ

အဖြေ= ထွေလာ၊ ဂါရီ

၁၀။ အပင်ထက်ကအသီး၊ အသီးထက်အပင်

အဖြေ= နန်တရာသီး

၁၁။ အပြင်ကချချော၊ အထဲကကျောက်စရစ်ကေတော

အဖြေ= ကယိုင်သီး

၁၂။ အဝတ်ကိုလှန်၊ အ**မွှီး**ကိုနှုတ်၊ အ**စိ**ကိုစား၊ အရိုးကိုပစ်

အဖြေ= ပြောင်းဖူး

၁၃။ မဖွတ်ဘဲဖြူ၊ မဖြည့်ဘဲပြည့်

အဖြေ= အုန်းသီး

၁၄။ နတ်သမီးအိမ်တိုင်ပိုးမဖောက်နိုင်၊ ဖောက်ပြန်ကေလဲ၊ တစ်ပေါက်ထဲ

အဖြေ= အပ်

၁၅။ မျက်နှာမည်းကြီးငိုလိမ့်မည်၊ ကမ္ဘာ့စည်ကြီးတီးလိမ့်မည်၊ ပျောက်နီသူများပေါ်လိမ့်မည်၊ သီနီသူများရှင်လိမ့်မည်

အဖြေ= မိုးရိပ်တက်ခြင်း၊ မိုးရွာခြင်း၊ မိုးကြိုးပစ်ခြင်း၊ ဖား၊ မြက်ပင်

၁၆။ တစ်နှစ်တစ်ခါပေါ်လို့လာ၊ ငါရာမင်းလာင်းထီးဖြူဆောင်း

အဖြေ= မှို

၁၇။ ငါးယောက်ကချီ၊ သုံးဆယ်ကကြိတ်၊ ဖျာကြီးနန့်လိပ်၊ ဂူကြီးထဲသွင်း

အဖြေ= ထမင်းစာခြင်း

၁၈။ မဲမတင်၊ နီမယက် (လျက်)

အဖြေ= အိုးနှင့်မီး

၁၉။ ကြည့်လီ၊ ဝီးလီ

အဖြေ= နားရွက်

၂၀။ ထိုပြည်ကလာ ရရဲ၊ အေပြည်မှာရောက်မမဲ

အဖြေ= မြေအိုး

၂၁။ လိုင်ဖင်းပါယင့်၊ မလှုပ်နိုင်

အဖြေ= ရီတကောင်း

၂၂။ ငှါပျိုင်ပက်လက်၊ တအောင့်သွီးကေ၊ အရည်ထွက်

အဖြေ= သနပ်ခါးကျောက်ပျဉ်

၂၃။ လားကေ ခြီခြီ၊ နီကေ စစန့်

အဖြေ= ခေါင်းခု

၂၄။ ဘီလူးလိုင်တို၊ လူကိုမျို

အဖြေ= အင်းကျီ

၂၅။ အတောင်စိမ်းပြာငှက်၊ အဂေါင်း မြီမှာဝှက်

အဖြေ= ငှက်ပျောပင်

၂၆။ ကျောက်တန်းစီ ညီပါယင့်လား၊ ဆံမြိတ်ချလှပါယင့်လား၊ ပိုးပဝါခြုံလုံပါယင့်လား

အဖြေ= ပြောင်းဖူး

(ရှင်းလင်းချက်များတွင် စကားထာများကို စံမြန်မာဘာသာစကားများဖြင့် ဖော်ပြထားပါသည်။)

**၂။ စံမြန်မာစကားထာနှင့် ရခိုင်စကားထာများ၏ အသံထွက်ကွဲပြားမှု**

၁။ ဆင်ပြောင်ကြီးငါးရာ**ရီ**သောက်လာ၊ **ခြီ**ရာလည်းပျောက်၊ **ရီ**လည်းနောက်(ရခိုင်ဘာသာစကား)

အဖြေ= ဆန်**ဆီး**သည်

ဆင်ပြောင်ကြီးငါးရာ**ရေ**သောက်လာ၊ **ခြေ**ရာလည်းပျောက်၊ **ရေ**လည်းနောက်(စံစကား)

အဖြေ= ဆန်**ဆေး**သည်

၂။ အ**ခြီ**ရှစ်ချောင်း၊ အဂေါင်းမပါ၊ သန်ညှပ်ကြီးကိုထမ်းလို့လာ(ရခိုင်ဘာသာစကား)

အဖြေ= ကဏန်း

အ**ခြေ**ရှစ်ချောင်း၊ အဂေါင်းမပါ၊ သန်ညှပ်ကြီးကိုထမ်းလို့လာ (စံစကား)

အဖြေ= ကဏန်း

၃။ **ရှိ**မှာလည်း**မနီ**၊ နောက်ကလည်းမလိုက်၊ဘေးမှာမျှောင်ဇိမ်နန့်လိုက် (ရခိုင်ဘာသာစကား)

အဖြေ= လွယ်အိတ်

**ရှေ့**မှာလည်း**မနေ**၊ နောက်ကလည်းမလိုက်၊ ဘေးမှာမျှောင်ဇိမ်**နဲ့**လိုက် (စံစကား)

အဖြေ= လွယ်အိတ်

၄။ အ**ခြီ** ဝါဝါလှသန္တာ၊ အလှမျိုးစုံ ဂေါင်းမြီးခြုံ၊ နာရီသိတတ် ယောကျ်ားမြတ်(ရခိုင်ဘာသာစကား)

အဖြေ= ကြက်ဖ

**ခြေထောက်** ဝါဝါလှသန္တာ၊ အလှမျိုးစုံ ဂေါင်းမြီးခြုံ၊ နာရီသိတတ် ယောကျ်ားမြတ် (စံစကား)

အဖြေ= ကြက်ဖ

၅။ တောင်ကြိုတောင်ကြား၊ **လှီ**ယှေတစ်စင်း**လား**(ရခိုင်ဘာသာစကား)

အဖြေ= ရက်ကန်းလွန်း

တောင်ကြိုတောင်ကြား၊ **လှေငယ်**တစ်စင်းသွား(စံစကား)

အဖြေ= ရက်ကန်းလွန်း

၆။ အ**ခြီ**လေးချောင်းသတ္တဝါ၊ ဆီမစားရမ**လား**ပါ(ရခိုင်ဘာသာစကား)

အဖြေ= ထွေလာ၊ ဂါရီ

အ**ခြေ**လေးချောင်းသတ္တဝါ၊ ဆီမစားရမ**သွား**ပါ(စံစကား)

အဖြေ= ယာဉ်

၇။ အဝတ်ကိုလှန်၊ အ**မွှီး**ကိုနှုတ်၊ အ**စိ**ကိုစား၊ အရိုးကိုပစ်(ရခိုင်ဘာသာစကား)

အဖြေ= ပြောင်းဖူး

အဝတ်ကိုလှန်၊ အ**မွှေး**ကိုနှုတ်၊ အ**စေ့**ကိုစား၊ အရိုးကိုပစ်(စံစကား)

အဖြေ= ပြောင်းဖူး

၈။ မျက်နှာမည်းကြီးငိုလိမ့်မည်၊ ကမ္ဘာ့စည်ကြီးတီးလိမ့်မည်၊ ပျောက်**နီ**သူများပေါ်လိမ့်မည်၊ **သီနီ** သူများရှင်လိမ့်မည် (ရခိုင်ဘာသာစကား)

အဖြေ= မိုးရိပ်တက်ခြင်း၊ မိုးရွာခြင်း၊ မိုးကြိုးပစ်ခြင်း၊ ဖား၊ မြက်ပင်

မျက်နှာမည်းကြီးငိုလိမ့်မည်၊ ကမ္ဘာ့စည်ကြီးတီးလိမ့်မည်၊ ပျောက်**နေ**သူများပေါ်လိမ့် မည်၊ **သေနေ** သူများရှင်လိမ့်မည် (စံစကား)

အဖြေ= မိုးဦးကျ

၉။ ကြည့်**လီ**၊ ဝီး**လီ** (ရခိုင်ဘာသာစကား)

အဖြေ= နားရွက်

ကြည့်**လေ**၊ ဝေး**လေ** (စံစကား)

အဖြေ= နားရွက်

၁၀။ လိုင်ဖင်းပါယင့်၊ မလှုပ်နိုင် (ရခိုင်ဘာသာစကား)

အဖြေ= **ရီ**တကောင်း

လည်ပင်းပါရဲ့၊ မလှုပ်နိုင် (စံစကား)

အဖြေ= **ရေ**တကောင်း

၁၁။ ငှ**ပျိုင်**ပက်လက်၊ တအောင့်**သွီး**ကေ၊ အရည်ထွက် (ရခိုင်ဘာသာစကား)

အဖြေ= သနပ်ခါးကျောက်ပျဉ်

ငှ**ပျဉ်**ပက်လက်၊ တအောင့်**သွေး**တော့၊ အရည်ထွက် (စံစကား)

အဖြေ= သနပ်ခါးကျောက်ပျဉ်

၁၂။ လားကေ **ခြီခြီ**၊ နီကေ **စစန့်** (ရခိုင်ဘာသာစကား)

အဖြေ= ခေါင်းခု

သွားတော့ **ခွေခွေ**၊ နေတော့ **စင်းစင်း** (စံစကား)

အဖြေ= ခေါင်းခု

၁၃။ အတောင်စိမ်းပြာငှက်၊ အဂေါင်း **မြီ**မှာဝှက် (ရခိုင်ဘာသာစကား)

အဖြေ= ငှက်ပျောပင်

အတောင်စိမ်းပြာငှက်၊ အဂေါင်း **မြေ**မှာဝှက် (စံစကား)

အဖြေ= ငှက်ပျောပင်

စံမြန်မာဘာသာစကားတွင် "အေ"သရသံအသုံးကို ရခိုင်ဘာသာစကားတွင် "အီ"သရသံဖြင့်သုံးသည်။ ထို့ကြောင့် "ရေကိုရီ၊ ခြေကိုခြီ၊ နေကိုနီ၊ လှေကိုလှီ၊ သေကိုသီ၊ လေကိုလီ၊ ခွေကိုခြွီ၊ မြေကိုမြီ" ဟူ၍အသံထွက်ပါသည်။ စံမြန်မာ ဘာသာ စကား "အေး"သရသံကို ရခိုင်ဘာသာစကားတွင် "အီး"သရသံဖြင့် အသုံးပြုပါသည်။ ထို့ကြောင့် "ဆေးကို ဆီး၊ မွှေးကို မွှီး၊ ဝေးကိုဝီး၊ သွေးကိုသွီး၊ ခွေးကိုခွီး" ဟုအသံထွက်သည်။ စံမြန်မာဘာသာစကားတွင် "အေ့"သရအသံ ထွက်ကို ရခိုင်ဘာသာ စကားတွင် "အိ"သရသံဖြင့်ထွက်သည်။ "ရှေ့ကို ရှိ၊ စေ့ကိုစိ"ဟူ၍အသံထွက်သည်။

အပြင်က**ချချော**၊ အထဲကကျောက်စရစ်ကေတော

အဖြေ= ကယိုင်သီး

ထိုပြည်ကလာ **ရရဲ**၊ အေပြည်မှာရောက်**မမဲ**

အဖြေ= မြေအိုး

လားကေ **ခြွီခြွီ**၊ နီကေ **စစန့်**

အဖြေ= ခေါင်းခု

ရခိုင်ဘာသာစကားတွင် လုံးတွဲစကားလုံးများသုံးသည့်အခါ ရှေ့စကားသံကို "အ" သရသံဖြင့် သုံးသည်။ စံမြန်မာဘာသာစကားနှင့် ရခိုင်ဘာသာစကားရှိ သရသံပြောင်းလဲမှုများဖြစ်ပါသည်။

မင်းသားမောင်ဖြူထွက်တော်မူ၊ ရန်သူငါးယောက်ဖမ်းဖို့ရောက်

အဖြေ= နှပ်**ညှိပ်** သည်။

တောင်ကြိုတောင်ကြား၊ **လှီ**ယှေတစ်စင်း**လား**

အဖြေ= ရက်ကန်းလွန်း

စံမြန်မာ ဘာသာစကားတွင် အသုံးပြုသော "အစ်"အသံထွက်ကို ရခိုင်ဘာသာစကားတွင် "အိုက်" သံဖြင့် ထွက်သည်။ "ညှစ်ကိုညှိပ်၊ တစ်ကိုတိုက်၊ နှစ်ကို နှိုက်"ဟူ၍အသံထွက်သည်။ စံမြန်မာဘာသာစကားတွင် "သွား"ဟူသော ကြိယာအသုံးကို ရခိုင်ဘာသာစကားတွင် "လား"ဟူ၍ သုံးပါသည်။

**လိုင်**ဖင်းပါယင့်၊ မလှုပ်နိုင်

အဖြေ= ရီတကောင်း

ဘီလူး**လိုင်**တို၊ လူကိုမျို

အဖြေ= အင်းကျီ

ငါ့**ပျိုင်**ပက်လက်၊ တအောင့်သွီးကေ၊ အရည်ထွက်

အဖြေ= သနပ်ခါးကျောက်ပျဉ်

စံမြန်မာဘာသာစကားတွင် အသုံးပြုသော “အည်”အသံထွက်ကို ရခိုင်ဘာသာစကားတွင် “အိုင်” သံဖြင့်ထွက်သည်။ “လည်ပင်း ကို လိုင်ဖင်း”၊ “ပျဉ်ကို ပျိုင်”၊ “စဉ်းစားကို စိုင်းစား” ဟူ၍ သံထွက်သည်။ စံမြန်မာဘာသာစကားနှင့် ရခိုင်ဘာသာစကားရှိ စကားသံကွဲပြားမှုများပင်ဖြစ်ပါသည်။

စံမြန်မာဘာသာစကားနှင့် ရခိုင်ဘာသာစကားတို့သည် ဘာသာစကားတစ်မျိုးတည်းကို သုံးစွဲ သည့် ဘာသာတူစုအတွင်း၌ရှိသော ဘာသာစကားအသွင်ကွဲများဖြစ်သည့်အားလျော်စွာ အသံထွက်ကွဲ ပြားမှုများကို လေ့လာတွေ့ရှိရပါသည်။

## ၃။ စံမြန်မာစကားထာနှင့် ရခိုင်စကားထာများ၏ ဝေါဟာရကွဲပြားမှု

ရခိုင်ဘာသာစကားသည် သီးခြားဘာသာစကားတစ်ခုမဟုတ်ဘဲ စံမြန်မာဘာသာစကား၏ အ သွင်ကွဲဘာသာစကားဖြစ်၍ အသံထွက်အားဖြင့်လည်းကောင်း၊ ဝေါဟာရအားဖြင့်လည်းကောင်းကွဲ ပြား မှုရှိပါသည်။ ထို့ကြောင့် ရခိုင်ရိုးရာစကားထာများမှ ဝေါဟာရများသည်လည်း စံဘာသာစကားရှိ ဝေါဟာ ရများနှင့် ကွဲပြားသည်များရှိပါသည်။

အိမ်တိုင်းအိမ်တိုင်း၊ ဒိုင်းတစ်ချပ်

အဖြေ= စံဂိုး

ဤစကားထာ၏အဖြေမှ “စံဂိုး”မှာ စံမြန်မာဘာသာစကားတွင် “ဆန်ကော”ပင် ဖြစ်ပါသည်။ “စံ” နှင့် “ဆန်”မှာ အရေးမတူသော်လည်း အသံထွက်တူပါသည်။ ရခိုင်ပြည်အချို့ဒေသများတွင် “အော”သရ သံကို “အိုး”သရသံဖြင့်ပြောလေ့ရှိသည်။ “ကောမှကိုး၊ ကိုးမှဂိုး”ဟု အသံထွက်ကာ “စံဂိုး”ဟူ၍ စံမြန်မာ ဘာ သာစကား “ဆန်ကော”နှင့် ဝေါဟာရကွဲပြားသွားပါသည်။

ငါ့နွားတစ်ကောင် ဗို့တစ်ထောင်

အဖြေ= ဂြင့်ခါးသီး

ဤစကားထာ၏အဖြေ “ဂြင့်ခါးသီး”မှာ စံမြန်မာဘာသာစကားတွင် “ကြက်ဟင်းခါးသီး”ဖြစ်ပါ သည်။ ရခိုင်ဘာသာတွင် “ဂရင့်ခါးသီး”ဟု အသံထွက်သည်။ ရခိုင်လူမျိုးတို့က /r/သံကို ပီသစွာထွက် သည်။ ဤစကားထာနှစ်ခုတွင် အသံထွက်ပုံကွာခြားမှုကြောင့်သာ ဝေါဟာရကွာခြားသွားခြင်းဖြစ်ကြောင်း ကိုတွေ့ရသည်။

အ**ခြ**ီလေးချောင်းသတ္တဝါ၊ ဆီမစားရမ**လား**ပါ

အဖြေ= ထွေလာ၊ ဂါရီ

ဤစကားထာ၏အဖြေ “ထွေလာ၊ ဂါရီ” ဝေါဟာရနှစ်ခုလုံး၏အနက်မှာ စံမြန်မာဘာသာ စကား “ယာဉ်”ကို ဆိုလိုခြင်းပင်ဖြစ်သည်။ ရခိုင်ဘာသာတွင် “ကား၊ လှည်း”စသော စီးနင်းစရာယာဉ်များ ကို “ဂါရီ”ဟု သုံးပါသည်။ မော်တော်ကားကို “ဂါရီ”၊ နွားလှည်းကို “နွားဂါရီ” မြင်းလှည်းကို “မြင်းဂါရီ” အသုဘယာဉ်ကို “မသာဂါရီ” စသည်ဖြင့်သုံးပါသည်။

အပင်ထက်ကအသီး၊ အသီးထက်အပင်

အဖြေ= နန်တရာသီး

ဤစကားထာ၏အဖြေ “နန်တရာသီး”မှာ စံမြန်မာဘာသာစကား “နာနတ်သီး”ဖြစ်ပါသည်။

အပြင်ကချချော၊ အထဲကကျောက်စရစ်ကေတော

အဖြေ= ကယိုင်သီး

ဤစကားထာ၏အဖြေ “ကယိုင်သီး”မှာ စံမြန်မာဘာသာစကား “မာလကာသီး”ဖြစ်ပါသည်။

စံမြန်မာဘာသာစကားနှင့် ရခိုင်ဘာသာစကားတို့သည် နေရာဒေသကိုလိုက်၍ ကွဲပြား သော အသွင်ကွဲမြန်မာဘာသာစကားများဖြစ်သဖြင့် အသံထွက်များအနေဖြင့်လည်းကောင်း၊ ဝေါဟာရ အခေါ်အဝေါ် အသုံးအနှုန်းများ၌ သော်လည်းကောင်း ကွဲပြားခြားနားမှုများ ရှိကြောင်း လေ့လာတွေ့ရှိရ ပါသည်။

**၄။ မြန်မာ့ရိုးရာစကားထာနှင့် ရခိုင်စကားထာများ၏ အနက်အဓိပ္ပါယ်တူညီမှု**

၁။ မဖွတ်ဘဲဖြူ၊ မဖြည့်ဘဲပြည့်(ရခိုင်ဘာသာ)

မဖွတ်ဘဲဖြူသည့်နတ်ပုဆိုး၊ မခပ်ဘဲပြည့်သည့် နတ်ရေအိုး(စံစကား)

အဖြေ= အုန်းသီး

၂။ နတ်သမီးအိမ်တိုင် ပိုးမဖောက်နိုင်၊ ဖောက်ပြန်သော်လည်း တစ်ပေါက်ထဲ (ရခိုင်ဘာသာ)

နတ်သမီးအိမ်တိုင် ပိုးမဖောက်နိုင်၊ ဖောက်ပြန်သော်လည်း တစ်ပေါက်တည်း(စံစကား)

အဖြေ=အပ်

၃။ မျက်နှာမည်းကြီးငိုလိမ့်မည်၊ ကမ္ဘာ့စည်ကြီးတီးလိမ့်မည်၊ ပျောက်နီသူများပေါ်လိမ့်မည်၊ သီနီသူများရှင်လိမ့်မည် (ရခိုင်ဘာသာ)

မျက်နှာမည်းကြီးငိုပြီ၊ စည်တော်ကြီးလည်းတီးပြီ၊ သေသောသူများရှင်လာပြီ၊ ပုန်းသူများ လည်း ပေါ်လာပြီ (စံစကား)

အဖြေ= မိုးရိပ်တက်ခြင်း၊ မိုးရွာခြင်း၊ မိုးကြိုးပစ်ခြင်း၊ ဖား၊ မြက်ပင်

၄။ တစ်နှစ်တစ်ခါပေါ်လို့လာ၊ ငါရာမင်းလောင်းထီးဖြူဆောင်း(ရခိုင်ဘာသာ)

တစ်နှစ်တစ်ခါပေါ်လို့လာ၊ ရာဇာမင်းလောင်းထီးဖြူဆောင်း(စံစကား)

အဖြေ=မှို

၅။ ငါးယောက်ကချီ သုံးဆယ်ကကြိတ်၊ ဖျာကြီးနန့်လိပ်၊ ဂူကြီးထဲသွင်း(ရခိုင်ဘာသာ)

ငါးယောက်ကသယ်၊ သုံးဆယ်ကထောင်း၊ ဖျာကြီးနဲ့လိပ်၊ ဂူကြီးထဲသွင်း(စံစကား)

အဖြေ=ထမင်းစားခြင်း

၆။ မဲမဖင်၊ နီမယက်(လျက်) (ရခိုင်ဘာသာ)

ငမည်းဖင် ငနီလျက်(စံစကား)

အဖြေ=အိုးနှင့် မီး

၇။ ကြည့်လီ၊ ဝီးလီ(ရခိုင်ဘာသာ)

ကြည့်လေဝေးလေ၊ ဝေးလေကြည့်လေ(စံစကား)

အဖြေ=နားရွက်

၈။ ငှဲ့နွားတစ်ကောင်၊ ဘို့တစ်ထောင်(ရခိုင်ဘာသာ)

တို့နွားတစ်ကောင်၊ ဘို့တစ်ထောင်(စံစကား)

အဖြေ=ကြက်ဟင်းခါးသီး

၉။ ဆင်ပြောင်ကြီးငါးရာ၊ ရီသောက်လာ၊ ခြီရာလည်းပျောက်၊ ရီလည်းနောက်(ရခိုင်ဘာသာ)

နွားမတစ်ရာ၊ ရေဆင်းလာ၊ ခြေရာလည်းပျောက်၊ ရေလည်းနောက်(စံစကား)

အဖြေ=ဆန်ဆေးသည်

၁၀။ လားကေ ခ္ဍီခ္ဍီ၊ နီကေ စစန့် (ရခိုင်ဘာသာ)

သွားတော့ခွေခွေ၊ နေတော့စင်းစင်း (စံစကား)

အဖြေ= ခေါင်းခု

၁၁။ အတောင်စိမ်းပြာဂ၁က်၊ အဂေါင်း မြီမှာဂ၁က် (ရခိုင်ဘာသာ)

အတောင်စိမ်းပြာဂ၁က်သတ္တ၀ါ၊ အမောက်မြေမှာဂ၁က် (စံစကား)

အဖြေ= ဂ၁က်ပျောပင်

၁၂။ ကျောက်တန်းစီ ညီပါယင့်လား၊ ဆံမြိတ်ချလှပါယင့်လား၊ ပိုးပဝါခြုံလုံပါယင့်လား (ရခိုင်ဘာသာ)

ပဝါခြုံလုံပါ၏၊ ဆံမြိတ်ချလှပါ၏၊ ကျောက်တန်းစီညီပါ၏ (စံစကား)

အဖြေ= ပြောင်းဖူး

မြန်မာဘာသာသည် အများအားဖြင့် ဧကဝဏ္ဏဖြစ်သော်လည်း ပူးတွဲဘာသာမျိုးတွင်ပါဝင်သည့် စကားများကိုလည်း မြန်မာဘာသာတွင် တွေ့ရ၏၊ (ဖေမောင်တင်၊ ၂၀၁၉၊ ၂) ရခိုင်တို့၏စကားသံများမှာ မွင်နိုဆိုလိုလီဘီ (monosyllabie)ဆိုသော တစ်သံတည်းထွက်သော အသံဖြစ်သော်လည်း ရခိုင်တို့ အနေဖြင့် ပေါလီဆီလိဘိ (Polysyllabie) တစ်သံထက်ပိုသော အသံနှင့်လည်း ပြောဆိုနိုင်ကြပါသည်။ ရခိုင်လူမျိုးတို့သည် မြန်မာ လူမျိုးများနှင့် အနွယ်အားဖြင့် တူညီနိုင်ကြပါသည်ဟု လက်ခံနိုင်ကြပါသည်။ (စက္ကိန္ဒ၊ ၁၉၉၄၊ ၁၃၅) ထို့ကြောင့် စံမြန်မာဘာသာစကားနှင့် ရခိုင်ဘာသာစကားတို့တွင် အနက်အဓိပ္ပါယ် တူညီမှုများကိုလည်း တွေ့ရပါသည်။

## ခြုံငုံသုံးသပ်ချက်

စကားထာများသည် လူတို့အတွက်ဗဟုသုတလည်းရ၊ ဉာဏ်ပညာလည်းတိုးပွားစေပါသည်။ အဖြေကို စကားထာတွင်ပါသောဥပမာနှင့် ကိုက်ညီအောင် ရှာဖွေရသည်ဆိုသော်လည်း စိတ်ပင်ပန်းမှုမဖြစ်စေ ဘဲ စိတ်ရွှင်လန်း၊ စိတ်အပန်းပြေ၊ ပျော်ရွှင်မှုကို ရစေသည်။ စံမြန်မာဘာသာစကားနှင့် ရခိုင်ဘာသာ စကားတို့သည် ဘာသာစကားတူစုအတွင်းရှိ ဘာသာစကားအသွင်ကွဲများသာဖြစ်၍ အနက်အဓိပ္ပာယ် တူ၊ အသံထွက်တူညီမှုရှိသော ဝေါဟာရများကိုတွေ့ရသည်။ နေရာဒေသဝေးကွာမှု၊ ပထဝီအနေ အထားကွာ ခြားမှုတို့ကြောင့် စကားသံ ကွဲပြားမှု၊ ဝေါဟာရကွဲပြားမှုများရှိသည်ကိုလည်းတွေ့ရှိရပါ သည်။ “ဆန်ကော၊ ကြက်ဟင်းခါးသီး” တို့ကဲ့သို့သော ဝေါဟာရများမှာ စံမြန်မာဘာသာစကားနှင့် ရခိုင်ဘာသာစကား အခေါ်အဝေါ်အတူတူပင် ဖြစ်သော်လည်း အသံထွက်၊ လေယူလေသိမ်း ကွာခြားမှုကြောင့် ဝေါဟာရ ကွဲပြားသွားပုံကိုလည်း စိတ်ဝင်စားဖွယ် တွေ့ရှိရပါသည်။ ဆက်လက်၍ သုတေသနပြုသင့်သော အချက်ပင် ဖြစ်ပါသည်။ ရခိုင်ရိုးရာစကားထာများသည် ရခိုင်လူမျိုးတို့၏ ထုံးဓလေ့၊ အစဉ်အလာ ပြောဆို အသုံးပြုခဲ့သော စကားများပင်ဖြစ်ပါသည်။ ဘာသာစကားသည် တိုးပွားတတ်သော သဘောရှိပေရာ ရခိုင်စကားထာများ မှလည်း ပုံမှန်အားဖြင့် တစ်စတစ်စ တိုးပွားလာမည်သာဖြစ်သည်။ သို့ရာတွင်မှတ်တမ်းတင် ထိန်းသိမ်း ဖော်ထုတ်မှာသာလျှင် မတိမ်ကော မပပျောက် တည်တံ့ခိုင်မြဲတိုးပွားလာနိုင်မည်ဖြစ်သည်။

## နိဂုံး

ဤစာတမ်းသည် ရခိုင်ရိုးရာစကားထာများကို လူမှုဘာသာဗေဒရှုထောင့်မှ လေ့လောဖော်ထုတ် ထားသော စာတမ်းဖြစ်ပါသည်။ စကားထာများကို လေ့လာပြောဆိုကြခြင်းဖြင့် ဉာဏ်ရှင်၍ စိတ်ကူးဉာဏ် ကောင်းရစေကာ အကျိုးအကြောင်းနှိုင်းဆမှုကိုလည်း အထောက်အပံ့ပြုစေနိုင်ပါသည်။ ဆင်ခြင်တွေး တောဆုံးဖြတ်တတ်သော အသိဉာဏ်များလည်း ရရှိနိုင်သဖြင့် လူ့လောကကောင်းကျိုးများကိုလည်း ဖြစ်ပေါ်လာစေနိုင်ပါသည်။ ရခိုင်ရိုးရာစကားထာများကို စံမြန်မာဘာသာစကားနှင့် နှိုင်းယှဉ်လေ့လာ ထားသည့်အတွက် ဘာသာစကားတစ်ခု၏ ဒေသဆိုင်ရာအသွင်ကွဲများကို သိရှိစေပြီး ဘာသာစကားသုတ၊ ရခိုင်တိုင်းရင်းသားတို့၏ဓလေ့ထုံးတမ်းများကို သိရှိစေကာ ရိုးရာစကားထာများ ကိုလည်း စိတ်ပါဝင်စား လာစေနိုင်ပါသည်။ အသံကွဲပြားမှု၊ ဝေါဟာရကွဲပြားမှုတို့ကို သိရှိပြီး အသုံးချ နိုင်သဖြင့်လည်း လူမှုဆက် သွယ်ရေးများ ပိုမိုကောင်းမွန်ပြီး စီးပွားရေး၊ ပညာရေးစသော အရေးကိစ္စ များတွင်လည်း တိုးတက်လာ နိုင်မည်ဖြစ်သည်။ စကားပုံ၊ ဆိုရိုးများကိုသာ လေ့လာသိရှိမှုများပြီး စကား ထာလေ့လာမှု၊ သိရှိမှုနည်းလာ သည့်အတွက် ရိုးရာစကားထာများ မတိမ်ကော မပျောက်ကွယ်စေရန်၊ စကားထာများကို စိတ်ပါဝင်စား မှုရှိစေရန် ဤ စာတမ်းကို လေ့လာတင်ပြရခြင်းဖြစ်ပါသည်။

## ကျမ်းကိုးစာရင်း


**မြန်မာဘာသာ**

ကြည်ဦး။(၂၀၁၁)။ *မြန်မာ့ရိုးရာစကားထာများ။* ရန်ကုန်၊ ပန်းဝေဝေစာပေ။

*မြန်မာအဘိဓာန်(ခရီးဆောင်)။* (၂၀၁၄)။ နေပြည်တော်၊ မြန်မာစာအဖွဲ့ဦးစီးဌာန။

ခင်မင်၊ မောင်(ဓနုဖြူ)။ (၂၀၁၀)။ *မင်္ဂလာမောင်မယ်မဂ္ဂဇင်း။* ရန်ကုန်။

စက္ကိန္ဒ၊ အရှင်။ (၁၉၉၄)။ *ရခိုင်ဘာသာစကားလမ်းညွှန်။* ရန်ကုန်၊ ရခိုင်သားကြီးစာပေ။

ဖေမောင်တင်၊ ဦး။ (၂၀၁၉)၊ *ဘာသာလောကကျမ်း။* ရန်ကုန်၊ စိတ်ကူးချိုချိုစာပေ။

*မြန်မာဝိကီပီဒီးယား*

*ရခိုင်စာပေနှင့် ယဉ်ကျေးမှုဗဟုသုတ။* လူမှုကွန်ရက်စာမျက်နှာ။

အောင်မြင့်ဦး၊ဒေါက်တာ။ (၂၀၁၃)၊*လူမှုဘာသာဗေဒမိတ်ဆက်။* ရန်ကုန်တက္ကသိုလ်၊ မြန်မာစာဌာန။

**တွေ့ဆုံမေးမြန်းသူ**

ဦးကျော်စိန်သာ၊ ဘောင်းဒွတ်သားစုရပ်၊ စစ်တွေမြို့၊ ရခိုင်ပြည်နယ်။

ဒေါ်ခင်မိုးနွယ်၊ လက်ကောက်ဈေးရပ်၊ မြောက်ဦးမြို့၊ ရခိုင်ပြည်နယ်။

ဦးထွန်းအောင်ကျော်၊ ဒဂုံမြို့သစ်အရှေ့ပိုင်းမြို့နယ်၊ ရန်ကုန်တိုင်းဒေသကြီး။

# ထားဝယ်အပြောဒေသိယစကားလေ့လာချက်

ဇင်မာယု[1], ဇော်ဝင်း[2]

## စာတမ်းအကျဉ်း

ဤစာတမ်းသည် တနင်္သာရီတိုင်းဒေသကြီးအတွင်းရှိ ထားဝယ်ဒေသတွင် ပြောဆိုကြသော အပြောဒေသိယစကားများကို လေ့လာထားသော သုတေသနစာတမ်းဖြစ်သည်။ စာတမ်းကို လေ့လာတင်ပြရာတွင် အခန်း(၁)သုတေသန မေးခွန်း နှင့်ပြဿနာအချို့၊အခန်း(၂) စံမြန်မာစကားနှင့် အသုံးမတူ သော ထားဝယ်အပြောဒေသိယစကား၊ အခန်း(၃) စံမြန်မာစကားနှင့်မတူသော ဗျည်းသံ၊ သရသံ ကွဲပြားမှု များဟူ၍ အခန်း(၃)ခန်းခွဲကာ လေ့လာတင်ပြထားပါသည်။ အခန်း(၁)တွင် စာတမ်းပြုစုရခြင်း၏ ရည်ရွယ်ချက်၊ လေ့လာမှုနယ်ပယ်နှင့် အသုံးပြုမည့်နည်းနာ၊ အလေ့လာခံနယ်ပယ်ဟူ၍ အခန်းငယ်များခွဲကာ လေ့လာတင်ပြထားပါသည်။ အခန်း(၂)တွင် စံမြန်မာ စကားနှင့်မတူဘဲ ရှေ့ဆက်ဖြတ်၍ပြောသော ထားဝယ်ဒေသိယအပြောစကားများ၊ စံမြန်မာစကားနှင့် မတူဘဲ ဝါကျအဆုံးသတ် မတူသော ထားဝယ်ဒေသိယ အပြောစကားများ၊ အငြင်းဝါကျများတွင် ငြင်းပယ်ခြင်း အနက်ရှိသည့် "မ" ဖြုတ်၍ ပြောဆိုသော ထားဝယ်ဒေသိယ အပြောစကားများ၊ ထားဝယ်ဒေသတွင်သာ ပြောဆိုကြသော ထူးခြားသည့် အပြောစကားဟူ၍ ခေါင်းစဉ်ငယ်များခွဲကာ လေ့လာတင်ပြထားပါသည်။ အခန်း(၃) တွင် ထားဝယ်ဒေသိယအပြောစကားတွင် စံမြန်မာဘာသာစကားနှင့် မတူဘဲ ဗျည်းသံပြောင်းလဲ ပြောဆိုသော ဒေသိယအပြောစကားများ၊ စံမြန်မာဘာသာစကားနှင့် မတူဘဲ သရသံပြောင်းလဲပြောဆိုသော ဒေသိယအပြောစကားများ ဟူ၍ ကဏ္ဍများခွဲကာ လေ့လာတင်ပြထားပါသည်။

**သော့ချက်စေါ်ဟာရများ–** ဒေသိယစကား၊အပြောစကား၊ ဝါကျ၊ ဗျည်း၊ သရ

## နိဒါန်း

စကားသည် လူအချင်းချင်း ပေါင်းသင်းဆက်ဆံရာတွင် ဆက်သွယ်ရေးကြားခံ ပစ္စည်းတစ်မျိုးဖြစ်သည်။ လူမျိုးတစ်မျိုးစီတွင် သီးခြားဘာသာစကားရှိသည်။ လူအချင်းချင်းဆက်ဆံရာတွင် စကားသည် အဓိကကျသော ဆက်သွယ်ရေး ကြားခံပစ္စည်းဖြစ်သည်။ တစ်ဦး၏ဆန္ဒသဘောကို စကားပြောခြင်းဖြင့် နားလည်ရသည်။ ထားဝယ်စကားသည် မြန်မာစကားနှင့် နေရာဒေသကွဲပြားမှုကြောင့် ဖြစ်ပေါ်လာသော မြန်မာဘာသာစကား၏ မျိုးကွဲတစ်ခုဖြစ်သည်။ ထားဝယ်ဒေသ အပြောစကားသည် စံမြန်မာဘာသာစကားနှင့် ကွဲပြားမှုများစွာရှိကြောင်း တွေ့ရသည်။

### ၁။သုတေသနမေးခွန်းနှင့်ပြဿနာအချို့

ထားဝယ်ဒေသိယပြောစကားများကို လေ့လာရာတွင် အောက်ပါမေးခွန်းများ ထွက်ပေါ်လာသည်။

၁။ ဒေသိယစကားဟူသည် အဘယ်နည်း။

၂။ဒေသိယစကားကို ပညာရှင်များက မည်သို့သတ်မှတ်ကြသနည်း။

အဆိုပါမေးခွန်းများအနက် ဒေသိယစကားနှင့် ပတ်သက်၍ ပညာရှင်များ၏ ဖွင့်ဆိုသတ်မှတ်ချက်များကို စာအုပ် စာတမ်းများတွင်လည်းကောင်း၊အင်တာနက်ပေါ်တွင်လည်းကောင်း ရှာဖွေလေ့လာနိုင်ပါသည်။ ဒေသိယစကား ဆိုသည်မှာ နေရာဒေသ၊ ပထဝီအနေအထား ကွဲပြားမှု ၊လူနေမှု အဆင့်အတန်း ကွဲပြားခြားနားမှုတို့ကြောင့် စကားသံ၊ ဝေါဟာရ၊ အသုံးအနှုန်း၊ သဒ္ဒါ စသည်တို့ ကွဲပြားနေသော ဘာသာစကား၏ အသွင်ကွဲဖြစ်သည်။ (ခင်မင်၊၂၀၀၇၊စာ–၉၃)ဟု ဆရာကြီး ဒေါက်တာခင်အေးက မိန့်ဆိုခဲ့ပါသည်။ ထို့ကြောင့် ဒေသိယစကားနှင့် ပတ်သက်၍ မေးခွန်းများအတွက် အခက်အခဲမရှိသော်လည်း

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[1] လက်ထောက်ကထိက၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

[2] ဒေါက်တာ၊ ပါမောက္ခ၊ ဌာနမှူး၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

ကျန်မေးခွန်းများအတွက် အဖြေရှာရာတွင် အောက်ပါ ပြဿနာတစ်ခု ပေါ်ပေါက်လာပါသည်။ ထိုပြဿနာမှာ ထားဝယ်ဒေသိယစကားကို လေ့လာကြည့်သောအခါ စံမြန်မာစကားနှင့်မတူသော အပြောစကား အမျိုးမျိုးရှိနေခြင်းဖြစ်သည်။ အဆိုပါမေးခွန်းနှင့် ပြဿနာကို အဖြေရှာဖော်ထုတ်နိုင်ရန်အတွက် ဒေသိယစကားနှင့်ပတ်သက်သော စာအုပ်စာတမ်းများကို ဖတ်ရှုရှာလည်းကောင်း၊ ကိုယ်တိုင်လေ့လာစူးစမ်းရှာ လည်းကောင်း လေ့လာတင်ပြသွားမည်ဖြစ်ပါသည်။

**၁၊၁။ ပြုစုရခြင်း၏ရည်ရွယ်ချက်**

ထားဝယ်ဒေသအပြောစကားများကို လေ့လာရသည့် ရည်ရွယ်ချက်မှာ ထားဝယ်ဒေသိယစကားများ တိမ်ကော ပျောက်ကွယ်မသွားစေရန်နှင့် ဒေသိယစကား လေ့လာလိုသူများအတွက် အထောက်အကူ ဖြစ်စေရန် ရည်ရွယ်ပါ သည်။

**၁။၂။လေ့လာမှုနယ်ပယ်နှင့် အသုံးပြုမည့်နည်းနာ**

ထားဝယ်ဒေသ အပြောစကားများကို လေ့လာရာတွင် ထားဝယ်ဒေသ၌ ပါဝင်သော ရေဖြူမြို့နယ်၊ သရက်ချောင်းမြို့နယ်၊ ထားဝယ်မြို့နယ်နှင့် လောင်းလုံးမြို့နယ်စသည့် မြို့နယ်လေးမြို့နယ်အတွင်း ပြောဆိုနေကြသည့် ဒေသိယပြောစကားများကို လေ့လာမှုနယ်ပယ်အဖြစ် သတ်မှတ်ထားပါသည်။ ထားဝယ်ဒေသ အပြောစကားများကို စုစည်းပြီး အမျိုးအစားတူရာများကို ခွဲခြမ်းစိတ်ဖြာသောနည်းဖြင့် လေ့လာတင်ပြထားပါသည်။

**၂။ စံမြန်မာစကားနှင့် အသုံးမတူသော ထားဝယ်အပြောဒေသိယစကား**

ထားဝယ်အပြောဒေသိယစကားတွင် စံမြန်မာဘာသာစကားနှင့် အသုံးမတူသော ထားဝယ်ဒေသိယ အပြော စကားကို လေ့လာတွေ့ရှိရပါသည်။ထားဝယ် အပြောဒေသိယစကားများတွင် “စားပြီးပြီးလား”ကို“ စားပီးပီလော်” “ ငါမသိဘူး” ကို “ ငါမသိရ”၊ “ စကားပြောနေသည်” ကို “စကားပြောနေဟှယ်” စသည်ဖြင့် မြန်မာဘာသာ စကားနှင့် ဝါကျအဆုံးသတ် ပစ္စည်းမတူသော ပြောစကား၊ “ ပိုက်ဆံရှိတယ်” ကို “ကပ်ရှိဟယ်” “အကြွေးရှိတယ်” ကို “ကပ်ကွီးရှိဟယ်” ၊ “ မနက်ဖြန်တွေ့မယ်” ကို “နတ်ကီးတိုင်တွေ့မယ်”၊ “မဂ်လာဆောင်သည်” ကို “အီတတ်ဟယ်” ၊ “ရှင်ပြုသည်”ကို “ မွန်ရင်တန်” စသည်ဖြင့် မြန်မာစကားနှင့် အသုံးမတူသော ထားဝယ်အပြော ဒေသိယစကားများကို တွေ့ရသည်။

**၂၊၁။ ရှေ့စကားလုံးဖြုတ်သုံးသော ထားဝယ်အပြောဒေသိယစကား**

ထားဝယ်ဒေသပြောစကားတွင် စံမြန်မာဘာသာစကားနှင့် အသုံးမတူသည့် ရှေ့စကားလုံးဖြုတ်၍ ပြောဆိုသော ထားဝယ်ဒေသိယပြောစကားများကို တွေ့ရသည်။ ဤအခန်းကို အပိုင်း(၃)ပိုင်းခွဲ၍ လေ့လာတင်ပြပါမည်။ ရှေ့စကားလုံးဖြုတ်၍ ပြောဆိုသော ထားဝယ်ဒေသိယပြောစကားများ၊ ရှေ့စကားလုံး ဖြုတ်၍ ဗျည်းသံပြောင်း ပြောဆိုသော ဒေသိယစကားများနှင့် ရှေ့စကားလုံးဖြုတ်၍ သရသံပြောင်း ပြောဆိုသော ဒေသိယစကားများဟူ၍ အပိုင်း(၃)ပိုင်းခွဲကာ လေ့လာတင်ပြထားပါသည်။

**၂၊၁၊၁။ရှေ့စကားလုံးဖြုတ်၍ ပြောဆိုသော ထားဝယ်ဒေသိယစကားများ**

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| စဉ် | ထားဝယ်စကား | စံစကား |
| ၁။ | နဲ့သီး | ပိန္နဲ့သီး |
| သာဓက။ | “နဲ့သီးစားမော်” | |
| | (ပိန္နဲ့သီးစားမလား) | |

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| ၂။ | | ဝိ | ငဝိ |
| | သာဓက။ | “ ဝိစားလော်” | |
| | | (ငဝိစားလား) | |
| ၃။ | | ခမ်းနီ | နှုတ်ခမ်းနီ |
| | သာဓက။ | “ ခမ်းနီရှိလော်” | |
| | | (နှုတ်ခမ်းနီရှိလား) | |
| ၄။ | | ခမ်း | နှုတ်ခမ်း |
| | သာဓက။ | “ခမ်းကလှစမား” | |
| | | (နှုတ်ခမ်းလေးကလှလိုက်တာ) | |

၂၁၂။ရှေ့စကားလုံးဖြုတ်၍ ဗျည်းသံပြောင်း ပြောဆိုသော ဒေသိယစကားများ

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| စဉ် | | ထားဝယ်စကား | စံစကား |
| ၁။ | | ဂါး | စကား |
| | | (ကား>ဂါး) | |
| | သာဓက။ | “သူနဲ့ငါဂါးပြောရ” | |
| | | (သူနဲ့ငါစကားမပြောဘူး) | |
| ၂။ | | ဂျား | သကြား |
| | | (ကြား> ဂျား) | |
| | သာဓက။ | “ဂျားရှိလား” | |
| | | (သကြားရှိလား) | |
| ၄။ | | ဗျောသီး | ငှက်ပျောသီး |
| | | (ပျော>ဗျော) | |
| | သာဓက။ | “ ဗျောသီးရှိလော်” | |
| | | (ငှက်ပျောသီးရှိလား) | |
| ၅။ | | ဗား | စပါး |
| | | ( ပါး>ဗား) | |
| | သာဓက။ | “ ဗားစိုက်နေဟယ်” | |
| | | (စပါးစိုက်နေတယ်) | |

၂၁၂၂။ရှေ့စကားလုံးဖြုတ်၍ သရသံပြောင်း ပြောဆိုသော ဒေသိယစကားများ

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| ၁။ | | လောက် | အလုပ် |
| | | (လုပ်>လောက်) | |

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| သာဓက။ | " လောက်ရှိလော်" | |
| | (အလုပ်ရှိလား) | |
| ၂။ | ယောတ်တည်း | တစ်ယောက်တည်း |
| | (ယောက်>ယောတ်) | |
| သာဓက။ | " ယောတ်တည်းလော်" | |
| | (တစ်ယောက်တည်းလား) | |

ထားဝယ်ဒေသိယအပြောစကားများသည် စံမြန်မာစကားနှင့်မတူဘဲ ရှေ့ဆက်ဖြုတ်၍ ဗျည်းသံပြောင်းလဲပြောဆို မှုတွင် "က" ဗျည်းမှ "ဂ" ဗျည်းသို့လည်းကောင်း၊"ပ" ဗျည်းမှ "ဗ" ဗျည်းသို့လည်းကောင်း ပြောင်းလဲပြောဆိုကြ သည်ကို တွေ့ရသည်။သံညင်းမှ သံပြင်းသို့ပြောင်းလဲပြောဆိုကြသည်ကို တွေ့ရသည်။ ရှေ့ဆက်ဖြုတ်၍ သရသံ ပြောင်းလဲ ပြောဆိုမှုတွင် "အုပ်" သရမှ "အောက်" သရသို့လည်းကောင်း ပြောင်းလဲပြောဆိုကြသည်ကို တွေ့ရ သည်။

**၂၊၂။ ဝါကျအဆုံးသတ်ပစ္စည်းအသုံးမတူသော ထားဝယ်အပြောစကား**

ထားဝယ်အပြောစကားတွင် မြန်မာဘာသာစကားနှင့် ဝါကျအဆုံးသတ်ပစ္စည်းမတူသော ထားဝယ်အပြောစကား များကို လေ့လာတွေ့ရှိရပါသည်။ထားဝယ်အပြောဒေသိယစကားတွင်တွေ့ရသော "လော်" ၊ "ဝေ့" ၊ "နိုဝ" ၊ "ဇ" ၊ "ဂီး" ၊ "နဲ" ၊ "မား" စသော ဝါကျအဆုံးသတ်ပစ္စည်းအသုံးများကို အသုံးပြုပြောဆိုသည်ကို တွေ့ရသည်။ သာဓကပြရလျှင်-

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| စဉ် | ထားဝယ်စကား | စံစကား |
| ၁။ | စားကွန်းဇ | စားကောင်းတယ် |
| | (ကောင်း>ကွန်း) | |
| ၂။ | သွားနိုဝလော် | မသွားချင်ဘူးလား |
| ၃။ | မုဟလော် | မဟုတ်ဘူးလား |
| ၄။ | ထားလိုက်ဝေ့ | ထားလိုက်တော့ |
| ၅။ | ငါသိသိဂီး | ငါသိပါတယ် |
| ၆။ | လျာမှန်းသိရ | ဘာမှန်းမသိဘူး |
| ၇။ | ပြောနဲ | မပြောနဲ့ |
| ၈။ | သိရလော် | မသိဘူးလား |
| ၉။ | ငါသိရှင်ဂျော့ | ငါသိချင်လို့ |
| ၁၀။ | ဂါးလည်းပြောရမား | စကားလည်းမပြောပါလား |
| | (စကား>ဂါး) | |

အထက်ဖော်ပြပါ ထားဝယ်အပြောစကားများကို လေ့လာကြည့်ပါက ထားဝယ်ဒေသပြောစကား၏ ဝါကျအဆုံးသတ်ပစ္စည်းအသုံးသည် စံမြန်မာဘာသာစကားနှင့် ကွဲပြားသည်ကို တွေ့ရသည်။ မိမိပြုလုပ်ချင်သော ဆန္ဒ တစ်ခုကို ဖော်ပြလိုသောအခါတွင် ပြောဆိုသော အပြောစကားတွင် " ဂျော့" ဟူသော ဝါကျအဆုံးသတ်ပစ္စည်းနှင့် အမေးဝါကျများတွင် "လော်" ဟူသော ဝါကျအဆုံးသတ်ပစ္စည်းကိုလည်းကောင်း၊ ခွင့်ပြုပေးသော

သဘောကို ပြောလိုသောအခါတွင် “ဝေ့” ဟူသော ဝါကျအဆုံးသတ် ပစ္စည်းကိုလည်းကောင်း၊ သာမန်ထက် လွန်ကဲသော သဘောမျိုးကို ဖော်ပြလိုသော အခါတွင် “ဇ” ဟူသော ဝါကျအဆုံးသတ်ပစ္စည်းကို လည်းကောင်း၊ အငြင်းဝါကျများကို ပြောဆိုသောအခါတွင် “နဲ” ဟူသော ဝါကျအဆုံးသတ်ပစ္စည်းကို လည်းကောင်း သုံးနှုန်းပြောဆိုသည်ကို တွေ့ရသည်။

**၂၃။ ငြင်းပယ်ခြင်းအနက်ရှိသည့် “မ” ကို ဖြုတ်၍ပြောဆိုသော ထားဝယ်အပြောဒေသိယစကားများ**

အငြင်းဝါကျများတွင် ငြင်းပယ်ခြင်းအနက်ရှိသည့် “မ” အသုံးကိုဖြုတ်၍ ပြောဆိုသော ထားဝယ်ဒေသ အပြောစကားများကို တွေ့ရသည်။ စံမြန်မာဘာသာစကားတွင် ငြင်းပယ်သည့်သဘောကို ပြောလိုသောအခါ ငြင်းပယ်ခြင်း အနက်ရှိသည့် “မ” ကို အသုံးပြုပြောဆိုကြသည်။ ထားဝယ်အပြောစကားတွင်မှ “မ” အသုံးဖြုတ်၍ ပြောဆို ကြပါသည်။

| | | |
|---|---|---|
| စဉ် | ထားဝယ်စကား | စံစကား |
| ၁။ | ပြောရ | မပြောဘူး |
| ၂။ | သွားရ | မသွားဘူး |
| ၃။ | နိုရ (လို>နို) | မလိုဘူး |
| ၄။ | လောက်ရ(လုပ်>လောက်) | မလုပ်ဘူး |
| ၅။ | လာရ | မလာဘူး |
| ၆။ | အိရ(အိပ်>အိ) | မအိပ်ဘူး |
| ၇။ | နေရ | မနေဘူး |
| ၈။ | စားရ | မစားဘူး |
| ၉။ | ခေါ်ရ | မခေါ်ဘူး |
| ၁၀။ | ပျော်ရ | မပျော်ဘူး |

အငြင်းဝါကျဖြစ်သော်လည်း ငြင်းပယ်ခြင်းအနက်ရှိသည့် “မ” အသုံးကို ဖြုတ်၍ ပြောဆိုကြသည်။ စံမြန်မာ ဘာသာစကားတွင် မ--ဘူး ကို ထားဝယ်ဒေသိယစကားတွင် "ရ" တစ်လုံးတည်းဖြင့် ပြောဆိုကြခြင်းဖြစ်သည်။

**၂၄။ ထူးခြားသော ထားဝယ်ဒေသိယအပြောစကားများ**

ထားဝယ်ဒေသအပြောစကားများတွင် စံမြန်မာဘာသာစကားနှင့် လုံးဝကွဲပြားခြားနားသော ထူးခြားသည့် အပြောစကားများကို တွေ့ရသည်။ “စပါးဂျီရှိတယ်”ကို “ဗားဂတ်ရှိဟယ်” ၊ နေ့တစ်ဝက်နားတယ်” ကို “နပ်စာနားဟယ်” ၊“ကောင်မလေးလှတယ်” ကို “ဝယ်ရားဂန်းလှဟယ်” ၊ “လူရွှင်တော် တော်တယ်” ကို “လူဗျစ်တော်ဟယ်” ၊ “ညနေပိုင်းလာမယ်” ကို “ နေတန်ဇာလာမယ်” ၊ မင်္ဂလာဆောင်သည်” ကို “အီဒတ်ဟယ်” စသည်ဖြင့် စံမြန်မာစကားနှင့် လုံးဝကွဲပြားသည့် ဒေသိယစကားများကို သုံးနှုန်းပြောဆိုကြသည်ကို လေ့လာ တွေ့ရှိရသည်။

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| စဉ် | ထာဝယ်စကား | စံစကား |
| ၁။ | ကတ် | ပိုက်ဆံ |
| သာဓက။ | “ ကတ်မ့ေရ” (မရှိ > မ့ေ) | |
| | (ပိုက်ဆံမရှိဘူး) | |

| | | | |
|---|---|---|---|
| ၂။ | | ကတ်ကွီး | အကြွေး |
| | သာဓက။ | “ငါ့မှာကတ်ကွီးရှိဟယ်” | |
| | | (ငါ့မှာ အကြွေးရှိတယ်) | |
| ၃။ | | အီဒတ်(အိမ်> အီ) | မင်္ဂလာဆောင် |
| | | “ အီဒတ်သွားမယ်” | |
| | | (မင်္ဂလာဆောင်သွားမယ်) | |
| ၄။ | သာဓက။ | မွန်ရင်တန် | ရှင်ပြု |
| | | “ မွန်ရင်တန်ပွဲသွားမယ်” ( တင်> တန်) | |
| | | (ရှင်ပြုပွဲသွားမယ်) | |
| ၅။ | | နပ်စာ | နေ့တစ်ဝက် |
| | သာဓက။ | “ နပ်စာနားဟယ်” | |
| | | (နေ့တစ်ဝက်နားတယ်) | |
| ၆။ | | နေတန်ဇာ | ညနေပိုင်း |
| | သာဓက။ | “နေတန်ဇာငါလာမယ်” | |
| | | (ညနေငါလာမယ်) | |
| ၇။ | | မိုက် | မိုးချုပ် |
| | သာဓက။ | “ မိုက်သွားဗီ” | |
| | | (မိုးချုပ်သွားပြီ) | |
| ၈။ | | ဗားဂတ် | စပါးဂျီ |
| | | (စပါး>ဗား) | |
| | သာဓက။ | “ငါ့အီမှာဗားဂတ်ရှိဟယ်”(အိမ်>အီ) | |
| | | (ငါ့အိမ်မှာ စပါးဂျီရှိတယ်) | |
| ၉။ | | အီးခလယ်သွား | အိမ်လည်သွား |
| | သာဓက။ | “ငါအီးခလယ်သွားဟယ်” | |
| | | (ငါအိမ်လည်သွားတယ်) | |
| ၁၀။ | | လူဗျစ် | လူရွှင်တော် |
| | သာဓက။ | “အယ်လူဗျစ်လေးကချောဟယ်”(ပျက်> ဗျက်> ဗျစ်) | |
| | | (ဒီလူရွှင်တော်လေးကချောတယ်) | |
| ၁၁။ | | အယ်ဇာ | ဒီဟာ |
| | သာဓက။ | “အယ်ဇာလှဟယ်” | |
| | | (ဒီဟာလှတယ်) | |
| ၁၂။ | | ဟယ်မြတ် | ဘယ်လောက် |
| | သာဓက။ | “အယ်ဇာဟယ်မြတ်” | |
| | | (ဒီဟာဘယ်လောက်) | |
| ၁၃။ | | နူး | လဲ |
| | သာဓက။ | " အယ်ဇာဟယ်မြတ်နူး" | |
| | | (ဒီဟာဘယ်လောက်လဲ) | |

"ပိုက်ဆံ" ကို "ကတ်" ဟု ပြောဆိုသုံးစွဲခြင်းမှာ ကတ်ပြားသဘောကို ပြောလိုခြင်းဖြစ်သည်ဟု ယူဆရပါသည်။ "မင်္ဂလာဆောင်" ကို "အီဒတ်" ဟု ပြောဆိုသုံးစွဲခြင်းမှာ ထားဝယ်ဒေသတွင် မင်္ဂလာဆောင်ပြီးသောအခါ သတိုးသားဖြစ်စေ၊သတို့သမီးဖြစ်စေ မိမိတို့နေမည့် မိဘအိမ်တွင် တက်ရောက်နေထိုင်ကြသည်။ အိမ်ပေါ်သို့ တက်ရောက်နေထိုင်ကြရသဖြင့် "အီဒတ်" ဟု ပြောဆိုကြခြင်းဖြစ်သည်။ "ရှင်ပြုသည်" ကို "မွန်ရင်တန်"ဟု ပြောဆိုသုံးစွဲခြင်းမှာ ထားဝယ်ဒေသတွင် "ကိုရင်" ကို "မွန်ရင်"ဟု ခေါ်ဝေါ်ပြောဆိုသည်။ "တန်" ဆိုသည်မှာ တင်မြှောက်သည့်သဘောဖြစ်သည်။သားယောကျာ်းလေးများကို ကိုရင်အဖြစ် တင်မြှောက်ခြင်း ဖြစ်သည့်အတွက် "မွန်ရင်တန်" ဟု ပြောဆိုကြခြင်းဖြစ်သည်။

**၃။စံမြန်မာစကားနှင့်မတူသော ဗျည်းသံ၊ သရသံ ကွဲပြားမှု**

ဘာသာစကားတစ်ခုကို ပြောဆိုသုံးစွဲသူတို့သည် နေထိုင်ရာဒေသ ပထဝီအနေအထား ကွဲပြားမှုကြောင့် စကားသံအရ ဝေါဟာရအသုံးအနှုန်းများ ကွဲပြားသွားတတ်သည်။ ထားဝယ်အပြော စကားတွင် မြန်မာစကားနှင့် စကားသံပိုင်း၊ သဒ္ဒါပိုင်းတို့တွင် တူညီမှုများရှိသကဲ့သို့ ကွဲပြားခြားနားမှုများလည်းရှိကြောင်း တွေ့ရသည်။ထိုသို့တူညီမှု၊ ကွဲပြားမှုများရှိသည့်အနက် မြန်မာစကားနှင့် မတူဘဲ ဗျည်းသံ၊ သရသံကွဲပြားသော ထားဝယ်ဒေသရှိ ပြောစကား များကို လေ့လာတင်ပြထားပါသည်။

**၃၊၁။ ဗျည်းသံကွဲပြားသော ထားဝယ်ဒေသအပြောစကားများ**

| စဉ် | ထားဝယ်စကား | မြန်မာစကား |
|---|---|---|
| ၁။ | "ငါမှန်းတယ်ရားရယ်"<br>(ထား>ရား) (ထ>ရ) | "ငါထမင်းချက်ထားတယ်" |
| ၂။ | "ငါဝါမှာနေရယ်"<br>(ရှာ>ဝါ) (ရ>ဝ)<br>(တယ်>ရယ်) (တ>ရ) | "ငါရှာမှာနေတယ်" |
| ၃။ | "ဆေးဂီးနားထမင်းဆိုင်ရှိဟယ်"<br>"ဈေးကြီ:နားထမင်းဆိုင်ရှိတယ်"<br>(ကြီ: >ဂီး) (က>ဂ) | (ဈေး> ဆေး) (စျ>ဆ) |
| ၄။ | "မုလတ်သောက်<br>ငှါဝိုဝယ်ကျွေးပါလော်"<br>(ကို > ဝို) (က>ဝ) | "မုန့်လက်သုပ်<br>ငှါကိုဝယ်ကျွေးပါလား" |

စသည့်ဖြင့် စံမြန်မာစကားနှင့် ဗျည်းသံမတူဘဲ ပြောဆိုကြသည်ကို တွေ့ရသည်။ထားဝယ်ဒေသိယ စကားတွင် "ထ" ဗျည်းကို "ရ"ဗျည်းသို့လည်းကောင်း၊ "ရ" ဗျည်းမှ "ဝ" ဗျည်းသို့လည်းကောင်း၊ "စျ" ဗျည်းမှ "ဆ" ဗျည်းသို့ လည်းကောင်း၊"က"ဗျည်းမှ "ဂ"ဗျည်းသို့လည်းကောင်း၊ "က"ဗျည်းမှ "ဝ" ဗျည်းသို့လည်းကောင်း ပြောင်းလဲပြောဆို ကြသည်ကို တွေ့ရသည်။

**၃၊၂။ သရသံ ကွဲပြားသော ထားဝယ်အပြောဒေသိယစကားများ**

ထားဝယ်ဒေသအပြောစကားများတွင် မြန်မာနှင့်စကားသံပိုင်းအရ သရသံကွဲပြားသော အပြောစကားများကို တွေ့ရသည်။သာဓကပြရလျှင်-

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| စဉ် | | ထားဝယ်စကား | စံစကား |
| ၁။ | | ဟန်း | ဟင်း |
| | သာဓက။ | “ငါးဟန်းစားမော်” | |
| | | (ငါးဟင်းစားမလား) | |
| ၂။ | | အန်း | အင်း |
| | သာဓက။ | “ငါးအန်းထဲမှာငါးရှိဟယ်” | |
| | | (ငါးအင်းထဲမှာငါးရှိတယ်) | |
| ၃။ | | ခန်း | ခင်း |
| | သာဓက။ | “အိရာခန်းလဲလိုက်ဝေ့” (အိပ်>အိ) | |
| | | (အိပ်ရာခင်းလဲလိုက်တော့) | |
| ၄။ | | မန်း | မင်း |
| | သာဓက။ | “မန်းဂီးကြွလာဟယ်” (ကြီး>ဂီး) | |
| | | (မင်းကြီးကြွလာတယ်) | |
| ၅။ | | သန် | သင် |
| | သာဓက။ | “စာသန်နေဟယ်” | |
| | | (စာသင်နေတယ်) | |

စသည်ဖြင့် ထားဝယ်ဒေသပြောစကားများတွင် မြန်မာစကား (အင်) / ĩ/ သရသံကို (အန်) /ã/ သရသံဖြင့် ပြောင်းလဲ ပြောဆိုသည်ကို တွေ့ရသည်။ထို့အပြင် မြန်မာရပ်သံသရ / auʔ/(အောက်) ကို /uʔ/ (အွတ်) သံဖြင့် ပြောင်းလဲရွှတ်ဆိုသော ထားဝယ်ဒေသ ပြောစကားများကိုလည်း တွေ့ရပါသည်။

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| စဉ် | | ထားဝယ်စကား | စံစကား |
| ၁။ | | ယွတ် | ယောက် |
| | သာဓက။ | “လူယွတ်လဲနေဟယ်” | |
| | | (လူတစ်ယောက်လဲနေတယ်) | |
| ၂။ | | ဆွတ် | ဆောက် |
| | သာဓက။ | “အီဆွတ်နေဟယ်” | |
| | | (အိမ်ဆောက်နေတယ်) | |
| ၃။ | | မျှော့တ် | မျောက် |
| | သာဓက။ | “အယ်တောထဲမှာမျှော့တ်ရှိဟယ်” | |
| | | (ဒီတောထဲမှာမျောက်ရှိတယ်) | |
| ၄။ | | ဖျော့ | ဖျောက် |
| | သာဓက။ | “ဖျော့ပစ်လိုက်” | |
| | | (ဖျောက်ပစ်လိုက်) | |
| ၅။ | | လွတ် | လောက် |
| | သာဓက။ | “လွတ်ကောင်တွေရှိဟယ်” | |
| | | (လောက်ကောင်တွေရှိတယ်) | |

ထို့အပြင် မြန်မာရပ်သံ /ouʔ/ အုတ်ကို /auʔ/ အောက်သံဖြင့် ရွတ်ဆိုသော ထားဝယ်ဒေသ ပြောစကားများ တွေ့ရှိရသည်။သာဓကပြရလျှင်-

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| စဉ် | | ထားဝယ်စကား | စံစကား |
| ၁။ | | လောက် | လုပ် |
| | သာဓက။ | "လောက်သွားနေဟယ်" | |
| | | (အလုပ်သွားနေတယ်) | |
| ၂။ | | ပေါက် | ပုပ် |
| | သာဓက။ | "ပေါက်နုံ့နုံဟယ်" | |
| | | (ပုပ်နုံ့ နုံတယ်) | |
| ၃။ | | ကောက် | ကုပ် |
| | သာဓက။ | "ကောက်ခြစ်ပစ်လိုက်" | |
| | | (ကုပ်ခြစ်ပစ်လိုက်) | |
| ၄။ | | စောက် | စုပ် |
| | သာဓက။ | "ရေစောက်ဟယ်" | |
| | | (ရေစုပ်တယ်) | |
| ၅။ | | ထောက် | ထုပ် |
| | သာဓက။ | "ထောက်ပြင်နေဟယ်" | |
| | | (အထုပ်ပြင်နေတယ်) | |

စသည်ဖြင့် စံမြန်မာဘာသာစကားနှင့် သရသံမတူဘဲ ပြောင်းလဲပြောဆိုသည့် ထားဝယ်ဒေသိယစကားများကို တွေ့ရသည်။

## ခြုံငုံသုံးသပ်ချက်

ထားဝယ်အပြောဒေသိစကားများကို လေ့လာကြည့်ရာတွင် စံမြန်မာစကားနှင့်မတူဘဲ ရှေ့ဆက်ဖြုတ်၍ အနောက် ကဗျည်းကို သံပြင်းဖြင့် ပြောဆိုကြသည်ကို တွေ့ရသည်။သံပြင်းဖြင့် ပြောဆိုခြင်းသည် ပင်ပန်းသော်လည်း မိမိပြောဆိုသောစကားကို ပိုမိုထိရောက်စေရန် လေးလေးပင်ပင် ပြောဆိုကြခြင်း ဖြစ်သည်ဟု ကောက်ချက်ချ မိပါသည်။ ဝါကျအဆုံးသတ်ပစ္စည်းအသုံးတွင်မူ စံမြန်မာဘာသာစကားနှင့်မတူသော "လော်"၊"ဇ"၊ "ဇမား"၊ "မား"၊ "ဂျော့" ၊ "ဟယ်"၊ "ဂီး"၊ "ဝေ့" စသည့် ဝါကျအဆုံးသတ်ပစ္စည်းအသုံးများကို တွေ့ရသည်။ အမေးဝါကျများကို ပြောဆိုရာ တွင် "လော်" ဟူသော ဝါကျအဆုံးသတ်ပစ္စည်းကိုသုံး၍ အငြင်းဝါကျများကို ပြောဆိုသောအခါတွင် "နဲ" ဟူသော ဝါကျအဆုံးသတ်ပစ္စည်းအသုံးဖြင့် ပြောဆိုကြသည်ကို တွေ့ရသည်။ အလွန်အကျွံသဘောကို ပြောလိုသောအခါတွင် "ဇ" "ဇမား" "မား" ဝါကျအဆုံးသတ်ပစ္စည်းများကို သုံး၍ပြောဆိုကြ သည်ကိုတွေ့ရသည်။ တစ်စုံတစ်ခုကို ပြုလုပ်ချင်သောသဘောကို ပြောလိုသောအခါတွင် "ဂျော့"ဟူသော ဝါကျအဆုံးသတ် ပစ္စည်းကို သုံး၍ ပြောဆိုကြသည်ကိုတွေ့ရသည်။ခွင့်ပြုပေးသည့်သဘောပါသော ဝါကျများတွင် "ဝေ့" ဟူသော ဝါကျ အဆုံး သတ် ပစ္စည်းကိုသုံး၍ ပြောဆိုကြသည်ကိုတွေ့ရသည်။ အငြင်းဝါကျများတွင် ငြင်းပယ်ခြင်း အနက်ရှိသည့် "မ" ကို ဖြုတ်၍ ပြောဆိုကြသည်ကို ထူးခြားစွာ တွေ့ရသည်။ ဗျည်းသံပြောင်းလဲမှုတွင် "ဟ"ဗျည်းမှ "ထ" ဗျည်းသို့ ပြောင်းလဲပြောဆိုခြင်း၊"ရ" ဗျည်းမှ "ဝ" ဗျည်းသို့ ပြောင်းလဲပြောဆိုခြင်း၊"ရ"ဗျည်းမှ "တ" ဗျည်းသို့ ပြောင်းလဲ ပြောဆိုခြင်း၊ "ရ" ဗျည်းမှ "က"

ဗျည်းသို့ ပြောင်းလဲပြောဆိုခြင်း၊"ဝ"ဗျည်းမှ "က" ဗျည်းသို့ ပြောင်းလဲ ပြောဆိုကြ သည်ကို တွေ့ရှိရသည်။သရသံပြောင်းလဲပြောဆိုမှုတွင် မြန်မာ /ĩ/ အင် သရသံကို /ã/ အန်သရသံဖြင့် ပြောဆိုခြင်း၊ မြန်မာရပ်သံသရ /ou?/အုတ်ကို / au?/ အောက် သံဖြင့် ရွတ်ဆိုခြင်း၊မြန်မာရပ်သံသရ / au?/အောက် ကို / u?/ အွတ် သံဖြင့် ပြောင်းလဲရွတ်ဆိုကြသည်ကို လေ့လာတွေ့ရှိရပါသည်။ဤသို့ဖြင့် ထားဝယ်ဒေသိယစကားတွင် စံမြန်မာဘာသာစကားနှင့်မတူသော ကွဲပြားသည့် အချက်များကို တွေ့ရှိရပါသည်။

## နိဂုံး

ပြည်ထောင်စုမြန်မာနိုင်ငံတွင် တိုင်းရင်းသားပေါင်းစုံ မှီတင်းနေထိုင်လျက်ရှိရာ တိုင်းရင်းသား စည်းလုံးညီညွတ်ရေး တိုင်းရင်းသားလူမျိုးများ ဖွံ့ဖြိုးတိုးတက်ရေးသည် အရေးကြီးဆုံးဖြစ်သည်။ တိုင်းရင်းသား ချစ်ကြည်ရေးနှင့် သွေးစည်းညီညွတ်ရေးကို ဆောင်ရွက်ရာတွင် နိုင်ငံရေး၊ လူမှုရေး၊ စီးပွားရေး၊ အုပ်ချုပ်ရေး စသည်ဖြင့် နည်းလမ်း များ ရှိသည်အနက် စာပေယဉ်ကျေးမှုအားဖြင့် ဆောင်ရွက်ခြင်းသည် အထိရောက်ဆုံးဖြစ်သည်။ ယခုအခါတွင် ထားဝယ်ဒေသသည် လမ်းပန်းဆက်သွယ်ရေး လွယ်ကူချောမွေ့ လာသည့်အလျောက် ပြည်မနှင့် ကူးလူးဆက်ဆံမှု များပြားလာပြီး စံဘာသာစကားနှင့် ရောနှောပြောဆိုလျက် ရှိကြသည်။ ထို့ကြောင့် တနင်္သာရီတိုင်းဒေသကြီးအတွင်းရှိ ထားဝယ်ဒေသအပြောစကားများ မတိမ်ကော စေရန် ထိန်းသိမ်းထားရန် လိုအပ်ပေသည်။ ထားဝယ်ဒေသအပြောစကားများကို စံမြန်မာဘာသာစကားရှိ ပြောစကားများနှင့် နှိုင်းယှဉ်လေ့လာခြင်းဖြင့် ထားဝယ်ဒေသ၏ အပြောစကားများကို မှန်းဆသိရှိနိုင်ပြီး တိုင်းရင်းသား စည်းလုံးညီညွတ်ရေးသာမက ထားဝယ်ဒေသ၏ ဘာသာစာပေ ယဉ်ကျေးမှုကိုလည်း ထိန်းသိမ်းရာ၌ တစ်ဖက်တစ်လမ်းမှ အထောက်အပံ့ပြုနိုင်စေရန် ဆန္ဒပြု ပါသည်။

## ကျမ်းကိုးစာရင်း


ကျော်မင်း၊ထားဝယ်။(၁၉၆၈)။*ထားဝယ်ယဉ်ကျေးမှုအမြှုတော*။ရန်ကုန်။အေးအေးပုံနှိပ်တိုက်။

ခင်မင်၊မောင်။(၈နေ့ဖြူ)။(၂၀၁၇)။*မြန်မာစကားမြန်မာရှပ်ပုံလွှာ*။စတုတ္ထအကြိမ်၊ရန်ကုန်။စိတ်ကူးချိုချိုပုံနှိပ်တိုက်။

မြန်မာစာအဖွဲ့။(၂၀၀၇)။*မြန်မာအဘိဓာန်*။ရန်ကုန်။မြန်မာစာအဖွဲ့ဦးစီးဌာန။


**တွေ့ဆုံမေးမြန်းသူများ**

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| ဦးဝင်းသိန်း | သရက်ချောင်းမြို့နယ် |
| ဦးသိန်းလွင် | ထားဝယ်မြို့နယ် |
| ဒေါ်သိန်းရီ | လောင်းလုံးမြို့နယ် |

# မြိတ်မြို့သိမ်တော်ကြီးစေတီစိန်ဖူးတင်ပိုဒ်စုံရတုကဗျာမှစာဆို၏အရေးအဖွဲ့ လေ့လာချက်

ခတ္တာ[1]

## စာတမ်းအကျဉ်း

ဤစာတမ်းသည် မြိတ်မြို့သိမ်တော်ကြီးစေတီစိန်ဖူးတင်ပိုဒ်စုံရတုကို လေ့လာထားသော စာတမ်း ဖြစ်ပါသည်။ ရတုမှာရေးဖွဲ့သည့် ပုံသဏ္ဌာန်သည် စည်းစနစ်ရှိပြီး အကြောင်းအရာများမှာလည်း အမျိုးအစားစုံလင်လှပါသည်။ ထိုစာတမ်းတွင် အလေ့လာခံအဖြစ် ဘုရားတိုင်ရတုတစ်ပုဒ်ဖြစ်သော သိမ်တော်ကြီးစေတီစိန်ဖူးတင်ပိုဒ်စုံရတုကို လေ့လာတင်ပြထားပါသည်။ ရတုကဗျာ၏ ဂုဏ်ရည်များ ပေါ်လွင်စေရန် စာပေရှုထောင့်မှ လေ့လာတင်ပြပါမည်။ ရတုမှာ (၆၃)နှစ်သက်တမ်းရှိပြီး စေတီမှာ နှစ်ပေါင်းနှစ်ရာ၀ါးဆယ်ကျော် သက်တမ်းရှိသော သမိုင်း၀င်စေတီတော်ကြီးဖြစ်ပါသည်။ ထို့ကြောင့် မြိတ်မြို့၏ သမိုင်း၀င်စတီတော်ကြီးစိန်ဖူးတော်တင်ပုံနှင့် မြိတ်မြို့ရှိ တန်ဖိုးရှိသော စာပေကဏ္ဍာများကို ဖော်ထုတ်၍ ထိန်းသိမ်းစေလိုသော ရည်ရွယ်ချက်ဖြင့် ထိုစာတမ်းကို လေ့လာပြုစုရခြင်း ဖြစ်ပါသည်။

**သော့ချက်ဝေါဟာရ– အသံ၊ ကာရန်၊ အချီအချ၊ ရတု၊ အသတ်။**

## နိဒါန်း

မြန်မာစာပေသမိုင်းတွင် ရတုစာပေပုံသဏ္ဌာန်သည် ပင်းယခေတ်မှ စတင်တွေ့ရှိခဲ့ပြီး တောင်ငူခေတ်တွင် ရတုခေတ်ဟုခေါ်ရလောက် ထွန်းကားခဲ့သော စာပေအဖွဲ့ပုံစံဖြစ်ပါသည်။ ဤစာတမ်းသည် တောကျောင်းဆရာတော် အဂ္ဂမဟာပဏ္ဍိတအရှင်ပဒုမ၏ မြိတ်မြို့သိမ်တော်ကြီးစေတီ စိန်ဖူးတင်ပိုဒ်စုံရတုကို လေ့လာတင်ပြ ထားပါသည်။ စာတမ်းတွင် အခန်း(၃)ခန်းခွဲ၍ တင်ပြထားပါသည်။ အခန်း(၁)တွင် ကဗျာဖွင့်ဆိုချက်နှင့် ရတုသဘောသဘာ၀များ၊ အခန်း(၂)တွင် သိမ်တော်ကြီးခေါ် လေးကျွန်းဆီမီးစေတီတော်ကြီးခေါ်တွင်ပုံ၊ အခန်း(၃)တွင် မြိတ်မြို့သိမ်တော်ကြီးစေတီစိန်ဖူးတင်ပိုဒ်စုံရတုကဗျာမှ စာဆို၏အရေးအဖွဲ့လေ့လာချက်တို့ဖြစ်ပါသည်။ မြန်မာစာပေ၏ အစိတ်အပိုင်းတစ်ရပ်ဖြစ်သော ရတုကဗျာအမျိုးအစားများထဲမှ ဘုရားတိုင်ရတုကို လေ့လာခြင်းဖြင့် လူများ၏စိတ်ကို ကြည်နူးစေပြီး သဒ္ဓါတရားတိုးပွားလာအောင်၊ ဘာသာတရား ကိုင်းရှိုင်းလာအောင်၊ လောဘ၊ ဒေါသ၊ မာန်မာနများ နည်းပါးလာအောင်၊ ရတုကဗျာ၏ စာပေတန်ဖိုးသစ်များကို သိရှိနားလည်ခံစားတတ်လာအောင်၊ လူများ၏စိတ်ကို အပြောင်းအလဲဖြစ်စေရန်နှင့် ဂန္ဓ၀င်စာပေ လေ့လာသူတို့အတွက် အထောက်အကူပြုနိုင်စေရန် ရည်ရွယ်၍ လေ့လာတင်ပြခြင်းဖြစ်ပါသည်။

### ၁။ ကဗျာဖွင့်ဆိုချက်နှင့်ရတုသဘောသဘာ၀

> ကဗျာသည် မြန်မာစာပေပင်မမှ ဖြာထွက်လာသော အခက်အလက်တစ်ခုဖြစ်သည်။
> ကဗျာနှင့်ပတ်သက်၍ မြန်မာအဘိဓာန်အကျဉ်းချုပ်၌
>
> “သတ်မှတ်ထားသော စည်းမျဉ်းများနှင့်အညီစာလုံး၊ စာပိုဒ်အရေအတွက်၊ ကာရန်အချိတ်အဆက်၊ အသံအနေအထား စသည်တို့ဖြင့် စီကုံးထားသော အဖွဲ့အနွဲ့” (မြန်မာအဘိဓာန်၊၁၉၇၈၊စာ၅)
>
> ဟူ၍ဖော်ပြထားပါသည်။

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[1] နည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

> ‘ရတုဟူသည် သက္ကတဘာသာ ရိတုမှ ပျက်လာသော ရတုလည်းရှိပါသည်။ မြန်မာဘာသာ ပေါရဏာသက်သက် ရတုလည်းရှိသည်။ သက္ကတဘာသာ ရိတုမှာ အခါရာသီ အနက်ရသည်။ မြန်မာဘာသာရတုမှာ သဘင်ဟူသောအနက်၊ အခမ်းအနားဟူသောအနက်၊ အခြေအနေဟူသောအနက်ဟူ၍ အနက်သုံးမျိုးရှိပါသည်။’ ( ဖေမောင်တင်ဦး၊ ၁၉၈၇၊ ၄၈)

ဟူ၍ အသီးသီးဖွင့်ဆိုထားကြသည်။

ရတုသဘောသဘာဝနှင့်ပတ်သက်၍ ပညာရှင်၍များက အမျိုးမျိုးကြံဆခဲ့ကြပါသည်။ ရတုကို ပင်းယခေတ်တွင် စတင်တွေ့ရှိသည်ဟု ဆိုနိုင်သော်လည်း တကယ်တမ်း စတင်ထွန်းကား သည်မှာမူ အင်းဝခေတ်တွင်ဖြစ်သည်။ ရတုတွင် တစ်ပိုဒ်တည်း ဖွဲ့စပ်လျှင် ဧကပိုဒ်၊ နှစ်ပိုဒ်ဖွဲ့လျှင် အဖြည့်ခံ၊ သုံးပိုဒ်ဖွဲ့လျှင် ပိုဒ်စုံရတုဟုခေါ်သည်။

**၂။ သိမ်တော်ကြီးခေါ်လေးကျွန်းဆီမီးစေတီတော်ကြီးခေါ်တွင်ပုံ**

သက္ကရာဇ် ၈၉၃ခုနှစ်တွင် ယိုးဒယားလက်အောက်ရောက်ခဲ့ရသော တနင်္သာရီမြို့ကို ၉၁၀ခုနှစ်တွင် အထက်မြန်မာမင်းတို့ စစ်တံခွန်လွှင့်၍ ပြန်လည်သိမ်းယူခဲ့သည်။ တစ်ဖန် ၁၀၄၀ခုနှစ်တွင် ယိုးဒယား ပြန်လည်သိမ်းယူပြီး မြို့ဝန်(၉)ဆက်၊ ၇၃နှစ်ပတ်လုံး ယိုးဒယားရှမ်းတို့အုပ်စိုးနေခိုက် သက္ကရာဇ်၁၀၉၃ခုနှစ်တွင် မာရတ်ခေါ်မြတ်မြို့၏ မြို့လူကြီးများက မြန်မာအရှင်စတိန်ဆရာတော်ဘုရားကြီး အရှင်ဇာဂရမထေရ်ကို အကြီးမှူးထား၍ မြတ်စွာဘုရား၏ ဓာတ်တော်သုံးဆူကို ရွှေကြုပ်၊ ငွေကြုပ်၊ ကြေးကြုပ်တို့တွင် ထည့်လျက် ရွှေရုပ်ပွားတော်၊ ငွေရုပ်ပွားတော်၊ ကြေးရုပ်ပွားတော်များနှင့်အတူကောင်းမွန်စွာ ထည့်သွင်းဌာပနကာ ဖိနပ်တော်(၁၈)တောင်၊ ဉာဏ်တော်အမြင့်(၃၂)တောင်ရှိသော စေတီတစ်ဆူကို ခယ်တောင်ထိပ်တွင် တည်ထားကိုးကွယ်ခဲ့ကြလေသည်။ ခယ်တောင်ပေါ်တွင်တည်ထားခဲ့၍ ခယ်တောင်စေတီဟု ခေါ်ဝေါ်သမုတ်ခဲ့ကြသည်။

သက္ကရာဇ် ၁၁၁၉ခုနှစ်တွင် ဖရာပလိချေပဒေါင်(ဖရာပလိချေပဒေါင်း) ကိုးဆက်မြောက်မြို့တော်ဝန် ခန့်ထားပြီးနောက် (၂)နှစ်အကြာ ၁၁၂၁ခုနှစ်တွင် ကုန်းဘောင်ဆက်အလောင်းမင်းတရားကြီး ဦးအောင်ဇေယျ သည် ပုလောမြို့၊ မြတ်မြို့၊ တနင်္သာရီမြို့တို့ကို အခုအခံမရှိသိမ်းယူတော်မူခဲ့သည်။ ဦးအောင်ဇေယျ၏ သားတော်ကြီးဖြစ်သော နောင်တော်ကြီးမင်းက ၁၁၂၃ခုနှစ်၌ ဥဒိန်းကျော်အား ပထမမြို့ဝန်ခန့်ထားခဲ့သည်။ ဥဒိန်းကျော်သည်(၇)နှစ်အုပ်စိုးနေစဉ်အတွင်း သက္ကရာဇ် ၁၁၂၄ခုနှစ်၊ သီတင်းကျွတ် လဆုတ်(၇)ရက်နေ့တွင် မြို့အဝှမ်း သစ်လုံးတပ်(၁၁၃၈)တာကိုတည်၍ မာရိတ်အမည်ကိုဖျက်ပြီး မြတ်မြို့ဟုတွင်စေသည်။ ခယ်တောင် စေတီကို အသစ်ထပ်မံ၍ တည်ခဲ့သည်။

ဆင်ဖြူရှင်မင်းလက်ထက် ၁၁၃၀ပြည့်နှစ်တွင် ဒုတိယမြို့ဝန်ဖြစ်လာသော ခေမာရာဇာသည် ခယ်တောင်စေတီတော်ကြီးကို အပြီးသတ်တည်၍ ထီးတော်တင်လေသည်။ မြတ်မြို့ကိုလည်းတောရွာများမှ လူအများကိုခေါ်ယူ၍ ရပ်ကွက်များ သတ်မှတ်ပြီးတိုးချဲစီမံလေသည်။ ထိုမင်းလက်ထက်တွင် မြတ်မြို့၌ ပညာအရာတွင် ကျော်ဇောကိတ္တိရှိသော စတိန်ဆရာတောကြီးဦးဇာဂရကို အင်းဝသို့ ပင့်ဆောင်တော်မူ ပြီးလျှင် ဂုဏာသာရဓမဟာဓမ္မရာဇာဘွဲ့တံဆိပ်တော်ကိုဆက်ကပ်လျှုဒါန်းတော်မူသည်။ ဆရာတော်ကြီးသည် နေပြည်တော်သို့ ရောက်ရှိနေစဉ်အတွင်း ခယ်တောင်ကုန်းပေါ်တွင် ဗုဒ္ဓသိမ်သမုတ်ရန် မင်းတရားထံခွင့် ပန်ခဲ့သည်။

ဆရာတော်ကြီးသည် မြတ်မြို့သို့ ပြန်လည်ကြွရောက်လာတော်မူပြီးနောက် ၁၁၄၀ပြည့်နှစ်၊ (၆)ဆက်မြောက် မြတ်မြို့ဝန် ခေါ်တော်ကြီးလက်ထက် နတ်တော်လပြည့်၊ တနင်္လာနေ့၊ ညနေသုံးချက်တီး အချိန်တွင် ဆရာတော်ကြီးကိုယ်တိုင်ဦးစီးလျက် ထားဝယ်မြို့ သာသနာပြုဆရာတော် ပညာသာဓမဟာ ဂုရုဆရာတော်နှင့် ကောဏ္ဍည၊ ပုပ္ပဖလ၊ ရေဝတ၊ သောဘိတ အစရှိသော သံဃာတော်ကြီးအပါးတစ်ရာနှင့် အတူသိမ်တော်ကြီးကို သမုတ်၍ အောင်မြင်ပြီးစီးခဲ့သည်။

မြိတ်မြို့ဝန်နေမျိုးကျော်ထင်လက်ထက် ဂုဏာသာရဓေမဟာဓမ္မရာဇာ စတိန်ဆရာတောကြီး အရှင်ဇာဂရမထေရ် အမှူးပြုသော သံဃာတော်ကြီးများနှင့် တကွ မြို့လူကြီးများသည် တတိယအကြိမ် ခယ်တောင်စေတီတော်ဟောင်းကို တိုးချဲ့ပြီးလျှင် ၁၁၇၄ခု၊ တန်ဆောင်မုန်းလဆန်း(၄)ရက်၊ တနလင်္ဂနေ့ တစ်ချက်တီးကျော်ချိန်တွင် အသစ်ထပ်မံတည်တော်မူပြီး လေးကျွန်းဆီမီးစေတီတော်ကြီးဟု အမည်တွင် ခဲ့လေသည်။

သက္ကရာဇ် ၁၁၇၅ခုနှစ်တွင် (၁၉)ဆက်မြောက် မြိတ်မြို့ဝန်ဖြစ်လာသော ပဲတောင်စားလက်ထက်၌ မြိတ်မြို့နေ ပန်းမင်းရဲလှကျော်ခေါင်က ၁၁၇၇ခုနှစ်၊ တန်ဆောင်မုန်း လဆုတ်(၉)ရက်သောကြာနေ့ နံနက် သုံးချက်တီးအချိန်တွင် လေးကျွန်းဆီမီးစေတီတော်ကြီးကုန်းတော်ပေါ်၌ ရွှေဂူစေတီတစ်ဆူကို တည်ထားခဲ့သည်။ မြိတ်မြို့နေလူအများမှာ ခယ်တောင်ပေါ်တွင်တည်ထားသည့် သမုတ်သိမ်တော်ကြီးကို အစွဲပြု၍ သိမ်တော်ကြီးဟုသာ ခေါ်ဝေါ်သုံးစွဲကြရာ လေးကျွန်းဆီမီးစေတီတော်ကြီးဟု အမည်တွင်စေခဲ့သော်လည်း သိမ်တော်ကြီးဘုရား၊ သိမ်တော်ကြီးတောင် ဟူ၍သာ ယနေ့ထက်တိုင် အသုံးများလျက်ရှိကြလေသည်။

**၂၁။ စေတီတော်ကြီး တည်ထားတော်မူပုံအဆင့်ဆင့်**

သက္ကရာဇ် ၁၁၈၁ ခုနှစ်တွင် ခန့်ထားသော (၂၃)ဆက်မြောက် မြိတ်မြို့ဝန် ဦးမြတ်လေး လက်ထက် ၁၁၈ဖခုနှစ်၊ သီတင်းကျွတ်လဆန်း (၉)ရက်နေ့တွင် ဒု ဗိုလ်မှူးကြီး ဟိုင်းလ် ဦးစီးသောတပ်မ (၈၉)မှ တပ်သား ၃၇၀ပါဝင်သည့် စစ်သင်္ဘော(၄)စင် မြိတ်မြို့သို့ ဝင်ရောက်လာသဖြင့် မြိတ်မြို့ဝန် ဦးမြတ်လေးသည် ဆိပ်ငယ်ရပ်ကိုဖြိုဖျက်၍ သူ့ရဲခိုခိုင်ခံ့စွာစီရင်ပြီး သိမ်တော်ကြီးကုန်တော်ပေါ်တွင် ရန်ပုံခွင်အမြောက်ကြီး နှင့်အတူ ဝတ်တိုက်ကျောင်းတောင်အထိ အမြောက်ကြီးငယ်များစီမံလျက် (ဖ)ရက်တိုင်တိုင် ခုခံ တိုင်ခိုက်ခဲ့သည်။ သို့ရာတွင် စစ်အင်အားမမျှတမှုကြောင့် သီတင်းကျွတ်လဆန်း(၁၄)ရက် ညနေ(၅)နာရီတွင် မြိတ်မြို့သည် အင်္ဂလိပ်လက်အောက်ကျရောက်ခဲ့ရသည်။ အင်္ဂလိပ်တို့ မြိတ်မြို့ကိုပိုင်စိုးနေစဉ်အတွင်း မြို့သူမြို့သားများမှာ ထိုလေးကျွန်းဆီမီးစေတီတော်ကြီးကို ပြုပြင်စောင့်ရှောက်လျက်ရှိနေကြသည်။

မြန်မာနိုင်ငံလွတ်လပ်ရေးရပြီး (၁၀)နှစ်အကြာ၁၃၁၉ခုနှစ်၊ ပြာသိုလပြည့်၊ စနေနေ့တွင် ရွှေထီးတော်၊ စိန်ဖူးတော်နှင့် ၄က်မြတ်နားတော်တို့ကို ပြန်လည်တင်လှူခဲ့သည်။ ဤတစ်ကြိမ်တင်လှူရာတွင်လည်း စိန်ဖူးတော်နှင့် ၄က်မြတ်နားတော်တို့ကို အသစ်ပြန်လည်ပြုပြင်ခဲ့ကြသည်ဖြစ်ရာ အောက်ပါအတိုင်း မှတ်တမ်းတင်ထားခဲ့ပါသည်။

စိန်ဖူးတော်ကြီးမှာ အမြင့်(၁၅)လက်မ၊ လုံးပတ်(၁၅) လက်မရှိသည့် အကွက်ပေါင်း(၁၀၈)ကွက် ဖော်ထား၍ ကကာကလပ်အပါအဝင်စိန်ဖူးတော်ကြီး၏ (၂၅)လက်မတွင် ရွှေချိန် ၁၇၄ကျပ်၊ ၄ပဲ၅ရွေး၊ ငွေချိန် ၁၅ပိသာ၂ကျပ် ၈ပဲ၊စိန် ၂၅ဖလုံး၊ပတ္တမြား ၉၇၂လုံး၊နီလာ ဖ၄၈လုံး၊ရောင်စုံကျောက် ၁၅ဖ၉လုံး၊ စုစုပေါင်းကျောက်မျက်ရတနာ (၃၄၄၅)လုံးဖြင့်တင့်တယ်အောင် မွမ်းမံထားသည်။ထို့နောက်၁၃၂၈ခုနှစ်၊ တန်ခူးလဆန်း (၇)ရက်(၁ဖ-၄-၁၉၄၇)၊ တနင်္ဂနွေနေနေ့ မွန်းလွဲ ၅နာရီတွင် လေပြင်းမုန်တိုင်းဒဏ်ကြောင့် စိန်ဖူးတော်မှာ ကွဲကြေသွားခဲ့သည်။

အသစ်ပြန်လည် မွမ်းမံတပ်ဆင်လှူဒါန်းခဲ့သော စိန်ဖူးတော်ကြီးမှာ အမြင့် (၁၄)လက်မ၊ လုံးပတ်(၁၇) လက်မ၊ စလင်းကျောက်ကြီး၏အလေးချိန် ၅ပိသာ၊ ၃၀ ကျပ်သား၊ ရွှေကလပ်တော်ရွှေချိန်၂ပိသာ ၁၁ကျပ်သား ဖပဲ ဖရွေးနှင့် ပတ္တမြား ဖ၄၉လုံး၊ စိန် ၂၅၈ လုံး၊ နီလာဖ၄၈လုံး၊ ရတနာမျိုးစုံ ၁ဖ၄၈လုံး၊ ရွှေခေါင်းလောင်း (၁၀)လုံး၊ ရွှေကြာလံအမြင့် ၅လက်မ၊ လုံးပတ် ၂၅လက်မ၊ ရွှေခါးစည်းအမြင့် ၄လက်မ၊ လုံးပတ် ၁၂ လက်မ၊ ရွှေကြာမောက်အမြင့် ၅လက်မ၊ လုံးပတ် ၂၀လက်မ၊ စုစုပေါင်း (၃၂၀၃) လုံး၊ (၃၅၃၅)ရတီ (၁၂)ဗီဇွာရှိပါသည်။

အသစ်ပြန်လည်ပြုလုပ်သည့် ၄က်မြတ်နားတော်ကြီးမှာ အမြင့် (၁၃) လက်မ၊ အလျား (၃၉)လက်မ၊ ရွှေသားအချိန် ၃ပိသာ ၄၃ကျပ် ၉ပဲ ဖရွေးနှင့် ပတ္တမြား ၈၇၀လုံး၊ စိန် ၉၉လုံး၊ ဂေါ် ၄၃၅လုံး၊

ရွှေခေါင်းလောင်းကြီးငယ် ၅၃လုံး၊ ရတနာမျိုးစုံ ၁၂၄၅၅လုံး၊ စုစုပေါင်း ၇၄၅ရတီ ရှိကြောင်းနှင့် ထီးတော်အမြင့် ၂၇ပေ၊ ထိပ်ဝအချင်း ၈ပေ ၄လက်မ၊ဘုံ ၇ဆင့်၊ အနောက်ဌာပနာရွှေပိုက်လုံး ၁၈.၆လက်မ ရှိကြောင်း မှတ်တမ်းတင်ထားပါသည်။

**၃။ မြိတ်မြို့သိမ်တော်ကြီးစေတီစိန်ဖူးတင်ပိုဒ်စုံရတုကဗျာမှစာဆို၏အရေးအဖွဲ့လေ့လာချက်**

'မြိတ်မြို့သိမ်တော်ကြီးစေတီစိန်ဖူးတင်'ရတုကဗျာသည် တောကျောင်းဆရာတော် အဂ္ဂမဟာပဏ္ဍိတ အရှင်ပဒုမ၏ အချီညီအချည် ပိုဒ်စုံရတုတစ်ပုဒ်ဖြစ်ပါသည်။ ထိုကဗျာကို ၁၃၁၉ခု၊ ပြာသိုလပြည့် စနေနေ့တွင် ရေးသားသည်ဟုမှတ်တမ်းပါရှိရာ(၆၃)နှစ် သက်တမ်းရှိသော ရတုတစ်ပုဒ်လည်းဖြစ်ပါသည်။ ပိုဒ်စုံရတုတွင် တစ်ပိုဒ်နှင့်တစ်ပိုဒ် အကွာရာအတိုအရှည်ညီနေလျှင်'မင်္ဂလာ'ဟုခေါ်ရာ 'မြိတ်မြို့သိမ်တော်ကြီးစေတီစိန်ဖူးတင်' ကဗျာမှာလည်း ကျက်သရေအဖြာဖြာပြည့်စုံသော မင်္ဂလာမည်သော ရတုတစ်ပုဒ်လည်းဖြစ်ပါသည်။ စာဆိုသည် ဗုဒ္ဓဘာသာတို့၏ အလှူအတန်းရက်ရောပုံ၊ သဒ္ဓါတရားပွားများပုံတို့ကို အခြေခံကာ စကားအသုံးအနှုန်း၊ သရုပ်ဖော်အဖွဲ့၊ ကာရန်ယူပုံ၊ ဂုဏ်၊ အလင်္ကာ၊ ရသဟူသော အရေးအဖွဲ့တို့ဖြင့် ပေါ်လွင်အောင် ခြယ်မှုန်းထားသည်မှာ စာဖတ်သူများအနေဖြင့်လည်း ဗုဒ္ဓဘာသာတရားတော်များကို ပိုမိုသက်ဝင် ယုံကြည်လာစေပါသည်။

စကားအသုံးအနှုန်းကိုလေ့လာကြည့်လျှင် ကျစ်လျစ်လှပသော စကားလုံးများကို တွေ့ရပါသည်။ သတ္တလောက (လူသတ္တဝါတို့၏လောက)၊ သခ်ီရလောက (ဖြစ်ပျက်ပြုပြင်လောက)၊ သြကာသလောက (ရှိရှိသမျှလူသတ္တဝါအားလုံးရှိသောလောက)ကို **'ခေတ်သုံးဖြာ၌နှိုင်းစာမရှိ'** ဟုလည်းကောင်း၊ ဘဒ္ဒကမ္ဘာတွင် ကကုသန်၊ ကောဏာဂုံ၊ ကဿပ၊ ဂေါတမဟူ၍ ဘုရားလေးဆူပွင့်ပြီးသည်ကို ဘုရားအမည် နောက်ဆုံး စကားလုံးကိုယူ၍ **'သံ-ဂုံ-ပ-မ၊ပွင့်ကုန်ကြသည်'**ဟု၍ စာဆို၏အခွင့်ထူးကိုသုံး၍ သွေဖည်ရေးဖွဲ့ထားသည်။ စာဖတ်သူမှန်မှန်ကန်ကန် အနက်ကောက်နိုင်သော သွေဖည်မှုမျိုးကိုသုံးထားသည်မှာ စာဆို၏ စာပေကျမ်းဂန်ကျွမ်းကျင်ပိုင်နိုင်ကြောင်းလေ့လာတွေ့ရှိရပါသည်။

ထိုပြင်အနက်တူစကားလုံးများကို အလဲအလှယ်သုံး၍ ရေးဖွဲ့ထားသည်မှာ **'ခယ်တောင်၏ထိပ်'၊ 'ခယ်တောင်ထိပ်စွန်း'၊ 'မြိတ်နယ်ပတ်ဝန်း'၊ 'မြိတ်နယ်မြန်မာ၊' 'သဒ္ဓါပေါင်းဆုံ'၊'သဒ္ဓါရောင်စို့'၊'သဒ္ဓါဖွံ့ဖြိုး'** ဟူ၍ အနက်တူစကားလုံးများကို အလဲအလှယ်သုံးထားသည့်အတွက် စာဖတ်သူအာရုံကို အပြောင်းအလဲဖြစ်စေသည်။ လေးလုံးစပ်ကဗျာတွင် စကားပရိယာယ်ကြွယ်ဝခြင်းသည် ကဗျာအပေါ်တွင် စိတ်ဝင်စားဖွယ်၊ နှစ်သစ်ဖွယ်ဖြစ် လာစေနိုင်ပါသည်။

> အလင်္ကာအဖွဲ့များကိုကြည့်လျှင် ထိမိပေါ်လွင်စွာသုံးနှုန်းထားသည်ကို တွေ့ရပါသည်။
> 'ရှင်မြတ်သုံးဆူ၊ ကိန်းတော်မူ၍၊ နတ်လူရွှင်လန်း၊ **လနှယ်ဆန်းသို့'၊** ဟုလည်းကောင်း၊
> 'သူတော်စွာတို့၊ ဥစ္စာပွားမြင့်၊ သုံးကြိမ်ဆင့်၍၊ငုံလင့်ကစား၊ နောက်သား ကြိမ်ကြိမ်၊
> တင်းမတိမ်လိမ့်၊ **လအိမ်ထိလောက်**၊ စိတ်ဇောမြောက်၍၊'

ဟူသော ဥပမာအလင်္ကာဖြင့် ဖွဲ့ပြထားပုံမှာ စိန်ဖူးတော်တင်ရာတွင် နတ်လူတို့ ရွှင်လန်းဝမ်းမြောက်ကြပုံ၊ မြိတ်မြို့သူ၊မြိတ်မြို့သားအပေါင်းတို့၏ စေတနာသဒ္ဓါတရားထက်သန်ကြပုံမှာ ပိုမိုထင်ရှားပေါ်လွင်လာသည့် အပြင် ကဗျာမှာ နှစ်သက်ဖွယ်ဖြစ်လာပါသည်။ စာဖတ်သူများ၏ စိတ်တွင်လည်း ကြည်နူးသဒ္ဓါ စိတ်များ အလှူ ဒါနပြုချင်စိတ်များ ဖြစ်ပေါ်လာစေသော အလင်္ကာအသုံးများဖြစ်ပါသည်။

စာဆို၏ သရုပ်ဖော်အဖွဲ့ စွမ်းရည်အဖြစ် ကဗျာတွင် ရေးဖွဲ့ထားသည်မှာ မြိတ်မြို့ကျက်သရေဆောင် စေတီတော်ကြီး၏ ခမ်းနားထည်ဝါစွာ သပ္ပာယ်နေပုံကို မြင်ယောင်လာစေပြီးကြည်ညြို စိတ်များဖြစ်ပေါ်လာစေပါသည်။

> ‘ခယ်တောင်၏ထိပ်၊ ရွှေရောင်ရိပ်တွင်၊ တံဆိပ်သဘွယ်၊ လွန်သပ္ပါယ်၍။ မြိတ်နယ်ပတ်ဝန်း၊ ခေါ်တွင်ညွှန်းသည်၊ လေးကျွန်းဆီမီး၊စေတီကြီးတွင်၊’

ဟုလည်းကောင်း

> ‘စိန်ဖူးတော်အား၊ငှက်မြတ်နားနှင့်၊ ရွှေသားဆင့်၍၊ကြာပွင့်တမျိုး၊ ရွှေကြာအိုး နှင့်၊ရွှေကိုးဖွဲ့မှီ၊ စိန်တွေစီလျက်၊ ကျောက်နီပတ္တမြား၊ နီလာများနှင့်၊ အခြားရတနာ၊ စီမံရာ၌၊ ပညာမသိမ်၊ ရွှေလိမ်နွယ်လျက်၊ ပန်းတိမ်ဥာဏ်ထူး၊ သိကြားဖူး သို့၊’

ဟူ၍ ကာရန်အချိတ်ဆက်မိမိဖြင့် ရေးဖွဲ့ထားပါသည်။ ခယ်တောင်ထိပ်တွင် ရွှေရောင်ထိန်ထိန်ဖြင့် လေးကျွန်းဆီမီးစေတီတော်ကြီးမှာ လွန်စွာသပ္ပာယ်နေပုံ၊ စိန်ဖူးတော်ကြီးအား ရတနာမျိုးစုံဖြင့်စီခြယ်ထားပုံကို အသေးစိတ်ရေးဖွဲ့ထားရာ စိတ်မျက်စိ စိတ်နားတွင် မြင်ယောင်ကြားယောင်လာစေသော သရုပ်ဖော်အဖွဲ့ဖြစ်သည်။ မြိတ်မြို့သူမြိတ်မြို့သားတို့၏ သဒ္ဓါတရားထက်သန်ပုံ၊ ဘာသာတရားကိုင်းရှိုင်းပုံ ပိုမိုပေါ်လွင်လာပါသည်။ ၄-၃-၂ ဟူသော သုံးချက်ညီကာရန်ဖြင့်အများဆုံး ရေးဖွဲ့ထားသည်မှာ စေတီဘုရား အနီးရောက်သည့် လူတိုင်း သောကများခဏာငြိမ်း၍ တည်ငြိမ်အေးချမ်းသော စိတ်အခြေအနေ၏ သဘောကို ပေါ်လွင်စေပါသည်။

ရတုတွင် အချီအချသာမက ပဒေါ်သ၊ ဝါကျဒေါ်သ၊ ဝါကျတ္ထဒေါ်သ ကင်းစင်ရမည်။ ဂုဏ်ရသတို့နှင့် ပြည့်စုံရမည်။ အသတ်(၆)ပါးရှောင်၍ ပင့်ရစ်မှန် မည့်ဆိုသည့် ဥပဒေသများသည် ရတုဖွဲ့ရာတွင် ထိန်းသိမ်းချုပ်ကိုင်ခြင်းတစ်ရပ်ပင်ဖြစ်ပါသည်။ တစ်နည်းအားဖြင့် ရတုကဗျာဖွဲ့ရာတွင် တင်းကြပ်ထားသော စည်းမျဉ်းများဖြစ်သည်။ မြိတ်မြို့သိမ်တော်ကြီး စေတီစိန်ဖူးတင်ပိုဒ်စုံရတုတွင်လည်း ထိုသို့ဥပဒေသများ၊ စည်မျဉ်းစည်းကမ်းများနှင့် အညီ ရေးဖွဲ့ထားကြောင်းလေ့လာတွေ့ရှိရပါသည်။

> ထူးဆန်းတေဇ၊ ခေတ်သုံးဖြာ၌၊နှိုင်းစာမရှိ၊ မာရဇိဟု၊မုနိတမွတ်၊ သုံးလူထွတ်သည်၊ ကျွတ်ထိုက်ဝေနေ၊ တရားရေဖြင့်၊ တိုက်စေပြီးမူ၊ ပြည်နိဗ္ဗုကို၊မယူမှီပင်၊ ရှေ့ကြိုတင်၍၊ အမြင်သန်စွာ၊ သာသနာသည်၊ အနာဂတံ၊ ဒိဗ္ဗညာဏ်ဖြင့်၊ နိုင်ငံရပ်ခြား၊ တိုင်းပြည်များသို့၊ ထွန်းကားလတ့ံ၊ တရားပျံ့၍၊ ကျွတ်အံ့သတ္တဝါ၊ ဂရုဏာဖြင့်၊ ငါ၏ကိုယ်မှ၊ သရိရဓာတ်၊ ရှစ်စရွတ်လျှင်၊ အလွတ်ကွဲနေ၊ ဆူစီကြွေ၍၊ တည်စေသားဟု၊ ဓိဋ္ဌာန်ပြု၍၊ ဓာတုဆူပွား၊ ကျွင်းကျန်ထားသည်၊ ဘုရားတရထည်၊ ကိုယ်စီလည်သို့၊ တိုင်းပြည်အများ၊ ကြွသွားရာတွင်၊ တနင်္သာရီ၊ တိုင်းဌာနီ၏၊ နဒီမြစ်တ၊ ရှုမြင်လှသည်၊ မြည်ကြောင်ရိပ်၊ သင်္ဘောဆိပ်ဟု၊ လိပ်ကမ္ဘည်းပေါ်၊ ကမ္ဘာကျော်သည်၊ ရွှင်တော်ဗျာဒိတ်၊ ရှေးအတိတ်နှင့်၊ မြိတ်မြို့ဂုဏ်ရောင်၊ ထွန်းလင်းပြောင်၍၊ ခယ်တောင်၏ထိပ်၊ ရွှေရောင်ရိပ်တွင်၊ တံဆိပ်သဘွယ်၊ လွန်သပ္ပါယ်၍။ မြိတ်နယ်ပတ်ဝန်း၊ ခေါ်တွင်ညွှန်းသည်၊ လေးကျွန်းဆီမီး၊ စေတီကြီးတွင်၊ သရီရဓာတ်၊ ဗုဒ္ဓမှတ်သည်၊ ရှင်မြတ်သုံးဆူ၊ ကိန်းတော်မူ၍၊ နတ်လူရွှင်လန်း၊ လနယ်ဆန်းသည်၊ ဥဒါန်းကြေညာ၊ အခါမရွေးအေးစေတည်း။ ။ (သိမ်တော်ကြီးစေတီသမိုင်း၊စာ၊ ၁၂)

ဟူ၍ကဗျာ ပထမအပိုဒ်တွင် ငါးမာရ်အောင်မြင်ပြီးသော အရှင်မြတ်စွာဘုရား၏ ဂုဏ်ရည်များကို ကာရန်၊ နဘော ညီညွတ်စွာဖြင့် ရေးဖွဲ့ထားပါသည်။ ၄-၃-၂၊ ၄-၃-၁၊ ၄-၂ ၊၄-၃-၃ ကာရန်များယူထားပါသည်။ ဘုရားတိုင်ရတုဖြစ်၍ တည်ငြိမ်အေးဆေးသော အသံကို ပေါ်လွင်စေရန် သုံးချက်ညီခေါ် ၄-၃-၂ကာရန်ကို (၂၁)ကြိမ် ထပ်ကာထပ်ကာသုံးထားသည်။ စာရေးသူပြောချင်သော အကြောင်းအရာမှာဝေဝေဆာဆာ ဖြစ်လာစေပါသည်။ တစ်ပိုဒ်လုံးတွင် သုံးချက်ညီစပ်၍ အနက်ပြည့်ဂုဏ်၊ စကားရှင်ဂုဏ်၊ စကားယဉ်ဂုဏ်၊ တင်စားဂုဏ်၊ နှစ်သက်ဖွယ်ဂုဏ်တို့နှင့်ပြည့်စုံပါသည်။ ရတုတွင် အသံမှန်ခြင်း၊ ကာရန်မှန်ခြင်း ဟူသည့် စည်းကမ်းများနှင့် စနစ်တကျရေးဖွဲ့ထားနိုင်သောကြောင့် စာဆို၏ ကဗျာဖန်တီးမှုတတ်ပညာ ကျွမ်းကျင်ပိုင်နိုင်ကြောင်း လေ့လာတွေ့ရှိရပါသည်။

ကဗျာဒုတိယပိုဒ်တွင် ပဒ(၆၃)ပဒရှိပါသည်။ ၄-၃-၂ဟူသော သုံးချက်ညီ ရတုဖွဲ့နည်းသည် စည်းကမ်းအတင်းကျပ်ဆုံးဖြစ်သည်။ အခြားသောနှစ်ချက်ညီရတုကဗျာစပ်နည်းများမှာ များစွာလွတ်လပ်ပေသည်။ တစ်ပိုဒ်နှင့်တစ်ပိုဒ်ချိတ်ရုံဖြင့်ရလေသည်။ ယခုရတုတွင် ၄-၃-၂ ကာရန်တစ်ခုတည်းကိုပင် အများဆုံးသုံးထားသဖြင့် စာဆို၏ ရတုကဗျာအဖွဲ့အစပ်ပိုင်နိုင်ကြောင်းတွေ့ရှိရပါသည်။

ဥဒါန်းကြေညာ၊ မင်္ဂလာဟု၊ နေရာဘုမ္မီ၊နက်သန်ရှိ၍၊ မုနိလေးဆူ၊ ကိန်းတော်မူသည်၊ ဥပမာပုံ၊ ထူပါရုံသို့၊ သံ-ဂုံ-ပ_မ၊ ပွင့်ကုန်ကြသည်၊ ဗုဒ္ဓဂုဏ်ရောင်၊ ရှေးယခေါင်က၊ ခယ်တောင်ထိပ်စွန်း၊ ရွှေရောင်ထွန်းသည်၊ လေးကျွန်းဆီမီး၊ စေတီကြီးကို၊ မပြီးစေတနာ၊ နောင်သောအခါ၌၊ သဒ္ဓါပေါင်းဆုံ၊ ထပ်၍စုံလိမ့်၊ ပဒုမ္မတ္တိုရ်၊စေတီကိုလျှင်၊ ကြည်ညိုသူများ၊ အစလူတို့၊ ယူဇနာမြင့်၊ နည်းတူဆင့်၍၊ နတ်နှင့်နဂါး၊ ဂဠုန်များတဖန်၊ ဂုမ္ဘဏ်ယက္ခ၊ ဂန္ဓဗ္ဗတို့၊ ထပ်ခါထပ်ခါ၊ ရတနာမျိုး၊ ဆက်ခါတိုး၍၊ ပုထိုးကြီးပမာ၊ နည်းတူစွာဖြင့်၊ သဒ္ဓါရောင်စို့၊ မြေတောင်ပို့သို့၊ မြိတ်မြို့စေတီ၊ လက်ဦးချီ၍၊ လေးလီရှစ်မြောက်၊ တောင်အစောင်နှင့်၊ ခြောက်ခုသုံးသွယ်၊ ဖိနပ်ကျယ်၍၊ မြိတ်နယ်မြန်မာ၊ သဒ္ဓါဖွံ့ဖြိုး၊ သျှမ်းအုပ်စိုးစဉ်၊ ထောင်ကိုးဆယ်ဖြစ်၊ သုံးခုနှစ်တွင်၊ အမြစ်တည်လာ၊ သူတော်စွာတို့၊ ဥစ္စပွားမြင့်၊ သုံးကြိမ်ဆင့်၍၊ ငုံလင့်ကစား၊ နောက်သားကြိမ်ကြိမ်၊ တင်းမတိမ်လိမ့်၊ လအိမ်ထိလောက်၊ စိတ်ဇောမြှောက်၍၊ မြင့်မောက်ပေမည်၊ ကုသိုလ်တည်လျက်၊ စိတ်ရည်မျှော်မှန်း၊ ပေးလှူဒါန်းသည်၊ ကူးသန်းခေမာ၊ တဏှာအမြှေးဝေးစေသတည်း။ ။

ဟူ၍ အောင်မြေအချက်အချာကျသော သိမ်တော်ကြီးကုန်ပေါ်တွင် ပွင့်ပြီးသော ဘုရားလေးဆူကိုတည်ထားပုံ၊ နတ်၊နဂါး၊ ဂုမ္ဘဏ်ယက္ခ၊ဂဠုန်များကပါဝိုင်းဝန်းပူဇော်ကြပုံ၊ နောင်လာနောင်သားများ ဆက်လက်ထိန်းသိမ်းရန် စိတ်ရည်မှန်း၍ တည်ထားကိုးကွယ်ပုံ စသည့်အကြောင်းအရာများကို စုံစုံလင်လင်ဖော်ပြထားသည်။ အသံယူပုံမှာ 'ညာ-လာ-ရာ'ဟူသည့် 'အာ' ကာရန်တက်သံ၊ 'မိ-ရှိ-နိ'ဟူသည့် 'အိ' ကာရန်သက်သံ၊ 'ဆူ- မူ'ဟူသည့် တက်သံ၊ 'ပုံ-ရုံ-ဂုံဟူသည့် နိမ့်သံ'၊ 'မ-ကြ-ဓ'ဟူသည့် သက်သံ၊ ရောင်-ခေါင်-တောင်'ဟူသည့် တက်သံ၊ စွန်း-ထွန်း-ကျွန်း'ဟူသည့် နိမ့်သံ၊ မီး-ကြီး-ပြီး' ဟူသည့် နိမ့်သံ စသည် ကာရန်များကို တစ်လှည့်စီယူ၍ ရေးဖွဲ့ထားသည်မှာ အကြောင်းအရာနှင့် လိုက်ဖက်၍ အနက်ကိုပိုမိုထင်ရှားအောင် ဖန်တီးထားနိုင်သည်ကို လေ့လာတွေ့ရှိရပါသည်။ တက်သံ(ချီသံ)၊ သက်သံ(ချသံ)၊ နိမ့်သံ (ချသံ)၊ တိုင်သံ (ချသံ)များကို တစ်လှည့်စီရေးဖွဲ့ထားသောကြောင့် ချီသံချသံ ညီညွတ်၍ ကဗျာမှာ သာယာနာပျော်ဖွယ်ဖြစ်လာပါသည်။

ကဗျာတတိယပိုဒ်တွင် နောင်အခါ၌ သာသနာရောင်ဝါ ထွန်းလင်းစေရန်အတွက် မြိတ်မြို့ကျက်သရေဆောင် လေးကျွန်းဆီမီးစေတီတော်ကြီးကို ကြာပွင့်၊ ကြာအိုးပုံ သဏ္ဌာန် များဖြင့်ဖွဲ့စည်ထားပုံ၊ စိန်ရွှေများဖြင့် ခမ်းနားထည်ဝါစွာ တည်ထားကိုးကွယ်ပုံ၊ သိကြားမင်းကိုယ်တော်တိုင် လာရောက်ဖူးမြော်ရပုံ စသည့်အကြောင်းအရာများကို ပေါ်လွင်အောင် ရေးဖွဲ့ထားသည်ကို တွေ့ရှိရပါ သည်။

ကူးသန်းခေမာ၊ မင်္ဂလမ်းရှာသည်၊ သာသနာအခက်၊ အညွှန်တက်သို့၊ မြိတ်ကြက်သရေ၊ ဤအောင်မြေ၌၊ ရွှေစေတီကြီး၊ အံ့မဉီးသည်၊ ရွှေထီးတင်လား၊ ဒါယကာတို့၊ပင်းပါဦးနှိမ်၊ ခုနစ်ကြိမ်ဖြင့်၊ မတိမ်ခုပင်၊ ရာဇဝင်နှင့်၊ ရွှေစင်တဆင့်၊ နောက်စင်မြင့်သို့၊ ရဲရင့်စိတ်ကူး၊ ရှေးထက်ထူးသည်၊ စိန်ဖူးတော်အား၊ဌက်မြတ်နားနှင့်၊ ရွှေသားဆင့်၍၊ ကြာပွင့်တမျိုး၊ ရွှေကြာအိုးနှင့်၊ရွှေကိုးဖွဲ့မှီ၊ စိန်တွေစီလျက်၊ ကျောက်နီပတ္တမြား၊နီလာများနှင့်၊ အခြားရတနာ၊ စီမံရာ၌၊ ပညာမသိမ်၊ရွှေလိမ်နွယ်လျက်၊ ပန်းတိမ်ဥာဏ်ထူး၊ သိကြားဖူးသို့၊ စိတ်ကူးယှဉ်လှ၊ ပြုကုန်ကြသည်၊ ဒါနဦးစီး၊သူဌေးကြီးဆို၊ဦးတက်ဟိုနှင့်၊ပုဂ္ဂိုလ်များမြောင်၊ ကုသိုလ်ဆောင်၍၊ ထောင်သုံးရာဝယ်၊ တစ်ဆယ်ကိုးနှစ်၊ ပြာသိုဖြစ်၍၊ လပြည့်နေ့တွင်၊ သုနက္ခတ္တာ၊ သုမင်္ဂလဟု၊ ကုသိုလ်ပြုသော်၊ သုံးလူ့ဘုရား၊ နေ့ကောင်းထား၍၊ သံဃာများနှင့်၊ မြို့သားစုံလင်၊ စေတီပြင်၌၊ သဘင်ချိမ့်ချိမ့်၊ သဒ္ဓါစိမ့်အောင်။ နှစ်သိမ့်ဘွယ်ယူ၊ အသံလှ၍၊ ပြည်သူဦးစီး၊

ဒုဝန်ကြီးအနေ၊ ဦးဗဆွေက၊ ဖော်ရွေအသင်း၊ မင်းတို့စုံလင်၊ စိန်ဖူးတင်သည်၊ စိတ်ရှင်လုံးပမ်း၊ ဤလုပ်ငန်းသည်၊ ထူးဆန်းတေဇာ၊ သဒ္ဓါသူဌေးပေးစေသတည်း။ ။

ဟူ၍ ဖော်ပြထားပါသည်။ ပဒ(ဖဖ)ပဒဖြင့်ရေးဖွဲ့ထားပါသည်။ 'ရွှေစေတီကြီး၊ အုံ့မငြီးသည်၊ ရွှေထီးတင်လား၊ ဒါယကာတို့၊' 'ရွှေသားဆင့်၍၊ ကြာပွင့်တမျိုး၊ ရွှေကြာအိုးနှင့်၊ရွှေကိုးဖွဲ့မှီ၊' ဟူ၍ ရွှေဟူသော စကားလုံးကို တစ်လုံးနှင့်တစ်လုံးနီးနီးကပ်ကပ် ဖွဲ့ဆိုထားသောကြောင့် အသံချိုသာ၍ မဓုရတာဂုဏ်မြောက်ပါသည်။ 'မာ-ရှာ-နာ'၊ 'ခက်-တက်-ကြက်' စသော ၄-၃-၂ကာရန်များဖြင့် စပ်ဆိုထားသည်။ ၄-၃-၂ကာရန်အဖွဲ့သည် ကဗျာဟန်ကို အေးဆေးတည်ငြိမ်သည့်သဘော၊ ပြေပြစ်သည့် သဘောဖြစ်စေပါသည်။ ၄-၃-၂ကာရန်ကို အဆက်မပြတ် စပ်ဆိုလာပြီး ရတုအချနားတွင်'စီး -ကြီး' ၄-၂ကာရန်၊ စပ်ဆိုထားသည်။ ၄-၂ကာရန်စနစ်သည် အကြောင်းအရာများကို ခပ်သွက်သွက်မြင်ယောင်လာစေသည်။

စာဆိုသည်အေးဆေးတည်ငြိမ်နေသည့် သဘောမှ အားပါလာသော သဘောကိုတွေ့ရပါသည်။ ရတုတွင် အချိုးအဆစ်၊အခံ၊ အအုပ်၊ အချ၊ တက်သံ၊ သက်သံတို့သည် အချိုးအစားပြေပြစ်နေပါသည်။ အနက်သိလွယ်၍ ရိုးရှင်သောစကားအသုံးအနှုန်းများကြောင့် အကြောင်းအရာမှာ ပိုမိုပေါ်လွင်၍ ပဿာဒဂုဏ် မြောက်ပါသည်။ အသံချိုသာ၍ မဓုရတာဂုဏ်မြောက်ပါသည်။

## ခြုံငုံသုံးသပ်ချက်

ကဗျာလေ့လာရာတွင် စကားအသုံးအနှုန်း၊ ဂုဏ်၊ အလင်္ကာ၊ ရသမြောက်သောအဖွဲ့များကြောင့် အကြောင်းအရာမှာ ပိုမိုပေါ်လွင်လာပါသည်။ ဆရာတော်သည် ရတုကဗျာစပ်ဆိုရာတွင် စကားလုံးများ၊ လေးနက်ခံ့ညားသော ဝေါဟာရများကို ရွေးချယ်၍ စပ်ဆိုလေ့ရှိသည်ကိုတွေ့ရပါသည်။ ကာရန်ယူပုံမှာ အင်းဝခေတ်ကကဲ့သို့ သတ်စေ့နှက် သုံးချက်ညီကို အသုံးများကြောင်းတွေ့ရသည်။ အသံယူပုံမှာ သံလွင်၊ သံလတ်၊ သံလေး သုံးမျိုးလုံးသူနေရာနှင့်သူယူထားသည်။ ရတုအချီ တွင်'ထူးဆန်းတေဇာ'၊ 'ဥဒါန်းကြေညာ'၊ 'ကူးသန်းခေမာ'၊ ဟုချီ၍ အချတွင်'အခါမရွေးအေးစေတည်း'။ 'တဏှာအမြေးဝေးစေသတည်း'။ 'သဒ္ဓါသူဌေး ပေးစေသတည်း'။ ချထားသောကြောင့် အချီညီ အချညီရတုကဗျာတစ်ပုဒ်ဖြစ်ပါသည်။ ၄လုံးစပ်အင်ဖမျိုးတွင် သုံးချက်ညီစပ်နည်း၊ ကိုယ်တွင်ပြည့်(၀ါ) ပဒအရေအတွက်အားဖြင့် ၃ပိုဒ်လုံးညီမျှအောင် ဖွဲ့ဆိုထားနိုင်သည် မှာ ဆရာတော်၏ ကဗျာဖန်တီးမှုအတတ်ပညာကျွမ်းကျင်ပိုင်နိုင်ကြောင်း တွေ့ရပါသည်။ လေးလုံးစပ်၍ (၁၁)လုံးချထားသောကြောင့် အာသာဝတီဝတ်ဆံချနည်းဖြင့် ရေးထားသည်။ ရတုကဗျာသည် စကားရှင်း အနက်ပြည့်ဂုဏ် (အတ္ထဗျတ္တိဂုဏ်)၊ အသိလွယ်သောအနက်၊ ထင်ရှားသောအနက်ရှိခြင်းဂုဏ်(ပဿာဒဂုဏ်)၊ ဖတ်လွယ်စကားယဉ်ဂုဏ် (သုခုမာလတာဂုဏ်)၊ ချိုသာနာပျော်ဖွယ်ဖြစ်အောင်စပ်ဆိုသောဂုဏ် (မဓုရတာ ဂုဏ်)၊ နှစ်လိုသာယာဖွယ်ဂုဏ်(ကန္တိဂုဏ်)၊ တင်စားဂုဏ်(သမာဓိဂုဏ်)တို့နှင့်လည်းပြည့်စုံသည့် ရတုကောင်း တစ်ပုဒ်ဖြစ်ပါသည်။

## နိဂုံး

စာပေအနုပညာရှင်တို့သည် မိမိရေးဖွဲ့သော ကဗျာ၊စာများတွင်စာဖတ်သူများ အသိတရားရစေရန်၊ အမျိုးသားရေးစိတ်ဓာတ်၊ အမျိုးဘာသာသာသနာ အခွန့်ရှည် တည်တံ့ရန်၊ နိုင်ငံချစ်စိတ်များဖြစ်ပေါ်စေရန်နှင့် ရသခံစားနိုင်စေရန် ရည်ရွယ်ရေးသားကြသည်။ ဆရာတော်၏ရတုကိုလေ့လာရာတွင် ဆရာတော် သက်ရှိ ထင်ရှားရှိစဉ်ကြုံတွေ့ရသော စိန်ဖူးတော်တင်ပုံကို ကဗျာအဖြစ်ပြောင်းလဲ၍ နောင်လာနောင်သားများ ဘာသာအကျိုး၊ သာသနာအကျိုးဆောင်ရွက်စေလိုသော စေတနာရည်ရွယ်ချက်နှင့်အတူ ဗုဒ္ဓဘာသာ မြန်မာလူမျိုးတို့၏ သဒ္ဓါစေတနာတရား ထက်သန်ပုံကို ကြည်းနူးဖွယ်ကြည်ညိုဖွယ်တွေ့မြင်လာရပါသည်။ စာဆိုသည် ရတုကို ရိုးရှင်းလွယ်ကူသော စကားအသုံးအနှုန်းတို့ဖြင့် တန်ဆာဆင်ရေးဖွဲ့ထားပါသည်။ စကားအသုံးအနှုန်းများ ကျစ်ကျစ်လျစ်လျစ်သုံးခြင်း၊ စကားပရိယာယ်ကြွယ်ကြွယ်ကြောင့် ရတုဂုဏ်ရည်မှာ ပိုမိုပေါ်လွင်လာ၍လေးကျွန်းဆီမီးသိမ်တော်စေတီမှာလည်း မြိတ်မြို့ကျက်သရေဆောင်အဖြစ် ယနေ့တိုင်

သပ္ပာယ်ကြည်ညိုဖွယ်တည်ရှိနေပါသည်။ ထိုသို့ သပ္ပာယ်ကြည်ညို ဖွယ်ကောင်းသော လေးကြီးဆီမီးစေတီ တော်ကြီးအား လာရောက်ဖူးမြော်၍ ကုသိုလ်များပွားများကြပါရန် ဆရာတော်၏ ရတုကဗျာကို ရေးသားပြုစု၍ ဖိတ်ခေါ်လိုက်ပါသည်။

**၁၃၁၉ခု ၊ပြာသိုလပြည့် စနေနေ့**

**မြိတ်မြို့ သိမ်တော်ကြီးစေတီစိန်ဖူးတင်ရတုပိုဒ်စုံ**

ထူးဆန်းတေဇာ၊ ခေတ်သုံးဖြာ၌၊နှိုင်းစာမရှိ၊ မာရဇိဟု၊မုနိတမွတ်၊ သုံးလူထွတ်သည်၊ ကျွတ်ထိုက်ဝေနေ၊ တရားရေဖြင့်၊ တိုက်စေပြီးမှ၊ ပြည်နိဗ္ဗာန်ကို၊ မယူမီပင်၊ ရှေ့ကြိုတင်၍၊ အမြင်သန်စွာ၊သာသနာသည်၊ အနာဂတံ၊ဒိဗ္ဗညာဏ်ဖြင့်၊ နိုင်ငံရပ်ခြား၊ တိုင်းပြည်များသို့၊ ထွန်းကားလတ္တံ့၊ တရားပျံ့၍၊ ကျွတ်အံ့သတ္တဝါ၊ဂရုဏာဖြင့်၊ ငါ၏ကိုယ်မှ၊ သရိရဓာတ်၊ ရှစ်စရွတ်လျှင်၊ အလွတ်ကွဲနေ၊ ဆူစီကြွေ၍၊ တည်စေသားဟု၊ဓိဋ္ဌာန်ပြု၍၊ ဓာတုဆူပွား၊ ကျွင်းကျန်ထားသည်၊ ဘုရားတရထည်၊ ကိုယ်စီလည်သို့၊ တိုင်းပြည်အများ၊ ကြွသွားရာတွင်၊ တနင်္သာရီ၊ တိုင်းဌာနီ၏၊ နဒီမြစ်တ၊ ရူမြင်လှသည်၊ မြည်ကြောင်ရိပ်၊သင်္ဘောဆိပ်ဟု၊ လိပ်ကမ္ဘည်းပေါ်၊ ကမ္ဘာကျော်သည်၊ ရွှင်တော်ဗျာဒိတ်၊ ရှေးအတိတ်နှင့်၊ မြိတ်မြို့ဂုဏ်ရောင်၊ ထွန်းလင်းပြောင်၍၊ ခယ်တောင်၏ထိပ်၊ ရွှေရောင်ရိပ်တွင်၊ တံဆိပ်သဘွယ်၊ လွန်သပ္ပါယ်၍။ မြိတ်နယ်ပတ်ဝန်း၊ ခေါ်တွင်ညွှန်းသည်၊ လေးကျွန်းဆီမီး၊စေတီကြီးတွင်၊ သရီရဓာတ်၊ ဗုဒ္ဓမှတ်သည်၊ ရှင်မြတ်သုံးဆူ၊ ကိန်းတော်မူ၍၊ နတ်လူရွှင်လန်း၊ လနယ်ဆန်းသည်၊ဥဒါန်းကြေညာ၊ အခါမရွေးအေးစေတည်း။ ။

ဥဒါန်းကြေညာ၊ မင်္ဂလာဟု၊ နေရာဘုမ္မာ၊နက်သန်ရှိ၍၊ မုနိလေးဆူ၊ ကိန်းတော်မူသည်၊ ဥပမာပုံ၊ထူပါရုံသို့၊ သံ-ဂုံ-ပ_မ၊ ပွင့်ကုန်ကြသည်၊ ဗုဒ္ဓဂုဏ်ရောင်၊ ရှေးယခေါင်က၊ ခယ်တောင်ထိပ်စွန်း၊ ရွှေရောင်ထွန်းသည်၊ လေးကျွန်းဆီမီး၊ စေတီကြီးကို၊ မပြီးစေတနာ၊ နောင်သောအခါ၌၊ သဒ္ဓါပေါင်းဆုံ၊ ထပ်၍စုံလိမ့်၊ ပဒုမ္မတ္တိ၊ရ်စေတီကိုလျှင်၊ ကြည်ညိုသူ များ၊ အစလူတို့၊ ယူဇနာမြင့်၊နည်းတူဆင့်၍၊ နတ်နှင့်နဂါး၊ ဂဠုန်များတဖန်၊ ဂန္ဓာဏ်ယက္ခ၊ ဂန္ဓဗ္ဗတို့၊ထပ်ခါထပ်ခါ၊ရတနာမျိုး၊ ဆက်ခါတိုး၍၊ ပုထိုးကြီးပမာ၊ နည်းတူစွာဖြင့်၊ သဒ္ဓါရောင်စို့၊ မြေတောင်ပို့သို့၊ မြိတ်မြို့စေတီ၊လက်ဦးချီ၍၊ လေးလီရှစ်မြောက်၊ တောင်အစောင်နှင့်၊ ခြောက်ခုသုံးသွယ်၊ ဖိနပ်ကျယ်၍၊ မြိတ်နယ်မြန်မာ၊ သဒ္ဓါဖွံ့ဖြိုး၊ သ္ဘျမ်းအုပ်စိုးစဉ်၊ ထောင်ကိုးဆယ်ဖြစ်၊ သုံးခုနှစ်တွင်၊ အမြစ်တည်လာ၊ သူတော်စွာတို့၊ ဥစ္စပွားမြင့်၊ သုံးကြိမ်ဆင့်၍၊ငုံလင့်ကစား၊ နောက်သားကြိမ်ကြိမ်၊ တင်းမတိမ်လိမ့်၊ လအိမ်ထိလောက်၊ စိတ်ဇောမြောက်၍၊ မြင့်မောက်ပေမည်၊ ကုသိုလ်တည်လျက်၊ စိတ်ရည်မျှော်မှန်း၊ ပေးလှူဒါန်းသည်၊ ကူးသန်းခေမာ၊ တဏှာအမြေးဝေးစေသတည်း။ ။

ကူးသန်းခေမာ၊ မင်္ဂလမ်းရှာသည်၊ သာသနာအခက်၊ အညွှန်တက်သို့၊ မြိတ်ကြက်သရေ၊ ဤအောင်မြေ၌၊ ရွှေစေတီကြီး၊ အံ့မဉီးသည်၊ ရွှေထီးတင်လား၊ ဒါယကာတို့၊ပင်းပါဦးနှိမ်၊ ခုနစ်ကြိမ်ဖြင့်၊ မတိမ်ခုပင်၊ ရာဇဝင်နှင့်၊ ရွှေစင်တဆင့်၊ နောက်စင်မြင့်သို့၊ ရဲရင့်စိတ်ကူး၊ ရှေးထက်ထူးသည်၊ စိန်ဖူးတော်အား၊ဌက်မြတ်နားနှင့်၊ ရွှေသားဆင့်၍၊ ကြာပွင့်တမျိုး၊ ရွှေကြာအိုးနှင့်၊ရွှေကိုးဖွဲ့မှီ၊ စိန်တွေစီလျက်၊ ကျောက်နီပတ္တမြား၊နီလာများနှင့်၊ အခြားရတနာ၊ စီမံရာ၌၊ ပညာမသိမ်၊ ရွှေလိမ်နွယ်လျက်၊ ပန်းတိမ်ဥာဏ်ထူး၊ သိကြားဖူးသို့၊ စိတ်ကူးယှဉ်လှ၊ပြုကုန်ကြသည်၊ ဒါနဦးစီး၊ သူဌေးကြီးဆို၊ ဦးတက်ဟိုနှင့်၊ ပုဂ္ဂိုလ်များမြောင်၊ ကုသိုလ်ဆောင်၍၊ ထောင်သုံးရာဝယ်၊ တစ်ဆယ်ကိုးနှစ်၊ ပြာသိုဖြစ်၍၊ လပြည့်နေ့တွင်၊ သုနက္ခတ္တံ၊ သုမင်္ဂလံဟု၊ ကုသိုလ်ပြုသော်၊ သုံးလူ့ဘုရား၊ နေ့ကောင်းထား၍၊ သံဃာများနှင့်၊ မြို့သားစုံလင်၊ စေတီပြင်၌၊ သဘင်ချိမ့်ချိမ့်၊ သဒ္ဓါစိမ့်အောင်။ နှစ်သိမ့်ဘွယ်ယူ၊ အသံလှူ၍၊ ပြည်သူဦးစီး၊ ဒုဝန်ကြီးအနေ၊ ဦးဗဆွေက၊ ဖော်ရွေအသင်း၊ မင်းတို့စုံလင်၊ စိန်ဖူးတင်သည်၊ စိတ်ရွှင်လုံးပမ်း၊ ဤလုပ်ငန်းသည်၊ ထူးဆန်းတေဇာ၊ သဒ္ဓါသူဌေးပေးစေသတည်း။ ။

ရတုချနည်း။ ။ ၁၁လုံးချ အာသာဝတီဝတ်ဆံမည်၏။

ပြုစုသူ တောကျောင်းဆရာတော် အဂ္ဂမဟာပဏ္ဍိတ အရှင်ပဒုမ

**ကျမ်းကိုးစာရင်း**


ခင်မင်၊မောင်(ဓနုဖြူ)။(၂၀၁၇)။ *ဂုဏ်၊အလင်္ကာ၊ရသ၊သင်ကြားရေး* ။ရာပြည်စာပေ။

ဖေမောင်တင်ဦး။(၁၉၈၇)။ *မြန်မာစာပေသမိုင်း*။ ရန်ကုန်၊ စပယ်ဦးပုံနှိပ်တိုက်။

မင်းသုဝဏ်။( ၂၀၁၇)။ *ကဗျာရေးချင်စာစပ်သင်*။ ရန်ကုန်။ရွှေပြည်မွေးပုံနှိပ်။

မြန်မာစာအဖွဲ့။(၂၀၀၈)။ *မြန်မာအဘိဓာန်*။ ရန်ကုန်၊ နေလင်းပုံနှိပ်တိုက်။

ဓမ္မစရိယဦးထွန်းရွှေ။(၁၉၇၈)။*ကဗျာစွယ်စုံကျမ်းကြီး*။ ရန်ကုန်။ မင်္ဂလာပုံနှိပ်တိုက်။

အဂ္ဂမဟာပဏ္ဍိတပဒုမ။(၁၃၁၉)။*သိမ်တော်ကြီးစေတီသမိုင်းအကျဉ်း*။ ရန်ကုန်၊ သီဟရတနာပုံနှိပ်တိုက်။

# မြိတ်ဒေသရှိ ဓနိလုပ်ငန်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများလေ့လာချက်

ရှိုင်းမောင်မောင်[1], ဇော်ဝင်း[2]

## စာတမ်းအကျဉ်း

ဓနိလုပ်ငန်းသည် မြိတ်ဒေသ၏ စီးပွားရေးလုပ်ငန်းတစ်ခုဖြစ်သည်။ ထိုလုပ်ငန်းမှ ဖက်၊ ဖက်ဖူး၊ ဓနိပွင့်ခြောက်၊ ဓနိရည်ချို၊ ဓနိရည်ခါး၊ ပအုံးရည် (အုံးရည်)၊ ပျားစသည့် ကုန်ပစ္စည်းများထွက်ရှိသည်။ ထိုဓနိလုပ်ငန်းမှ ထွက်ရှိသည့် ထွက်ကုန်ပစ္စည်းများထုတ်လုပ်ပုံအကျဉ်းနှင့် ဝေါဟာရများကို ဤစာတမ်းတွင် လေ့လာတင်ပြထားပါသည်။ ဝေါဟာရတို့ကို လေ့လာတင်ပြရာတွင် လုပ်ငန်းခွင်၌ ပြောဆိုသုံးစွဲသော ဝေါဟာရအသုံး၊ အသံထွက်နှင့် အနက်ဖွင့်ဟူ၍ ခွဲခြားတင်ပြထားပါသည်။

**သော့ချက်ဝေါဟာရ–** ဓနိလုပ်ငန်း၊ ဝေါဟာရ၊ အဓိပ္ပာယ်ဖွင့်ဆိုချက်။

## နိဒါန်း

မြိတ်မြို့သည် တနင်္သာရီတိုင်းအတွင်းတွင် တည်ရှိသော ပင်လယ်ကမ်းရိုးတန်းမြို့တစ်မြို့ဖြစ်သည်။ ပင်လယ်ရေ ပိုင်နက်များစွာကို ပိုင်ဆိုင်ထားသော မြိတ်မြို့၏ အဓိကစီးပွားရေးလုပ်ငန်းမှာ ရေလုပ်ငန်းဖြစ်သည်။ ထို့အပြင် မွေးမြူရေးလုပ်ငန်း၊ ပို့ဆောင်ဆက်သွယ်ရေးလုပ်ငန်း၊ စိုက်ပျိုးရေးလုပ်ငန်းများကိုလည်းလုပ်ကိုင်ကြပါသည်။ အခြားသောဒေသများတွင် လုပ်ကိုင်လျက်ရှိသော စီးပွားရေးလုပ်ငန်းများ ရှိသကဲ့သို့ မတူညီသော စီးပွားရေး လုပ်ငန်းများစွာလည်း ရှိပါသည်။ ရာဘာ (ကော်ပတ်) လုပ်ငန်း၊ သီဟိုဠ်စေ့ (ခရုစေ့) လုပ်ငန်း၊ ကွမ်းသီးခြောက်လုပ်ငန်း၊ ဓနိလုပ်ငန်း၊ ကင်းမွန်မီးထွန်းလုပ်ငန်း၊ ငါးဖမ်းလုပ်ငန်း၊ ပုလဲမွေးမြူရေးလုပ်ငန်း၊ ငါးပိ၊ ငါးခြောက်၊ ပုစွန်ခြောက်၊ ငံပြာရည်လုပ်ငန်းစသည်ဖြင့် ထူးခြားသည့်လုပ်ငန်းမြောက်မြားစွာရှိသည်။ ထိုလုပ်ငန်းများထဲမှ ဓနိလုပ်ငန်းဆိုင်ရာလုပ်ငန်းသဘောတရားများနှင့် ဝေါဟာရများကို လူမှုဘာသာဗေဒ[3] ပညာရပ် အသုံးကွဲစကား[4] ရှုထောင့်မှ သုတေသနပြုလေ့လာတင်ပြထားပါသည်။

### ၁။ ဓနိလုပ်ငန်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများလေ့လာချက်

ဓနိပင်သည် ပင်လယ်ဒီရေရောက်ရှိသော ရွှံ့မြေများတွင် ပေါက်ရောက်ဖြစ်ထွန်းသည်။ အများအားဖြင့် လူသားတို့ စိုက်ပျိုးရန်မလိုဘဲ သဘာဝအလျောက်ပေါက်လေ့ရှိသော အပင်မျိုးဖြစ်သည်။ ကြီးပြင်းမြန်ပြီး နှစ်ရှည်ပင် အမျိုးအစားထဲတွင် ပါဝင်သည်။ မည်သည့်မြေသြဇာကိုမျှ အသုံးပြုရန်မလိုဘဲ ဒီရေတွင်ပါဝင်လာသော နုန်းမြေ များ၏ အထောက်အပံ့ဖြင့်သာ ရှင်သန်ကြီးပြင်းသည်။

တနင်္သာရီတိုင်းဘက်တွင်မူ ဓနိလုပ်ငန်းမှ ဖက်၊ ဖက်ဖူး၊ ဓနိပွင့်ခြောက်၊ ဓနိသီး၊ ဓနိရည်ချို၊ ဓနိရည်ခါး၊ ပအုံးရည် (အုံးရည်)၊ ပျား (သကာရည်)စသည့် လူသုံးကုန်များကို ထုတ်လုပ်ကြပါသည်။ လုပ်ငန်းတစ်ခု ဖြစ်လာသည်နှင့်အမျှ ထိုလုပ်ငန်းနှင့် ဆက်စပ်သော ဝေါဟာရအသုံးများကို တီထွင်၍ အသုံးပြုကြသည်။ ဓနိလုပ်ငန်းသည် မြန်မာတစ်နိုင်ငံလုံးတွင် အနည်းငယ်သော ဒေသများတွင်သာ တွေ့ရှိရသဖြင့် ဓနိလုပ်ငန်းနှင့် ပတ်သက်သော ဝေါဟာရများကို အများအားဖြင့် ရင်းနှီးကျွမ်းဝင်မှုမရှိပေ။ ထို့ကြောင့် ဤစာတမ်းတွင် တနင်္သာရီတိုင်းဒေသကြီး၊ မြိတ်ခရိုင်၊ မြိတ်မြို့နယ်တစ်ဝိုက်ရှိ ဓနိလုပ်ငန်းမှ စိတ်ဝင်စားဖွယ်ကောင်းသော လုပ်ငန်းသုံးဝေါဟာရများအကြောင်းကို သုတေသနပြုလေ့လာတင်ပြထားပါသည်။ ထိုသို့တင်ပြရာတွင် ကုန်ပစ္စည်းထုတ်လုပ်ပုံအကျဉ်းနှင့် လုပ်ငန်းသုံးဝေါဟာရများဟူ၍ ကဏ္ဍခွဲကာ လေ့လာတင်ပြထားပါသည်။

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[1] နည်းပြ၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

[2] ဒေါက်တာ၊ ပါမောက္ခ၊ ဌာနမှူး၊ မြန်မာစာဌာန၊ မြိတ်တက္ကသိုလ်

[3] sociolinguistics

[4] registers

**၁၊ ၁။ အိမ်မိုးဖက်ပြုလုပ်ပုံ**

ဖက်သည် အိမ်၏ အမိုးအဖြစ်လည်းကောင်း အကာအရံများအဖြစ်လည်းကောင်း အသုံးပြုကြသည်။ ဖက်ပြုလုပ် ရန်အတွက် အဓိကလိုအပ်သောပစ္စည်းမှာ ဓနိရွက်ဖြစ်ပြီး ဒုတိယအနေဖြင့် လိုအပ်သော ပစ္စည်းမှာ ဝါးဖြစ်သည်။ ဝါးကို သတ်မှတ်ထားသော အရွယ်အစားများဖြစ်သည့် သုံးတောင်၊ နှစ်တောင်တစ်ထွာ အလျားအတိုင်းအတာ ပမာဏရှိသည့် ဝါးခြမ်းစိတ်များပြုလုပ်ရသည်။ ထို့နောက် ဝါးခြမ်းစိတ်များတွင် တစ်တောင့်တစ်ထွာအရှည်ရှိသော ဓနိရွက်များကို ခေါက်ချိုးညီအတိုင်း ခေါက်ရသည်။ ခေါက်ထားသော ဓနိရွက်များ ပြုတ်ထွက်မသွားစေရန်အတွက် ဖက်စက်ကမတံဖြင့် ကန့်လန့်ဖြတ် အနေအထား ထိန်းညှိပေးထားရသည်။ ပြီးနောက် အဆိုပါဓနိရွက်၏ တစ်ဝက် ပေါ်တွင် နောက်တစ်ရွက်ကို ထပ်ရသည်။ ထိုသို့ ထပ်ကာထပ်ကာပြုလုပ်ခြင်းဖြင့် ဖက်ဗျစ်တစ်ဗျစ်ကို ရရှိလေသည်။ ရရှိလာသော ဖက်ဗျစ်များကို နေရောင်ခြည်တိုက်ရိုက်မထိတွေ့နိုင်သော နေရာတွင် စီထပ်၍ တစ်ပတ်ခန့် ကြာအောင် ဖက်အချဉ်ဖောက်ရသည်။ ထိုအခါ အသင့်အသုံးပြုနိုင်သော ဖက်ဗျစ်ကို ရရှိသည်။

**၁၊ ၁၊ ၁။ အိမ်မိုးဖက်ပြုလုပ်ခြင်းဆိုင်ရာလုပ်ငန်းသုံးဝေါဟာရများ**

| လုပ်ငန်းသုံးဝေါဟာရ | အသံထွက် | အဓိပ္ပာယ် |
|---|---|---|
| ၁။ နိဘင် | /ní -bì/ | ဓနိပင် |
| ၂။ နိခက် | /ní khɛʔ/ | ဓနိခက် |
| ၃။ နိရွက် | /ní ɟwɛʔ/ | ဓနိရွက် |
| ၄။ ဖက်ဗျစ် | /phɛʔ bjiʔ/ | ဓနိရွက်ဖြင့် ရက်လုပ်ထားသော အိမ်မိုးဖက် |
| ၅။ ထွင်(သင်) | /-thwì/(/-θì/) | ခုတ်ယူသည် |
| ၆။ စဲ | /sɛ̀/ | စည်းသည် |
| ၇။ နိခေါက်ခွာ | /ní khauʔ khwā/ | ဓနိခက်မှ အခေါက်ကို ခွာယူသည် |
| ၈။ ဖက်ပေါ | /phɛʔ pɔ̀/ | ဓနိခေါက်ဖြင့် စည်းထားသော ဓနိရွက်စည်း |
| ၉။ တပေါ | /tə pɔ̀/ | ဓနိရွက်စည်းတစ်စည်း |
| ၁၀။ နဲပေါ | /nɛ̀ pɔ̀/ | ဓနိရွက်စည်း နှစ်စည်း |
| ၁၁။ ဂေါင်ရိုး | /-gaʊ̃ jɔ̀/ | ဓနိရွက်များခုတ်ယူထားသော ဓနိခက်၏ အလယ်ရိုး |

၁၂။ ဖက်စက်ကမတံ /phɛʔ sɛʔ kə má -tā́/ ဖက်ပြုလုပ်ရာတွင် ဝါးခြမ်းစိတ်၌ခေါက်ထားသော ဖက်ရွက် များပြုတ်မထွက်စေရန် ဓနိရွက်၏ အရင်းမှ ချိုးယူ၍ ထိန်းညှိပေးရသော အချောင်းအတံ

၁၃။ ပိုးကျ /pò tɕá/ ဖက်မှအမည်းရောင်အလုံးကလေးများထွက်သည်

၁၄။ ဖက်အချဉ်ဖောက် /phɛʔ ə -tɕhì phauʔ/ ဖက်ဗျစ်များကိုကောက်ရိုး၊ ဓနိခက်ခြောက်စသည်တို့ဖြင့် ဖုံးအုပ်၍ ကြာရှည်အသုံးခံအောင် ပြုလုပ်သည်

၁၅။ ရေဒိုးရက် (ရေဂျမ်းရက်)/jē dò jɛʔ/(/jē dʒ̀ jɛʔ/)ရေထရက် (မြန်မာရက်–၁၀ ရက်၊ ၁၁ရက်၊ ၁၂ရက်၊ ၁၄ရက်၊ ၁၅ရက်၊ ၁၆ရက်၊ ၂ရက်၊ ၃ရက်စသည့်နေ့ရက်များ)

၁၆။ ရေသေရက် /jē θē jɛʔ/ ရေငြိမ်ရက်(မြန်မာရက် ၄ရက်၊ ၅ရက်၊ ၆ရက်၊ ၇ရက်၊ ၈ရက်၊ ၉ရက် စသည့်နေ့ရက်များ)

ဓနိလုပ်ငန်းမှ အိမ်မိုးဖက်ပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများကို လေ့လာကြည့်သောအခါ ဗျည်းသံကွဲပြားနေသော ဝေါဟာရအသုံးများနှင့် သရသံကွဲပြားနေသော ဝေါဟာရအသုံးများကို စိတ်ဝင်စားဖွယ် လေ့လာတွေ့ရှိရသည်။ ဓနိ ကို 'ဓ' ဖြုတ်၍ နိ၊ နိပင်၊ နိသီး၊ နိရည်စသည်ဖြင့် ပြောဆိုသုံးနှုန်ကြသည်ကို တွေ့ရသည်။ ထို့အတူ စံဘာသာစကားမှ 'အီ' သရကို 'အယ်' သရဖြင့် အစားထိုးကာ ပြောင်းလဲအသုံးပြုကြသည်လည်း တွေ့ရသည်။ 'နှစ်' ကို 'နဲ' ဟူ၍ ထူးခြားစွာ သုံးစွဲသည်ကိုလည်း တွေ့ရသည်။ တစ်ခါတစ်ရံ အယောသဗျည်းကို ယောသဗျည်းအဖြစ် ပြောင်းလဲကာ ပြောဆိုသုံးနှုန်းကြသည်ကိုလည်း တွေ့ရသည်။

**၁၊ ၂။ ဖက်ဖူးပြုလုပ်ပုံ**

ဖက်ဖူးသည် ဖက်ဗျစ်ပြုလုပ်သည့် ဓနိရွက်အဖြစ်သို့မရောက်သေးသော နုနယ်သေးသည့် ဓနိရွက်အဖူးဖြစ်သည်။ ဖက်ဖူးပြုလုပ်ရန်အတွက် ရှေးဦးစွာ ဓနိပင်မှ ဖက်ဖူးစိမ်းများကို ခုတ်ယူရပါသည်။ ထို့နောက် ခုတ်ယူထားသော ဓနိဖူး၏ အရင်းကို ဓားဖြင့် ခုတ်၍ ခွာရသည်။ ထိုအခါ ဓနိခက်၏ ရိုးတံပေါ်လာပြီး လိုအပ်သော အရွက်ကို ဓားဖြင့်ခုတ်၍ တစ်ရွက်ချင်း ခွာယူရသည်။ ခွာယူရရှိလာသော ဓနိရွက်နုများကို နေပူထဲတွင် ဖြန့်ခင်း၍ တစ်ပတ် ခန့်အခြောက်လှန်းရသည်။ အခြောက်ခံပြီးသော ဖက်ဖူးများကို အရွက်တစ်ထောင်လျှင် တစ်စည်း၊ အရွက် နှစ်ထောင်လျှင်တစ်စည်းစသည်ဖြင့် လိုအပ်သလို ကြိုးဖြင့် စည်း၍ ထိုင်းနိုင်ငံ ရနောင်းမြို့သို့ တင်ပို့ရောင်းချ ကြသည်။

၁၊ ၂၊ ၁။ ဖက်ဖူးပြုလုပ်ခြင်းဆိုင်ရာလုပ်ငန်းသုံးဝေါဟာရများ

| လုပ်ငန်းသုံးဝေါဟာရ | အသံထွက် | အဓိပ္ပာယ် |
|---|---|---|
| ၁။ ဖက်ဖူး | /phɛʔ phù/ | ပြန့်ကားခြင်းမရှိသေးသည့် ထွက်ခါစ ဓနိရွက် |
| ၂။ ရိုးဒံ | /jò -dã/ | ဖက်ဖူးမှ ဓနိရွက်နုခွာယူပြီး ကျန်ရစ်သည့် ဓနိရိုး |
| ၃။ ဆမ်းပြည် | /sʰã pjĩ/ | ထိုင်းနိုင်ငံ |

ဖက်ဖူးကို မြန်မာနိုင်ငံတွင် ကုန်ချောအဖြစ်ထုတ်လုပ်နိုင်သော အဆင့်မြင့်နည်းပညာမရှိသဖြင့် နိုင်ငံခြားသို့ တင်ပို့ရောင်းချရသည်။ အဓိကအားဖြင့် မြိတ်ဒေသနှင့် အနီးဆုံးဖြစ်သော ထိုင်းနိုင်ငံသို့ တင်ပို့ရောင်းချကြရကြောင်း လေ့လာတွေ့ရှိရပါသည်။ ထိုင်းနိုင်ငံကို 'ရှမ်းပြည်' ဟု ခေါ်ဝေါ်သော အသုံးသည် ထူးခြားလှသည်။ 'ရှ' ဗျည်းကို အသံမထွက်နိုင်သည့်အတွက် 'ဆ'ဗျည်းဖြင့် အစားထိုးသုံးစွဲပြောဆိုရသည်ကို တွေ့ရသည်။

**၁၊ ၃။ ဓနိပွင့်ခြောက်ပြုလုပ်ပုံ**

ဓနိပွင့်ခြောက်သည် လက်ရှိတွင် ဈေးကွက်အတွင်းသို့ မရောက်ရှိသေးသော ဓနိလုပ်ငန်းမှ ထွက်ကုန်ပစ္စည်း တစ်မျိုးဖြစ်သည်။ သို့သော်လည်း ဓနိလုပ်ငန်းကို လုပ်ကိုင်သော အိမ်တိုင်းတွင် ဓနိပွင့်ခြောက်ကို အိမ်သုံးပစ္စည်း အဖြစ် အသုံးပြုကြပါသည်။ ဓနိပင်သည် တစ်နှစ်တွင် တစ်ကြိမ်သာ ပန်းပွင့်သော အပင်မျိုးဖြစ်သည်။ ဓနိအပွင့်ဖူး ထွက်ပြီး တစ်လကျော် နှစ်လခန့်ကြာသောအခါ ပွင့်အာလာ၍ ဓနိပန်းများအဖြစ်သို့ တဖြည်းဖြည်းချင်း ရောက်ရှိ လာသည်။ ဓနိအပွင့်ဖူးတစ်ဖူးတွင် အနည်းဆုံး ဓနိပန်းခိုင်သုံးခိုင်နှင့် အများဆုံးခြောက်ခိုင်ခန့်အထိ ပါရှိသည်။ ဓနိအပွင့်ဖူးမှ ဓနိပန်းခိုင်သုံးခိုင် အနည်းဆုံးထွက်ရှိနိုင်သော်လည်း ဓနိသီးအဖြစ်သို့မူ အများဆုံးနှစ်ခိုင်ခန့်သာ ရောက်ရှိနိုင်သည်။ ဓနိသီးအဖြစ်သို့ မရောက်ရှိသော ဓနိပန်းများကိုသာ ဓနိပွင့်ခြောက်အဖြစ် အသုံးပြုရသည်။ ဓနိပွင့်ခြောက်ပြုလုပ်ရန်အတွက် ဓနိသီးအဖြစ်သို့ မရောက်သော ဓနိပန်းများကို ခူး၍ ရေနွေးဖြင့် ပြုတ်ရသည်။ ပြုတ်ထားသော ဓနိပန်းများကို ရေစစ်၍ နေလှန်းအခြောက်ခံရသည်။ ဤသို့ဖြင့် ဓနိပွင့်ခြောက်ကို ရရှိသည်။

**၁၊ ၃၊ ၁။ ဓနိပွင့်ခြောက်ပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများ**

| | | |
|---|---|---|
| လုပ်ငန်းသုံးဝေါဟာရ | အသံထွက် | အဓိပ္ပာယ် |
| ၁။ နိဘွင့်ဖူး | /ní bwî phù/ | သံလျက်ပုံသဏ္ဌာန် ထွက်ခါစ ဓနိပန်းခိုင် |
| ၂။ နိဘန်း | /ní ɓa̰/ | ဓနိပန်း |
| ၃။ လီး | /lì/ | လှီးဖြတ်သည် |
| ၄။ ရေဘူဂျမ်း | /jē bū dʒa̰/ | ရေနွေးကြမ်း |
| ၅။ ဖန်တန်းဒန် | /-pha̰ ta̰ -da̰/ | ဖန်သော အရသာ |
| ၆။ ခါးရိတူး | /khà jí tù/ | အလွန်ခါးသက်သော |

မြိတ်ဒေသတွင် နေထိုင်ကြသောသူများသည် မြိတ်ဒေသိယစကားကို ပြောဆိုသုံးနှုန်းရာတွင် ဟထိုးသံကို ဖျောက်၍ ပြောဆိုကြသည်။ ထို့ကြောင့် မြိတ်ဒေသရှိ ဓနိလုပ်ငန်းကို လေ့လာသောအခါတွင်လည်း လုပ်ငန်း သုံးဝေါဟာရများတွင် ဟထိုးသံများပျောက် လှီး ကို လီး၊ နှမ်း ကို နမ်း စသည်ဖြင့် ပြောဆိုသုံးနှုန်းကြသည်ကို တွေ့ရသည်။ စံမြန်မာဘာသာစကားရှိ ခါးတူး၊ မည်းတူး၊ ချိုပျို့စသည့် ဝေါဟာရစကားလုံးများတွင် 'ရိ' ကို ကြားဆက်အဖြစ် အသုံးပြုကာ ခါးရိတူး၊ မည်းရိတူး၊ ချိုရိပျို့စသည်ဖြင့် ပြောဆိုသုံးနှုန်းကြသည်ကို တွေ့ရသည်။ ဤနေရာတွင် 'ရိ' ကို အလွန်ဟူသော အဓိပ္ပာယ်ဖြင့် အသုံးပြုကာ ပြောဆိုသုံးနှုန်းကြသည်ကို လေ့လာ တွေ့ရှိရပါသည်။

**၁၊ ၄။ ဓနိရည်ချိုပြုလုပ်ပုံ**

ဓနိရည်ချိုသည် ဓနိခိုင်၏ အညှာကို ဓားဖြင့် လှီးရာမှ ထွက်လာသော ချိုမြသည့် အရည်ဖြစ်သည်။ ဓနိရည်ရရှိရန် ရှေးဦးစွာ ဓနိခိုင်ကို တစ်နေ့လျှင် တစ်ကြိမ်ဖြင့် ၁၅ ရက်ဆက်တိုက် ချကျောက်ပြုလုပ်ခြင်း ဆောင်ရွက်ရသည်။ ထို့နောက် တစ်လစောင့်ဆိုင်းရသည်။ ပထမအကြိမ်ချကျောက်ပြုလုပ်၍ တစ်လကြာ သောအခါ ဒုတိယအကြိမ် ထပ်မံ၍ ချကျောက်ပြုလုပ်ရသည်။ ထိုတစ်ကြိမ်တွင် ချကျောက်လုပ်ခြင်းကို တစ်နေ့တွင် မနက်တစ်ကြိမ် ညနေတစ်ကြိမ် ပေါင်းနှစ်ကြိမ်ပြုလုပ်ရပါသည်။ ထိုသို့ တစ်နေ့နှစ်ကြိမ် ပြုလုပ်ပြီး ငါးရက်ပြည့်သောအခါ ချကျောက်ခြင်း ကို တစ်လခန့် ရပ်တန့်ထားရသည်။ တစ်လပြည့်သောအခါ ချကျောက်ပြုလုပ်ပြီးသည့် ဓနိခိုင်များရှိ ဓနိသီးများကို ကောက်ပဖြင့် ခုတ်ဖြတ်ရသည်။ ထိုနောက် ဇနုတ်ပစ်ခြင်းကို ဆောင်ရွက်ရသည်။ ဇနုတ်ပစ်ပြီးသောအခါ ဓနိလှီးခြင်းကို ဆောင်ရွက်ရသည်။ ဓနိလှီးရာတွင် ဓနိလှီးဓားဖြင့် ဓနိအညှာ၏ မျက်နှာပြင်ကို ညီညာနေအောင် သုံးချက်မှ ဆယ်ချက်အထိ ပါးပါးလှီးရသည်။ ထို့နောက် ဓနိအညှာမှ ထွက်လာမည့် ဓနိရည်ကို ဇနုတ်ဖြင့် ခံယူရသည်။ အများအားဖြင့် ဓနိအညှာကို ညနေ ၃ နာရီလောက်မှ လှီးဖြတ်၍ တစ်ညလုံးခံယူထားကာ နံနက် ၆ နာရီလောက်တွင် ဓနိရည်ဖျက်သည်။ ပုံမှန်အားဖြင့် နံနက် ၆ နာရီ ဝန်းကျင်မှသာ ဓနိဖျက်လေ့ရှိသော်လည်း အိမ်သို့ ညအိပ်ဧည့်သည်များ ရောက်လာသောအချိန်များတွင်မူ ညဦးအချိန်၌ ဓနိဖျက်၍ ဓားဇက်ရည် ခေါ် ဓားဇက်ရည်ဖြင့် ဧည့်သည်ကို ဧည့်ခံလေ့ရှိသည်။

ဓနိရည်ချိုရရှိရန်အတွက် ဓနိရည်ကို ခံယူထားသော ဇနုတ်ကို ရေဆေး၍ မီးမြိုက်ရသည်။ ဇနုတ်ကို ရေဆေးရန်အတွက် ပဏာအင်းကို အသုံးပြုရသည်။ ပဏာအင်းနံဘေးတွင် ဆေးထားသော ဇနုတ်များကို မီးမြိုက် ရန်အတွက် ဆောက်လုပ်ထားသော စင်ရှိသည်။ နံနက်ပိုင်း ဓနိဖျက်၍ပြီးသောအခါ ဓနိပင်ရင်းမှ ဇနုတ်များကို လိုက်လံသိမ်းဆည်း၍ ရေဆေးကာ ဓနိခက်ဖြင့် မီးမြိုက်ရသည်။ မီးမြိုက်ပြီးသောအခါ နောက်တစ်နေ့အတွက် ဇနုတ်ပစ်ခြင်းကို ဆောင်ရွက်ရသည်။ ဓနိရည်ထုတ်လုပ်သော လုပ်ငန်းကို အများအားဖြင့် တစ်ဦးတစ်ယောက် တည်းကသာ တာဝန်ယူဆောင်ရွက်ရသည်။ အခြားတစ်ဦးက တစ်ဆင့်ခံဆောင်ရွက်ပါက ဓနိပြေးတတ်သည်။ ဓနိလှီးခြင်းကို တစ်ရက်ပျက်ကွက်လိုက်သည်နှင့်

နောက်ရက်တွင် ဓနိအညှာခြောက်သွားပြီး ဓနိရည်မထွက်တော့ပေ။ အပူချိန်မြင့်လာသောအခါ ဓနိရည်ချို သည် အချဉ်ပေါက်လာသည်။

**၁၊ ၄၊ ၁။ ဓနိရည်ချိုပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများ**

| လုပ်ငန်းသုံးဝေါဟာရ | အသံထွက် | အဓိပ္ပာယ် |
|---|---|---|
| ၁။ နိရယ်ချို | /ní jē tɕhō/ | ချိုသောအရသာရှိသည့် ဓနိရည် |
| ၂။ ချ | /tɕhá/ | ဓနိသီးခိုင်များကိုအောက်သို့ကိုင်းညွှတ်လာအောင် ပြုသည် |
| ၃။ ကျောက် | /tɕauʔ/ | ဓနိသီးခိုင်၏ အညှာကို အရည်ထွက်စေရန် ပျော့သွားအောင် ခြေဖနောင့်ဖြင့် ကန်ကျောက်သည် |
| ၄။ နိညာ | /ní ɲā/ | ဓနိသီးခိုင်၏ အညှာ၊ ဓနိညှာ |
| ၅။ ဇနုတ် | /zə nouʔ/ | နံဘေးတွင်အပေါက်ငယ်ဖောက်ထားသည့် ဓနိရည်ခံယူရန် ပြုလုပ်ထားသော တစ်ဖက်ပွင့်ဝါးဆစ်ပိုင်း |
| ၆။ ပွင့်ချပ်ခြောက် | /pwî tɕhaʔ tɕhauʔ/ | ခြောက်နေသော ဓနိပွင့်ချပ် |
| ၇။ ဇနုတ်ပြစ် | /zə nouʔ pjiʔ/ | ဓနိပင်အနီးအနားတွင် ဇနုတ်များကို နေရာချသည် |
| ၈။ ညီ | /ɲī/ | ညီညာအောင် လုပ်သည် |
| ၉။ ထိုးထည့် | /thò thɛ́/ | ထိုးလျှို၍ စွပ်ထားသည် |
| ၁၀။ စောဇောနပ် | /sɔ̀ zɔ̀ naʔ/ | နံနက်စောစောပိုင်း |
| ၁၁။ နေအေးနပ် | /nē è naʔ/ | ညနေပိုင်း |
| ၁၂။ မိုက်ကျ | /maiʔ tɕá/ | မိုးချုပ်သည် |
| ၁၃။ နိရယ်ဖျက် | /ní jē phjɛʔ/ | ဓနိရည်များကို လိုက်လံသိမ်းဆည်းသည် |
| ၁၄။ ဓားဇက်ရယ် | /dà zɛʔ jē/ | ဓနိလှီးပြီး နှစ်နာရီခန့်အကြာတွင်ရရှိသော ဓနိရည်ချို |
| ၁၅။ ကြယ်ဇက်ရယ် | /tɕē zɛʔ jē/ | ကြယ်များထွက်ချိန်တွင် သိမ်းဆည်းသော ဓနိရည်ချို |
| ၁၆။ ဇနုတ်ဆံ | /zə nouʔ -shǎ/ | ဇနုတ်အတွင်းမှ ဓနိရည်ချိုများ ပြည့်လျှံသည် |
| ၁၇။ ပဏာအင်း | /pə nà ˋî/ | ဇနုတ်များ ဆေးကြောရန် ဓနိတောတစ်နေရာတွင် တူးထားသည့် လူအရပ်တစ်ရပ်နီးပါး အမြင့်ရှိသည့် ရေငန်တွင်း |
| ၁၈။ ဇနုတ်မီးမြိုက် | /zə nouʔ mì mjaiʔ/ | ဆေးထားသော ဇနုတ်များကို ဓနိခက်ခြောက်ဖြင့် မီးမြိုက်သည် |
| ၁၉။ ဇနုတ်မီးမြိုက်ဇင် | /zə nouʔ mì mjaiʔ -zî/ | ဇနုတ်များကို မီးမြိုက်သည့်စင် |
| ၂၀။ ဇနုတ်ဆေးဒံ | /zə nouʔ shè -dǎ/ | ဓနိအညှာကို အဖျားဖွကာပြုလုပ်ထားသည့် ဇနုတ်ဆေး သည့် အချောင်းအတံ |

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| ၂၁။ နိပြေး | /ní pjè/ | ပုံမှန်ထွက်နေသည့်ပမာဏထက် ဓနိရည်အထွက်နည်းသွားသည် |
| ၂၂။ နိလီး | /ní lì/ | ဓနိရည်ရရှိအောင် ဓနိအညှာကို ဓားဖြင့် လှီးသည် |
| ၂၃။ အချဉ်ပေါက် | /ə -tɕhĩ pauʔ/ | အပူချိန်ကြောင့် ဓနိရည်များ ချဉ်လာသည် |
| ၂၄။ တည် | /tē/ | ကျိုချက်သည် |
| ၂၅။ နိရယ်ရွဲ | /ní jē jwɛ̀/ | ဓနိရည်များဇနုတ်ထဲသို့မရောက်ဘဲအပြင်သို့ ထွက်ကျသည် |
| ၂၆။ ကောက်ပ | /kauʔ pá/ | ပုဆိန် |

ဓနိရည်ချိုထုတ်လုပ်ခြင်းသည် စိတ်ဝင်စားဖွယ်ကောင်းသကဲ့သို့ ဓနိရည်ချိုထုတ်လုပ်ရာတွင် ပြောဆိုသော ဝေါဟာရများသည်လည်း စိတ်ဝင်စားဖွယ်ကောင်းလှပါသည်။ စကားအသုံးအနှုန်းလှပပြေပြစ်ပြီး လုပ်ငန်း သုံးဝေါဟာရလေ့လာမှုမှတစ်ဆင့် မြိတ်ဒေသိယစကားလေ့လာမှုကို အထောက်အပံ့စေပါသည်။

**၁၊ ၅။ ဓနိရည်ခါးပြုလုပ်ပုံ**

ဓနိရည်ခါးသည် သောက်သုံးသူများကို မူးယစ်စေတတ်သည့် ယမကာအနွယ်ဝင်ဖြစ်သော ဓနိရည်ဖြစ်သည်။ ဓနိရည်ခါးပြုလုပ်ရာတွင် ဇနုတ်ကိုဆေးခြင်း၊ ဇနုတ်မီးမြိုက်ခြင်း၊ ဇနုတ်ပစ်ခြင်းစသည်တို့ကို ဆောင်ရွက်ရန် မလိုပေ။ ဓနိရည်ချိုပြုလုပ်ရာတွင် ဓနိချေးများကို စင်ကြယ်အောင် ဇနုတ်ကို ဆေးကြောပေးရသည်။ ဓနိရည်ခါးတွင်မူ ဓနိချေးအကျများလေလေ အရည်အသွေးကောင်းမွန်လေလေ ဖြစ်သည်။ ဓနိချေးတွင် အလုံးနှင့် အဖတ်ဟူ၍ နှစ်မျိုးရှိသည်။ ဓနိရည်ချိုထဲသို့ ဒူးမုန့်ခြောက်ရောထည့်လျှင်လည်း ဓနိရည်ခါးကို ရရှိနိုင်သည်။

**၁၊ ၅၊ ၁။ ဓနိရည်ခါးပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများ**

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|---|---|---|
| လုပ်ငန်းသုံးဝေါဟာရ | အသံထွက် | အဓိပ္ပာယ် |
| ၁။ နိရယ်ခါး | /ní jē khà/ | ခါးသက်၍ အနည်းငယ်ချဉ်သော အရသာရှိသည့် ဓနိရည် |
| ၂။ နိချေး | /ní tɕhè/ | ဓနိရည်များအနည်ထိုင်ရာမှဖြစ်လာသော အဖြူရောင်ရှိသည့်ဓနိခဲအဖတ် |
| ၃။ နိချေးလုံး | /ní tɕhè lòŭ/ | လုံးဝန်းသော သဏ္ဌာန်ရှိသည့် ဓနိချေး |
| ၄။ နိချေးဖတ် | /ní tɕhè phaʔ/ | ဓနိခဲအဖတ် |
| ၅။ နိချေးကျ | /ní tɕhè tɕá/ | ဓနိချေးများဖြစ်လာသည် |
| ၆။ ဒူးမုန့်ခြောက် | /dù mouʔ tɕhauʔ/ | ကျုံဖြင့်ပြုလုပ်ထားသောမုန့်ခြောက်တစ်မျိုး |

ဤသို့လျှင် ဓနိရည်ခါးပြုလုပ်ပုံနှင့် လုပ်ငန်းသုံးဝေါဟာရများကို စိတ်ဝင်စားဖွယ်လေ့လာတွေ့ရှိရပါသည်။

**၁၊ ၆။ ပအုံးရည် (အုံးရည်)ပြုလုပ်ပုံ**

ပအုံးရည် (အုံးရည်)သည် ချဉ်သောအရသာရှိပြီး ဟင်းလျာများချက်ပြုတ်ရာတွင် အသုံးပြုသည်။ ပအုံးရည် (အုံးရည်)ကို ဓနိရည်ချိုမှလည်းကောင်း၊ ဓနိရည်ခါးမှလည်းကောင်းရရှိသည်။ ဓနိရည်သည် အပူချိန်မြင့်မားလာ သောအခါ အချဉ်ပေါက်လာပြီး ပအုံးရည် (အုံးရည်)အဖြစ်သို့ ပြောင်းလဲသွားသည်။ ဓနိရည်ကို အချဉ်ဖောက်မှု အချိန်ကာလကြာမြင့်လေလေ ပအုံးရည် (အုံးရည်)၏ အရည်အသွေးကောင်းမွန်လေလေဖြစ်သည်။ ဓနိရည်သည် ပအုံးရည်အဆင့်တွင် အဖြုတ်မထတော့ချေ။

အများအားဖြင့် ပအုံးရည် (အုံးရည်)ကို စားဆီပုံးဝါများထဲတွင် သိုလှောင်ကာ အချဉ်ဖောက်လေ့ရှိသည်။ စားသုံးရန်အသင့်ဖြစ်နေသော ပအုံးရည် (အုံးရည်)များကို စျေးကွက် အတွင်းသို့ တင်သွင်းသည်။

**၁၊ ၆၊ ၁။ ပအုံးရည် (အုံးရည်) ပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများ**

| | | |
|---|---|---|
| လုပ်ငန်းသုံးဝေါဟာရ | အသံထွက် | အဓိပ္ပာယ် |
| ၁။ အုံးရယ်/ ပအုံးရယ် | /oǔ jɛ̄/ /pə oǔ jɛ̄/ | အချဉ်ဖောက်ထားသော ဓနိရည် |
| ၃။ အဖြုတ် | /ə phjouʔ/ | အမြှုပ် |
| ၄။ ဆီဘုံးဝါ | /shī bòǔ wā/ | စားဆီထည့်သော အဝါရောင်ပုံး |
| ၅။ အချဉ်ဖောက် | /ə -tɕhī phauʔ/ | ဓနိရည်များကို ချဉ်လာအောင် ပြုလုပ်သည် |

ပအုံးရည် (အုံးရည်)ပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများကို လေ့လာကြည့်သောအခါ စံဘာသာစကားတွင် 'အမြှုပ်' ဟုသုံးနှုန်းပြောဆိုသော်လည်း ဒေသလုပ်ငန်းအသုံးတွင်မူ 'အဖြုတ်'ဟူ၍ ခေါ်ဝေါ် ပြောဆိုသည်ကို တွေ့ရသည်။

**၁၊ ၇။ ပျား (သကာရည်)ပြုလုပ်ပုံ**

ပျားသည် ဓနိရည်ချိုကို မီးဖြင့် ကျို၍ ရင်ကန်းတုတ်ဖြင့် မွှေရာမှ ရရှိလာသော ပျစ်နေသည့် သကာရည်တစ်မျိုး ဖြစ်သည်။ ပျားကျိုရန်အတွက် လိုအပ်သော ပစ္စည်းများမှာ နှစ်လုံးဖောင်း၊ ထင်း၊ ကခ၊ ဓနိရည်ချို၊ ယောင်းမ၊ ရင်ကန်းတုတ်ခြောက်၊ ရှည်လျားသော သစ်သားလက်ကိုင်တပ်ထားသည့်ခွက်၊ လက်နှီးပိုင်း၊ တည စသည်တို့ဖြစ် သည်။ ပျားချက်လုပ်ရန်အတွက် ဓနိရည်ချိုတစ်မျိုးတည်းကိုသာ ပြုလုပ်ရသည်။

ပျားကျိုရန်အတွက် ကခများအတွင်းသို့ ဓနိရည်ချိုနှစ်ပုံးစီထည့်၍ မီးအရှိန်ပြင်းပြင်းဖြင့် တစ်နာရီခန့်ကြာအောင် ကျိုရသည်။ တင်းမေးလိုက်လာသောအချိန်တွင် ဖောင်းပေါ်ရှိ ကခများထဲမှ ကျိုထားပြီးသော ဓနိရည်များကို ဖောင်းအောက်ရှိ ကခအလွတ်တစ်ခုထဲသို့ ပြောင်းထည့်၍ ရင်ကန်းတုတ်ခြောက်ဖြင့် တစ်နာရီခန့်မွှေပေးရသည်။ မွှေသည့်အချိန်ကြာလာသည်နှင့်အမျှ မူလက ပျစ်နေသော ဝါညစ်ညစ်ရောင် ဓနိရည်ချိုများသည် ဝါရွှေခဲပျစ်သော ပျား (သကာ) အဖြစ်သို့ ရောက်ရှိသည်။ ထို့နောက် ရရှိလာသောပျားများကို ကခထဲမှတစ်ဆင့် သန့်စင်ထားသည့် ဆီပုံးဝါများထဲသို့ ပြောင်းထည့်သည်။ ကခထဲတွင် စေးကပ်၍ ကျန်ရှိနေသည့် ပျားများကို တည ဖြင့် ယက်၍ သိမ်းထည့်ရသည်။ ရရှိလာသော ပျားများကို ဆီပုံးဝါများထဲသို့ ပြောင်းထည့်ကာ စျေးကွက်အတွင်းသို့ တင်ပို့သည်။ ပျားသည် အနည်းဆုံး ၆ လမှ အများဆုံး တစ်နှစ်ခန့်အထိ ကြာရှည်ခံပေသည်။ ထို့ထက်အချိန်ကာလ ကြာသောအခါ ပျားသည် ကြက်တက်ရည်များဖြစ်လာပြီး တစ်ချို့မှာ အရည်ပြန်ပျော်လာသည်။

**၁၊ ၇၊ ၁။ ပျား (သကာရည်) ပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများ**

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|---|---|---|
| လုပ်ငန်းသုံးဝေါဟာရ | အသံထွက် | အဓိပ္ပာယ် |
| ၁။ ပျား | /pjà/ | ဓနိရည်ချိုကိုမီးဖြင့်ကျို၍ရရှိသည့်ပျစ်နေသော ဓနိရည်ကို ရင်ကန်းတုတ်ဖြင့် မွှေရာမှ ရရှိလာသည့် သကာရည် |
| ၂။ ရင်ဂန်းဘင် | /-jī ɡǎ -bī/ | အုန်းပင်ပေါက်နှင့်အလားသဏ္ဌာန်တူပြီး တစ်ပင်လုံးတွင် ဆူးများစွာပါရှိသည့် အပင်တစ်မျိုး |
| ၃။ မွှေ | /mwē/ | ဓနိရည်ချိုကို မွှေသည် |

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| ၄။ ထပ် | /thaʔ/ | ပျစ်နေသော |
| ၅။ ချိုရိပျို့ | /tɕhō ɟí pɟó/ | အလွန်ချိုသော |
| ၆။ ဖောင်း | /phàʔ̃/ | ပျားကျိုရာတွင် အသုံးပြုသည့် မီးဖိုကြီး |
| ၇။ နှစ်လုံးဖောင်း | /nè lòʔ̃ phàʔ̃/ | နှစ်ခုပူးတွဲ၍ ပြုလုပ်ထားသော မီးဖို |
| ၈။ ကခ | /kə dá/ | ပျားကျိုရာတွင် သုံးသည့် မိုးပြဲဒယ်အိုးကြီး |
| ၉။ ယမ်းမ | /ɟ̃ ã má/ | ယောင်းမ |
| ၁၀။ လက်လုံးဘိုင်း | /lɛʔ lóʔ̃ bàĩ/ | လက်နှီးပိုင်း |
| ၁၁။ ဆီဘုံးလပ် | /shĩ bòʔ̃ laʔ/ | ဆီမပါသော ဆီပုံးအလွတ် |
| ၁၂။ မီးထည့် | /mĩ thé/ | မီးမွေးသည် |
| ၁၃။ မီးကြမ်း | /mì tɕã́/ | မီးအရှိန်ပြင်းသည် |
| ၁၄။ မီးသေ | /mì θē/ | မီးငြိမ်းသွားသည် |
| ၁၅။ အရယ်ခန်း | /ə ɟē khã́/ | အရည်ခန်းသည် |
| ၁၆။ တင်းမေးလိုက် | /tĩ mè leiʔ/ | မီးအပူကြောင့် ဓနိရည်ချိုများ ပျစ်လာသည် |
| ၁၇။ လပ်ထည့်၊ ကဲ့ထည့် | /laʔ thé/ /ké thé/ | ဖလှယ်ထည့်သည် |
| ၁၈။ လေး | /lè/ | နှေးကွေးသည် |
| ၁၉။ တည | /tə ɲá/ | အရည်မထွက်တော့သောဓနိအညှာခြောက်ကို ထက်ခြမ်း ခြမ်း၍ဝိုက်ဝိုက်ကလေးပြုလုပ်ထားသောအရှည် နှစ်တောင်ခန့်ရှိသည့်အချောင်းအတံ |
| ၂၀။ ပျားရယ်ဂျင် | /pjà ɟē -dʒĩ/ | ပျားရည်အကြည် |
| ၂၁။ ကြက်တက်ရယ် | /tɕɛʔ tɛʔ ɟē/ | ပျားအရည်ပျော်ရာမှ ထွက်လာသောအရည် |
| ၂၂။ ထင်းဆိုက် | /thĩ shaiʔ/ | မီးအရှိန်ရလာအောင် ထင်းများကို စုစည်းသည် |
| ၂၃။ ပုံးဖြတ် | /pòʔ̃ phjaʔ/ | ပုံးအရေအတွက်ကိုလိုက်၍ |
| ၂၄။ ပိတ်သာဖြတ် | /peiʔ θā phjaʔ/ | ပိသာအရေအတွက်ကိုလိုက်၍ |
| ၂၅။ ပျားဒဂုတ် | /pjà də gouʔ/ | ပျားကျိုသည့် တဲနေရာ |

ပျား (သကာရည်) ပြုလုပ်ခြင်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများသည် စိတ်ဝင်စားဖွယ်ကောင်းပြီး စကားအသုံးအနှုန်းလှပသည့် ဝေါဟာရများဖြစ်သည်။ ထို့ကြောင့် ဘာသာစကားလေ့လာသူများကို ဆွဲဆောင်နိုင် သော လုပ်ငန်းတစ်ခုလည်းဖြစ်သည်ဟု ဆိုနိုင်သည်။

## ခြုံငုံသုံးသပ်ချက်

မြန်မာနိုင်ငံတွင် ဧရာဝတီတိုင်းဒေသကြီး၊ ရခိုင်ပြည်နယ်နှင့် တနင်္သာရီတိုင်းဒေသကြီးတို့သည် ပင်လယ်သမုဒ္ဒရာနှင့် ထိစပ်နေသော ကမ်းရိုးတန်းဒေသများဖြစ်ကြသည်။ ဓနိပင်သည် ပင်လယ်ရေငန်ရောက် ဒေသများတွင် ပေါက်ရောက်ပုံချင်းတူသော်လည်း နေရာဒေသကိုလိုက်၍ ဓနိလုပ်ငန်းမှ ကုန်ပစ္စည်းများ

ထုတ်လုပ်ပုံချင်းမတူကြပေ။ တနင်္သာရီတိုင်းဒေသကြီးအတွင်းတွင်မူ ဓနိလုပ်ငန်းမှ ဖက်၊ ဖက်ဖူး၊ ဓနိပွင့်ခြောက်၊ ဓနိသီး၊ ဓနိရည်ချို၊ ဓနိရည်ခါး၊ ပအုံးရည် (အုံးရည်)၊ ပျားစသည်တို့ကို ထုတ်လုပ်ရရှိပါသည်။ ဖက်သည် အိမ်၏ အမိုးအကာအဖြစ် အသုံးဝင်ပြီး ဖက်ဖူးသည် ကုန်ကြမ်းအနေဖြင့် နိုင်ငံခြားသို့ တင်ပို့ရောင်းချကြသည်။ ဓနိပွင့်ခြောက်သည် ဈေးကွက်အတွင်းသို့ ဝင်ရောက်ထိုးဖောက်နိုင်ခြင်း မရှိသေးသော်လည်း အခြားဒေသများတွင် ထုတ်လုပ်နေသော ဓနိဖူးခြောက်များကဲ့သို့ပင် နောင်ကာလများတွင် ဈေးကွက်အတွင်းသို့ ရောက်ရှိလာနိုင်သည်။ ဓနိဖြင့်မိုးထားသော အိမ်များသည် မြန်မာတို့၏ ရိုးရာလူနေမှု ပုံစံကိုပြသနိုင်ပြီး နိုင်ငံခြားသားခရီးသွားများကိုလည်း စိတ်ဝင်စားဖွယ် ဖြစ်အောင်လည်း ဆွဲဆောင်စည်းရုံးနိုင်ပေသည်။ မျက်မှောက်ကာလတွင် လူဦးရေတိုးပွားလာသည်နှင့်အမျှ နေထိုင်ရန်အတွက် လိုအပ်သော မြေယာလိုအပ်ချက်များကို ဓနိတောများအား ခုတ်ထွင်ရှင်းလင်း၍ အသုံးပြုလာကြသည့်အတွက် ဓနိလုပ်ငန်းမှ ထွက်ရှိသော ကုန်ပစ္စည်းများသည် ဈေးကွက်အတွင်းသို့ ဝင်ရောက်မှုလျော့ကျလာပြီး ဓနိလုပ်ငန်း လုပ်ကိုင်သူများအနေဖြင့် စီးပွားရေးအကြပ်အတည်းနှင့် ရင်ဆိုင်လာခဲ့ရသည်။ ထို့အပြင် ဓနိပင်များသည် ရေငန်နေသတ္တဝါများအတွက်လည်း မျိုးပွားရာနေရာဖြစ်သည်။ ထို့ကြောင့် ဓနိတောများသည် ရေငန်သယံဇာတပေါများလာအောင် အထောက်အပံ့ပြုသော နေရာလည်းဖြစ်သည်ဟု ဆိုနိုင် သည်။ ထို့အပြင် ဓနိတောများသည် သဘာဝဘေးအန္တရာယ်များကိုလည်း ကာကွယ်တားဆီးပေးနိုင်သည်။

ဓနိလုပ်ငန်းမှ ကုန်ပစ္စည်းများထုတ်လုပ်ပုံကိုသာမက လုပ်ငန်းသုံးဝေါဟာရများ၏ ဆန်းသစ်လှပမှုကို လည်းကောင်း၊ ပြောဆိုသုံးနှုန်းမှုကိုလည်းကောင်း ထူးခြားစွာ လေ့လာတွေ့ရှိရသည်။ ဓနိလုပ်ငန်းဆိုင်ရာ လုပ်ငန်းသုံးဝေါဟာရများတွင် ဗျည်းသံကွဲပြားနေသော ဝေါဟာရအသုံးများနှင့် သရသံကွဲပြားနေသော ဝေါဟာရ အသုံးများကို စိတ်ဝင်စားဖွယ် လေ့လာတွေ့ရှိရသည်။ ဓနိ ကို 'ဓ' ဖြုတ်၍ နိ၊ နိပင်၊ နိသီး၊ နိရည်စသည်ဖြင့် ပြောဆိုသုံးနှုန်းကြသည်ကို တွေ့ရသည်။ သာမန်အားဖြင့် 'ပန်း' ကို 'ပန်း' ဟူ၍သာ ပြောဆိုသုံးနှုန်းကြသော်လည်း အရှေ့မှ တစ်ခုခုထပ်ဖြည့်လိုက်သောအခါ 'ပန်း' ကို 'ဘန်း' ဟူ၍ 'ပ' ဗျည်းကို 'ဘ' ဗျည်းနှင့် လဲလှယ်ကာ ပြောဆိုကြောင်းကို တွေ့ရသည်။ ထို့အတူ စံဘာသာစကားမှ 'အီ' သရကို 'အယ်' သရဖြင့် အစားထိုးကာ ပြောင်းလဲအသုံးပြုကြသည်လည်း တွေ့ရသည်။ တစ်ခါတစ်ရံ အယောသဗျည်းကို ယောသဗျည်းအဖြစ် ပြောင်းလဲကာ ပြောဆိုသုံးနှုန်းကြသည်ကိုလည်း တွေ့ရသည်။ စံဘာသာစကားရှိ 'ခုတ်ထွင်ရှင်းလင်း' ဟူသောအသုံးကိုမူ 'ထွင်' ဟူ၍လည်းကောင်း၊ 'သင်' ဟူ၍လည်းကောင်း လုံးတွဲကြိယာကို လုံးချင်ကြိယာအနေဖြင့် အသုံးပြုသည်ကို တွေ့ရသည်။ လုံးတွဲကြိယာကို လုံးချင်းကြိယာအနေဖြင့် အသုံးပြုသော်လည်း ဆိုလိုချက်ကို ထင်းကနဲပေါ်လွင်စေသည်ကို တွေ့ရသည်။ ထိုင်းနိုင်ငံကို 'ရှမ်းပြည်' ဟု ခေါ်ဝေါ်သော အသုံးသည် ထူးခြားလှသည်။

လုပ်ငန်းသုံးဝေါဟာရများတွင် ဟထိုးသံများပျောက် လှီး ကို လီး၊ နှမ်း ကို နမ်း စသည်ဖြင့် ပြောဆိုသုံးနှုန်းကြသည်ကိုလည်း တွေ့ရသည်။ ထို့အတူ 'သ' နှင့် 'ဿ' ကို ကွဲပြားစွာ မထွက်နိုင်ဘဲ 'သ' ဗျည်းတစ်ခု တည်းကိုသာ အသုံးပြုကြသည်ကိုလည်း တွေ့ရသည်။ စံမြန်မာဘာသာစကားရှိ ခါးတူး၊ မည်းတူး၊ ချိုပျို့စသည့် ဝေါဟာရစကားလုံးများတွင် 'ရိ' ကို ကြားဆက်အဖြစ် အသုံးပြုကာ ခါးရိတူး၊ မည်းရိတူး၊ ချိုရိပျို့စသည်ဖြင့် ပြောဆိုသုံးနှုန်းကြသည်ကို တွေ့ရသည်။ ဤနေရာတွင် 'ရိ' ကို အလွန်ဟူသော အဓိပ္ပာယ်ဖြင့် အသုံးပြုကာ ပြောဆိုသုံးနှုန်းကြသည်ကို လေ့လာတွေ့ရှိရပါသည်။

## နိဂုံး

မြိတ်မြို့နယ်တစ်ဝိုက်ရှိ ကျေးရွာများတွင် လုပ်ကိုင်လျက်ရှိသည့် ဓနိလုပ်ငန်းမှ ဖက်၊ ဖက်ဖူး၊ ဓနိပွင့်ခြောက် ဓနိရည်ချို၊ ဓနိရည်ခါး၊ ပအုံးရည် (အုံးရည်)၊ ပျားစသည့် ကုန်ပစ္စည်းများ၏ ထုတ်လုပ်မှုမှ လုပ်ငန်းသုံးဝေါဟာရ များကို ဤစာတမ်းတွင် လေ့လာတင်ပြခဲ့ပါသည်။ ထို့ကြောင့် ဤစာတမ်းသည် ဓနိလုပ်ငန်းကို စိတ်ဝင်စား သည့်သူများအတွက် အထောက်အကူပြုနိုင်သော စာတမ်းတစ်စောင်ဖြစ်မည်ဟု

ယုံကြည်ပါသည်။ ထို့အပြင် ဓနိလုပ်ငန်းဖြင့် အသက်မွေးဝမ်းကြောင်းပြုနေသူများကို အထောက်အကူ ပြုပေးနိုင်သော စာတမ်းတစ်စောင်ဖြစ် လိမ့်မည်ဟုလည်း မျှော်လင့်မိပါသည်။ စင်စစ်အားဖြင့် ဓနိပင်များသည် လူသားတို့အား သွယ်ဝိုက်၍လည်းကောင်း၊ တိုက်ရိုက်သော်လည်းကောင်း များစွာအကျိုးပြုသော အပင်များ ဖြစ်ပါသည်။ ထို့အတူ ဓနိလုပ်ငန်းသည် ဘာသာစကားတိုးတက်ရေး အတွက်လည်း အထောက်အပံ့ ဖြစ်စေသောလုပ်ငန်းတစ်ခုဖြစ်သည်။ ထိုကဲ့သို့ အကျိုး များလှသည့် ဓနိလုပ်ငန်းကို ထိန်းသိမ်းကာကွယ် စောင့်ရှောက်ကြပြီး ပိုမိုတွင်ကျယ်လာအောင် ဆောင်ရွက်ကြရန် လိုအပ်လှပေသည်။ တစ်ဖက်တွင်လည်း မြိတ်ဒေသ၏ စီးပွားရေးလုပ်ငန်းတစ်ခုဖြစ်သည့် ဓနိလုပ်ငန်းနှင့် ဓနိလုပ်ငန်းဆိုင်ရာဝေါဟာရများကိုလည်း ထိန်းသိမ်းစောင့်ရှောက်ကြနှင့် ဒေသိယစကားကို သုတေသနပြု လေ့လာနေသူတို့အတွက် ဤစာတမ်းသည် တစ်ဖက်တစ်လမ်းမှ အထောက်အပံ့ပြုပေး နိုင်လိမ့်မည်ဟု ယုံကြည်မိပါသည်။

## ကျမ်းကိုးစာရင်း


ကျော်အောင်စံထား၊ ဆရာတော်(ဒုတိယ)။ (၁၉၆၆)။ ***ဝေါဟာရတ္ထုပကာသနီကျမ်း။*** ဒု-ကြိမ်၊ ရန်ကုန်၊ လယ်တီမဏ္ဍိုင် ပုံနှိပ်တိုက်။

ခင်မင်၊မောင်(ဓနုဖြူ)။ (၂၀၁၁)။ ***ရေးဟန်ပညာနိဒါန်း။*** ရန်ကုန်၊ စိတ်ကူးချိုချိုစာပေ။

ခင်မင်၊မောင်(ဓနုဖြူ)။ (၂၀၁၃)။ ***ဘာသာနှင့် စာပေ၊ စာပေနှင့် ဘာသာ။*** ရန်ကုန်၊ ကံ့ကော်ဝတ်ရည်စာပေ။

ခင်မင်၊မောင်(ဓနုဖြူ)။ (၂၀၁၁)။ ***ဘာသာအမြင် စာပေအမြင်။*** ဒု-ကြိမ်၊ ရန်ကုန်၊ စိတ်ကူးချိုချိုစာပေ။

ခင်မင်၊မောင်(ဓနုဖြူ)။ (၂၀၁၅)။ ***စကားသမုဒ္ဒရာ စာသမုဒ္ဒရာ။*** ရန်ကုန်၊ ရာပြည့်စာပေ။

ခင်မင်၊မောင်(ဓနုဖြူ)။ (၂၀၁၇)။ ***သက်တံရောင်စုံဘာသာစကား။*** ဒု-ကြိမ်၊ ရန်ကုန်၊ စိတ်ကူးချိုချိုပုံနှိပ်တိုက်။

မြန်မာစာအဖွဲ့။ (၂၀၁၅)။ ***မြန်မာအဘိဓာန်အကျဉ်းချုပ်။*** ရန်ကုန်၊ မြန်မာစာအဖွဲ့ဦးစီးဌာန။

အောင်မြင့်ဦး၊ ဒေါက်တာ။ (၂၀၀၃)။ ***လူမှုဘာသာဗေဒမိတ်ဆက်။*** ရန်ကုန်၊ ရန်ကုန်တက္ကသိုလ်၊ မြန်မာစာဌာန။

အောင်မြင့်ဦး၊ ဒေါက်တာ။ (၂၀၁၀)။ ***ဘာသာစကားသုတေသန။*** ရန်ကုန်၊ ရူဝံစာပေ။


## တွေ့ဆုံမေးမြန်းသူများ

ဒေါ်ခင်စန်းမူ။ ကမ်းကြီးကျေးရွာ၊ ကမ်းကြီးကျေးရွာအုပ်စု၊ ကျွန်းစုမြို့နယ်။

ဒေါ်ရတင်။ တညက်ကျေးရွာ၊ ပသောင်းကျေးရွာအုပ်စု၊ မြိတ်မြို့နယ်။

မမူ။ တညက်ကျေးရွာ၊ ပသောင်းကျေးရွာအုပ်စု၊ မြိတ်မြို့နယ်။

အောင်သူရစိုး။ တညက်ကျေးရွာ၊ ပသောင်းကျေးရွာအုပ်စု၊ မြိတ်မြို့နယ်။

# Developing Students' Writing Ability by Using Activities of Writing to Learn Approach

Thet Ni[1], Thandar Min[2], Yin Min Tun[3]

## Abstract

Writing is an important skill in language production. It is intimidating to a lot of students, particularly who are learning English as a second language. Like other ESL learners, students from Myeik University find writing skills difficult. The present study was conducted with the aim of developing students' writing abilities by using Writing to Learn activities. Writing to Learn approach is designed to make sure that students have frequent and significant opportunities to write, revise, and discuss their writing in their classes. This project could help the students develop in generating ideas, organization, using appropriate vocabulary and grammatical structures, and mechanic, by using activities of WTL approach. The study employed Classroom Action Research (CAR) design. 20 English specialization students from Myeik University were chosen as the subjects of the study and the instruments of the study were tests (pre-test and post-test), questionnaires, and observation checklist. The study had been done in one cycle which included planning, acting, observing, and reflecting by Ferrance (2000). The quantitative data analysis of two tests reveals that students gained enhancements in their writing ability as well as in twenty-first century skills such as collaboration, communication, and critical thinking.

**Key Words**: Writing to Learn, writing skills, Classroom Action Research, writing activities

## Introduction

People use languages in their daily life conversation. Language enables them to express their wishes, feelings, likes, dislikes, and ideas. Apart from communicating with each other, teachers and students use language to present tasks, engage in learning processes, assess learning, and build classroom life. Students from Myeik University consider writing in English is challenging and find difficulty in producing a good piece of writing. This motivates the researcher to develop an action research on "Improving writing skills by using activities of Writing to Learn Approach."

Nowadays, English language teachers from various disciplines and institutions are seeking for the better teaching methods and practices to relate language skills and particular field of disciplines such as science, technology, engineering, mathematics, computer technology, tourism, nursing, etc. In this case, the foundational writing practices and activities of IWT (Institute for Writing and Thinking) are very useful and applicable [3]. By means of these writing practices, teachers from diverse disciplines can enhance the critical thinking skills of their students and promote the understanding of their subject area, building their disciplinary knowledge and education [10].

## Literature Review

According to the research findings, it is confirmed that students who possess course material through writing retain that information longer, and improve critical thinking skills and become more familiar with details and precise meaning. The more the students write in a course, the more they engage with the contents in the course. Langer and Applebee (1987) noted that rather than other activities, those which are dedicated to the improvement of

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writing skills can grant the students' improvement in their learning process [9]. By doing the variety of writing activities, students are automatically familiar with different kinds of knowledge, information data, and topics.

Teachers who use Writing to Learn approach must understand how to show examples of discipline-specific writing, how to write about subject-specific texts, to assess students writing assignments, and to give feedback [11].

**Some activities of Writing to Learn Approach**

"Writing to learn activities are generally short, impromptu or otherwise informal and low-stakes writing tasks that help students think through the key concepts or ideas presented in a course" [12]. Sometimes, tasks in the WTL approach are limited to less than five minutes of class time.

The IWT contributed a lot of writing activities to use in the classrooms of different disciplines. Based on the nature of discipline, there may be more various writing tasks. It is obvious that writing a laboratory report of an engineering student may be quite different from writing algorithms in pseudo-code [7]. An academic report for a tourism and hospitality student will be quite different from a meeting minutes of a Business Management student. Thus, teachers of English can work together with particular specialization teachers, to help students learn their disciplinary knowledge through writing activities in English. Teachers need to adapt the activities according to the nature of the discipline they are to deal with (to teach).

Some of the activities of the WTL approach that may be adaptable and feasible in the context of any Arts and Science specializations are

1. The learning log
2. Summary Writing/ nutshell writing
3. Solving real problems/Using cases
4. Dialogue Journal Writing
5. Pre-test Warm-up activity
6. Note-taking
7. Response Paper activity

**Activity (1) The learning log**

Among the several WTL activities, 'learning log' is a very simple and engaging activity for students of any discipline. In this activity, students have to reserve a space to write, a notebook or, a word file in the computer, in which they can write their thoughts, feelings, and things they are not quite clear about what they are studying.

For example, for science students, they may write the meaning of a word, a usage, or a new concept in one of their major subjects. They have to write mainly on the concepts and questions about their subject including keywords. They can also write the key concept or the explanation of a theory they understand well from the lesson. They have to write regularly, every day or twice a week. Writing this way, the students will remember, get familiarity, and understand the concepts of the subjects. They can highlight the main points they know, and still need to know so that they can clarify these highlights with the peers or respective teachers.

The learning log is also something like diary writing, in that students have to write about the previous lecture at the beginning of the class, that they get warm-up for the lesson. At the end of the class, they have to write reflection topics like "today's most interesting point" or "thing they are not happy."

One important point is that, this activity is quick and ungraded, that it gives no stress to students for entry.

**Example**

As an easy starter for this activity, the teacher asks the students to designate a space for their learning log. Then distribute the copies of a written assignment about "Tanintharyi Cultural and Heritage sites" to every student, let them read, and respond individually for 5 minutes about what they learned or still need to learn.

They write about the definition of the topic, the sites mentioned, the words and terms they are unclear, and so on. Then feedback, in general, is given. After that, the students get the idea of writing the learning log.

The following points are the starters for learning log entry.

- The main point I learned from the lesson
- How I understand the key concept
- The point I am still unclear
- The word I do not understand though I already checked in the dictionary (due to the context, or referential meaning).

The teacher collects the logs after every two weeks or sometimes picks up from a couple of students to know students' thoughts and feelings about the lessons, and gives feedback. The teacher always checks if there is anyone who would like to get immediate response and answer for the entry, and gives feedback, such as the meaning of an idiom or the usage or jargon. Some teachers pick up a single response, particularly after introducing a key concept. By doing snapshots of students' comprehension occasionally, teachers can know how well students understand the material. Teachers can then tailor the next lecture to clarify and elaborate as their best for students.

**Activity (2) Summary Writing/ nutshell writing**

In order to capture the main points and key details of a lesson or a reading text, and write in a shorter form, summary writing is used. These summary writing practices help students understand the original reading text more when they are first assigned to write. They remember the points clearly for later tests or homework assignments. Providing key questions about the lesson can help students narrow in on the main ideas to emphasize and remember from the lesson.

If abstracts are significant in the students' discipline, they might be asked to analyze the abstracts in a major professional journal and write similar abstracts of the readings they are assigned in the course.

**Example**

The teacher uses easy-to-read content text from the students' discipline, reads aloud, and asks the whole class to write the summary together as a group work. Then, using another content text, the teacher asks students to read with partners and create a summary together. Finally, when students seem to write summaries well in pairs, the teacher assigns the students to generate a summary individually.

**Nutshell writing**

Nutshell writing is the technique in which the whole idea of a text or a lesson is summarized in one sentence. This term originally comes from the idiom “put it in a nutshell”, meaning that putting the things in the smallest place possible.

**Example**

The maroon leaves Crusoe on an island where he must learn to survive himself for years.

**Activity (3) Solving real problems/ Using cases**

In the activity "solving real problems", the teacher asks students to analyze a case study; an authentic problem in the industry, either in group or individually. Students are to write down the problem as well as the solution they think to be true. For the sake of being quick and easy, teachers should choose the simple cases related to the subject matter. Sometimes, the teacher set up the scenario, and different students have different writing tasks.

**Example**

The teacher assigns students authentic and updated students' problems from Myeik University, to think for the best solution in group or individually, and write down the solution on a piece of paper. Due to the time frame, some case studies can be extended. This activity is very useful for the students as they get experience before they write formal business reports in the industry.

**Activity (4) Dialogue Journal Writing**

Unlike the learning log, journal writing is a little more formal than that, students have to write down the regular progress of their lessons in the discipline.

Gillis (2001) found that journal writing integrates classroom and clinical experiences [6]. Gillis recommended some guidelines for students with the title of “embarking on the journaling process”. In this guideline Gillis introduced several steps to write journal entry; to set purpose, to begin with, first clinical experience, to be regular that the progress can be traced, keep immediate entry, to use a spiral notebook, to use the double-entry format in that reflection and clinical analysis is separated from and so on [6].

**Activity (5) Pre-test Warm-up activity**

It is sometimes a kind of extension of the problem-solving activity that the materials used in the activity are the sample of their test. Sometimes teachers should give out sample test questions before the real exam.

Another alternative for pre-test warm-up writing is to give out sample test questions in advance of the exam. Students can work individually or in groups to write out responses. They know the test material will come from the WTL activity and they are likely to prepare more carefully. During this activity they gain better awareness of the subject matter.

**Example**

In the class of English specialization, the students are divided into groups of six, in which they have to negotiate on a business contract. Three from each side are taking the roles of representatives of an organization or business firm, and one of the group members writes down the minutes. The teacher gives an outline for the negotiation, and after 5 minutes, they have to end up the meeting and finish the writing in a group. The similar material with a little different but the authentic situation is set for the test, that they are quite familiar with the writing task, as well as the concept of negotiation.

**Activity (6) Note-taking**

Note-taking is in fact, not a particular activity but a way of learning through writing. While listening to a lecture of the curriculum, some students highlight, while some underline the textbook, but some write down short notes of key points and difficult words. Those who write down the notes can remember the lecture better than others. Some of the scientific concepts are easier to understand once they are written down as different types of note writing styles such as spider chart, vanned diagram, circles and arrows, flow-chart and/or tree diagram, etc.

**Activity (7) Response Paper activity**

In this activity, students are to read the assigned reading text from their specialization subject and write responses that analyze key features of reading. Unlike the summary writing, the students have to react and write responses that analyze the features of the assigned reading specifically (the quality of data, the focus of the research reported, the validity of research design, the effectiveness of logical argument). Sometimes they might write arguments for the text and/or write counter-arguments. In this way, students of any specialization can raise awareness of their disciplinary knowledge.

This activity is something like giving feedback from one's own point of view or writing a review on the contents of the text.

**Example**

The teacher assigns the English specialization students with an authentic, argumentative, updated news article to read and respond in pairs or individually. Then let them peer checked.

## Methodology

The research design was a Classroom Action Research as the purpose of the study is to develop students' writing skills using WTL activities. The study had been done in one cycle which included planning, acting, observing, and reflecting by Ferrance (2000)[5]. The instruments of the study were using tests (pre-test and post-test), questionnaires, and observation checklist.

In order to achieve the goal of the study, the detailed plan was implemented in the planning phase. The subjects were twenty students (third year) specializing in English in Myeik University who were enthusiastic in developing their writing skills. A pre-test was administered by the researcher and two collaborators and a set of questionnaires was also created to analyze the attitude of the students to the writing tasks. From the questionnaire, it was found that some students who didn't have a good command of English expressed the skills they wished to develop.

In carrying out the acting phrase, a twelve-week plan of developing writing skills was implemented. It included a detailed procedure of lesson plans together with teaching strategies and materials which equipped students with an understanding of layout, organization, grammar and lexis, and mechanic. The researcher made sure every activity overlooked the important elements of successful writing which included planning content, peer correction, and collaborative writing. Participants took the four writing classes (four periods) for two days a week. In the first period of every week, the context of the lesson was introduced. To motivate the learners and to create an interactive environment, the teachers assigned the tasks to discuss, predict, identify, consider, and apply to their own experiences.

Moreover, the students are allowed to search in the internet for the updated data, information and usages. They can use the dictionary for correct use of vocabulary and collaborations. Before students did the writing activities, they had group discussions in which they shared their ideas, gave suggestions to each other. At the same time, instructional scaffolding and necessary guidance were paid to enhance, encourage, and help students. Students revised, re-edited, and re-checked their pieces of writing and submitted them to the teachers who assessed and scored with the writing skills scoring rubric. For the first four weeks, the teachers encouraged the students to give more attention to the content and not to the language accuracy.

At the end of the twelfth week, the participants did the post-test. Both the pre-test and post-test were designed in identical test types which assisted the same concept.

## Findings and Discussion

This section presents the analysis of data collected from the pre-test and post-test. The quantitative data were analyzed and it included the mean score of the students' writing test on WTL activities. The evaluation of students writing had been done on four factors: Content, Vocabulary, Grammar, and Mechanic. The modified scoring rubric adapted from ( Heaton, 1988)[8] was used to analyse the students' scores.

Table-1 Students' writing score ( pre-test)

| **Students** | **Category** | | | | **Total** |
|---|---|---|---|---|---|
| | **Content** | **Vocabulary** | **Grammar** | **Mechanic** | |
| 1 | 3 | 2 | 3 | 2 | 10 |
| 2 | 3 | 2 | 3 | 2 | 10 |
| 3 | 3 | 2 | 3 | 2 | 10 |
| 4 | 2 | 3 | 4 | 2 | 11 |
| 5 | 3 | 2 | 3 | 2 | 10 |
| 6 | 3 | 3 | 3 | 2 | 11 |
| 7 | 3 | 3 | 4 | 2 | 12 |
| 8 | 3 | 3 | 2 | 2 | 10 |
| 9 | 3 | 3 | 4 | 2 | 12 |
| 10 | 3 | 2 | 3 | 2 | 10 |
| 11 | 3 | 2 | 3 | 3 | 11 |
| 12 | 3 | 2 | 3 | 2 | 10 |
| 13 | 3 | 2 | 3 | 2 | 10 |
| 14 | 3 | 2 | 3 | 3 | 11 |
| 15 | 3 | 3 | 4 | 3 | 12 |
| 16 | 3 | 2 | 3 | 2 | 10 |
| 17 | 2 | 3 | 3 | 2 | 10 |
| 18 | 3 | 2 | 3 | 2 | 10 |
| 19 | 3 | 2 | 3 | 3 | 11 |
| 20 | 3 | 2 | 3 | 2 | 10 |
| **Total** | | | | | **211** |
| **Mean** | | | | | **10.55** |

At the start of the activity, a pre-test was administered to the selected participants. The test consisted of two kinds of WTL activities: learning log and summary writing. Table- 1 shows the students' mean score before doing the action cycle. The mean score of the pre-test is 10.5. The mean score was calculated by using the formula: Mean= $\frac{211}{20}$ . The highest score is 12 and the lowest score is 10. Overall, it can be seen that three students had the highest scores at 12. The other five students got a score of 11 which rates the second highest. Ten students had by far the lowest score at 10 and the largest in number in all the twenty students. It can be seen that only a few students achieved the maximum criteria. The pre-test result showed that most students needed to develop in generating ideas and organization (content), appropriate use of vocabulary, correct use of sentence structure (grammar), and mechanic.

Table-2 Students' writing score (post-test)

| **Students** | **Category** | | | | **Total** |
|---|---|---|---|---|---|
| | **Content** | **Vocabulary** | **Grammar** | **Mechanic** | |
| 1 | 2 | 3 | 4 | 2 | 11 |
| 2 | 2 | 3 | 4 | 2 | 11 |
| 3 | 3 | 3 | 4 | 2 | 12 |
| 4 | 3 | 3 | 3 | 4 | 13 |
| 5 | 3 | 2 | 3 | 2 | 10 |
| 6 | 3 | 3 | 4 | 2 | 12 |
| 7 | 3 | 3 | 3 | 4 | 13 |
| 8 | 3 | 3 | 4 | 2 | 12 |
| 9 | 4 | 3 | 4 | 3 | 14 |
| 10 | 2 | 3 | 4 | 2 | 11 |
| 11 | 3 | 3 | 4 | 2 | 12 |
| 12 | 3 | 2 | 3 | 2 | 10 |
| 13 | 3 | 3 | 4 | 2 | 12 |
| 14 | 3 | 3 | 4 | 2 | 12 |
| 15 | 4 | 3 | 4 | 3 | 14 |
| 16 | 3 | 3 | 4 | 2 | 12 |
| 17 | 3 | 2 | 4 | 2 | 11 |
| 18 | 3 | 4 | 3 | 3 | 13 |
| 19 | 3 | 3 | 3 | 3 | 12 |
| 20 | 3 | 3 | 4 | 3 | 13 |
| **Total** | | | | | **240** |
| **Mean** | | | | | **12** |

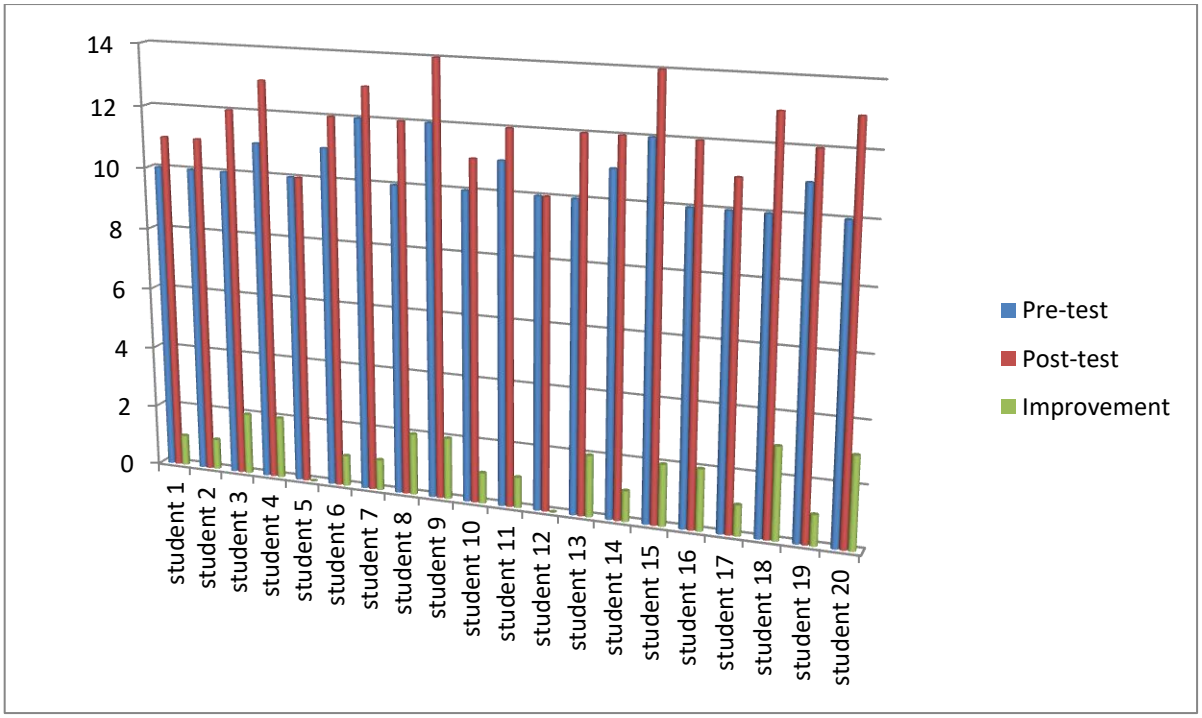


Figure (1) Scores and Improvement of Students' Writing Skill (Pre-test and Post-test)

At the end of the twelfth week, the post-test was administered. As a result of effective teaching strategies, intensive guidance, students' enthusiasm, there were significant improvements in the post-test. The data interpretation of the post-test reveals that the mean score, 12 was much increased. The highest score is 14 and the lowest score is 10. In contraction to the pre-test, the highest number of students, eight out of twenty scored 12. It was evidenced that all students developed in their writing ability except two participants. Two highest achievers scored 14 and the other four scored 13. On contrary to the pre-test, eight students scored 12 and this is the largest number out of twenty. Only two participants scored 10 which is the lowest rate. The reason might be the fact that they had not actively participated in group discussions, and doing writing assignments due to their background command of language.

According to Azjen (2005), "an attitude is a disposition to respond favourably or unfavorably to an object, person, institution, or event; the characteristic attribute of attitude is its evaluative nature ( such as pros and cons, pleasant or unpleasant) [1]. To check the students attitude on the activities, the students are given a set of structured questionnaires, in which their attitude on the writing activities, after the post-test, were checked and assessed. In Fig (2), the percentage of the students whose attitude on doing the activities have shown.

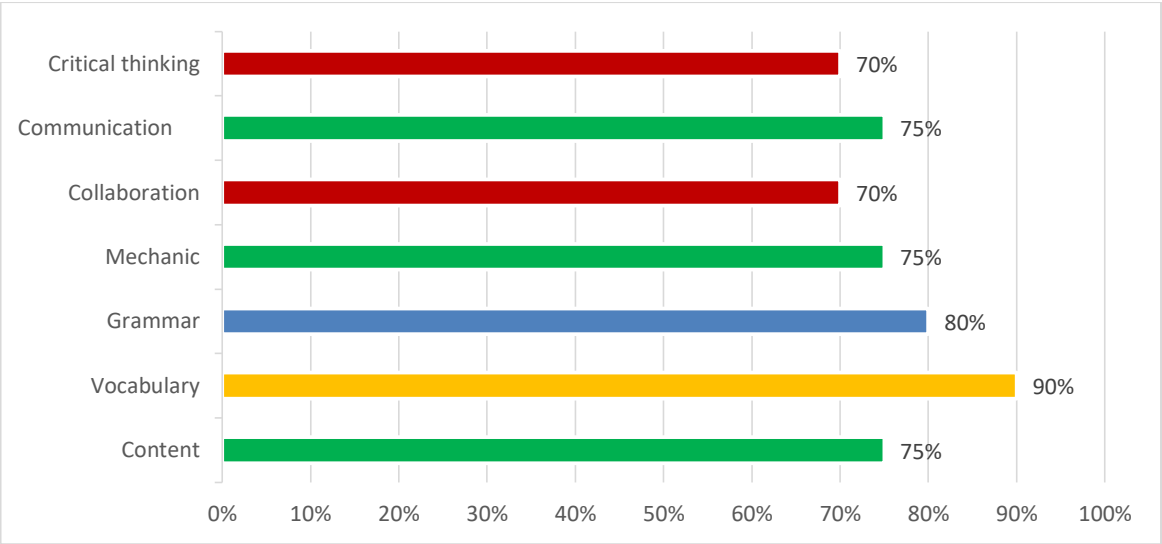


Figure (2) Students' Attitude on Doing WTL Activities

Based on the observation throughout the study and the questionnaire checklist, it was found that the students enjoyed learning WTL activities. Looking at Figure (2), the questionnaire checklist illustrated that 15 out of 20 (75%) had considerable development and content, mechanic, and communication. Besides, 18 out of 20 (90%) had significant enhancement in vocabulary which is the highest percentage of all. Additionally, the number of students who think that they had noticeable improvement in grammar are 16 out of 20 (80%). The minimal proportion of students 14 out of 20 (70%) feel that they gained collaboration and critical thinking skills.

## Limitations and Suggestions

In this study, only two of the WTL activities are used to test the students' development. Other activities can also be used to check its development. Moreover, though the WTL approach aims to use for the students of any discipline, English specialization students are chosen to test as the first step in this study. This means that, in the follow-up researches, the students of other specializations will also be chosen as participants, with the use of WTL activities. In fact, the writing skills of the students can be improved with the better teaching of writing strategy, and it is considerable to link their writing with the content of their specialization. In doing so, the students' motivation can be increased.

Teachers who use WTL activities can adapt the activities to fit with their own classrooms. As some weaker classrooms may have language difficulties, teachers should balance between learning to write and writing to learn. Proper language input is necessary in this case. Moreover, teachers who teach writing using Writing to Learn approach must understand how to show examples of discipline-specific writing, how to write about subject-specific texts, to assess students' writing assignments, and to give feedback [11]. Teachers should balance between learning to write and writing to learn. Then, students will get intellectual development as well as disciplinary knowledge and education during the WTL activities.

To get a better awareness of the WTL approach which plays an essential role in teaching writing, WTL workshop can help teachers have the opportunity to develop an understanding of writing-based teaching, its theory and practices, and its application in the classroom. If English teachers in various disciplines use the WTL approach, their students'

writing skills in the discipline will surely be improved, and at the same time, their disciplinary knowledge will also be enhanced. Making writing a regular part of the classroom, a teacher can raise his students' critical thinking skills with the best use of activities. This study is hoped to contribute to develop the writing skills to some extent, by introducing WTL approach.

## Conclusion

This study aimed at developing students' writing skills by using activities of the WTL approach. Based on the research findings and discussion, it can be concluded that using activities of the WTL Approach could make success in developing the writing skills of the students, including vocabulary usage and mechanic as well as their critical thinking skills. The study also suggests teachers of English should create successful writing classes by using WTL activities mentioned in the study.

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# Improving the Translation Skill of the English Specialization Students Through Translation Activities

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## Abstract

This research focuses on improving the practice of translation between languages: here English as the target language (TL) and the mother tongue as the source language (SL). This study aims to investigate the students' translation methods and strategies on translation in class as well as out of class. The study is an action research applied to a number of 30 students who are fourth year undergraduate level of English Specialization students at Myeik University in the first semester, 2019-2020 academic year. The main question of the study is 'Would translation practices help improve my students' translation skill? The findings indicate that the students had an improvement to a certain extent that have been trained about the translation strategies. The results of the research highlight the significance of the need of translation practice in daily life. They also serve as an answer to the question 'whether translation skill is important or not' for students, especially learning English as a second language. This research also points out that the teacher's effort and students' participation are key criteria in teaching and learning translation subject in classrooms. It is highly expected to bring successful achievement as well as to make contributions to teachers who are taking translation classes and to students who are engaging in translation studies.

**Key words:** translation, TL, SL, methods, strategies, skill

## Introduction

Translation is a phenomenon that affects daily life's communication. The study of translation as an academic subject has only begun in the past fifty years. In the English-speaking world, this discipline is now generally known as 'Translation Studies'.

Translation, an act of conveying the meaning of the source language (SL) to the target language (TL), is a difficult and complicated task. It requires the proficiency in the two languages, cultural knowledge and background knowledge of the subject matter, terminology and styles. That's why; teaching translation studies becomes a key element in developing students' comprehension.

Translation is a frequently used strategy that becomes a need for everyone in the global environment as people need to translate language to avoid miscommunication. It is a part of communicative English Language Teaching classroom. For this, English Specialization students have to take translation subject as compulsory in their third year and final year as a need. It can be used as communication activities to support students' learning process but students see translation as a specialized and challenging activity, not as an activity to help them learn language.

This is because most of the younger generation in Myanmar including English Specialization students read less and their knowledge about the world and their awareness of culture are quite limited. They also lack the practice of using certain vocabularies, grammar points, styles and registers. They need to widen their scope of knowledge much more for their personal development.

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Translation activities are techniques teachers can apply in class to make students read more texts in favour of translation practice. To support students in developing their skills like problem solving and decision making, to make them motivated in their translation class, to improve their language acquisition and cultural awareness, translation as highly communicative activities are really effective to apply during their class-time for translation module.

This study focuses on improving students' translation practice in English language classroom setting and analyses the errors and mistakes of the students who are taking part in translation class in their academic year. It is one of the motivating activities done in class to promote students' language skill in one way. In this research, individual work, peer check, and group activities are used to investigate how the students perform the translation process.

This research will not be enough to cover all the difficulties and challenges that both teachers and students are facing in their day-to-day practical teaching-learning situations within a non-native classroom setting. But learning what are the best equivalents or the most appropriate way in translation can upgrade the students to a certain level and drive their fear of translation. In other words, students can be trained to get confidence and widen their scope of knowledge.

Therefore, it is absolutely valuable to do translation practice that helps improve their communicative skills. This research can point out the weaknesses or difficulties in using the two languages and display how important the teacher's effort in teaching students and attracting their interest in learning the translation studies.

## Literature Review

According to 'The Concise Oxford English Dictionary', translation is (1) an act or an instance of translation (2) a written or spoken expression of the meaning of a word, speech, book, etc in another language.

Vermeer (1978) says that translation is a kind of transfer where communicative verbal and non-verbal signs are transferred from one language into another. Rogers (1988) defines authentic materials as 'appropriate' and 'quality' in terms of goals, objectives, learner needs and interest and natural in terms of real life and meaningful communication.

Pienemann, 1989 defines Translation as much more than substituting words of one language into another; it's an art, i.e; a teachable one. Therefore, teaching a translation course without touching on different textual genres and not bringing authentic material often seems impractical and only theoretical. According to Bella (1991), 'translation is the expression in another language (or target language) of what has been expressed in another source, preserving semantic and stylistic equivalences.

According to Dr Miremadi (1991), translation problems are divided into two main categories: lexical problems and syntactic problems. However, there is no completely exact translation between any two languages and as Dr Miremadi (1991) quoted Werner (1961), the degree of approximation between two language systems determines the effectiveness of the translation. Bell (1994) stresses the importance of materials in the teaching of translation 'Materials should be authentic in terms for texts and tasks'.

Different scholars have various perspectives to the aspects of the act of translation, so, they define and describe different types of strategies. Bergen's (n.d.) classification of the strategies includes three categorizations: 1. Comprehension strategies, 2. Transfer strategies, 3. Production strategies.

Mona Baker (1992) lists eight strategies, which have been used by professional translators, to cope with the problematic issues while doing a translation task:

13. Translation by a more general word
14. Translation by a more neutral / less expressive word
15. Translation by cultural substitution
16. Translation using a loan word or word plus explanation
17. Translation by paraphrase using a related word
18. Translation by paraphrase using unrelated words
19. Translation by omission
20. Translation by illustration

Kelly (2005) defines translation as the skill of understanding the source text and rendering it in the target language by using the register, the background knowledge and other language resources according to the intended purpose.

Translation between written languages remains today the core of translation research. There are several scholars who made contributions in the field of translation studies. Jakobson's discussion focuses on equivalence between items in SL and TL and the notion of translatability. There arrives a question, 'Is everything translatable?' According to Jakobson, the answer is 'yes, to a certain extent'.

## Some Effective Activities in the Classroom

It is the challenging task of the translation teacher to plan the activities in advance to give translation practice to his / her students and provide them to participate in the acting stage.

### Activity (1) Word Level Activity

To activate students' responsiveness and interest, students' coursebook is used as a key material in the classroom.

Stage (1) Students are asked to read some parts of a topic.

Stage (2) They are told to find out the words they don't know.

Stage (3) Students are randomly selected to stand up and read out the words, the teacher writes them down on the board.

Stage (4) The other students are asked to guess the meanings of the words and provide the proper translation.

Stage (5) They are told to check the appropriateness of the translated version and the teacher gives feedback.

### Activity (2) Word Level Activity (Extended Meaning)

Stage (1) Students are told they are going to work in groups.

Stage (2) They are divided into 6 groups of five each.

Stage (3) Each group needs to construct 10 sentences with the written words on the board.

Stage (4) A presenter of each group is to post their results on the paper stuck on the wall.

Stage (5) The other groups have to discuss and provide their translated version.

**Activity (3) Phrasal verbs exercise**

Stage (1) Students are asked to learn phrasal verbs from their coursework.

Stage (2) Students are divided into 5 groups of 6.

Stage (3) Each group is given a chart to come up with 20 phrasal verbs and post on the chart on the wall.

Stage (4) The other groups are asked to discuss and prepare their meanings on a sheet of paper without looking at dictionaries.

Stage (5) A representative of each group is to present their results of the discussion in front of the class.

Stage (6) The other groups are asked to comment on the presenter.

Phrasal verbs and idioms are a challenge for students and most of them are not willing enough to memorize them all. That's why, most commonly used phrasal verbs and idioms were chosen and provided as resources. This is a way to help them practise those phrasal verbs in real-life situation. After their presentation, the whole class has already memorized its forms and meanings.

**Activity (4) Sentence Level Construction**

At the sentence level, students are provided with different sentence structures, a variety of modifiers and tense markers and given chances to translate. Proverbs and sayings are the most difficult part for them and students are given opportunities to test their skills.

Stage (1) 50 proverbs and sayings are written down on the board.

Stage (2) Translated version of the proverbs are provided in advance and handed to each student.

Stage (3) Each student thinks of the meaning, translates and does the matching.

Stage (4) They need to come out individually and provide the matched translated version.

Actually, the target language proverbs are not within their scope of knowledge. That's why, the more the teacher gives chances for them to match and memorize, the more they can get them. Here, clever students can improve better than the weaker ones.

**Activity (5) Paragraph level translation**

This is the most boring part for the students and some of them didn't try that question in the exam. Their limited vocabulary, subject matter and sentence construction are barriers that make them less confident to answer. That's why, students are provided this kind of activity to drive away their fear of translation.

Stage (1) Students are told to form 6 groups of 5 each.

Stage (2) Each group is provided the same transcript in TL.

Stage (3) They are asked to prepare their translated version in their SL on a paper.

Stage (4) A representative from each group is ordered to go to another group and shared their translation.

Stage (5) Each group has to present their translation.

Stage (6) Teacher provides the most appropriate translation and explains their mistakes.

## Action Research Question

This research mainly focuses on an area to improve translation skill through translation practice. Creating effective lessons to meet students' active involvement in translation process is a challenge for the teacher. Thus, the researcher aims to develop the student's translation activities by laying down theoretical rules for translation strategies and providing authentic tests and tasks for practical translation practice. The most effective way is giving feedback that students can't get outside the class. By this way, students will develop a better communication and translation skills. The research question here is 'Would translation practice help improve my students' translation skill? This study aims to analyze how much they have improved after they have taken three months translation class on translation practice.

## Methodology

### Method

This is an action research as it is carried out in a school setting (Corey 1953). He believed that the value of action research is in the change that occurs in everyday practice rather than the generalization to a broader audience. The main aim of an action research is to find solutions to real problems faced in schools and searching ways to improve students' success. Simply the stages of an action research by (McNiff, 1988) are:

- Planning
- Acting
- Observing and
- Reflecting

### Participants

This study was conducted in Translation and Interpretation classes at Myeik University. 30 volunteers (3 male and 27 female) were chosen from Fourth Year English Specialization who had already learnt the basic principles of Translation and Interpretation in their Third Year. 3 one-hour classes per week were provided for three months. The researcher used the students' coursebook as the theoretical guide. They were asked to read something new about a certain topic, including idioms, phrasal verbs and proverbs every week. The Global New Light of Myanmar and social media were good resources for translation process. With the purpose of investigating students' attitudes and improvement of translation habits, methods like asking questionnaires, pre-test, post-test and activities were used. Students were motivated with the instant feedback after their activities.

### Research instruments

Two types of questionnaires were used to collect the basic data about the students: the attitudes and their difficulty level. Then, students were given pre-test to investigate how much they could translate. Based on their result, activities for three levels both from TL to SL and SL to TL were done in class. These activities were rulers for observation and they reflected what they have learnt in their post-test.

## Findings and Discussion

To obtain the attitudes of the students, the questions were distributed at the first period of lecture. The data obtained from the questions were presented by percentage. This is done to observe students' attitude towards translation subject and find out how much they are efficient enough to face translation difficulties in their day-to-day life. The following table

shows the result of the research on the attitude of student towards the translation practice.

Table 1: Attitude on the translation activities

| No | Questionnaires | Yes( %) | No(%) |
|---|---|---|---|
| 1 | Do you have the practice of translation outside classroom? | 46.6 | 53.4 |
| 2 | Do you think translation is an important skill in your real-life situations? | 93.3 | 6.7 |
| 3 | Do you want to improve your translation skill? | 100 | 0 |
| 4 | Are you interested in translation activities? | 73.3 | 26.7 |
| 5 | Do you think translation activities in your class are enough for practice? | 30 | 70 |
| 6 | Do you think translation is a difficult activity? | 83.3 | 16.7 |
| 7 | Do you like doing translation activities individually? | 20 | 80 |
| 8 | Do you like doing translation activities in group? | 93.3 | 6.7 |
| 9 | Do you want to do translation practices in class regularly? | 90 | 10 |
| 10 | Do you try all the practical translation questions in your exam? | 73.3 | 26.7 |

Table 1 shows the results of the research on the attitude of the students towards the translation activities in classes. According to the data collected by the questionnaires, it is clear that all students want to improve their translation skill and for most of them, translation is a difficult skill to master. 73.3% of students are interested in translation activities but they know the need for extra practice. 90% of them also like to do translation practices in class regularly but mostly in groups. The significant thing is that they rarely have the practice of translation outside class as they need to get feedback.

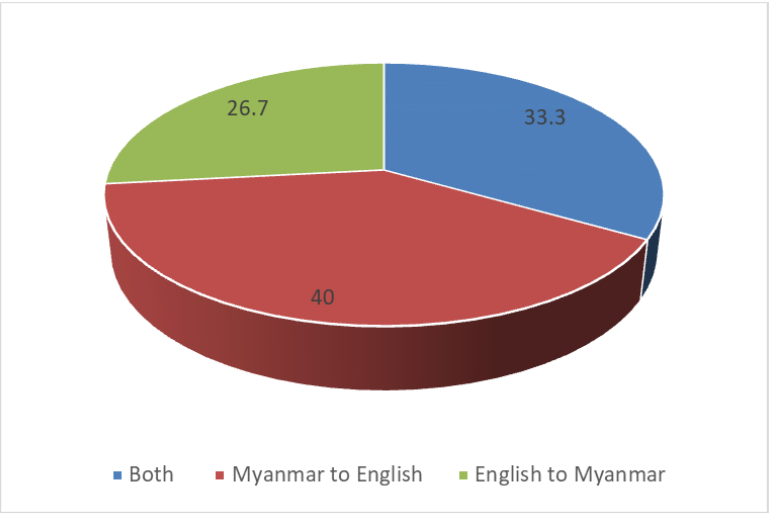


Figure (1) Difficulty Area of translation between languages

This analysis shows that 40% of students find translation from Myanmar to English is more difficult and 33.3% of students accept translation from English to Myanmar is more difficult. On the other hand, 26.7 % of students believe both are difficult enough. These data show that there is a need for translation practice but most of them are more confident translating English to Myanmar as they feel they have a wider range of vocabulary for their mother tongue.

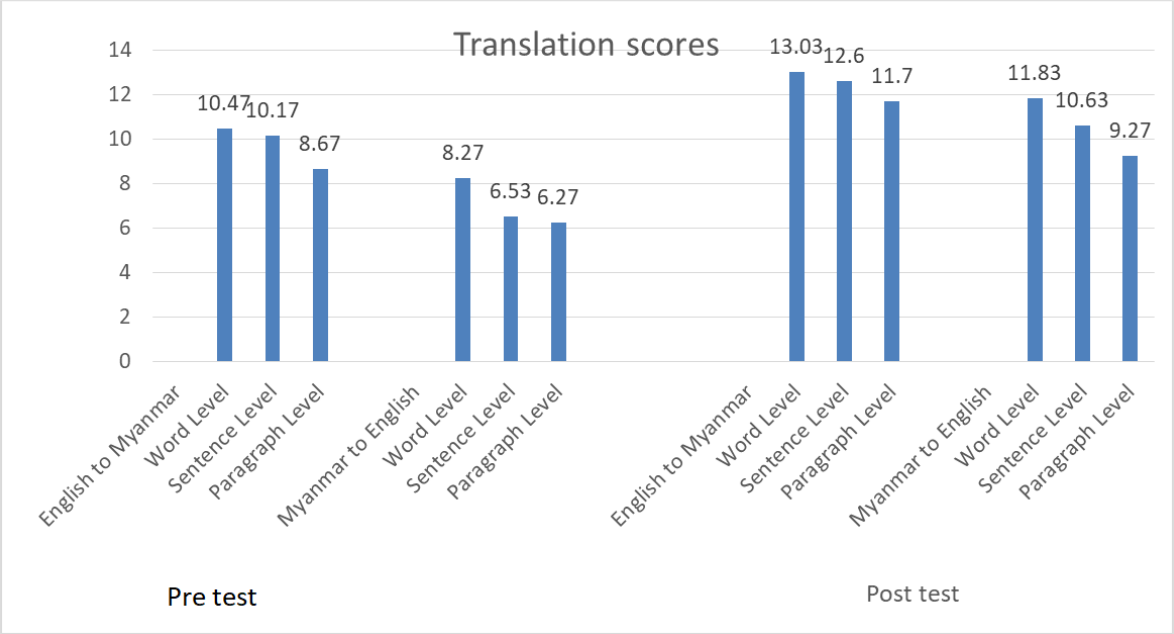


Figure (2) The comparison of the Translation scores between Pre-test and Post-test

The above chart showed the improvement in students' translation scores. Students improved in each level of translation both in their SL and TL. All of the levels improved from pre to post after taking part in classroom activities for translation. In other words, the activities hit their necessities and upgraded their marks in these three months of practice.

The teacher carefully chose the materials for practice that were up-to-date and authentic. Newspaper articles, coursebook and social-media were effective teaching resources for students to make the lessons interesting. Activities and groupworks were very effective to lessen their fear of translating. In pre-test, the mean score was 50.38 % and it increased to 69.06 % in post-test, it increased 18.68 % point. It showed that teaching translation through planned activities improved the student's translation skill. The improvement can be seen both in the target language and their mother tongue.

From the findings in this study, it is found that students made mistakes in their translation because they accepted translation as a basic strategy: just to change something. They replaced SL words by their equivalent TL words. They tended to translate word by word or sentence by sentence without using their scanning skill before they did their translation. They focused a lot on the original meaning of the SL vocabularies and they mostly forgot to look at how these words were structured and their context.

It is also revealed from the research that students preferred translation from TL to SL than SL to TL as they felt safe in constructing sentences in their mother tongue and more confident in their choice of vocabularies. A lot of translated version from SL to TL and vice versa were set as exercises to learn at home. Their improvement in both languages showed that these exercises were certainly good resources to upgrade their translation skill.

In addition, students were given feedback on every activity for what they translated with the translation theories and strategies. Translation problems occur due to the different grammatical structures and cultural issues. In reality, there is no completely exact translation, only the degree of approximation determines the effectiveness. The students came to know that the main thing was to keep the original meaning of the text unchanged. After that, they applied different skills and theories in their practical translation.

From this research, it can be clearly said that not only theories but practical translation is effective in promoting students' translation skill. The translation activities aroused the students' interest, made them engaged in the translation process and upgraded their confidence level. The most important thing is this will help them learn languages better.

That's why, students participated in translation activities about various themes and they were able to present their own translated version that was the result of how they understood the text and presented it in the target language by using another language media. They also felt proud as they involved themselves as very proficient translators of the two languages, those who could transfer the SL to the TL. In other words, they got other skills: decision making and problem-solving.

## Conclusion

Using questionnaires, this research finds out the students' attitudes towards translation activities and their difficulty level. It investigates how much students can translate and what methods or strategies they use by means of pre-test. Then the teacher initiates activities for their translation practice. Then their post- test answers the question 'Would translation practice help improve my students' translation skill? It would be a bit challenging both for the teacher and students to focus on translation activities for three months. But training students in their translation skills is very effective as they did not learn translation as a subject, but they did translation to learn.

The results of the students' translation marks showed that they had insufficient knowledge in the area of translation strategies and language at the beginning of the study. They were weak in their choice of vocabularies, sentence structure, style, figures of speech, idioms, proverbs and cultural awareness. They also did not have much practice in translation. However after the trainings in translation practice, there was a dynamic improvement in their language delivery.

To be successful translation class, there are needs both for students and teachers. Students tend to make errors because translation is more than substituting words of the SL into the TL and also due to their inadequate knowledge of vocabulary, grammatical structure, cultural terms, etc. Their mother tongue interference also creates translation errors. That's why, students need practice to be proficient in translating both languages. They also need to participate actively in classroom activities. But the teacher who can explain the best translated version is really a necessity.

To be an effective teacher in translation, planning is really important as he/she needs to take time and plan carefully about what are the source materials depending on the aim, how to integrate translation with other skills, how to encourage students to discuss the meaning and use language. Creating effective lesson plans to meet students' active participation depends much on the teacher and that is the key for students to succeed. If translation activities are designed well, it can practise all four skills. Therefore, it depends on the teacher to create translation as a real-life natural communicative activity. Classroom management is also important to apply translation as an activity in the classroom to support students' learning process. Teachers not only need widespread knowledge of L1 and L2

culture as well as lots of preparation to set up classroom activities but also will need a motivated classroom. That's why, to train students to be successful translators, there needs a systematic translation education plan and the use of authentic materials from real life.

To sum up, translation is a life-long learning skill for communication and this research points out that translation activities can be very effective communicative activities in class.

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The Concise Oxford English Dictionary

# Evaluating the English Compulsory Coursebook: The Inclusion of Lower-order and Higher-order Thinking Activities for First Year Students

Maw Lwin Htoo[1], Thet Ni[2], Saw Myat Ohn Mar[3]

## Abstract

A growing awareness of the significance of critical thinking in teaching-learning process has grown over the years. In language teaching, and learning, imparting only four skills of language is not sufficient. Integrating critical thinking into the context is required for teaching, and learning. The paper analyzed and described the activities in the coursebook *Straightforward A2*, indicating to what extent the activities demand each level of the cognitive domain. The paper studied the activities based on the framework of Bloom's taxonomy of educational objectives, the cognitive domain. The findings of the paper revealed that the activities in *Straightforward A2* help students mostly practice and improve lower-order thinking skills. However, activities and tasks for enhancing higher-order thinking skills appear in speaking, and writing components of the textbook, affording students the benefits of creating the unique one based on the facts they have learned. And it was observed that there was an imbalance between the activities that enhance higher-order thinking skills and those that enhance lower-order thinking skills. It was also found that the greater proportion of activities demand lower-order thinking skills. Basically, *Straightforward A2* gives satisfactory content for both students and teachers, supporting students with a lot of communicative activities.

Keywords: Critical thinking, Language teaching and learning, integrating

## Introduction

There has been a growing interest in infusing critical thinking into students' cognitive processes, curricula, examinations, and approaches to teaching in the realm of education. In many countries, the role of education is significant to the development of critical thinking and it is believed that schools are not merely the places where transmitting knowledge take place, yet they are places to help students become 'independent thinkers'(Vincent-Lancrin, et al., 2019). It is commonly claimed that critical thinking is one of the most desirable skills and essential skills and enables one to thrive in one's life or any workplace. In order to improve students' abilities, textbooks play a significant role as the essential materials in teaching and learning. Activities and tasks fostering critical thinking are required in the textbooks of all levels of education (Ilyas, 2015; Hikmat & Solihat, 2018). Most of the teachers follow textbooks and they are dependent on them. Depending on textbooks, they extend their lesson plans.

Margana and Widyantoro( 2017) stated that English textbooks should be designed for developing students' thinking skills so that they are familiar with dealing with challenging tasks in which students can internalize their memorized facts and they are fully engaged in the process. Teaching critical thinking and promoting a perspective of commitment to teaching critical thinking along with the English Language Course contributes students to more ultimately prepare for further academic studies and their future careers in the workplace, (Tuzlukova et al., 2017). Infusing critical thinking into an academic setting has a greater impact on not only the success of academic life but also the achievement in future lives (Ilyas, 2016). In addition, a great diversity of facts, opinions, information, and

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assumptions can easily be available due to technology in today's digital lifestyle, so critical thinking for everyone is becoming increasingly important to clearly differentiate the appropriate and reasonable one from other varieties (Vincent-Lancrin, et al., 2019). This paper relies on the classification of cognitive levels of Bloom's taxonomy. Bloom's taxonomy intends to support the classification of the goals of the education system and to be of general assistance for all teachers, educationists, administrators, professional specialists and researchers who deal with curriculum and evaluation problems. Bloom's taxonomy includes three major parts: the cognitive, the affective, and the psychomotor domains- and dealing with the identification of knowledge and the growth of intellectual abilities and skills is the main objective of the cognitive domain (Bloom et al., 1956).

This paper aims to investigate the extent to which critical thinking tasks are included in the English Compulsory coursebook used by tertiary level students. Also, the impact of the tasks on the students' critical thinking is analyzed and illustrated with some excerpts in this paper. The issue of encouraging critical thinking has been significant in Myanmar in recent years. Higher education takes responsibility to nurture human resources needed for globally and economically society. The National Education Strategic Plan (2016-2021) expresses that the examination system focusing on memorizing the lessons will be replaced by the system that focuses on the skills and education development indicators (Lwin, 2017). A survey by JICA (2013) made a recommendation that upgrading the existing curricula and examination through changes from knowledge acquisition focus to critical thinking and problem-solving skills results in an effective contribution to the needs of today's labor market.

This paper will be based on the compulsory coursebook used by tertiary level students, especially namely, *Straightforward A2*, in the Straightforward series published by Macmillan Education in 2012. Although the tertiary level lasts 4 years, the paper will only investigate the first-year level since this level is the foundation for other levels. This study will apply Bloom's revised taxonomy to study critical higher-order thinking skills involved in the textbook. Many scholars state that among the educational objective domain taxonomies, the suitable tool to analyze the cognitive process is Bloom's taxonomy (Nayef, Yaacob, & Ismail, 2013). This paper will investigate the following research questions:

1. To what extent does the English coursebook *Straightforward A2* cover each cognitive level activity based on Bloom's taxonomy?
2. Is there a balance between lower- and higher-cognitive level activities in the coursebook?
3. Does the coursebook facilitate to develop students' thinking skills?

The paper consists of six sections. The first part focuses on the introduction, including the context, aim and research questions, and the organization of the paper. The literature review is described in the second part. After that, the data and methodology are clarified in the third section. It is followed by section four, which describes data interpretation, frequencies, and percentages of the activities. And the next section describes the discussion of the results observed in the previous section. Finally, the last section concludes with some outlines to develop students' thinking skills and to enhance their performance in academic qualifications.

## Literature Review

### Theoretical Background

Critical thinking has been of great attention to educators, teachers, students, and scholars in the educational field. Scholars have defined the term "critical thinking" in

different ways. An early and innovative definition of critical thinking proposed by Bloom (1956) is that the higher mental processes allow students to make creative use of their knowledge. The work of Bloom reveals a classification of learner behaviours in the cognitive domain as a set of skills-knowledge, comprehension, application, analysis, synthesis, and evaluation. Bloom's taxonomy is a kind of the cumulative process that is based on the previous one, beginning at the easiest level and finishing with the most complicated and challenging level. Anderson and Krathwohl (2001) revised the original version of Bloom's taxonomy such as Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating. As mentioned below, higher-order thinking skills are Analyzing, Evaluating, and Creating, whereas lower-order thinking skills are Remembering, Understanding, and Applying. And, such notions play a significant role in framing educational curricula. Bloom's taxonomy is an effective tool to enhance higher-order thinking skills, that can be assumed as critical thinking (IIyas, 2016). In addition, Huges and Dummett, (2019) pointed out that it is necessary to give an emphasis that lower-order thinking does not intend less superior and less important than higher-order thinking, and Anderson and Krathwohl are preferable to see these different skills as equally important and engaged in learning at different times.

**Bloom's Revised Taxonomy**

| | Cognitive Processes | Explanation of each cognitive level, using language classroom examples. |
|---|---|---|
| Higher-order thinking | Creating | Creating may mean that learners use vocabulary and concepts they have learned to come up with something entirely original or special. |
| | Evaluating | This level includes the tasks that students make judgments on their basis of their own thinking. Examples of such activities involve making students review a text to recognize various points and to assess which one is the most and least validity, relevance to the situation. |
| | Analyzing | Analyzing includes the activities in which ideas and concepts in the text are broken down into individual pieces and students can see how the pieces relate to the larger structure. Such activities involve making students identify supporting facts or relating things to the conclusions. |
| Lower-order thinking | Applying | In applying, students apply their newly learned knowledge, usually in a controlled way. For example, the phrases they have learned are asked to use in a similar dialogue when they practice. |
| | Understanding | In understanding, students try to construct meaning by linking new information with existed information. |
| | Remembering | This level involves recalling what was taught. For example, this could be checked by making students match a list of terms to their definitions. |

Anderson and Krathwohl’s taxonomy of thinking skills

Source: Hughes & Dummett (2019)

## Critical Thinking in Language Course

According to Debela and Fang (2008), critical thinking is such a process that it is not achieved in an instant way and it takes time to happen in one's cognitive development. Besides, since critical thinking is a skill that improves with practice, that is why critical thinking can be learned, and also it can be taught (Debel & Fang, 2008). Hence, infusing critical thinking activities into lesson plans, textbooks, and stimulating critical thinking in classroom activities have been paid attention to boost students' critical thinking (Fahim & Eslamdoost, 2014). Students are encouraged to improve critical thinking in terms of engaging them in the critical thinking process by using effective questions, discussing, and reflecting effectively in a context (Rezaei, Derakhshan, & Bagherkazemi, 2011). Besides, if students are exposed to a greater range of activities that integrate critical thinking, it will contribute students to promote better learning and to shift their way of thinking from the lower level to the higher (Zarei, & Gandimathi, 2018).

A previous study by Komariah and Putri (2018) suggested that analyzing textbooks by using cognitive domain levels of Bloom's Taxonomy is one of the useful parts. And the researchers concluded that the textbook could invoke the students' minds to be more creative and critical when it involves many activities enhancing students' critical thinking. The findings by Ulum (2016) pointed out that the knowledge level is more dominant than other levels when analyzed the coursebook. The researcher suggested that the relationship between lower- and higher-cognitive questions should be viewed as the integration process.In addition, lower-cognitive questions will facilitate to acquire factual knowledge and they are the foundation for achieving high-cognitive skills. The research by Hikmat and Solihati (2018) indicated that although the components of critical thinking are found in the Indonesian language textbooks, the quantity is insignificant. Thus, promoting critical thinking should be operated by including it in textbooks and determining the objectives of teaching it. Kaung Myat San, (2019) found out that the instructions for reading activities in the global A2+ demand an understanding level of thinking. That study expressed that the coursebook writer of the global A2+ might have provided reading tasks, with an emphasis on developing comprehension skill by motivating learners to practice translating and paraphrasing the concepts.

## Research Materials and Methodology

This paper relies on activities and exercises included in the English coursebook for tertiary level students entitled "*Straightforward A2*" designed by Linsay Clandfied. Straightforward series include A2, A2+, B1, B1+, B1++, B2, B2+, C1- altogether eight textbooks from A 2 to C1. Each course has six chapters with grammar, vocabulary, functional language, pronunciation, reading, listening, speaking, and writing and students' workbook is also included. Also, a teacher book and audio CDs are provided. The activities and exercises in the coursebook were collected and calculated in individual sections such as vocabulary, grammar, reading, listening, speaking, and writing. However, the activities and exercises in the workbook were not collected since most of the activities support to develop the previous activities in the coursebook, they naturally help learners boost their skills learned in the previous ones.

This paper descriptively analyzed the activities and exercises involved in the textbook by employing the cognitive levels of Bloom's Revised Taxonomy. In this paper, frequencies and percentages of data were conducted as the quantitative design, while the data was analyzed and described as the qualitative design. Firstly, the researcher collected the activities and exercises in the coursebook, listed and categorized according to the cognitive levels of Bloom's Revised Taxonomy- remembering, understanding, applying, analyzing, evaluating,

and creating. Then, the researcher calculated the percentage and frequencies in which each activity stand for each level of cognition by using the following formula:

$$Percentage = \frac{\text{the frequency of activities}}{total\ activities} \times 100$$

In terms of analyzing the data collected, this paper is also considered as a kind of qualitative research. In Bloom's revised taxonomy, each cognitive level is expressed with the representation of question words and verbs for each level. Bloom (1956) expressed that classification and evaluation objectives must be considered as a part of the total process of curriculum development and in terms of education process students are expected to change in their thinking, feelings, and actions as a result of learning experiences. This paper presents some question samples related to cognitive levels and gives rational explanations of why the classifications are appropriate to the particular cognitive level.

## Data Analysis and Results

The results of to what extent critical thinking activities and questions entailed in the English coursebook *Straightforward A2* are presented. According to six levels of Bloom's revised taxonomy for the cognitive domain, this study presents the descriptive analysis covered classifying all questions in the coursebook, computing frequencies, and describing percentages. The activities and questions in each section of the coursebook are then classified through lower and higher-order cognitive thinking levels and then percentages are worked out to discover the coverage of lower and higher-order cognitive thinking questions in each section. Critical thinking and creative thinking tend to be associated with higher proficiency levels of English (B1 + level and above), however, that does not mean that lower proficiency levels, for example, (A 2) the English coursebook expresses only lower-order thinking (Huges and Dummett, 2019). Even at all levels, infusing critical thinking activities into the lessons and encouraging a concept of critical thinking can be operated completely. All the data that emerged from descriptive analysis are employed in the data analysis to deduce the results. The following tables and their data description emphasize that the extent to which lower and higher-order cognitive thinking skills entail in the English coursebook *Straightforward A2.*

Table 1: Frequencies and percentages of six cognitive levels in the activities of vocabulary section

| | Frequencies | Percentages |
|---|---|---|
| Remembering | 27 | 55% |
| Understanding | 17 | 35% |
| Applying | 4 | 8% |
| Analyzing | 0 | 0% |
| Evaluating | 1 | 2% |
| Creating | 0 | 0 |
| Total | 49 | 100% |

Table 1 shows the frequencies and percentages of six cognitive levels in the activities of the vocabulary section. As can be seen, most vocabulary activities are constructed in terms of lower-order thinking skills of Bloom's revised taxonomy, namely knowledge level, and comprehension level. The percentage of remembering level contained in the activities of the vocabulary section is 55 %, more than half of all the levels, while the percentage of

understanding level is by 35%. In contrast, the table shows a distinct lack of higher-order thinking skills, namely analysis (analyzing), synthesis (creating), and evaluation (evaluating). It expresses only by 2% at the evaluation level. That's not to say, this English course book lacks in fostering critical thinking to the students. Bloom's revised taxonomy is a cumulative process. Each level of the mental process is based upon the previous level, starting with the easiest and ending with the most complicated and challenging. Accordingly, higher cognitive levels do not imply superior thinking skills and lower orders are inferior ones. Each level plays an important role in learning in its own behavior. Thus, it can be drawn that more activities in remembering and understanding levels than other levels contribute the students to enhance their vocabulary that is supportive in their productive skills, speaking, and writing.

The activities in vocabulary section are categorized as knowledge level or remembering stage, the very fundamental level in the cognitive domain of Bloom's Taxonomy. It involves students recognizing and recalling what has been taught. One of the activities is from the theme of food, namely "miracle diet" and another one is the activity to enhance the vocabulary. In the former activity, the photos that are already familiar with the students are given at first. This activity asks the students to match the words in the box to the photos, thus students can recall their memories and from what they have learned at an early age. The another one asks students to practice what they have already known in the previous exercise and it shows the communicative approach among the students. However, this type does not include the task that asks students to express their reasoning skills, for example, why they like this kind of food. Therefore, this activity also belongs to one of the lower-order thinking skills, knowledge, or remembering.

The activity "Complete the information for the Nutrition Reference Guide with words from exercise 1" asks students to categorize the words. To complete this kind of activity, students need to understand how the words belong to each category. The activity is aimed to comprehend the taught materials or lessons and to connect new knowledge with students' existing knowledge. Thus, this activity is classified as "Understanding Level".

Regarding the grammar section, the following table 2 exhibits frequencies and percentages of six cognitive levels in the activities of the grammar section.

Table 2: frequencies and percentages of six cognitive levels in the activities of the grammar section

| | Frequencies | Percentages |
|---|---|---|
| Remembering | 22 | 42% |
| Understanding | 26 | 49% |
| Applying | 5 | 9% |
| Analyzing | 0 | 0% |
| Evaluating | 0 | 0% |
| Creating | 0 | 0% |
| Total | 53 | 100% |

In the result of the activities in the grammar section, the percentage of understanding level increases slightly more than the remembering level, by 49% and by 42% respectively. Looking at the applying level, it can be seen that the activities involve only 9% among all the levels, and no activities and exercises can be seen in higher-order thinking skills.

To answer the activities in grammar section, it is necessary for students to comprehend the rules and principles concerning the issues, but it does not demand students to think analytically and critically. Thus, these activities exhibit a way to ensure basic comprehension, understanding level.

When analyzing the activity like "Work in pairs. Read the dialogue", it can be seen that students do not need to apply their newly learned lesson in dialogue and they only need to practice the one that they have already answered. So this activity is categorized in remembering level.

Students have just learned grammar rules concerning the tasks. And, the tasks ask them to use their learned knowledge in real-world situation. Thus, it can be drawn that these tasks belong to applying level.

Regarding the reading section, the following table 3 exhibits frequencies and percentages of six cognitive levels in the activities of the reading section.

Table 3: Frequencies and percentages of six cognitive levels in bloom's taxonomy in the activities of the reading section

| | Frequencies | Percentages |
|---|---|---|
| Remembering | 0 | 0% |
| Understanding | 20 | 47% |
| Applying | 19 | 44% |
| Analyzing | 4 | 9% |
| Evaluating | 0 | 0% |
| Creating | 0 | 0% |
| Total | 43 | 100% |

As mentioned, there are 43 activities and exercises in the reading section and most of the activities involve in the cognitive level of Understanding, Applying, and Analyzing. In the result of activities and exercises in the reading section, the percentages of activities in understanding level appear as a maximum of 47% among these activities, following by 44% in applying level. The activities that appear for an analyzing level are only 9% and there are no other activities and exercises that demand the cognitive levels of evaluating and creating in the reading section.

Most of the activities are categorized under the cognitive level of Understanding. The tasks ask students to read the text and choose the right one from (A) and (B). When they read the texts, they process it and try to understand it. Although these types of activities are simply a case of knowing what they are reading in their native language, for language learners, it will really take longer to understand in the process. Thus, it can be drawn that the activity belongs to the level of Understanding.

All of the questions in the reading section ask students to read the article and answer them. The tasks generally help students boost their reading techniques such as skimming, scanning, or intensive reading. In the cognitive level of Applying, students take new information, having studied a text. And they apply it in the new context. For language learners, this often appears as the tasks of answering comprehension questions or filling in a table with facts or figures in the text. That means students must complete the task in terms of the new information they have understood. Therefore, the activities are classified into the cognitive level of "Applying".

Some tasks are considered as the category of the level of analyzing. For completing these tasks, students might have returned to the text described earlier and thought again what the author presented in the earlier text. Next, they might have found evidence in the text to choose the appropriate one. They might have analyzed the text what they have read before. Students are becoming more critical of the text while they are completing the task. Thus, this kind of activity belongs to higher-order thinking in the cognitive domain.

With regard to the listening section, the following table (4) expresses frequencies and percentages of six cognitive levels in Bloom's taxonomy.

Table 4: Frequencies and percentages of six cognitive levels in the activities of the listening section

| | Frequencies | Percentages |
|---|---|---|
| Remembering | 1 | 2% |
| Understanding | 33 | 78% |
| Applying | 4 | 10% |
| Analyzing | 4 | 10% |
| Evaluating | 0 | 0% |
| Creating | 0 | 0% |
| Total | 42 | 100% |

Looking at the listening section, the activities manifested in understanding are the most dominant among other cognitive levels, by 78%. The activities in the lower-cognitive levels are at remembering level and in applying, 2%, and 10% respectively. It can be seen that 10 % of activities takes place in analyzing level. According to Anderson and Krathwohl (2001), students require examining concepts thoroughly through individual parts and make an attempt to understand how the individual parts contribute to the overall structure. That is why this level is regarded as a higher-cognitive domain. Students need to construct meaning by connecting new things with the existing thing. In students' native language, this is simply a case of remembering, whereas, in the language teaching-learning process, it takes longer for them to construct meaning (Hughes, 2014). Thus, the questions are classified into understanding, one of the lower-cognitive levels.

Table 5: Frequencies and Percentages of six cognitive levels in the activities of the writing section

| | Frequencies | Percentages |
|---|---|---|
| Remembering | 0 | 0% |
| Understanding | 19 | 47% |
| Applying | 8 | 20% |
| Analyzing | 7 | 18% |
| Evaluating | 0 | 0% |
| Creating | 6 | 15% |
| Total | 40 | 100% |

Table (5) shows the frequencies and percentages of six levels of the cognitive domain in Bloom's taxonomy. Among total activities (40), the activities in the writing section cover higher-order thinking levels, in creating, and analyzing, by 15% and 18% respectively. The most maximum activity in this section belongs to the cognitive level of understanding, by 47% followed by the activities in the level of applying, by 20%.

In this section, writing a short paragraph, a reply, a thinking letter, an invitation can be seen as the production stage of the lesson. Such activities cover only the cognitive level of creating. Students are asked to form something unique using language and concepts they have learned. For the activities, students have already been introduced the language and concepts in previous activities such as,

Creating is the last and the highest-order thinking in the cognitive domain of the educational process. It is necessary for students to apply their new knowledge and to create something of their own out of it.

In regard to speaking activities, the following table (6) indicates the frequencies and percentages of six levels of the cognitive domain in Bloom's taxonomy in the activities of the speaking section.

Table 6: Frequencies and percentages of six cognitive levels in the activities of the speaking section

| | Frequencies | Percentages |
|---|---|---|
| Remembering | 0 | 0% |
| Understanding | 7 | 20% |
| Applying | 21 | 62% |
| Analyzing | 0 | 0% |
| Evaluating | 0 | 0% |
| Creating | 6 | 18% |
| Total | 34 | 100% |

In the case of the speaking section, the activities manifested in the Creating level- the higher-cognitive level involves by 18% of all activities. The most dominant activities are in the Applying level that shows the initial step toward the use of language for real communication. And the activities that correspond with the cognitive level of understanding are by 20% of all activities. In this section, role-play activities, giving a presentation, inventing their own works can be seen as the production stage of the lesson; that is to say, it covers only the cognitive level of Creating. Students are asked to perform something unique using language and concepts they have learned. In the activities, students are already introduced and taught vocabulary, grammar, and language use in the respective sections to perform this task. However, students have to apply their new knowledge and to create their unique work out of it.

The results in all the sections-vocabulary, grammar, reading, listening, writing and speaking indicate the percentages of each level in the cognitive domain. It can be clearly perceived that most of the activities cover only to the lower-cognitive domain, whereas some activities in writing and speaking sections cover the higher-cognitive domain. As a whole, the activities for all cognitive levels appear in the textbook, yet lower-order thinking questions

take place more than higher-order thinking questions that result in building a solid foundation for students. And this textbook also encourages students' thinking skills as they have chances to apply newly learned knowledge.

## Discussion

The present paper examined the activities in the coursebook entitled "*Straightforward A2*" that is compulsory for first-year students in Arts and Science universities in Myanmar. The previous research by Ulum (2016), Komariah & Putri (2018), Kaung Myat San (2019) use different materials for their research, however, there is a similar fact that all these studies rely on Bloom's taxonomy.

Data analysis and results showed that the activities that belong to lower-order thinking skills are more numerous than those in higher-order thinking skills, especially in vocabulary, grammar, and reading sections. The activities in these sections include the basics of comprehension such as testing students' ability to recall and apply language in a controlled way they have learned. These activities do not encourage students to arrive at a deeper understanding of the target language. Besides, a mindset which involves thinking reflectively, rationally, and reasonably cannot be practiced to have growth. Thus, material designs should include activities that encourage students to perform greater analysis and a series of activities that move from a basic understanding to a deeper understanding.

According to the data analysis and results, the tasks enhancing higher-order thinking skills appeared in writing and speaking components. That generally implies that the opportunity has been come out to train students on the higher levels of cognitive domain and to stimulate thinking and enhancing other cognitive skills such as problem-solving and devising the unique one on their own. Thus, overall, the tasks with a range of activities from lower-order thinking to higher-order thinking generally bring about the satisfaction in teaching and learning process.

On the other hand, rote learning habits and exam-oriented learning might continuously take place in an academic setting. Some factors such as exam-targeted situations and focus on rote learning of facts and information have an undesirable impact on students' overall development (Fok, 2002). In academic performance, getting good grades in examinations is one of the crucial things for students. That does not mean that only exam-oriented learning may be the reason for that. Lwin (2017) commented that the process of assessment should not be only focused on the examination conducted at the end of lesson learning. It is also suggested that the teaching/learning system enables students to promote active learning and critical thinking, enquiry based learning and project based learning. It can be suggested that the grading system should include the performance of students in the classroom. The more performance they create in class, the more active and critical their minds are. Accordingly, it is suggested that the activities in listening and speaking should be added to the grading system when students perform tasks.

## Conclusion

This paper is intended to analyze the activities in the coursebook "*Straightforward A2*", identifying the cognitive level associated with the activities in the book. In particular, this paper has focused on investigating to what extent the tasks in the coursebook include in concerning with lower-and higher-order thinking skills. The paper has also explored whether there is a balance of inclusion between lower-cognitive level activities and higher-cognitive level activities. In addition, the paper has addressed the question of whether the coursebook facilitates students' critical thinking skills.

The data analysis and results indicated that in the vocabulary section, the most two noticeable cognitive domains associated with activities are remembering and understanding-lower-level cognitive domains, indicated by 53% and 35% respectively. According to the results of the grammar section, the majority of the activities engaged with lower order thinking skills, and in this level, the activities appeared for applying level is not significant, involving by 9%. For the reading section, there was a move from low-order thinking skills to higher-order thinking skills, appearing insignificantly by 9% in analyzing level. It can be clearly seen that the majority of the activities were focused on the development of the lower-level cognitive domain. In language learning, lower-order thinking has its own value in each state, for instance, rote learning is useful to some extent in languages such as memorization of words, phrasal verbs, collocations, and idioms. However, opportunity must be formed for them to use their memorized words or facts in reflective, rational, and reasonable ways.

In addition, the finding showed that there are activities addressed higher cognitive processes in reading, listening, writing, and speaking, but the percentages are not significant. That implies that there is an imbalance between higher-order thinking questions and lower-order thinking questions. However, activities oriented to higher-order thinking skills arouse students' interest. The inclusion of higher-order thinking skills in language coursebooks can facilitate students to establish their creativity and self-regulated learning, the essential issues for acquiring the language.

The study gives an emphasis that coursebooks serve an important role in teaching and learning process as an essential tool for both teachers and students of any level of education to be actively engaged in classroom practices. Eventually, the point the study would like to discuss is that besides the effective materials, not only teachers but also learners need motivation and inspiration in teaching-learning process. Although teaching higher-order thinking skills may be easy, the result cannot be clearly seen in the cognitive level, which is abstract. The dominant factors to enhance the cognitive levels are students, teachers, and condition- Students need to have motivation; Teachers encourage and facilitate the learning process (IIyas, 2016). According to Dweck, Walton, and Cohen (2011), the essential thing missed in educational reforms is the psychology of students, called motivational factors that are more significant than cognitive factors for students' academic performance. The study by Zhang, Kuusisto, and Tirri (2017) showed that students' and teachers' mindsets are related to students' academic achievement. Thus, further studies concerning motivational factors are needed in teaching and learning process.

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# Professional Development for English Language Teachers from Higher Education, Myanmar

Yin Min Htun[1], Chit Su Maung[2], Thet Ni[3]

## Abstract

Professional Development is central to teacher competence and to be an effective English language teacher requires a combination of professional knowledge and specialized skills. This research discusses the self-reflection of English language teachers in Myanmar with regard to the checklist of SEA-TCF. The participants of this survey were 77 teachers from universities in Myanmar. Multiple-choice questionnaires were provided and the data showed the majority of teachers realize the importance of professional development and they are taking full responsibility for their own growth. There is also the need to strike a balance between the individual and organization to compete in the globally connected landscape of the 21st century.

**Keywords** – Professional Development, Professional Knowledge, Self-reflection, Specialized skill, 21st century

## Introduction

Professional Development is an alternative word for "learning. To be exact, professional development means continuous learning. It is not a one-time event but it is an activity in which teachers should have ongoing and sustainable involvement. In the constantly changing world of knowledge and information, every professional needs to polish their competencies to be in line with local and global practices. Competency, here, means a combination of skills, knowledge, behavior, and attributes that enable effective or better job performance. With regard to the evolving demands of teaching profession, teachers also need to continuously develop themselves professionally to improve their competencies for better performance. Professional development is a key strategy for teacher improvement and includes any activity which is designed to bring about positive change in practicing teacher's competence. There are many ways in which teachers can pursue professional development. From informal, brief, and individual activities such as reading professional articles to participation in large scales and extended teacher development projects organized by institution and organization such as the Ministry of Education.

Siuskey (2000 ) is widely cited in the evaluation of professional development. I have also found the literature on the monitoring and evaluation of development projects to be a particularly insightful source of ideas (for example, Bell and Aggleton, 2016, Gorgens-Albino and Kusek, 2009, Goling and Edwards, 2003, Markiewicz and Patrick, 2016). When it comes to Professional Development, new technology develops and its application to language learning and teaching needs to be explored. ( Macalister, 2007) . Familiar materials and activities no longer seem to be as suitable or effective as they once were, and need to be evaluated (Davies, 2006). Thus the term professional development should be taken into consideration in the daily lives of teaching professionals.

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## Literature Review

The centrality of teacher competence to student outcomes has been highlighted repeatedly in the literature in recent years (Hattic,2012; Schesille, 2007). Thus professional development plays a significant role for teachers and students. There are many research papers over years that have reported on how different kinds of professional development impact on practicing language teachers (for example, Borg, 2011; Curtis and Szesztay, 2005) but my specific focus here is not to present as these studies do, evidence of impact from a specific intervention, but to discover broadly how professional development of English language teachers in Ministry of Education can be conceptualized and implemented. Many other theoretical sources of relevant readings are Richards and Farrel (2005, p-14) list a range of individual, one-to-one, grouped-based and instructional teacher development activities such as these, self-monitoring, journal writing, teaching portfolios, action research, peer coaching, peer observation, critical friendship, team teaching, teacher support groups, and workshop. According to Zepeda 2012, other activities of professional development are learning communities, study group, book studies, lesson study, and learning circles.

It can be clearly stated that professional development can be done with many forms and my paper will highlight the professional development of English language teachers from universities of Myanmar by using the self-rating checklist by (SAE-TCF) Southeast Asia Teacher Competency Framework. SEA-TCF is a product of regional collaboration involving eleven Ministries of Education in Southeast Asia (10 ASEAN countries plus Timor Leste) working together on a framework to develop a Southeast Asia Teachers Competency Framework (SEA-TCF). The SEA-TCF is a set of skills, knowledge, behaviors, and attributes which the eleven Ministries of Education have agreed that teachers in their respective countries need to have.

In line with global best practices, ASE-TCF serves as a torchlight for use in teacher professional development toward realizing 21$^{st}$-century skills and practices within a context that is regionally appropriate. SES-TCF is considered an important document and it was designed for Southeast Asian teachers by Southeast Asian teachers. So the self-rating checklist of SEA-TCF will be of great help in evaluating the professional development of university English language teachers in Myanmar as well. According to the checklist, the result from this paper will highlight the area (competency) teacher need to prioritize in their professional development career and it will also help teachers (1) chart your success profile, (2) prepare your professional development plan and, (3) support your on-going professional growth.

## Methodology

A Google form was created and the contents of the survey were questions from the self-rating checklist and it has been approved by the SEA-TCF. The checklist consists of four essential competencies (see Appendix, the checklist is structured according to the general and descriptors. There are altogether 31 multiple-choice questions. Seventy-seven ( 77) university English language teachers (from Tutor to Professor) from different universities of Myanmar participated in this survey. The focus on specific specialization reflected the intention to investigate professional development in English Department in particular.

## Data Analysis

The survey contained multiple-choice questions of four essential competencies. Under each general competencies and the respondent had to choose the best option that best describes his or her competency level. As a result, the analysis was quantitative.

**Table (1) Participant of the Survey**

| | | |
|---|---|---|
| Male | **15** | **19.5%** |
| Female | **62** | **80.5%** |

**Table (2) Designation of the participants**

| | | |
|---|---|---|
| Tutor | **2** | **2.6%** |
| Assistant Lecturer | **10** | **13%** |
| Lecturer | **60** | **77.9%** |
| Associate Professor | **2** | **2.6%** |
| Professor | **3** | **3.9%** |

## Findings and Discussion

Following survey distribution, 77 teachers responded to the invitation to participate in the online survey. With regard to gender, 15 are male teachers and the rest 62 are female teachers. All kinds of rank (from Tutor to Professor) contributed in this survey but the participation of lecturers is relatively high, up to 60 respondents (Table- 2).

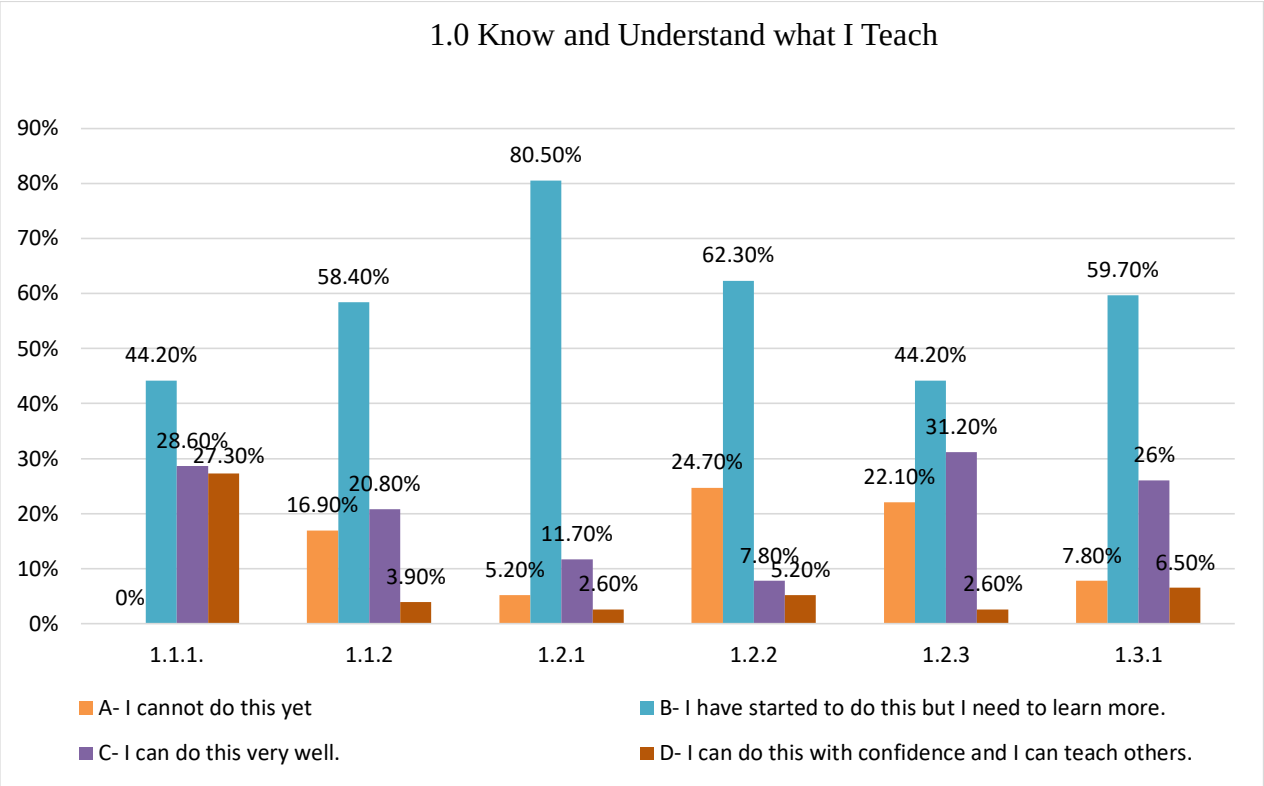


Figure (1) 1.0 . Know and Understand What I Teach

In the first section "Know and understand what I teach", the analysis showed the mastery of the subject content of the participants. 34 respondents reported that they have started but they feel they need to study more to master the content and none of the respondents said "I can't do this yet" with the other two options are relatively similar in

percentage. Regarding to 1.1.2, only 3.9% revealed their confidence in using research-based knowledge in their teaching practice but more than half of respondents committed that they are trying to polish research skills and to use their knowledge in their teaching. It can be concluded that there is a considerable gap between research and teaching practice.

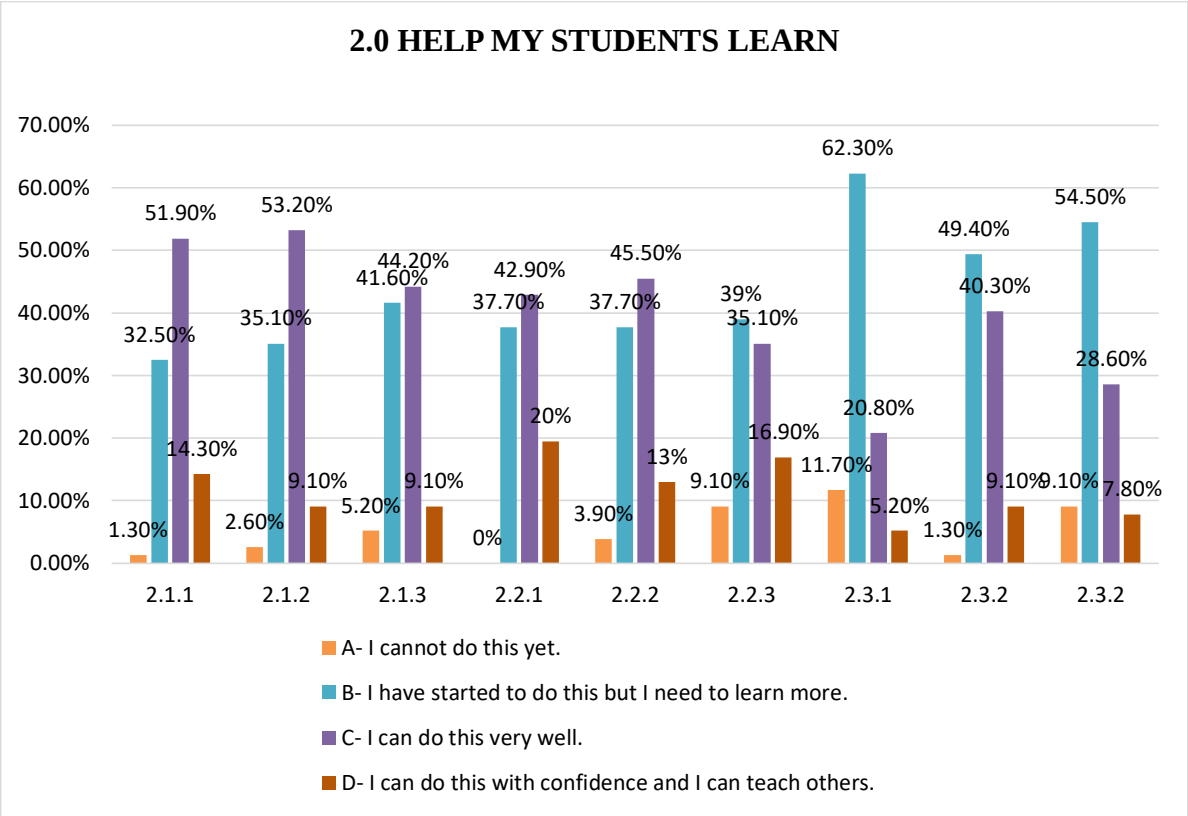


Figure (2) 2.0 Help My Students Learn

According to figure (2) 2.2.1, many university teachers feel pretty confident in understanding education trends, policies, and curricula. Regardless of their confidence level, they, however, sensed in need to know more and they are too forward to update themselves on new educational trends. 62.3% of respondents believed that educational policies can affect their teaching and they are making a fruitful attempt to understand more. Implementing the curriculum plays a significant role in shaping the professional development of a teacher. In my survey, only 2.6% reported that they can implement a curriculum with confidence and they can also teach others while 22.1% stated that they can't do. The majority of the respondents reported that they can keep abstract with the changes in education environment and the minority were relatively the same in the two different extremes on the ranking.

The section " Help my students learn" analysed and observed how teachers help students learn. This kind of analysis and observation is a form of professional development for teachers. According to the survey, the majority of the respondents mentioned that they know their students well but the statistics pointed out that knowing their students remained a huge challenge and it may be the consequence of class size in Myanmar. Similarly, the responses were nearly the same for the category "Understand how their students learn". The most common category of responses was something in the middle when they were supposed to design clear and effective lessons their students can understand as the results were fabulating in two options "I've started to do" and "I can do this very well". In terms of methodology, they feel easy and confident as none of the respondents chose "I can't do this yet" (figure 2.2.1) in selecting appropriate teaching and learning strategy. The responses also

suggested that teachers can create a positive and caring learning space. There is, unsurprisingly, a degree of uncertainty in designing assessment processes and tools as 48 out of 77 reported that they have started to do this but they need to learn more. With reference to (figure 2.3.2 and 2.3.3), respondents suggested putting much effort into monitoring their students' progress and providing appropriate support. They mentioned that they need to use results from assessments to improve instruction.

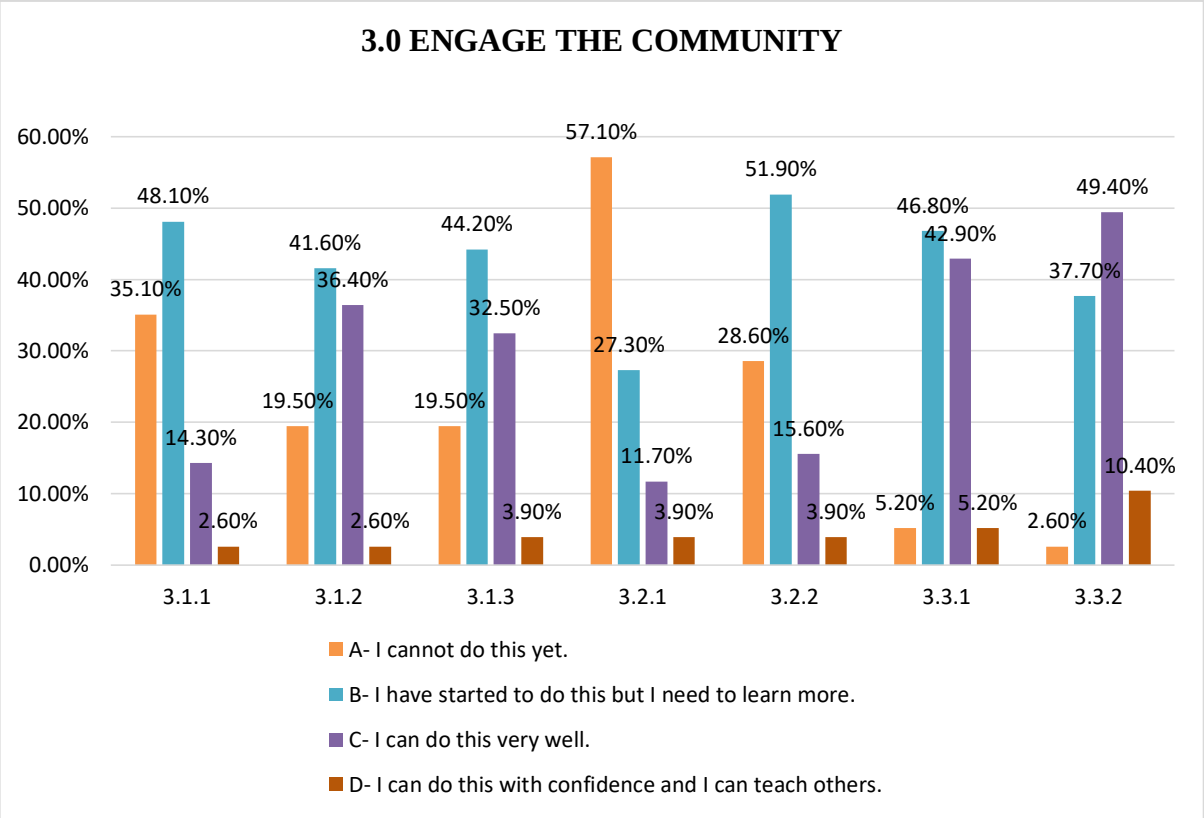


Figure (3) 3.0 Engage the Community

"Engage the community", the third part surveyed the considerable gap of social interaction between parents (caregivers) and teachers. Few respondents (14%) conveyed that they kept in touch with caregivers while the majority of respondents showed no contact with parents. Contacts with caregivers are beyond teachers' reach and it is much to do with the system and school authorities in Myanmar. But it is fortunate to know that teachers are very confident in creating a welcoming space for students.

A sense of responsibility is dramatically high and teaching-learning processes wholly depend on the teachers and students in universities as the majority of respondents reported that they do engage parents to be partners in learning but teachers occasionally put much effort into designing learning activities using community condition and tradition. As universities in Myanmar practice diverse culture, teachers undoubtedly are aware of different cultures and traditions. The vast majority of the responses are shown in picture 3.3.1 and 3.3.2. Mutual respect is one of the most valued categories in universities and teachers, therefore, practice inclusion and respect in the classroom.

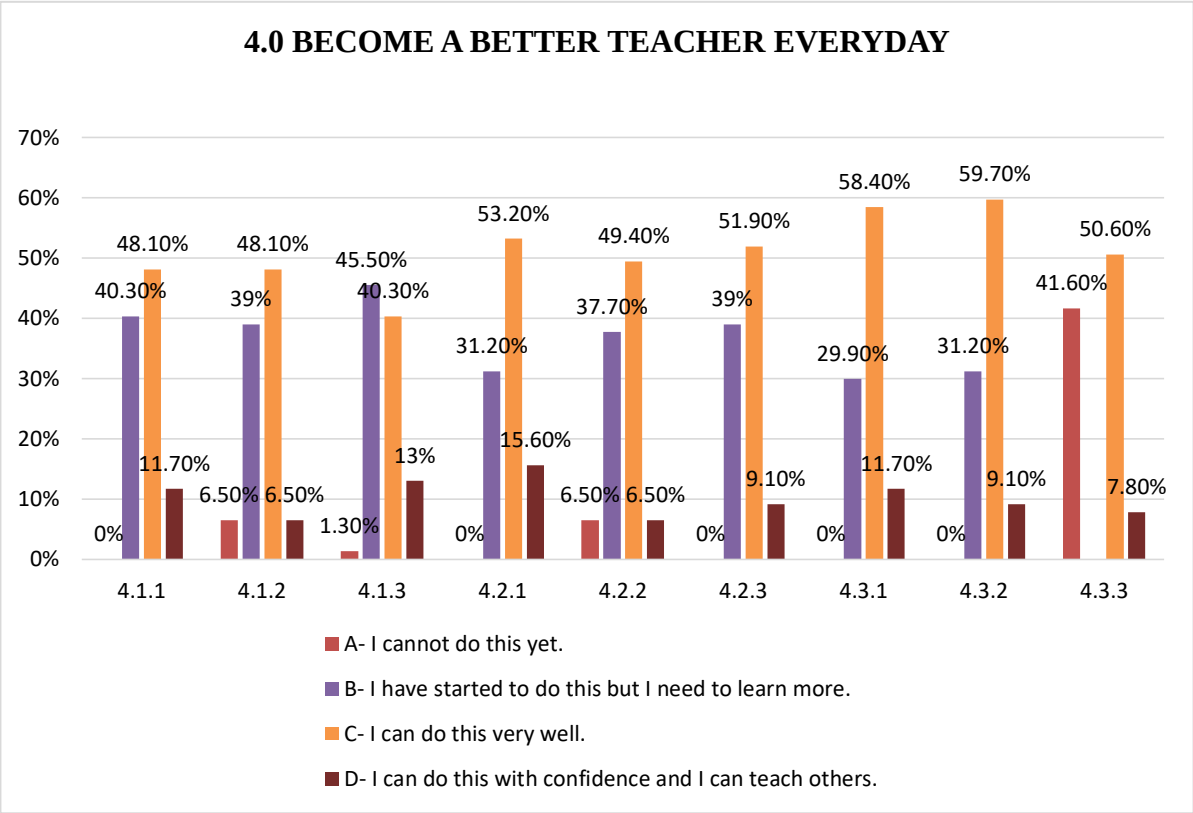


Figure (4) 4.0 Become A Better Teacher Everyday

" Become a better teacher everyday" is the fourth investigation on the core value of professional development which is to become a better teacher every day. The results from the survey were somewhat satisfactory as the majority of the respondents conveyed their willingness to polish themselves (figure 4.1.1). By reflecting, they became more aware of themselves and they feel responsible for their emotions and health as well. The results for (figure 4.13) outlined that respondents feel superiority in nurturing their relationship with care and respect. They did not fail to convey their kindness and compassion in their profession. Teachers in Myanmar are kind and compassionate by nature and 0% in this section “I can’t do this yet”, is not surprising. Most of the respondents were trying to set a good example to their college and 6.5% of the respondents claimed that they can inspire their colleagues very well. Consequently, cultivating the students' confidence in what they can do was significantly high in (figure 4.2.3) and 9.1% showed their upmost satisfaction in this category. A similar result can be seen in the topic "Keep alive my passion for teach" and it also plays a key role in shaping professional development. The respondents felt they were fully responsible for their own personal and professional growth. It can be claimed that teachers are self-made and independent. By comparing the responses from 4.2.1 and 4.3.3, the results were rather controversial as more than a half of respondents had reported they could inspire their students and colleges by setting their best example at (4.2.1) and the responses were different in the latter as 41.6% reported they couldn’t set a good example for other teachers. The differences of the results for the seemingly identical questions may be- the first question which is “inspiring students and colleague” and the second one is "inspiring other teachers". So it can be concluded that teachers feel more confident in inspiring their students but not other teachers.

## Conclusion

The purpose of this paper is to highlight the importance of professional development of English language teachers in Myanmar. Innovative ways, techniques, and last of all, criteria for Professional Development are unknowingly explored and the checklist from SEAT-TCF is used. Moreover, teachers have a great opportunity to reflect themselves and they definitely become more aware of the global practices and they hopefully can adapt in the local context.

There is little to be denied about the need for professional development for English teachers in Myanmar and the criteria set in the checklist are challenging but feasible for the teachers though some found it hard to live up to the expectation of checklist. This paper has mapped that university teachers undoubtedly are willing to be empowered to have the opportunity and the confidence to act upon the ideas as well as to influence the way they perform in their profession.

Although teachers take ownership of their own growth and personal development, it would be definitely better if the school, organization, department, etc. provide the opportunities to keep on going on the brighter way and teachers reconstruct themselves as advanced specialist practitioners of learning with their students.

To make it short, teachers are accountable for their own development and the most effective Professional Development will begin only when the institution or regulatory body provides opportunities to make improvements. Thus, interactive teacher professional development model is highly recommended in this paper.

## Acknowledgements

I would like to express my sincere thanks to Dr Ni Ni Oo, Rector and Dr Win Win Than, Pro-rector of Myeik University for their kind permission to do this research. My sincere gratitude goes to Daw Thet Ni, Associate Professor and Head of English Department who gave permission and encouragement to carry out my research paper.

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# An Investigation on the Solid Waste and Dumping Sites Management in Myeik

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Myint Myint Sein[4], Thida Win[5], Kyaw Ko Latt[6]

## Abstract

This paper is the investigation of the spatial distribution of solid waste disposal and dumping sites management, reuse and recycling shops in Myeik. The main aim of this research work is to clean and green the environment of Myeik. The main data based on is collected from the field survey and administrative offices. Collected data is promoted by the description method the interviews and questionnaire survey. The spatial distribution of solid disposal sites and dumping sites are displayed with the help of geographic information systems. The recycling of solid waste disposal makes raw material reuse and recycle in the industry. The final results of this paper can be applied for public awareness on the development of Myeik urban area and solid waste and dumping site management for the future clean and green environment.

**Keywords:** solid waste, dumping site, clean and green environment

## Introduction

Waste is any material discharged from human activities, which makes adverse impacts on human health and environment. Solid wastes are non-liquid and non-gaseous products such as those from households, municipal, supermarket, construction, and industries (Ajay, 2019; Kapilan & Elangovan, 2018). Solid waste has become a global environmental and health issue in the contemporary world both in developing and developed countries (UNEP, 2005; United Nations, 2017). Such environmental challenges combined with social, economic, and land availability issues raise concerns over land management and evaluation techniques (Coban, Ertis, & Cavdaroglu, 2018; Lein, 1990; Philippe & Culot, 2009). In developing countries, the increasing human population and associated anthropogenic activities have accelerated the process of waste generation at an alarming level. In recent decades, the waste management process used many Africa, Asian, American, and European countries have shifted from landfilling to incineration (Lino & Ismail, 2017b; Rezaei, Ghobadian, Samadi, & Karimi, 2018). Hence, it is essential to find out suitable waste management and disposal methods (Gizachew, Suryabhagavan, Mekuria Argaw & Hameed, 2012; Ebistu & Minale, 2013; Abedi-Varaki & Davtalab, 2016). Above mention lecture, daily lives of residents of Myeik, the management of waste disposal and dumping sites are investigated the following observation.

### Aim and Objectives

The main aim of this paper is to clean and green environment and to promote systematic management of waste disposal and dumping sites

The objectives are;

-to study sources of solid waste disposal of Myeik

-to examine the spatial distribution of dumping sites and waste disposal recycling shops

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-to analyse the future waste disposal and dumping sites' management for the clean and green environment

**Study area**

Myeik is a beautiful city in Tanintharyi Region in Myanmar. This town is located in the extreme southern part of the country on the coast off an island on the Andaman Sea. This town is the largest town in Tanintharyi Region. Myeik serves as the regional headquarters of Myanmar Navy's Tanintharyi Regional Command. The area inland from the city is a major smuggling corridor into Thailand. The Singkhon Pass, also known as the Maw-daung Pass, has an international cross-border checkpoint. (https://en.wikipedia.org/wiki/Myeik, _Myanmar). This is why we choose the study area for my research work. Figure 1 is the location of Myeik.

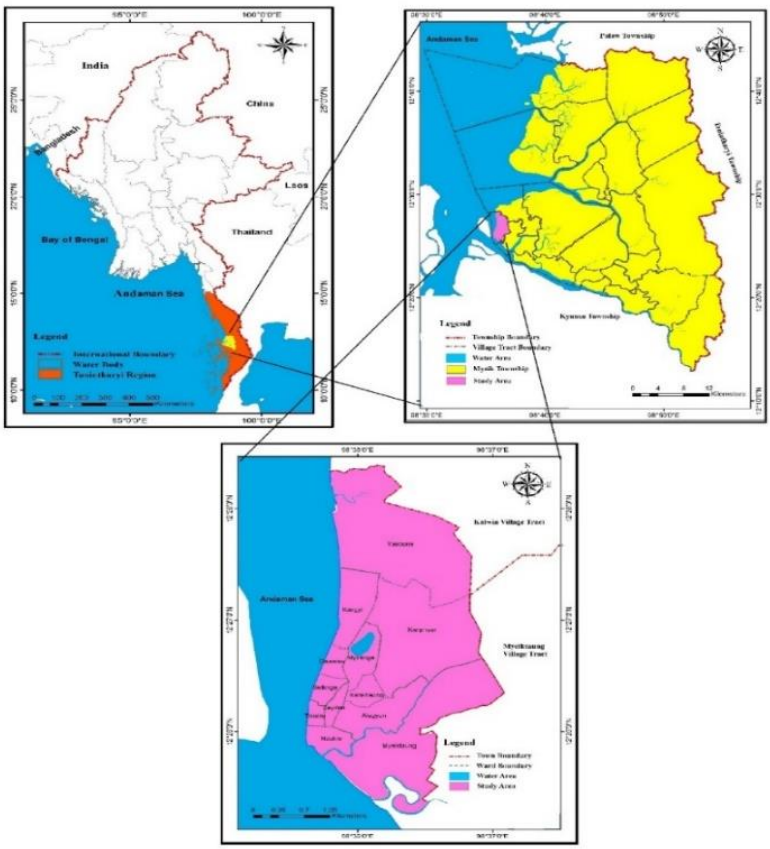


Figure 1. Location of Myeik

## Data and Methodology

For this research work, we are trying to get primary data and secondary data to approach the destination of the research framework.

Primary data is collected from a field survey. Open and deep interview to the waste disposal collected workers from the dumping sites and MTDC, taking photos of dust bins, dumping sites, recycling shops, and necessary documents are observed for the primary data. The data of household numbers, markets, hotels, schools and institutes, and public activities are got from the concerning administrated offices.

Based on the collected data, the creating of tables, graphs, and figures to explanation and description methods. The consequences from start to end, the arrangement of the research frame display as following;

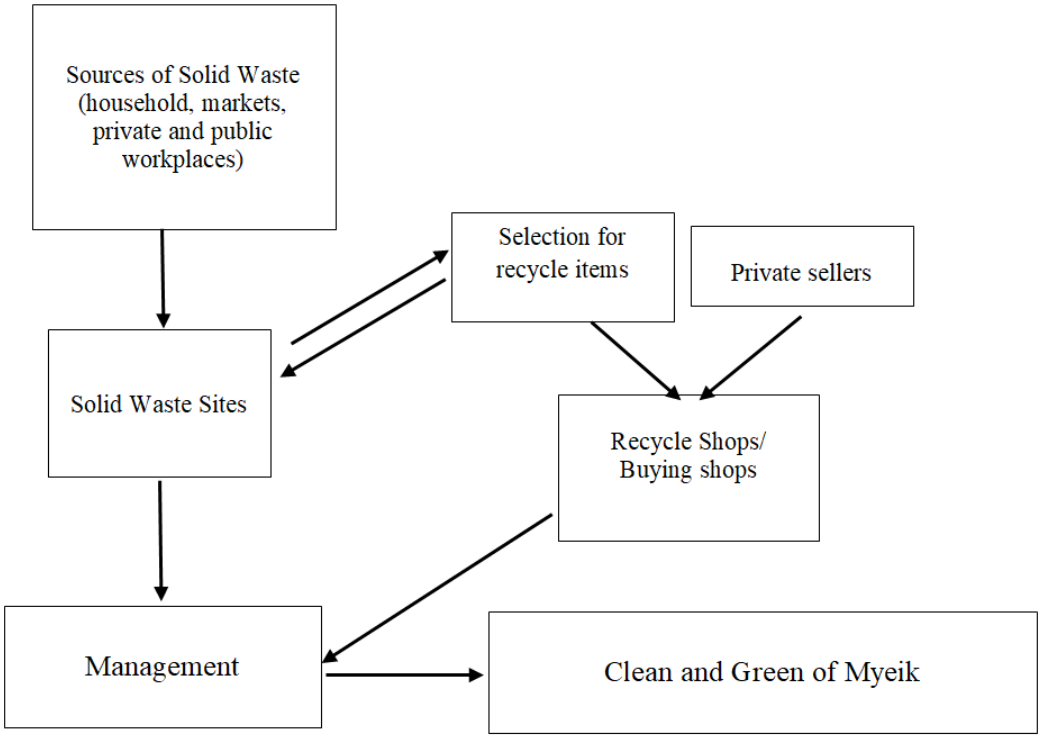


Figure 1. Research Frame Work

## Results and Discussion

### Sources of Solid Waste Disposal

All the residential areas, private, public and governmental infrastructures, workplaces, business activities are the places of sources of waste disposal. There are the least three main sources of solid waste disposal such as household, markets, and others (such as hotels, restaurants, public, and government infrastructures), etc.

Table 1. Waste Collection System of Myeik

| No. | Ward | Waste Collection Vehicles | Labour D/F | 2 or 3 day | Population | household | Area ($km^2$) | Tons | Driver Salary | Follower Salary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Yaebone | 1 | 1 + 3 | ✔ | 15,994 | 3,329 | 2.60 | ( 3 ) tons | 250,000 | 170,000 |
| 2 | Kanphyar | 2 | 1 + 3 = 8 | ✔ | 17,635 | 3,573 | 1.91 | ″ | | |
| 3 | Kangyi | 1 | 1 + 3 | ✔ | 5,888 | 1,172 | 0.54 | ″ | | |
| 4 | Myitnge | 1 | 1 + 3 | ✔ | 3,773 | 773 | 0.35 | ″ | | |
| 5 | Daweisu | ၄ စီး စည်ပင်ဝိုင် ကားနှင့် သိမ်း | 1 + 3 | ✔ | 1,893 | 417 | 0.15 | ″ | | |
| 6 | Seiknge | | 1 + 3 | ✔ | 822 | 164 | 0.16 | ″ | | |
| 7 | Talaisu | | 1 + 3 | ✔ | 734 | 166 | 0.09 | ″ | | |
| 8 | Zaydan | | 1 + 3 | ✔ | 2,240 | 451 | 0.11 | ″ | | |
| 9 | Naukle | 1 | 1 + 3 | ✔ | 2,731 | 602 | 0.24 | ″ | | |
| 10 | Kankhaung | 1 | 1 + 3 | ✔ | 3,530 | 696 | 0.18 | ″ | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 11 | Alekyun | 2 | 1 + 3 = 8 | ✔ | 15,469 | 3,016 | 0.58 | 〃 | | |
| 12 | Myeiktaung | 3 | 1 + 3 = 12 | ✔ | 36,696 | 7,396 | 2.12 | 〃 | | |
| * | (5) Market along the Kannar land | 2 | 1 + 3 = 8 | Daily | – | – | – | per day | | |
| * | | 1 | 1 + 3 | | – | – | – | 10 tons | | |
| | Total | 19 | 76 | | 107,405 | 21,755 | 9.02 | 65 tons | | |

Source; Field observation (May to July, 2020)

## Households and Markets

The total households number is 21, 755. There are five markets in Myeik such as Seiknge Bazaar, Naukle Bazaar, Thihazayar Bazaar, Tatpyin Bazaar, Thiri Mingalar Bazaar, and retail and wholesale activities. The shop's number is 3316 (2019) and about 10 tons of waste disposal per day.

-public and government infrastructures are included schools and institutions, monasteries, offices, airports, port, highway stations, playgrounds, parks, and gardens, etc.

## Solid Waste Collection Systems

Plate 1. Open Discussion with Authority person

Source; Field observation (May to July, 2020)

Myeik Township Development Committee (MTDC) has a plan for solid waste disposal, there are 19 tank cars for 12 Wards in Myeik. The one-time collection takes time two or three days' intervals with the 76 workers. Two workers take duty to clean the roads. The same song music system gives alarm to collection time for the whole city. The residents give the tax 2000 MMK for their solid waste disposal per month.

Plate 2. Dumping sites (Source; Field observation, May to July, 2020)

Plate 3. Reuse collection from dumping sites

Source; Field observation (May to July, 2020)

**Dumping Sites**

The figure shows the main dumping sites in Myeik. The old dumping site is located at the cemetery of Kelwin village tracts. This site is 4 acres. This site is called “A Myeike gone” (dumping hill). About 40 households stay and work at dumping sites and buying recycled solid waste disposal items such as plastic’ chair, basket, bottles, beer cans, iron, aluminum, parts of bicycle and cycle bikes, etc,. Waste pickers are collected number of reuse for their family of income in dumping sites but they are suffered impact of their health. They are not insufficient in health knowledge. So, public awareness is very important for dumping sites.

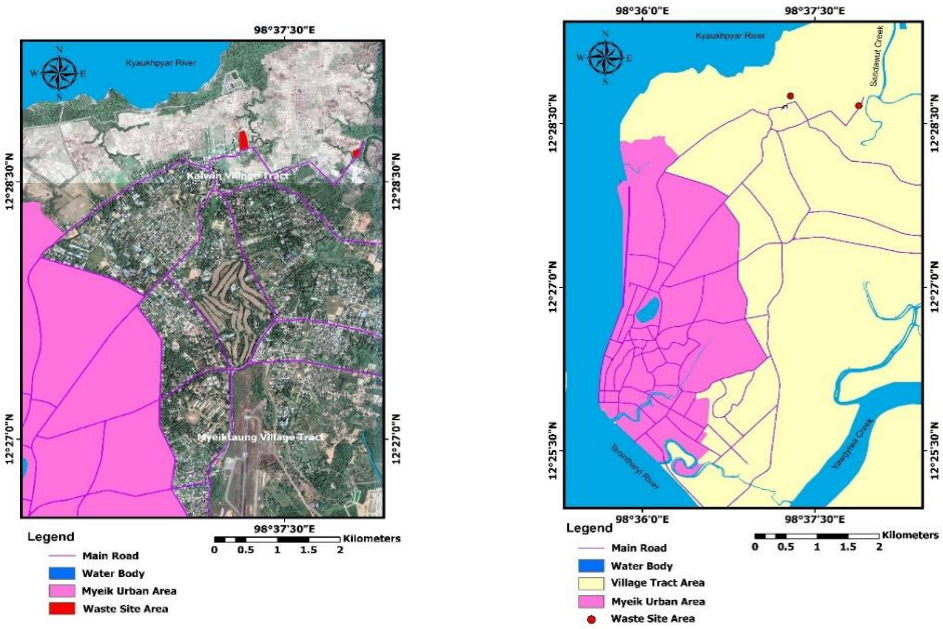


Figure 3. Dumping Sites of Study area

Source; Field observation (May to July, 2020)

**Recycle workplaces or shops**

The figure illustrates the distribution map of recycling workplaces or shops. There are 32 shops in which they buy the recycle solid waste disposal items and export to the factory of Shwe Pyi Thar, Yangon.

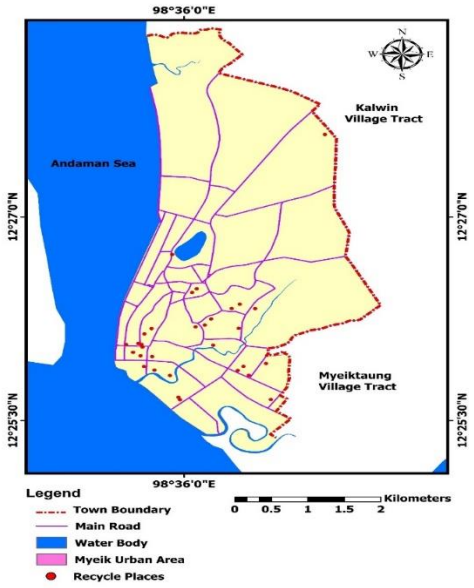


Figure 4. Recycle workplaces or shops of Myeik

Source; Field observation (May to July, 2020)

Plate 4. Recycling shops

Source; Field observation (May to July, 2020)

The recycle workers make and prepare from selected solid waste disposal to raw material for factories. The making raw material works are pressing papers, pounding fiber items, beating beer and soft drinking containers, and noise of iron and electronic items to use for the recycling factories.

### SWOT Analysis of the responses of solid waste management

According to responses, SWOT analysis shows the strength, weakness, opportunity, and threat of the situation for the waste disposal management in Myeik.

### Strength

All location of disposal sites is not too far from the residential area, markets and public. Regular waste collection system is daily or interval systems respectively with conditions (market and residential area). Recycling centers are very active to change from waste to raw material for the factories. Labour cost is very cheap.

### Weakness

Although there are many advantages, some weaknesses are still facing as the challenges the clean environment for the sustainable development because of the lack of planning and insufficient infrastructures (dump bins, waste collection points, fees of collection systems, labour capacity and skills, air pollution levels in dumping sites, sharing and giving information of public awareness for the local people, and weakness of collection management systems etc,.

### Opportunity

The opportunities can get from over challenges and advantages. If the increasing demand for sustainable technology, increasing preferences for recyclable factories in local area, knowing residents to conserve and sustainable development, the new opportunities will come out for the green and clean environment of study area.

### Threat

Moreover, the above mention, some threats are noticeable. They will be leachate toxification, increasing economic competitiveness overriding environmental protection, impact human health of dumping sites, no prevention waste pickers dumping sites and land-use changes.

## Conclusion

This research work can present the classifying solid waste disposal with wet and dry, using wheel hard carts, placing more number (needs) dust bin the whole city, placing the mobile collection systems, taking daily collection systems, doing the fines systems for unsystematically of globes, preparing the good drainage systems (according to topography and sea level), being suitable, systematic and safe dumping sites, giving and sharing knowledge public to clean and green environment.

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# An Investigation on the Settlement Pattern of Madaya Township

Myint Myint Sein[1], Ni Ni Aye[2], Khin Maung Soe[3], Cho Cho Htay[4], Thida Win[5]

## Abstract

This research work is approached to the study on the settlement pattern of Madaya Township. The term settlement here mentions that the characteristic groupings of the population into residence items together with the amenities in the form of houses and streets. The main data are obtained from primary and secondary sources. The primary sources are collected from the interview and questionnaire surveying. The secondary data are attained from the concerned administrative offices. Firstly, the settlement patterns were defined as a linear settlement patterns, compact settlement patterns, and dispersed settlement patterns. Then, the structure of the urban settlement structure was observed for the origin and growth, ward structure, street structure, and housing structure. Finally, the rural settlement was presented as settlement evolution, housing structure, and the quality of settlement and showed that the number of settlements in Madaya Township depends on the relief condition.

**Keywords:** linear settlement, compact settlement, dispersed settlement, quality of settlement

## Introduction

Planning is an important role for the sustainable development. Policies generally seek to accommodate housing growth within a form of settlement hierarchy, which aims to first locate new development at higher densities within and around larger cities and towns before expanding smaller towns and villages (Hart, T. & Webb, D. 2015). At the same time, while planning plays a key factor of shaping settlement patterns and urban form. G.R. Willey (1953), whose famous Virus Valley study in the 1940s joined aerial photography, architectural observations, and regional maps of site distributions, to reconstruct sociopolitical organization. From the first glance at population distribution, one can easily see that the settlement units of Madaya Township are concentrated in the low-level plain areas particularly in the western portion of the township. The major population center of the township namely Madaya Town is found in this portion. In general, the settlement patterns of Madaya Township can be assumed as a cluster pattern. Madaya Township has come into existence since the monarchial period. Due to its higher agricultural production and the location in the boundary zone of Central Myanmar and Shan High Lands, Madaya Township has gained socio-economic importance during these days and some garrison towns among 43 garrison towns of Bagan were established in Madaya Township. Therefore, Madaya Township has favorable conditions for the development of human settlements throughout the history of the country.

## Results and Discussion

For the analytical purpose, types of settlements in Madaya Township have divided into three: Settlement Patterns, Urban Settlement of Madaya, and Rural Settlement of Madaya Township.

### Settlement patterns of Madaya Township

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The settlement patterns of Madaya Township have studied the locational aspect of the settlement. The distribution of human occupation across a landscape supply information about how people use the landscape, about patterns of economic development, and about the social interaction of human groups. Therefore, the settlement patterns are examined physical environment but also the human environment of Madaya Township. Due to the main activity of agriculture in Madaya Township, it includes the accessibility to means of transportation and communication lines are also an important factor in the location of settlements.

In the study area, three types of settlement patterns can be identified.

1. Linear settlement pattern
2. Compact settlement pattern
3. Dispersed settlement pattern

**1. Linear settlement pattern**

This type of settlement pattern is found along the eastern bank of Ayeyarwaddy River along the main road and railway lines in the southern part of Township and along the Chaungmagyi Chaung.

The village of Ngetoe, Hinthagon, Powa, Shwe Kyaung, and Kywechangon is situated along the eastern bank of Ayeyarwaddy river. Their relief consists of flat plain regions with the flood areas. The alluvial soil of this region is particularly suitable for crop cultivation.

There are Yaynantha, Tegon, Kanbe, Wayindote, and Luntaung villages which are located along the Mandalay-Mogok road and Mandalay-Madaya railway lines. These villages are found producing agricultural products that are obtained from crops grown on the alluvial soil. Moreover, these villages get a moderate amount of water from the floods of Ayeyarwaddy. It has good transportation such as road and railways and socio-economic conditions. Therefore, these villages will gradually have a compact shape in the future.

This linear settlement pattern includes the villages of Wunsu, Kyauksayitgon (N), Kyauksayitgon (S), Sagapin, and Gwaypin villages along the Chaungmagyi Chaung. The intensity of water is moderate due to the lower part of the Sedawgyi Dam which can be used later to dig wells for agriculture.

**2. Compact settlement pattern**

The compact settlement pattern occurred near Madaya Town. There are Letkaunggyi, Kwetaw, Thayattaw, Halin, Panya, and Ywaysu villages. Topographically, these villages occur on the flat plain which is about 100 meters above sea level. Alluvial soil is found on the flood region and the intensity of the water body is abundant. So it is cultivated all the year-round. Therefore, it is found that there is the development of agricultural products and then good transportation and communication in the settlement. (Figure 1).

Another place of this settlement pattern is found in the southwestern part of Madaya Township. The villages are Nantawgyun, Paukwe, Kabaing, Chaungpauk, and Nyaunggon villages. These villages are near Mandalay city, which are cultivated all year round and which have good transportation and communication. Thus, compact settlement patterns have been developed gradually in this region.

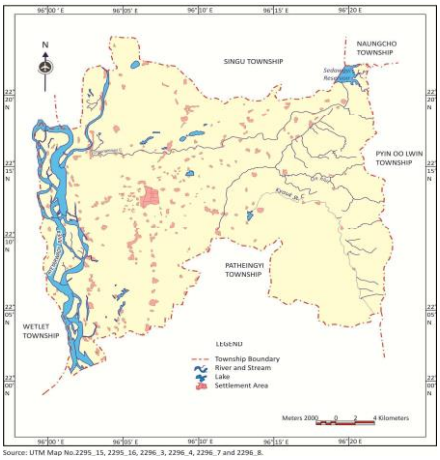



Figure 1 Settlement Pattern of Madaya Township

## 3. Dispersed settlement pattern

Dispersed settlement patterns are found in the south-eastern and northwestern parts of the Mandaya Township. These villages include Yaykyi and Kyarpin which are located in the southeastern part of the township. Topographically, these villages belong to the hills and uplands. Due to the reserved forest area, the intensity of water bodies is less and there is difficulty in transportation. Therefore, the settlements have dispersed pattern in this part of the township. There are Patlein and Nyaungoat villages which are located in the northwestern part of the Madaya Township. These villages belong to the hills and uplands and usually collapsed bank occurs during the flood season. Thus, in these regions are found the dispersed pattern of settlement (Figure 1).

## Analysis of Urban Settlement of Madaya

In studying the urban settlement of Madaya Township based on the four headings are as follows:

1. Origin and growth
2. Ward Structure
3. Street structure
4. Housing structure

## 1. Origin and Growth

The town was established by Pyu nationals before the Bagan period. According to historical records, Pyu capital of Maingmaw on the east of Kume was abandoned by the royal ministers, their families, and followers due to their opposition against the King's actions and founded a new town at the present location. As the number of the royal family's courtiers and servants was 100, the town was named Mattaya with reference to the number of royal families.

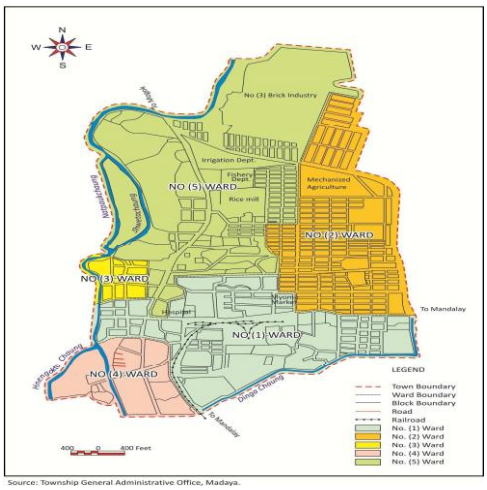
During the Bagan Dynasty period, Mattaya (Madaya), Yenantha, and Sone were established as garrison towns to prevent the invasion of Shan nationals from Shan Highlands. With the passage of time, the name of Mattaya also changed into Madaya. Due to the location in the Ayeyarwady flood plain area, the area could produce sufficient food supply and the local population had favorable economic conditions since ancient times as evidenced by the ancient poems. The existence of town in ancient times is also evidenced by the ancient walls, moats and old pagodas and stupas. The economic wealth and religious beliefs of the local population can be understood by these ancient pagodas and other religious buildings.

However, as the township economy was based upon agriculture and as commercial activities were directly performed with Mandalay City since the late Konbaung period, Madaya Town could not be developed into a large town. It had existed as a town merely to perform an administrative function during various periods. The urban area remained constant due to the lower urban population growth rate. However, due to the small town area, Madaya Town becomes the high population concentration area in the township.

## 2. Ward Structure

Madaya Town is composed of 5 wards and has a total area of about 258 square miles. The urban area is still composed of 343 acres of agricultural land and 49 acres of the fish pond area. Therefore, it can be considered that the urban development of Madaya Town is low and there is a need to perform urbanization works. In shape, Mandaya Town has a compact shape. However, its wards are varying in areas and the ward areas are demarcated mainly by the urban functions and road structures. Out of the total residential area of 537 acres, No.1, 3, and 4 wards have smaller urban areas with 13 acres, 16 acres, and 16 acres respectively. They collectively formed about 8.38% of the town's residential area. No. 2 Ward has the largest urban area with 307 acres which is followed by 185 acres in No. 5 Ward. Due to their larger size, No. 2 and 5 wards have the largest number of population settlements with 2,405 houses and 1,186 houses respectively. It is also found that the number of houses is 425 houses in No. 4 Ward, 334 houses in No. 3 Ward and 279 houses in No. 1 Ward respectively (Figure 2).

Therefore, the housing density is found to be the highest in the No (4) ward and the lowest in No. (5) Ward with about 27 houses per acre and about 6 houses per acre in No (3) ward also has a higher number of house density with about 26 houses per acre. The density of houses, in this case, is also related to economic conditions of the landowners and the wealthier persons used to live in large compounds while the people with lower economic status have to live in small residential lands and houses.



Source: Township General Administrative Office, Madaya.

Figure 2. Ward Structure of Medaya Township

## 3. Street Structure

In Madaya Town, the streets could be systematically constructed in the newly extended areas in No (2) and No (5) wards. The remaining wards have existed long before the streets could be first constructed that the location of houses and residential blocks prevents the systematic development of the streets. The streets in these older settlements areas are in an irregular shape that caused many traffic problems.

According to 2013-14 data, Madaya Town has a total of 83 streets including 22 tarred roads with a total length of 8 miles, 17 metallic roads with a total length of 5 miles 0.19 furlong, and 44 earthen roads with a total length of 13 miles 5.76 furlongs. Therefore, the town people are served by a total of 26 miles of 5.958 lengths of streets. These streets have stretched out from the major road or Bogyoke Aung San street, the entrance road to Madaya Town from Mandalay-Magok road in the colonial time. However, later the streets, particularly after 1988, were systematically constructed to satisfy the requirement of urban areas. Easy access and safe traffic policy have been given priority and new roads were constructed while the existing roads were upgraded.

Source: Township General Administrative Office, Madaya.

Figure 3. Street Structure of Madaya Township

As a result, the former high-way road nowadays becomes the major trunk road of Madaya Town and it has distinct influences upon residential settlement pattern, street pattern, drainage pattern, and performance of various economic activities. Although the earlier streets during the colonial period cannot be rearranged due to irregular settlement patterns of residential blocks, a systematic road network can be constructed in the newly extended areas of No. (2) and No (5) wards (Figure 3).

## 4. Housing Structure

According to 2013-14 data, Madaya Town is settled by 27,832 persons with 4,634 houses. Out of 4,625 houses, the houses can be roughly divided into 3 types as brick houses, bamboo houses with bamboo or corrugated iron roofs, and bamboo houses with thatch roofs. These housing types are therefore roughly indicators of the socio-economic status of the residents.

According to 2013-14 data, the total number of houses is composed of 431 huts, 1,870 bamboo houses, and 2,333 brick houses. They formed about 9.30 percent, 40.4 percent and 5.03 percent of total houses respectively. While the huts are single-storied, the majority of the remaining two types are with two and higher stories although the three-storied buildings are found in brick houses. Therefore, 1,190 or about 63.64 of bamboo houses are two stories houses and 1,264 or 54.28% of brick houses are two or higher story houses. In Madaya Town, three-story houses are found in No (2). No (3) and No (4) wards with 28, 8, and 2 houses respectively. Their number is only about 0.82% of total houses and about 1.63% of the brick houses. The huts are found in the largest number in No 5 ward with 254 huts forming about 58.93% of the total huts in Madaya Town and about 21.53% of total houses of the No. 5 ward. The ward is composed of the newly extended areas and families due to

various reasons so that the earlier settlers have to live in huts. As their economy relied upon their daily wages, they are unable to construct costly buildings, and they have to live in huts.

Bamboo houses are generally owned by middle-income earners and the government employees. As the family size is increasing the people have to extend their living space by means of increased stories. Usually, two stories are constructed as the costs are not great for large living areas. As a result, two stories houses form the largest number with 1,090 houses out of total 1,870 houses. However, the number of 2 stories bamboo houses are found largely in No 2 and No (1) wards over the single stories bamboo houses while the remaining wards have nearly the same number of single-story and two stories bamboo houses. It is also found that the number of bamboo houses is also the second-largest in No 5 ward with 425 houses. It can be considered that the new extension areas in No 2 and 5 wards were settled by immigrants from the neighboring rural areas to find better job opportunities to gain urban utility services and security which are difficult to obtain in rural areas.

As the people became economically more developed, they used to construct brick houses for comfortable residence against such environmental changes as heat, rain, etc, and longer life of the buildings to save the long term costs.

As a result, better brick houses have been constructed in highly accessible areas and in commercial areas especially in the downtown areas of the old Madaya Town. Out of a total of 2,333 brick houses, 1,200 brick houses are found in No (2) ward as it is located beside the Mandalay- Mogok road and by the side of Bogyoke Aung San Street, once the entrance road to Madaya from the highway road. Nowadays, No 2 ward has become the most accessible portion of Madaya Town and the town residents prefer to settle in this ward. The availability of large spacious land has become the attractive force for urban settlement in Madaya Town and anyone who can afford the costs usually settle in this ward. As a result, the number of urban residents is found to be the largest in the No 2 ward. In the No 5 ward, a large number of population and houses as well as a large land areas lead to the settlement with brick houses. A total of 507 brick houses are found in this ward.

It has been found that the highest density of houses in Madaya Town is found in the No (4) ward with about 27 houses per acre.

**Analysis on Rural Settlement of Madaya Township**

In studying the rural settlement of Madaya Township based on three headings are; Settlement evolution (Stage of Settlement according to administration), Housing structure (Establishment of houses according to house types); and Settlement quality.

1. Settlement Evolution
2. Housing Structure
3. Settlement Quality

**1. Settlement Evolution**

According to the administrative center of Madaya Township, which is composed of (83) village tracts. Some village tracts have only one village. Other village tracts have two villages, three villages, four villages, five villages, and more (Table 1 and Figure 4).

In examining the study area, based upon the area of village tracts in acres, four types of the community had been demarcated. The small community is found in village tracts with an area of fewer than 2,000 acres, the medium community is found in village tracts with an area between 2,000- 4,000 acres, a large community is found in village tracts with an area

4,000- 6,000 acres and very large community is found in village tracts with an area over 6,000 acres.

With regard to the small community of the land area, there are (51) village tracts which contain some village tracts that have one village, two villages and more. Thus the small community of land area includes (129) villages amounting to (53.02%) of the total area in Madaya Township. In a medium community of the land area, there are (14) village tracts which include (52) villages amounting to (13.11%) of the total area in Madaya Township.

Table 1. Settlement Patterns of Village Tracts in Madaya Township (2014)

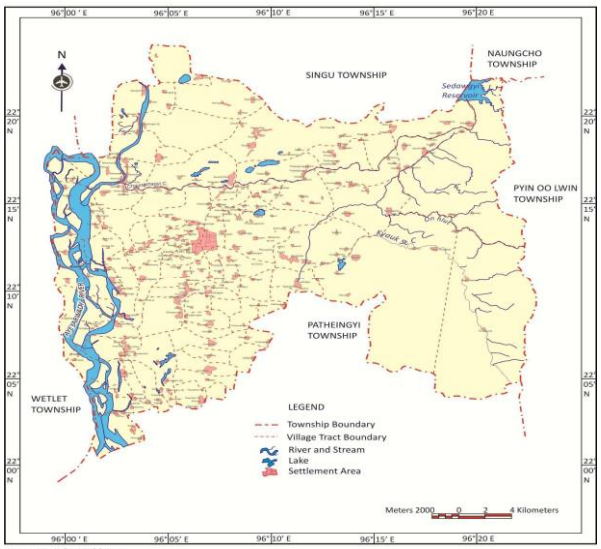
| Sr | class | village Tracts | One in one | two in one | three in one | four in one | five in one | over five | Total village | percentage | Remark |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | <2000 | 51 | 16 | 16 | 7 | 5 | 4 | 3 | 129 | 53.02% | small |
| 2 | 2000-4000 | 14 | 1 | 1 | 6 | 3 | 1 | 2 | 52 | 13.11% | medium |
| 3 | 4000-6000 | 9 | 1 | 1 | 1 | 2 | 2 | 2 | 36 | 14.38% | large |
| 4 | >6000 | 9 | - | - | 1 | 1 | 1 | 6 | 71 | 19.49% | very large |

Source: Land Records Department, Madaya

In large community of land area, there are (9) village tracts containing (36) villages amounting to (14.38%) of the Township. In very large community of land area, there are (9) village tracts containing (71) villages amounting to (19.49%) of the total area.

By examining the above conditions, it is found that within the four types of community, the small community has the number of village tracts which contain the number of villages amounting to (53.02%) of the total area which is more than the other community. Therefore, the rural settlement pattern in Madaya Township is clustered type.

MAP 4.4 SETTLEMENT COMPOSITION OF MADAYA TOWNSHIP




Source: Based on Table 4.2.

Figure 4. Settlement Composition of Madaya Township

## 2. Housing Structure

In examining the establishment and location of housing structure, the house patterns depend upon the estimation of settlement in the Madaya Township. From the data, it was found that there are four house types within Madaya Township. These are (1) Reinforced concrete brick houses type, (2) Brick House type, (3) Bamboo House type, and (4) hut type. The first types are found in three places which are the village of Kyauksayitgon (N), Yaynantha, and Udein. These villages situated along the Mandalay-Mogok high-way are with more cultivated activities than other villages. Thus, people in these villages had a high standard of living. The second house types which are brick houses are mostly found in the villages of Kyauksayitgon (N), Sagapin, Salay, Yaynantha, and Sakyin. These villages are having good transportation and agriculture activities.

The third house types which are bamboo houses are found mostly in the villages of Yaynantha, Salay, Lamaing, Kyauksayitgon (N), and Sakyin. This village had a medium standard of living due to the denser population than other villages and as it is far from Madaya Town. The fourth house types are huts which are found mostly in Kyauksayitgon (N), Taungkan, Shwebaung, Mweshwekhe, and Niyaungoat. These villages have been less developed with poor transportation.

By basing on four types of housing structures with (83) villages in Madaya Township, it is found that people in villages had a standard of living which depend upon the agricultural activities, transportation network, and the nature of the physical location.

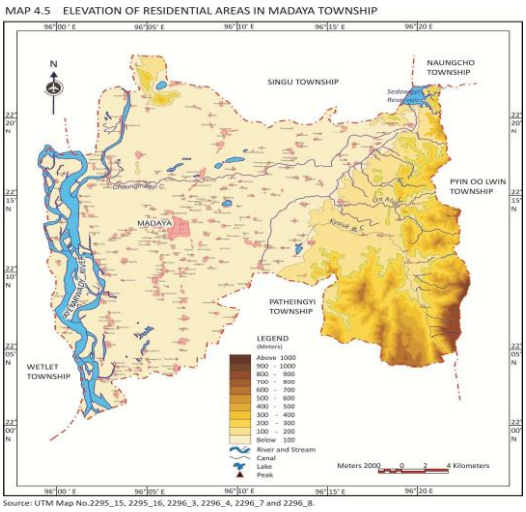



Figure 5. Elevation of Residential area in Madaya Township

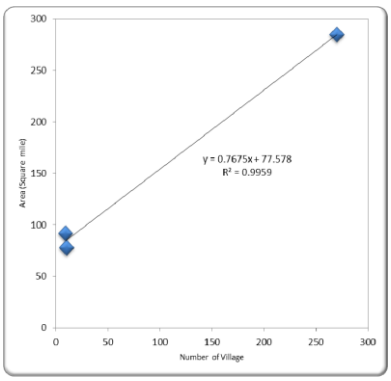



Figure 6. Correlation of area and settlement of Madaya Township

Source: Based on administrative data

### 3. Settlement Quality

The number of settlements in Madaya Township depends on the relief condition. Therefore, the relationship between the number of settlements and area square mile in Madaya Township are analyzed (Table 2, Figure 6).

According to the table (2) it is found that the highest number of settlements is under 100 metres due to the good agricultural lands near the Ayeyarwady river, over flat plains, and good transportation. There is the least number of settlements with areas over 200 metres where there are reserved forest areas with poor transportation.

## Conclusion

Madaya Township lies in Dry Zone of Central Myanmar and it has favorable climatic conditions due to its location on the marginal area of Shan Highland. It is located in the tropical latitudes. Madaya Township receives a high amount of temperature which is sufficient for the cultivation of various crops. Madaya Township has received a higher amount of rainfall than those in the southern portion of this township in this zone. Madaya Township can be defined as having Tropical Savanna (Aw) climate. The natural vegetative cover is clouded mainly by scattered growing trees and grasses.

Table 2. Village Density and Relief in Madaya Township

| Sr. | Relief (metre) | Area (sq. miles) | % of Total area | No of Settlement | Marking |
|---|---|---|---|---|---|
| 1 | under 100 | 284.82 | 62.6% | 270 | 1 |
| 2 | 100-200 | 77.80 | 17.1% | 10 | 2 |
| 3 | over 200 | 91.91 | 20.2% | 9 | 3 |

Source: 2014, Census, Madaya Township

Madaya Township has a total population that had increased 34,506 persons during the 10-year period from 1973 to 1983 at an average growth rate of about 2.61% annually. According to 2012 estimates, the total population is composed of 27,832 urban population and 217,600 rural population. The average population density of Madaya Township is about 539 persons per square mile. Ample natural resource endowment with a favorable climate, higher accessibility, fertile productive soil, abundant water supply, and security from natural and manmade disasters, are the favorable conditions for human settlement and economic and regional development. Commercial works in Madaya Township are found mainly as wholesale and retail trade. As the economy of Madaya Township is rapidly rising in recent years, the numbers of commercial works are also rapidly increasing and even the rural population can purchase their required products in or around their villages.

In Madaya Township, road transports, rail transport, and water transport can be used for transportation of people and goods. However, water transport is used only by small boats and there are no distinct ports or jetties in Madaya Township. Communication is mainly concerned with the exchange of information without direct contact. Due to the increased mobile phone usage, the income from the communication sector will increase and the people can make personal contacts more easily and conveniently in Madaya Township. The settlement is the permanent living and utilization of land by the people in an area. Madaya Township has favourable conditions for the development of human settlements throughout the history of the country. For the analysis purpose, the types of settlement in Madaya Township are divided into three:

1. Settlement Patterns of Madaya Township
2. Analysis of Urban Settlement of Madaya
3. Analysis on Rural Settlement of Madaya Township

In the study area, three types of settlements can be identified.

1. Linear settlement pattern
2. Compact settlement pattern
3. Dispersed settlement pattern

The numbers of settlements in Madaya Township depend on the relief condition. It is found that the highest number and settlement is in less than 100 meters due to the good agricultural activities near the Ayeyarwady River, which occur in the flat plains with good transportation. There is the least number of settlements in area over 200 metres where there are reserved forest areas with poor transportation.

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# Horticultural Crops by means of the Nearest Neighbor Analysis of Patheingyi Township, Mandalay Region

Cho Cho Htay[1], Khin Mar Yee[2], Ei Mon Hlaing[3],
Myint Myint Sein[4], Thidar Win[5]

## Abstract

Various horticultural crops such as fruits, vegetables, and flowers are grown in Patheingyi Township, Dry Zone of Myanmar. The purpose of this paper is to examine the horticultural crops with the Nearest Neighbor Spatial Analysis. The objectives of this paper are to study the main types of horticultural crops, to examine the different cultivation methods of horticultural crops, and to analyze the spatial distribution pattern of horticulture in Patheingyi Township. As a result, it is found that horticultural crops are mostly grown in irrigation canal-distributed village tracts and that major garden fruits are planted in the southeastern-most village tracts, vegetables in the northern portion, and flowers in the central portion. The spatial analysis of the nearest neighbor analysis indicates that the distribution of horticultural crops cultivated areas has a cluster pattern for each horticultural crops. The reason is found to be related to the effect of existing of irrigation agriculture and due to proximity to the markets.

**Keywords:** Dry Zone of Myanmar, horticultural crops, nearest neighbor analysis

## Introduction

For vegetable crops, the intercropping systems to be successful in a geographical location effective cultural practices must be determined, with respect to plant population. This has also been reported previously by other workers (Mashingaidze et al, 2000; Reddy and Willey, 1981) who observed that in a bean and maize mixture in which the population density of maize was varied increased maize yield was attributed to the increasing population of maize as in the study of sweet corn and southern pea (Reddy and Willey, 1981). Plant density and nitrogen fertilizer did not influence the number of ears produced per plant (Reddy and Willey, 1981) Light interception previously has been implicated as a major factor affecting plant growth and yield in a cereal-legume intercrop (Grossman and Quales, 1993). Intercropped southern pea was more affected by the reduction in light interception than intercropped sweet corn hence had lower yield (Reddy and Willey, 1981). As Patheingyi Township is situated between the western edge of the Shan Highland and the Ayeyarwady River, the topography is uneven. But the western alluvial plain occupies about 75 percent of the whole area of township and Mandalay Canal is constructed across the plain from north to south. This fact is very significant for the horticulture of Patheingyi Township. Being situated in the northeast of Mandalay City, marketing for products of horticulture is good.

### Study Area

The study area is Patheingyi Township which located near Mandalay City. It lies between latitudes 21° 50' N and 22° 09' N and between longitudes 96°01' E and 96°22' E. Except for its eastern hilly region, which is part of the western scarp of the Shan Plateau, the rest of western region is situated on the Mandalay Plain in the Dry Zone of Central Myanmar. This area lies the Ayeyarwady River on the west, the Myitnge River on the southern tip. The Mandalay Canal flows north to south and it is the important role of horticulture in the study area.

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## Aim and Objectives

The main aim is to study the spatial variation of horticultural crops in Patheingyi Township.

The objectives are as follows:

To find out the main types of horticultural crops

To understand the difference in horticultural crops cultivation

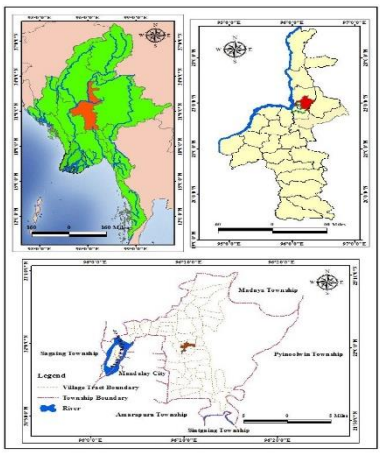
To investigate the distribution pattern of horticulture in the study area for the geographical point of view.

## Data and Methodology

In this paper, primary and secondary data are used. Primary data are collected by field observations, personal interviews, question responses, information analysis, and questionnaires. The secondary data are received from the Department of Agricultural Land Management and Statistics, Patheingyi Township, General Administration Department, Meteorology and Hydrology Department and then, they are transformed to the forms of tables, edited the various maps. These databases are analyzed by using qualitative and quantitative methods, such as Nearest Neighbor Analysis Method for the spatial distribution of horticultural crops in the study area.

Study area

Patheingyi Township is located in the Dry Zone of Central Myanmar. It lies in the northeast of Mandalay City and between latitudes 21° 50' N and 22° 09' N and between longitudes 96°01' E and 96°22' E (Figure 1). Patheingyi Township has an area of 231.55




square miles (148,192 acres).

Figure 1. Location of Patheingyi Township

Source: Department of Agricultural Land Management and Statistics, Patheingyi Township

## Results and Discussion

Patheingyi Township has a total area of 109699 acres and constituted with 59 village tracts. Among the village tracts, Bok is the largest in the area with 8.07 % of the township's area, the second-largest is Yekyi with 7.73% and the smallest is Surkarkhin with 0.18%. Out of the total township area, 56.21% is occupied by agricultural land, 7.76% by town and village land, 7.42% by religious and cemetery land, 6.45% by underwater and irrigation canal

land, 2.34% by transportation land, 1.23% by industrial land, 0.04% by mining land and 18.55% by other types of land use.

Types of Horticulture in Patheingyi Township

Types of horticulture in Patheigyi Townships are vegetables, flowers and gardens. Common garden fruits grown in the township are, in descending order of sown acres, mango (3792 acres), plum (3180 acres), lichee (391 acres), tamarind (270 acres), coconut palm (214 acres), palm (142 acres), lime (137 acres), custard apple (135 acres), banana (76 acres), grape (32 acres), orange (25 acres) and guava (9 acres). As flowers, common plants in Patheingyi Township are Thabye (431 acres), jasmine (27 acres), rose (26 acres), Thanaka (10 acres) and Gangaw (2 acres) whereas vegetables have 1,067 acres (10.7 % of horticultural crops' sown acres. Among the horticultural fruits, mango, plum, lychee, tamarind, coconut palm, palm, lime, custard apple, grape, orange, and guava are perennial ones and banana is biennial fruit. Flowers are perennial and vegetables are seasonal ones. Sown acreage of the horticultural crops in Patheingyi Township is described in figure (2). The fruits, vegetables, and flowers produced from the township are sent and sold mainly to the markets of Mandalay City.

Distribution of Horticulture in Patheingyi Township

Mango

Among the three types of horticultural crops, garden fruits occupy 84.22 % (8,394 acres) of the total sown acreage of horticultural crops. Of the garden fruits, mango has the largest sown acreage. Species commonly grown in the township are Seintalon, Shwehintha, Yingwe, and Myakyauk. A mango tree begins to fruit at the age of 6 - 7 years. In the first year, it produces about 200 fruits and about 2000-3000 fruits after 10 years later. Mostly grown village tracts are described in Table (1).

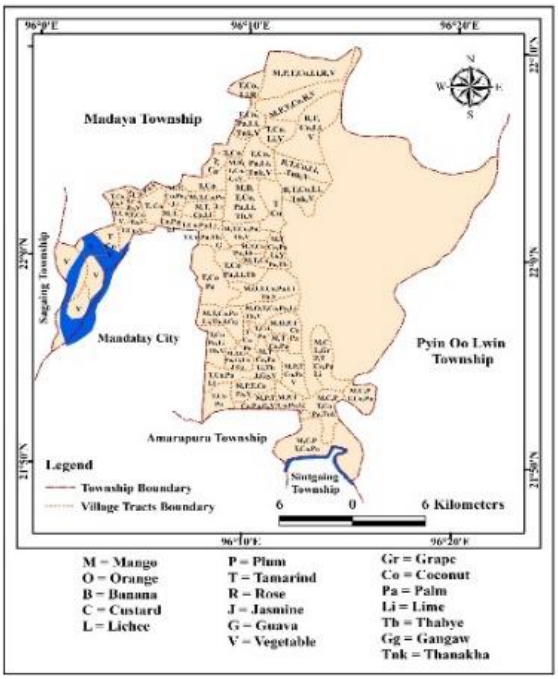



Figure 2. Basic Agricultural Map of Horticultural Crops in Patheingyi Township

Source: Department of Agricultural Land Management and Statistics, Patheingyi Township

Table (1) Village Tracts growing Mango in Patheingyi Township (2017-2018)

| Sr. | Group (acres) | Number | Included Village tracts |
|---|---|---|---|
| 1 | > 500 | 2 | Kyunsin, Sedaw |
| 2 | 100~200 | 6 | Shwesayan, Ngwedaung, Ohnchaw, Kyaukme, Aainggyi, Tadaingshe (N) |
| 3 | 10~100 | 7 | Dahattaw, Tadaingshe (S), Kangyi, Letthit, Aungchantha, Shindawgon, Yetwet |
| 4 | < 10 | 12 | Patheingyi, Yekyi, Letkaung, Thalekon, Botetkon, Zeechogon, Nayyinsaya, Hnumkye, Sinywagyi, Twathit, Nyeinchanthasan, nanda |

Source : Field observation, 2017-2018

According to the Table, it is known that there are a total of 27 village tracts, 2 village tracts with more than 500 acres, 6 village tracts with 100-200 acres, 7 village tracts with 10-100 acres and 12 village tracts with less than 10 acres. The largest mango acreage is found in Kyuwun village tract with 1,145 acres. A mango farmer who occupies an acre of 15- year aged mango trees earns about 50 lakh of kyats a year.

Plum

Plum particularly Yodaya Plum was introduced to be planted in Mingan and Bok village tracts in early 1988. Today it has been planted in acres of village tracts. In 1988-89 plum-planted area was 1,220 acres, but in 2017-2018 it has increased to 3,180 acres. Planted areas are in the twelve village tracts including Ohnchaw (580 acres), Kyuwun (550 acres). In 1999 Thai Plum has been substituted with Taiwan Plum. The biggest plum fruits are sent to China market, the first-class fruits to Yangon, the second class plum fruits to Mandalay, and the small ones to local markets. A plum farmer earns about 25 lakh of kyats per acre. Today the plum-planted acreage ranks second among the cultivated acreage of the garden fruits.

Other Garden Fruits

Lichee occupies the third largest planted acreage among the garden fruits. It has increased from 4 acres in 2007 to 391 acres in 2017. Planting of lichee in the township began in Ohnchaw village tract. Today it has been grown in the Kyuwun village tract only. All of the fruits are sent to Mandalay markets.

Tamarind has the fourth-largest acreage (270 acres) among the garden fruits. It has not been planted as mono-crop and cash crop but planted to get shelter in nearly all village tracts. Today from the tamarind trees leaves and seedless, dry tamarind fruits are obtained and have become cash produce. Seedless dry tamarind fruits are sent to the markets of Mandalay, Yangon, and other towns of Myanmar.

A garden plant, next to that of tamarind is coconut palm. Coconut plantations are also found in the village tracts where tamarind trees have been planted. The produced coconuts are sent to Mandalay markets.

Lime is planted in 137 acres of 22 village tracts, mostly in 34 acres in Kyuwun, 9 acres in Thalekon, 8 acres in Botetkon, 7 acres in Shindawgon, Yekyi, and Sinputkyi village tracts, 5 acres each in Dahattaw, Hnunkye, Sinywagyi, Nyeinchanthasan, Nanda and Zeeoat. The fruits are sent mainly to Mandalay markets and some to other markets. A lime acre provides the earning which can feed a nine-member family for a year.

Orange began to be planted in 2006, in the village tracts of Ohnchaw (27 acres), Shindawgon (6 acres), and Hmanpin (2 acres). In 2007 it has been substituted with mango and banana. Today it has been planted in the village tracts namely Shindawgon (11acres), Yekyi (9 acres), and Aainggyi (5 acres).

Banana which provides good income is planted in 5 village tracts such as Ywathit (31 acres), Sinywagyi (20 acres) Sinputgyi (10 acres), Bok (8 acres) and Mingan (7 acres) by means of irrigation. As it gets a good price in Mandalay markets, a banana farmer of Patheingyi Township has an easy livelihood.

Custard apple is planted in 4 village tracts namely Shwesayan (45 acres), Ohnchaw (35 acres), Kyuwun (30 acres), and Sedaw (25 acres) as cash fruits in 2017-2018. The produced custard apples are sent to the Mandalay Zegyo market.

Grape is planted in the Kyuwun village tract only. It was introduced to be planted here in the previous year. The plants are too young to fruit and cannot produce.

Flower Plants

Flower plants occupy a total of 496 acres, of which 431 acres are of Thabye, 26 acres of rose, jasmine of 27 acres, gangaw of 2 acres, and thanakha of 10 acres.

Thabye is planted in 12 village tracts. More than 200 acres of Thabye occur in the Yankintaung village tract, 25~50 acres of Thabye in 3 village tracts namely Yetwet, Shindawgon, and Patheingyi and less than 25 acres in 8 village tracts. Thabye sprout can be cut, starting from 6~7 months later. The sprouts have to be cut off in 15 days interval and sent mostly to Ohnchaw Roadside Bazaar of flowers and some to the 26th Road x the Ayeyarwady Strand Road Bazaar of flowers. High laborer wages and the high price of pesticide and thus the profit is not got as expected although the market price is high. However, if compared to those of other flowers, the return obtained from Thabye is still higher. Therefore, Thabye- planted acreage has been increased from 287 acres in 2006-2007 to 431 acres in 2017-2018. In the flower markets of Mandalay, the demand is always high. This will lead to increasing in Thabye-planted acreage in Patheingyi Township in the future.

Jasmine is cultivated on 27 acres, in the village tracts of Thalekon (23 acres), Letkaung, and Botetkon 2 acres each. During the 10 years from 2007-2008 to 2017-2018, there was no change of cultivated acreage and of cultivating village tracts. According to the field observation, it is known that jasmine is cultivated as subsistence agriculture for their own families.

Thanaka plantations are found in the village tracts namely Mingan (5 acres), Sinputgyi (4 acres), Ingyal (1 acre), and Ohnchaw (1 acre). These plantations are grown on compact savanna soil and mountain red earth soil. It can be cut off at least 20 years later being planted.

Vegetables

Among the horticultural crops, vegetable occupies the third largest sown acreage, with a total of 1067 acres. Among them, the largest sown acreage (672 acres) occurs in tomato, 153 acres in watermelon, 70 acres in onion, 62 acres in calabash, 40 acres in garlic, 25 acres in rape and white radish, and 20 acres in lettuce.

There are 30 village tracts that grow vegetables in Patheingyi Township. Of these, vegetable-sown acreage with more than 200 acres occurs in Ingyal village tract, the sown acreage with 100~200 acres in Dahattaw and Kangyi village tracts, 10~100 sown acres in 15 village tracts and sown area less than 10 acres in 12 village tracts.

Tomato is grown in 22 village tracts namely Ingyal (200 acres), Dahattaw (120 acres), Kangyi (112 acres), Sinputgyi (85 acres), Kanptin, Mingan and Bok (20 acres each), and less than 10 acres in 12 village tracts. Tomato is grown on the Kaing-Kyun land. As the labour wages are high the profit it should get is not received. All of the fruits are sold to the Mandalay markets.

Watermelon is cultivated as a cash crop in the eight village tracts namely Pagantat (25 acres), Hinywetsu 925 acres), Kyunsin (21 acres), Sukarkin (20 acres), Gaintgyi (20 acres), Minyehla (18 acres), Thayettabin (13 acres) and Phohlagon, particularly on the islands and annually flooded Kaing-Kyun land. The major market is China and Mandalay market.

Onion is cultivated in the village tracts on the islands. It is grown about 10~21 acres each in Giantgyi, Thayettabin, and Pagantat village tracts and about less than 10 acres in the village tracts of Minyehla and Kyunsin. The produces are sent to the Mandalay markets.

Calabash is also cultivated on Kaing-Kyun land. The largest sown acreage occurs in Hinywetsu with 15 acres. The major market is in Mandalay. It also begins to be cultivated a month after the recession of the annual flood.

Spatial Analysis of Horticulture in Patheingyi Township

In this chapter horticultural crops grown in Patheingyi Township are analyzed by using overlay known as overlapping method and nearest neighbor analysis.

Spatial Analysis by Means of Overlay Method

In order to know where horticultural crops are distributed in the township is examined by overlapping each of the distribution maps of the four main horticultural crops on the map of the canal irrigated areas (Figure 3 and 4). The main aim is to investigate whether the horticultural crops are cultivated in the irrigated areas or in the non-irrigated areas.

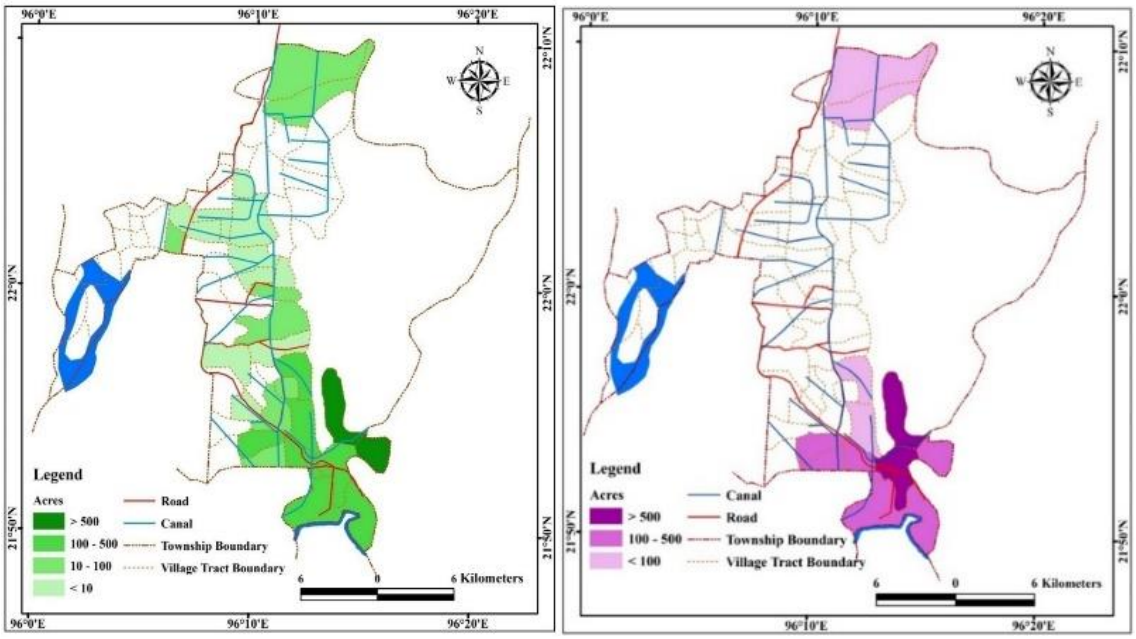



Figure 3. Relationship between Distribution of Canals, Mangos and Plum Cultivating Village Tracts in Patheingyi Township (2017-2018)
Source: Field Observation and based on Official Data

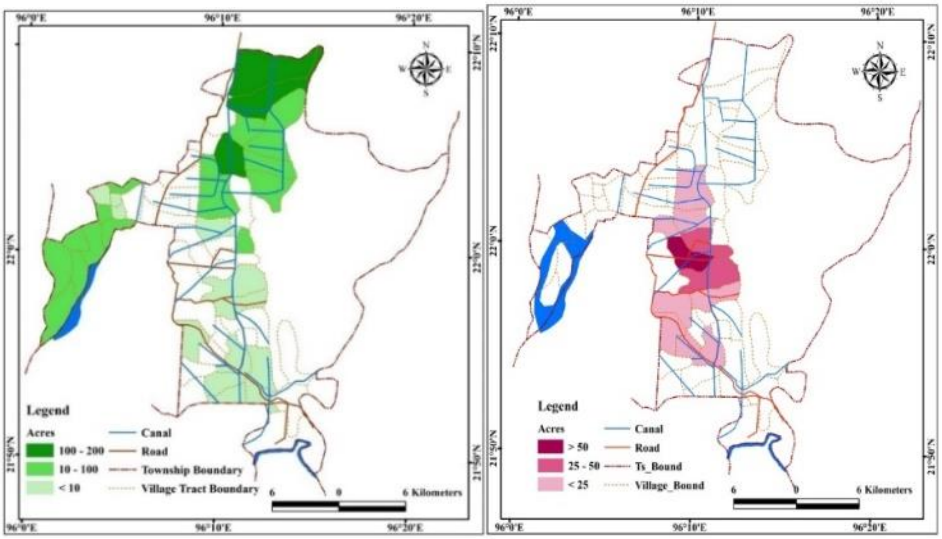



Figure 4. Relationship between Distribution of Canals, Vegetable and Thabye-Cultivating Village Tracts in Patheingyi Township (2017-2018)

Source: Field Observation and based on Official Data

The overlapping method (Figure 3) shows that all of the mango-planting village tracts are those with irrigation and the largest mango-planted acres are located near foothills lying in the southeastern village tracts of the township, for example in Kyuwun and Sedaw .

The overlapped (Figure 3) displays that large plum tree plantations with more than 500 acres are found in the southeastern of the township, for example in Kyuwun, and Ohnchaw.

The overlapped (Figure 4) reveals that large vegetable-planting village tracts with 100~ 200 acres are found in the northern such as most acres in Ingyal, Dahattaw, and Kangyi village tracts. In these village tracts, vegetables are grown throughout the year depending upon the Sedawgyi dam irrigation. Secondly, most acres are found on the islands of the Ayeyarwady River, depending upon the fertile alluvium deposits and upon the tube-wells.

The overlapped (Figure 4) indicates that large Thabye-planting village tracts with 100~ 200 acres are found in the middle portion of the township which practice irrigated cultivation. Good examples are Yankintaung, Yehtwet, Shindawgon village tracts, and Patheingyi.

This method clearly shows that the horticultural crops are cultivated, most of mango and plum trees in the southeastern village tracts lying near at the destinations of the irrigation canals, most of the flower plants in the village tracts of the middle portion which have minor irrigation canals, and vegetables in northern village tracts and on the island village tracts.

Analysis of Spatial Distribution Pattern of Horticultural Crops by means of the Nearest Neighbour Analysis

In this analysis, the nearest neighbor analysis method of Clark and Evans (1954) is used in examining the distribution pattern of horticultural crops in Patheingyi Township. The formulae are described as follows:

$$R = (\bar{r}A) \div (\bar{r}E)$$

$$\bar{r}A = (\Sigma r) \div (N) \quad \text{and}$$

$$\bar{r}E = 1 \div (2\sqrt{P}) \quad , \qquad \text{where}$$

R is the Nearest Neighbour scale, "r" is the distance from each village tract to its nearest neighbor village tract, "N" is the number of village tracts and "P" is defined as (number of village tracts / total area). Mathematically the three formulae can be modified into one formula for the Nearest Neighbour scale "R", as shown below

$$R = (\bar{r}_A) \div (\bar{r}_E)$$

$$\bar{r}_A = (\Sigma r) \div (N) \quad \text{and}$$

$$\bar{r}_E = 1 \div (2\sqrt{P}) \quad ,$$

$$R = \frac{\Sigma r \times 2\sqrt{\Sigma N \div \Sigma A}}{\Sigma N} \qquad \text{or}$$

$$R = \frac{(\Sigma \text{distance}) \times 2\sqrt{(\text{Total Number of village tracts}) \div (\Sigma \text{Area})}}{\text{Total Number of village tracts}}$$

The R score can take on any value between zero, signifying absolute clustering to 2.1491, signifying maximum dispersion, with unity indicating the presence of a random observed distribution. This means that if the R score is closer to zero, that pattern is defined as "clustered pattern" and if the "R" score is closer to the value (2.149) that is assumed to be "absolute dispersion". If the "R" score is closer to the value of (1.079) or the half value of between zero and 2.149, that is defined as "random pattern".

Following the formulae, the nearest neighbor scales for the spatial distribution patterns of mango, of plum, of Thabye and of vegetable-cultivating village tracts are calculated. The calculation results are described in Table (2).

Table (2) Calculation of the Nearest Neighbour Scale for Main Horticultural Crops of Patheingyi Township (2017-2018)

| Sr. | Horticultural Crops | Area (Sq.miles) | Number of Cultivated Village Tracts | Total distance (mile) | Nearest Neighbour Scale |
|---|---|---|---|---|---|
| 1 | Mango | 231.82 | 21 | 1.55 | 0.02 |
| 2 | Plum | 231.82 | 11 | 1.31 | 0.03 |
| 3 | *Thabye* | 231.82 | 9 | 0.99 | 0.02 |
| 4 | Vegetable | 231.82 | 24 | 1.37 | 0.02 |

Source : Self-calculation, based on field observation

The calculation results show that the nearest neighbor scale "R" scores for mango, plum, Thabye, and vegetables range from 0.02 to 0.03. All of the scale values are very close to zero value and thus the spatial distribution patterns of all four main horticultural crops are nearly absolute cluster patterns.

In detail, major mango-cultivating village tracts and major plum-cultivating village tracts are clustered in the southeastern portion, Thabye-cultivating village tracts in the middle portion and major vegetable-cultivating village tracts in the northern portion of the township.

## Conclusion

Nowadays Patheingyi Township has good transportation and is easily accessible to Mandalay, Yangon, and other towns in Myanmar. Regarding markets, the route to the China market has to be passed through Patheingyi Township and is also very close to the Mandalay market. This transportation condition and proximity to the markets support the development

of horticultural crop cultivation of the township. In this way, the horticultural crop-cultivated area in Patheingyi Township has increased from 3,329 acres in 2007-2008 to 9,967 acres in 2017-2018.

Accordingly, with the increase in horticultural crops-cultivated area, the spatial distribution pattern of horticultural crop-cultivating village tracts also takes more places and the sown areas are distributed widely in Patheingyi Township. Based on the above-mentioned, spatial distribution of such crops are studied, examined, and analyzed by using the overlay method and the nearest neighbor analysis method.

According to the results of overlay method, it is known that the mango-planting village tracts are those with irrigation and the largest mango-planted acres are located near foothills lying in the southeastern village tracts of the township, plum tree plantations with more than 500 acres are found in the southeastern village tracts of the township, and large vegetable-planting village tracts with 100~ 200 acres are found in the northern village tracts of the township.

According to the results of the nearest neighbor analysis, the nearest neighbor scale "R" scores for mango, plum, Thabye, and vegetables range from 0.02 to 0.03. All of the scale values are very close to zero value. Therefore, and thus the spatial distribution patterns of all four main horticultural crops are nearly absolute cluster patterns.

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# A Geographical Study on the Health care services in Myeik Town

Nu Nu Lwin[1], Khin Mar Yee[2], Thida win[3], Myint Myint Sein[4], Wah Wah Soe[5], ThinnThinn Aye[6], Nway Nway Latt[7]

## Abstract

The study of Health care services is an integral part of Medical Geography. Moreover, to analyze the spatial distribution pattern of existing health care services available in Myeik and private hospitals, public hospitals, and all health care services of Myeik. All identified public and private hospital services were classified with government, private hospitals, and clinics. There were primary and secondary data collection. The primary data was collected from the field surveying with the open interview and asking questions. The secondary data was obtained from the concerning administrative office. Based on the data information and responses, tables, graphs, and figures with the help of the GIS technique. The results show the spatial distribution of health care services and the relationship between population and health care services in the study area. This research work will apply for the sustainable development of other research works in Myeik.

**Keywords:** health care service, Medical Geography, public and private hospital service.

## Introduction

This paper emphasized the spatial distribution patterns of the hospitals and health care services in Myeik. After independence, most of the high-quality social services especially hospitals and clinics are found and expanded mainly in the urban centers. Health care services have contributed enormously to get better health for most of the global population during the twenty centuries, rich and poor, play and bigger and more influential role in people's than ever before.

(https://www.researchgate.net/publication/257830385, 2013).

This paper examines the spatial distribution of health care services in the urban centers of Myeik with emphasis on their utilization in terms of accessibility to urban populations. The major factors that determine the location and utilization of these health services are outlined and suggestions are made on some possible policy implications especially within the framework of the recently declared strategy of the Myeik focus for Urban Development. The urbanization in Myeik has a elongated area, in the coastal region. The urban pattern compacts shape and population concentrated at the center of Myeik.

The classification of health care services is Governmental Hospitals, Private Hospitals, and Clinics. Patients, hospital services, general medical, surgical, pediatric cases, community health services such as laboratory, diagnostics, blood bank, rehabilitation, and physiotherapy are also provided by health care services. Other health care services are orthopedic, eye, psychiatric, and pediatric cases.

### Aim

The main aim of this paper is to examine the various types of health care services in Myeik.

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**Objectives**

-to study the various type of health care services.

- to examine the spatial distribution of health care service in Myeik.

-to analyze between population and health care services.

**StudyArea**

The study area is Myeik. This town is in the southern part of Myanmar as well as the Western part of Adman Sea. Before 1988, the residents of the study area had low awareness for health care knowledge. In 2000, the extension of private hospitals and clinics had been gradually increased. At the same time, the increase of population demands for enough health care services. The problem was solved in collaboration with government, private hospitals,clinics and health care services. Thus, this study area was selected to study the balance of the health care services and population.

**Data and Methodology**

**Data**

Primary data are acquired through field surveys and observations, discussions with the local Staff of Hospital in Myeik. Secondary data are obtained from the Township Administrative office, the Health care centers in Myeik Town, and a record of Private Hospital services. Tertiary data are base-maps from Land Records Department and satellite images from the United States Geological Survey (USGS). As regards with Hospitals, clinic data, and their physical requirements collected the documents from the library of Myeik University.

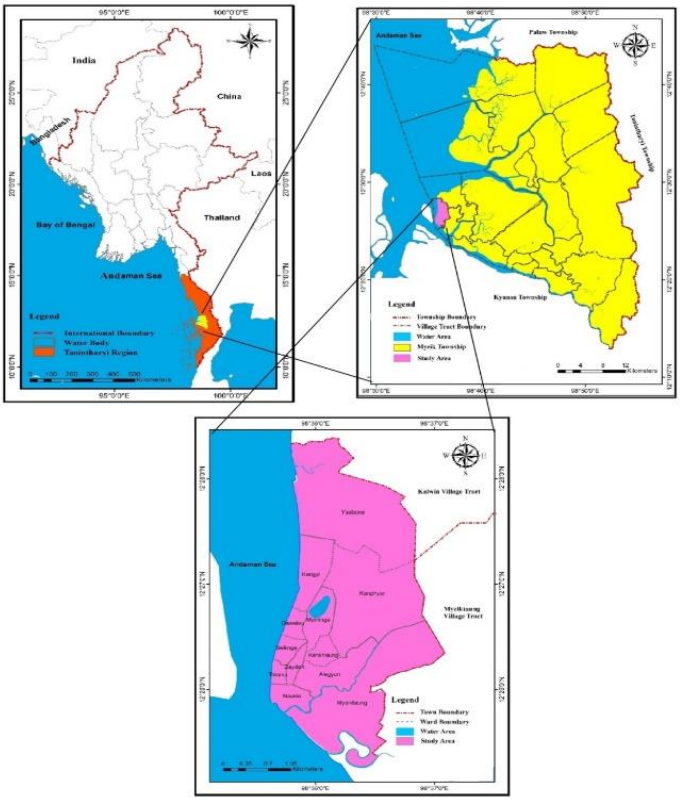


Figure (1) Location of Myeik.

Sources; The Union of Myanmar Agriculture Atlas

**Methodology**

Based on the population, the number of patients, doctors, and health care services has described both structures and functionally with tables, graphs, and figures. Spearman's Rank Correlation Method examines the relationship between the number of doctors and the total population in Myeik. GIS techniques help to show the spatial distribution of hospital location and clinic location. Finally, the results show that the relation of population and health care services with circle divided method spatially and between the doctors and the total population with the Spearman's rank correlation method used.

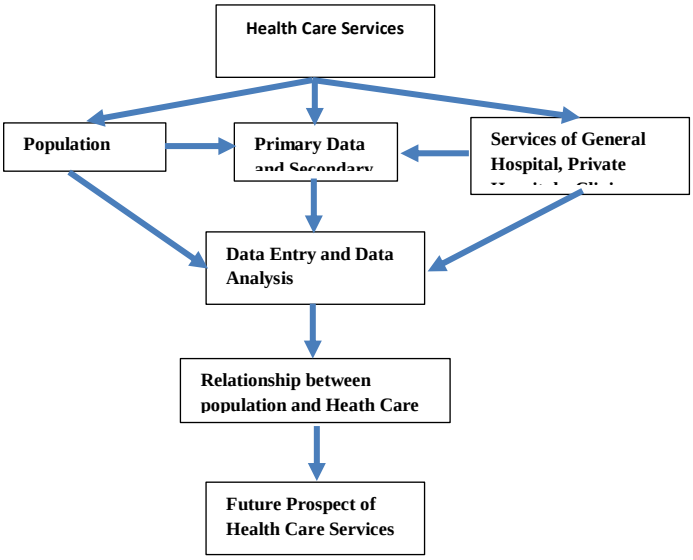


Figure (2) Research Flow Chart of Healthcare in Myeik

## 3. Results and Discussion

3.1 Social Factors

Population distribution, population growth, and population density Urban Population of Myeik has an area of 8.6 sq-km. It is composed of 12 wards. The total population of Myeik was 100385 persons in 2016, 107,657 persons in 2017, and 107,396 in 2019. The most populated area is spread out from the downtown area to urban fringe areas such as Myeiktaung and Yebone wards. Distribution of the population in Myeik depends upon the location, economy, transport, and communication of the town. It can be seen that Alegun, Kanphyar, Myeiktaung, Yebone, Kangyi, and Myintnge wards are high density and Talaisu, Zaydan, Seiknge, Daweisu ward low density of population distribution of Myeik in 2019. Myeik population was concentrated in the downtown area. At present population density is found Alekyun, Naukle, and Zaydon wards very high density, Seiknge, Talaisu, and Yebone ward were low density. The spatial distribution of the population in the downtown area shows in Figure 3.

Table (1) Population density of Myeik Town (2019)

| Sr.No | Wards | Total | Area sq-km | Populatiodendity |
|---|---|---|---|---|
| 1 | Ahlegun | 15,460 | 0.49 | 31,551.02 |
| 2 | Dewaisu | 1,893 | 0.17 | 11,135.29 |
| 3 | Kangyi | 5,888 | 0.54 | 10,514.28 |
| 4 | Kankaung | 3,530 | 0.18 | 19,611.11 |
| 5 | KanPhyar | 17,635 | 2 | 8,817.5 |
| 6 | Myeiktaung | 36,696 | 1.76 | |

| | | | | |
|---|---|---|---|---|
| 7 | Myitnge | 3,773 | 0.35 | 10,780 |
| 8 | Naukle | 2,731 | 0.2 | 13,655 |
| 9 | Seiknge | 822 | 0.16 | 5,125 |
| 10 | Talaisu | 734 | 0.1 | 7,340 |
| 11 | Yebone | 15,994 | 2.54 | 6,296.85 |
| 12 | Zaydan | 2,240 | 0.11 | 20,363.63 |
| | **Total** | **107,396** | **8.6** | **297,581.361** |

Sources; Immigration and Man Power Department of Myeik Township

Table 1. mention the population density of Myeik in 2019.Myeiktaung ward is the highest population (36696) and Talaisu ward is the lowest population number. However, the the highest population density occurs in Aleigun ward (31,551 per sq-mile) and lowest population density is Seiknge ward 5,125 per sq-mile).

### 3.2 Spatial Distribution of Hospitals and Clinics

There are eight governmental hospitals in Myeik. They are included two General hospitals (General Hospitals and Indigenous hospital) and six private hospitals. Figure 4 illustrates the distribution of government hospitals in Myeik.

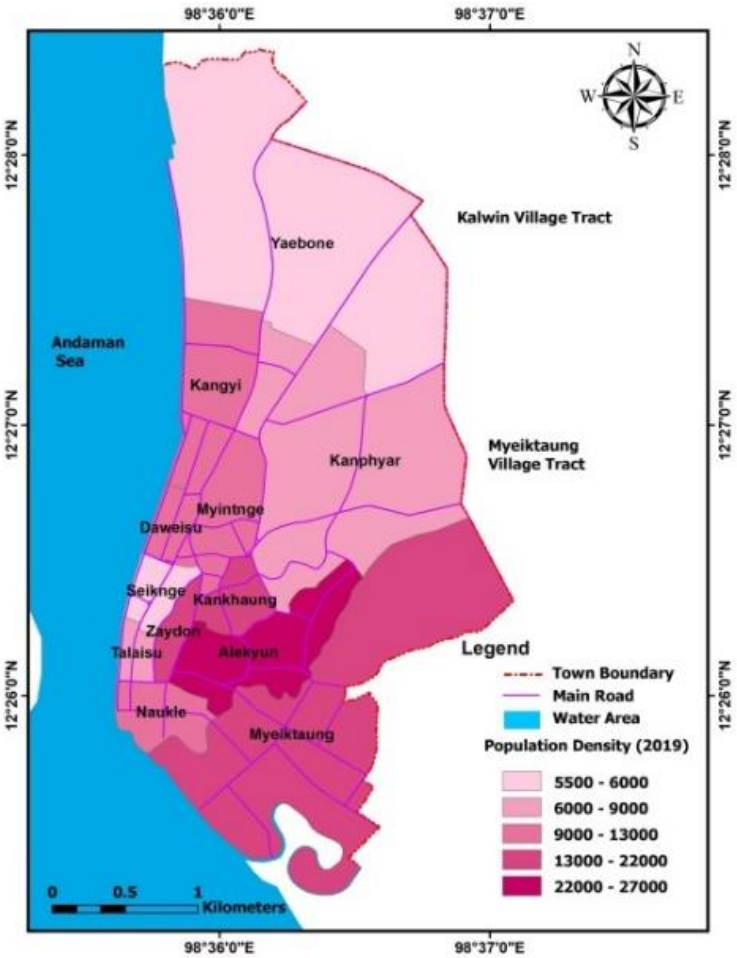


Figure (3) Population density of Myeik .2018-19

Sources; Based on Table (1)

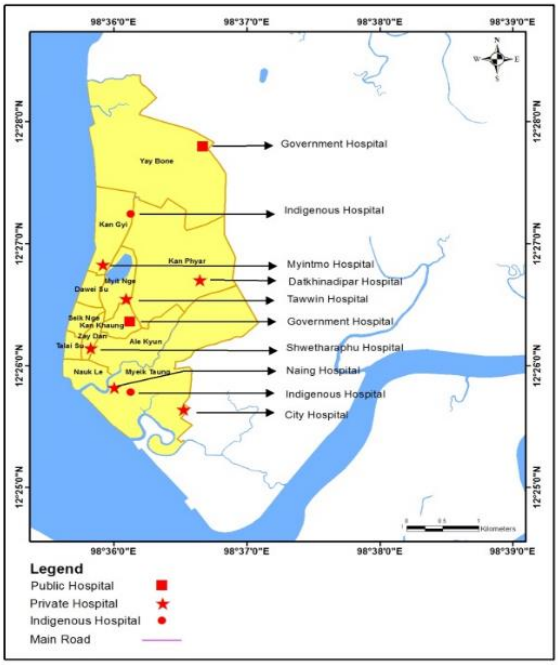


Figure (4) Distribution of Hospital in Myeik Town

Sources; Based on Field Survey

### 3.2.1 Government Hospitals

The following is detailed information about governmental hospitals. Table (2) shows the total Health care services in Myeik. According to table 2, formerly Governmental Hospital was opened of the Kankaung ward with 60 bedded hospital. In 2004-2005, the Governmental Hospital was relocated to Sabarshwewar road in Tatpyin ward and was extended to 200 bedded hospital. Both urban and rural residents depend on the main Governmental Hospitals. The Government Hospital facilities of Health care services are generally better and better before and extending health care buildings for patients and staff.

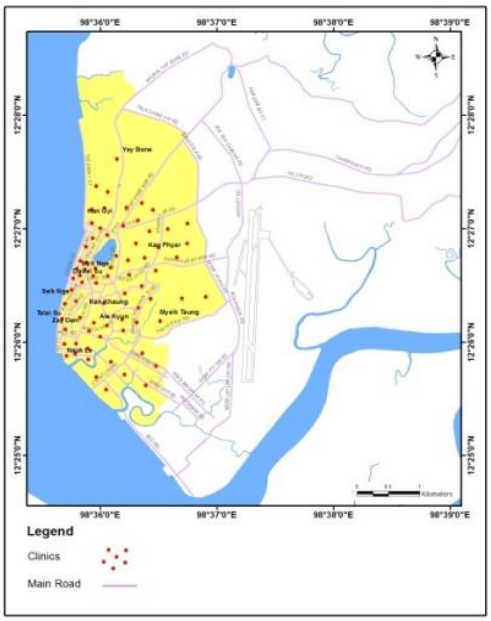


Figure (5) Distribution of Clinics of Myeik Town

Sources; Based on Field Survey

In 2019, 23,856 out-patients and 45,802 in patients relied on Governmental Hospital. The number of medical staff are District Medical Officer (D.M.O ), three Anesthetic, three Specialists, four pediatrics(child specialists) seventy- seven assistant Surgeons (senior doctors) are hundred and eighty nurses, five health assistants, six laboratory services, and fifty-five paramedical staff (ultrasound) and general workers. The staff of General hospital took their duties. Moreover, the authorized persons of Health care services or skillful doctors gave and shared. There health care knowledge to the public such as giving health education, taking data of seasonal diseases (regular checking to residents' health condition), and awareness for public health seasonally and locationally.

The Indigenous medical hospital was opened in 2014, with 25 beds, at the Yebone ward. This hospital is 25 bedded hospital and serves nine doctors, ten nurses, and sixteen general works. The number of patients is 500 out-patients and 25 in-patients. The data is shown in table 2.

### 3.2.2 Private Hospitals

There are six major private hospitals. They are Myintmo, Tawwin, Datkhinadipar, Shwetharaphu, Naing and City hospitals,.Table .2. Myintmo hospital was opened at Kangyi Ward in 2007, with a 100 bedded hospital. There are 12,650 out-patients and 2,750 in-patients in 2019. The medical staff is H.M.O (Hospital Medical officer) two Anesthetic, three Pediatrics (Child Specialist), twenty-five Assistant Surgeons, twenty nurses, twenty-five Health Assistant seven lab orations servants, paramedical staff, and other general workers.

Tawwin private hospital was built in 1991 and it is situated at Myintnge Ward. Therefore 50 bedded hospital. The medical staff is ten junior doctors, twenty-five Assistant surgeons, two Anesthetic doctors, twenty-five nurses, nine compounders, and nineteen other general workers. There are 14,200 outpatients and 2,000 in-patients in 2019.

Datkhinadipar private hospital, it was opened at Kanphyar ward in 2014 with 150 bedded hospital. There are The Medical Officers are 32 physicians, 12 junior doctors, 35 nurses, 10 medical compounders, and 46 other general workers. There are 16,032 outpatients and 2,900 in-patients in 2019.

Shwetharyaphu private hospital was built in 1991 at the Zaydan ward. This hospital is 50 bedded hospital. There are 17 physicians, 13 junior doctors, 33 nurses, 37 other general workers. The number of patients is 13,219 out-patients and 2,027 in-patients in 2019. Naing private maternal hospital is a maternal clinic. It was opened in 2011, at Myeiktaung ward. This hospital is 10 bedded hospital. The number of medical staff is five doctors, seven nurses, and four other general workers. There are 140 patients in 2019.

City Private Maternal Hospital was opened in 2014, at Myeiktaung ward. This hospital is also the maternal hospital and the number of staff are, four doctors, three nurses, and four other general workers. There are 200 patients in 2019. There are many clinics widely distributed 12 wards in Myeik.

Table (2) Hospital distribution of Myeik Town.

| No. | Names | Doctors | Nurses | General Workers | Hospital Beds |
|---|---|---|---|---|---|
| 1 | Government Hospital | 115 | 180 | 55 | 260 |
| 2 | Indigenous Hospital | 9 | 10 | 16 | 25 |
| 3 | Myintmo Hospital | 30 | 20 | 32 | 100 |
| 4 | Tawwin Hospital | 37 | 25 | 28 | 50 |
| 5 | Datkhinadipar Hospital | 44 | 35 | 56 | 150 |
| 6 | Shwetharyaphu Hospital | 30 | 33 | 37 | 50 |
| 7 | Naing private Maternal Hospital | 5 | 7 | 4 | 10 |
| 8 | City private maternal Hospital | 4 | 3 | 4 | 15 |
| 9 | Total | 274 | 313 | 232 | 670 |

Source; Field Survey

In Table 2, the data are shown the spatial distribution of health care services and the number of health workers. The private hospitals are found in downtown areas. They are Myintmo Hospitals (Kankong ward), Town (Myintnge ward), Datkhinadipar (Kanpyar ward), Shwetharyiphu (Zaydon ward) Naing and City maternal Hospitals. The total staff number of health care services in Myeik are 274 doctors, 313 nurses, 232 general workers.

### 3.3 Clinic

Table (3) and Figure (5), can be found in the spatial distribution of Clinics. The number of 78 clinics is situated in 12 wards in Myeik. They are 18 in Kanphyar and 10 in Myeiktaung wards, 9 in Aleigun, 7 in Myintnge, and 6 in Naukle,7 in Dewaisu, and 9 in Kangyi.

Table (3) : Spatial Distribution of Health Services in Myeik Town 2018-2019

| Sr.No | Wards | Type of Health Facilities | | | | |
|---|---|---|---|---|---|---|
| | | Government Hospital | Private Hospital | Clinic | The Indigenous | Total |
| 1 | Alegun | - | - | 9 | | 9 |
| 2 | Dewaisu | - | - | 7 | | 7 |
| 3 | Kaungyi | - | 1 | 8 | | 9 |
| 4 | KanKaung | 1 | - | 5 | 3 | 9 |
| 5 | KanPhyar | - | 1 | 18 | - | 19 |
| 6 | MyeikTaung | - | 2 | 10 | 1 | 13 |
| 7 | Myitnge | - | 1 | 7 | 1 | 8 |
| 8 | Naukle | - | | 6 | | 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 9 | Seiknge | - | | 3 | | 3 |
| 10 | Talaisu | - | | 2 | | 2 |
| 11 | Yebone | 1 | | 2 | 1 | 4 |
| 12 | Zaydan | | 1 | 1 | | 2 |
| | **Total** | 2 | 6 | 78 | 6 | 91 |

Sources: Field Survey (15.6.2020)

Analysis he relationship and population and Health care services

Table (4) Ratio of Patients and Health workers (2019)

| No. | Hospitals | Patients | Health worker | Patients and Health worker Ratio |
|---|---|---|---|---|
| 1 | Government Hospital | 45,802 | 350 | 1;131 |
| 2 | Indigenous medical Hospital | 527 | 35 | 1:15 |
| 3 | Myintmo Hospital | 15,440 | 82 | 1:188 |
| 4 | Tawwin Hospital | 16,200 | 90 | 1:180 |
| 5 | Datkhinadipar Hospital | 18,932 | 135 | 1:140 |
| 6 | Shwetharyaphu Hospital | 15246 | 100 | 1:152 |
| 7 | Naing private maternal Hospital | 140 | 16 | 1;9 |
| 8 | City private maternal Hospital | 200 | 11 | 1;18 |
| | Total | 112,487 | 819 | |

Sources; Field Survey

The ratio of Patients and Health Workers are shown in table (4). Government hospitals are 45,802 patients and 350 health workers. Thus, these hospitals are the ratio of patients and health workers are 1:131. The patients of Indigenous medical Hospital are 527 and general workers are 35, thus ratio is 1:15. The ratio of patient and health workers of Myintmo Hospital is 1:188 and Tawwin private Hospital is 1:180, Datkhinadipar Hospital is 1:140, Shwetharyaphu Hospital is 1:152, Naing and City maternal Hospitals are 1:9 and 1:18 Private Hospitals are more charges than General Hospital care services.

Table (5) The number of doctors and total population of Myeik

| No | Wards | Doctors | Total Population(2019) |
|---|---|---|---|
| 1 | Alegun | 9 | 15,460 |
| 2 | Daweisu | 7 | 1,839 |
| 3 | Kangyi | 23 | 5,888 |
| 4 | Kankaung | 1 | 3,530 |
| 5 | Kanphar | 33 | 17,635 |
| 6 | Myeiktaung | 18 | 36,696 |
| 7 | Myintnge | 22 | 3,773 |

| | | | |
|---|---|---|---|
| 8 | Naukle | 6 | 2,731 |
| 9 | Seiknge | 3 | 822 |
| 10 | Taleisu | 2 | 734 |
| 11 | Yebone | 7 | 15,994 |
| 12 | Zaydan | 15 | 2,240 |
| | Total | 146 | 107,396 |

Source; Field survey

Table (6) Spearman's correlation method

| x | y | d | $d^2$ |
|---|---|---|---|
| 6 | 4 | 2 | 4 |
| 7 | 10 | -3 | 9 |
| 2 | 5 | -3 | 9 |
| 2 | 7 | 5 | 25 |
| 1 | 2 | -1 | 1 |
| 4 | 1 | 3 | 9 |
| 3 | 6 | -3 | 9 |
| 9 | 8 | 1 | 1 |
| 10 | 11 | -1 | 1 |
| 11 | 12 | -1 | 1 |
| 8 | 3 | 5 | 25 |
| 5 | 9 | -4 | 16 |

Sources: Base on table (5)

$\sum d^2 = 110$

Table 5 and Table 6 are represented to calculate for Spearman's Rank Correlation Method.

Formula = $rs = 1 - \frac{6 \sum d^2}{N^3 - N}$

$$\mathbf{rs} = 1 - \frac{6 .110}{12^3 - 12}$$

$$= 1 - \frac{660}{1728-12}$$

$$= 1 - \frac{660}{1726}$$

$$= 1 - 0.38$$

$$= + 0.62$$

Where “rs” is the rank correlation value. (d) is the difference of rank between the two variables, (N) is the number of wards? This result shows a positive degree of correlation (median level). Plus (+ 0.62) show the positive relationship between the total population and the doctors.

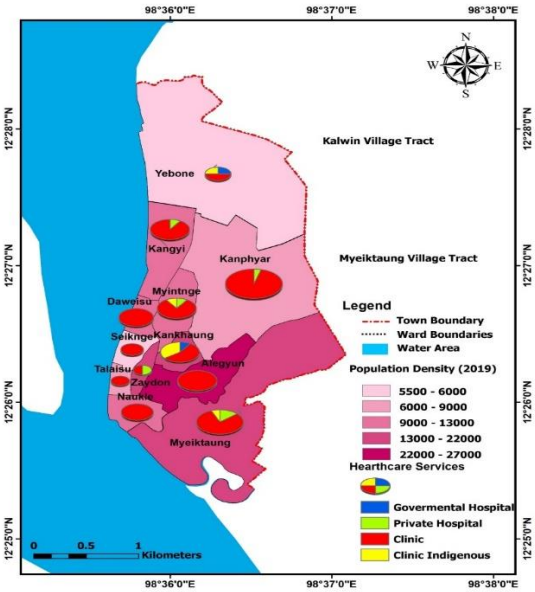


Figure (6) The Relationship of population density and Health care services.

Sources; Base on table 1 and table 3

Figure 6 shows the relationship between population and health care services. The overlay circle divided method represents population density and the number of health care services. According to data, Kanphya, and Myeiktaung wards, although the population density (6000-9000), the more number of health care services take place than the other wards. Talaisu ward, the population density has between 6000 and 9000, but the health care services are only 2 clinics. Zaydan ward, the population density has between 13000 and 22000, the number of health care services is 2 (private and clinic). Alegun ward is the highest population density (22000-27000) and a high number of health care services. Health care services of Government, Private Hospitals, and Clinics should be more than in the higher populated area. Therefore, the correlation result will be a higher degree in positively.

## Conclusion

This paper examined the various condition of health care services not only quantitative but also qualitative explanations and clarification in detail.1) unequal distribution health care services are classified into three groups (Government, private, and clinic).2) the spatial distribution of health care centers can be found that higher numbers in downtown and lower number in suburban areas. 3) the overlay spatial distribution of population and health care services point out the needs and requirements of health care services of the residents in Myeik.

## References

(https://www.researchgate.net/publication/257830385, 2013 ).

# Analysis of Paddy Productivity and Subsistence Sufficiency in Pyawbwe Township

Thida Win[1], Ni Ni Aye[2], Khin Mar yee[3], Myint Myint Sein[4],
Khin Maung Soe[5], Cho Cho Htay[6], Nu Nu Lwin[7]

## Abstract

This research paper emphasizes on analyzing paddy productivity and subsistence sufficiency in Pyawbwe Township from the geographical point of view. To measure the paddy productivity level and food security are also determined by using Paddy Productivity Index (PPI) and Paddy Subsistence Sufficiency Analysis. As the population grows, local food supply is needed to increase. As a result, there have been influences of transportation development. Paddy productivity still stands as the main career in the township's economic activities.

**Keywords**: Pyawbwe Township, Paddy Productivity, Township's Economy

## Introduction

Myanmar's economy depends on agricultural enterprises. It needs to develop agricultural enterprises for surplus food because of the population of Myanmar which is increasing annually at rapid rates. Agricultural enterprise is essential for the economic development of the local people. And then, agriculture plays a vital role in the economic life of Pyawbwe Township.

Agriculture is the production, processing, marketing use of foods, fibers, and by-products from plant crops and animals (International Labour Office (1999) Safety and Health in Agriculture).

Paddy is primarily a tropical or subtropical cereal and most paddies are grown in water or the fields with ample water supplies. Upland, or dry land, paddy is grown in limited areas.

Paddy is grown most commonly in areas with flatlands and more water. Higher rainfall, irrigation, and fertilization, however, boost the yields of paddy. This paperwork emphasizes to analyze the paddy productivity and subsistence sufficiency of Pyawbwe Township.

## Aim and Objectives

The main aim of this paper is to analyze the paddy productivity and subsistence sufficiency of Pyawbwe Township.

The main objectives of this study area are as follows:

- to study the physical factors which are responsible for paddy productivity,
- to examine the paddy productivity of the study area,
- to suggest the ways that can improve the socio-economic conditions of paddy farmers.

## Data, Materials, and Methods

In this study, questionnaire and interviewed methods are especially used. Data collecting is essentially making an inventory of pertinent facts. Materials have been collected

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from numerous sources and they include personal field investigation. Both primary and secondary data were collected and utilized for the present research. Primary data are collected from questionnaires, field observations, and interviews. Secondary data are collected from the Myanmar Agriculture Department, Department of Agricultural Land Management and Statistics, the Department of Meteorology and Hydrology, of Pyawbwe and Mandalay, and other secondary data is based on the database from various Departments. Moreover, the digital elevation model (DEM) with the 30-meter resolution is devoted to extract the general relief of the study area and to determine the relief influences upon paddy productivity.

## Basic Facts of Study Area

Pyawbwe Township is situated in the northern part of Yamethin District in Mandalay Region. It lies between 20º 23' N and 20º 47' N latitudes and 95º 34' E and 96º 20' E longitudes (Figure – 1). The total area of Pyawbwe Township covers about 408,605 acres (638.45 square miles). It consists of 9 wards in the urban area of Pyawbwe Town proper and 75 village tracts including 315 villages. These village tracts are grouped into 10 stations. Therefore, it has a rectangular shape.

The Pyawbwe Township can be divided into three distinct topographic regions: the Western Hilly Region, the Central Plain, and the Eastern Highland. The Pyawbwe Township and its environs are mostly composed of sedimentary rocks. The underlying rocks of the township are divided into the ancient rocks in the east and tertiary rocks in the west. The former includes igneous and metamorphic rocks.

Based on the temperature and rainfall conditions of the 30 years, according to Koppen's classification of climate, Pyawbwe Township has "Tropical Steppe Climate" (BSh). In Pyawbwe Township, types of soils vary with different topography and drainage conditions.

The natural vegetation and forest of Pyawbwe Township can be divided into three main types; *Dry Upper Mixed Deciduous* Forest, *Dry* Forest, and *Dry Savanna* Forest.

In 2019, Pyawbwe Township had a total population of 291,947 persons. Pyawbwe Township has an area of 408,605 acres. In 2018-2019, the total acreage of cultivable land amounted to 237,833 acres, of which 97,344 acres of 40.9% was '*Le'* lands, 140,236 acres or 58.9% was '*Ya'* lands and 253 acres of 0.2% was garden land.

In Pyawbwe Township, crops vary according to the variation in the types of agricultural lands. As Pyawbwe Township, is a region where irrigated farming developed, the main cultivated crop is paddy. Other crops such as pulses, chili, cotton, groundnut, sesamum, sunflower, and onion are grown on '*Ya'* lands. The vegetable plantation is grown on 'Garden' lands.

Paddy is grown in all the village tracts of the township. It is grown in both the summer and monsoon periods. In the paddy cultivation, it is necessary to receive mean temperature between 27ºC and 32ºC and total rainfall between 20" and 40". It is best to have a pH value of soil ranging from 5.5 to 7.5. It likes meadow alluvial soils and dark compact savanna soils.

## The Historical Background of Paddy and the Nature of Paddy

Paddy (rice) (*Oryza Sativa*) is a member of the grain or grass family (*Poaceae*). A botanist would describe rice has to have a morphology characterized by hollow erect stems with long unsheathing leaves. *Oryza Sativa*, it is believed, is associated with the wet, humid climate, though it is not a tropical plant.

It is probably a descendent of wild grass that was most likely cultivated in the foothills of the far Eastern Himalayas.

Paddy has shaped the culture, diets, and economic of thousands of millions of peoples. Rice is an important staple food crop for more than 60 percent of the world's people. In many regions, it is eaten with every meal and provides more calories than any other single food. Paddy is a nutritious food, providing about 90 percent of calories from carbohydrates and as much as 13 percent of calories from protein. According to the United Nations Food and Agricultural Organization (FAO), paddy supplies an average of 889 calories per day per person.

A paddy plant, a type of grass, has narrow, tapered leaves and grows from about 60 to 180 cm (about 2 to 6 feet) tall. Although paddy originally flourished in the dry climate of Myanmar, it spread to the flood plains of tropical regions, resulting in the evolution of varieties with the capacity to grow with roots submerged in water.

The paddy varieties that are flooded during the growing season are more productive than the varieties that are not flooded, partly because the submerged roots easily extract needed nutrients from the water. Some paddies are fed by rainfall, while others are grown by a combination of rainfall and irrigation. Other paddy varieties, known as upland rice, are grown in regions of low rainfall that do not provide enough moisture for paddies, or in tropical rain forests where high humidity prevents the ripening of other edible grains. Upland paddy is less productive than a lowland paddy. Rice farmers choose varieties adapted to the region's length of the growing season, soil, altitude, and paddy farmers, the depth of water in the fields.

## Results and Discussion

Paddy productivity is unevenly distributed in Pyawbwe Township. Paddy is generally grown almost in all stations of the study area. It ranks second in all cultivated crops of Pyawbwe Township occupying about 97,344 acres or 40.93 % of the main cropped areas in 2018-2019.

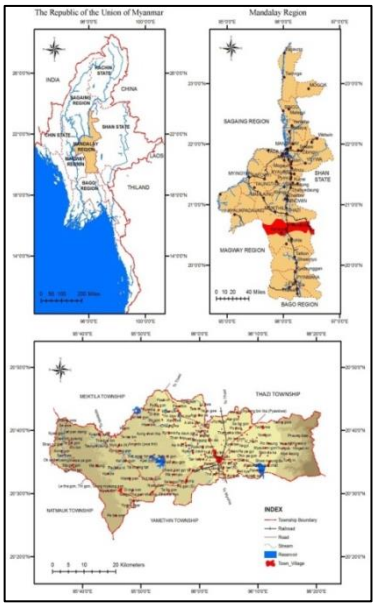


**Figure 1 Location of Pyawbwe Township**

Source: Department of Geography, Mandalay University.

In Pyawbwe Township, paddy was grown two times in a year, during pre-monsoon and monsoon seasons. Those are known as summer paddy and monsoon paddy. With the help of irrigation, paddy is grown as double crops this year. In the cultivation of paddy crops, water should be permanent in the field and more fertilizers are also necessary to get a high yield. By doing so, the land became boggy and salty and it can also reduce productivity. Therefore, the farmers want to grow paddy after sesame.

Summer paddy is grown in the pre-monsoon from February to June within 5 months including land preparation period.

Monsoon paddy is usually grown in the monsoon period started from the last week of July for land preparation to the harvesting time of November or December in the study area. The crop calendar for paddy cultivation in Pyawbwe Township is shown in Figure - 2.

A crop calendar is a figure of the rice-growing season: crop production from the fallow, land preparation, crop establishment, and maintenance through harvest and storage. By using a crop calendar, farm activities are better planned and performed at the right time. It is easier to organize labor and obtain inputs such as seed and fertilizer. Better planning will decrease input costs and increase yields.

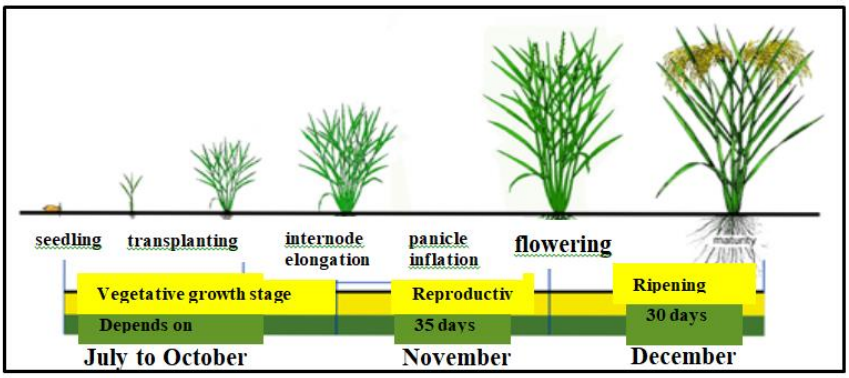


Figure – 2 The Crop Calendar the Paddy Grown in Pyawbwe Township

Source: The International Rice Research Institute (IRRI), India.

Most of the paddy cultivation found in Pyawbwe Township is individual subsistence farms or small-family, mixed-farm types rather than commercial ones. Paddy cultivation of the township varies from one village tract to another, from one station to another station and also from year to year.

In the 2018-2019 agricultural years, the total cultivated area of paddy in Pyawbwe Township was 38,667 acres. Out of the village tracts of the township, the paddy cultivated area was the highest in the Kyaukse village tract with 2961 acres and was the second-highest in Chaungmagyi village tract with 1746 acres while the lowest cultivated area of paddy was recorded in Moegaung village tract with 5 acres of this study area. Batta and Hpaungdaw village tracts are no cultivated areas of paddy cultivation.

The paddy production was also the highest in the Kyaukse village tract and the least in Moegaung. The yield per acre and a total output of the Kyaukse village tract were 72.19 baskets and 210,506 baskets and those of Chaungmagyi village tract were 83.56 baskets and 145,896 baskets while that of Moegaung was 66.60 baskets and 333 baskets. The spatial variation of paddy cultivation and production by village tracts of Pyawbwe Township is shown in Table - 1.

## Paddy Productivity Level of Pyawbwe Township

Agriculture is one of the most important economic activities of local people in Pyawbwe Township. Many scholars and geographers have taken into consideration one or more features of agriculture and tried to regionalize it. The study of crop productivity is essential for any economy, particularly in an agro-based economic region like Pyawbwe Township.

The paddy cultivation is one of the major economic activities of Pyawbwe Township. Hence, the paddy productivity for an individual village tract in the study area is analyzed by using the Paddy Productivity Index (PPI) method. The formula for the Paddy Productivity Index (PPI) is as follows;

$$PPI = \frac{Y_i}{Y_n} \times 100$$

Where PPI = Paddy Productivity Index,

$Y_i$ = Paddy Production of individual village tract

$Y_n$ = Paddy Production of the entire township.

By using the formula mentioned above, the paddy productivity index values were calculated for each village tract of Pyawbwe Township for the year 2017-2018 and then paddy productivity levels of an individual village tract in the study area are determined by the calculated results.

After calculation, the PPI index, the village tracts of Pyawbwe Township are demarcated as the high paddy productivity areas (PPI above 2.0), the medium paddy productivity areas (PPI between 1.0 and 2.0), and low paddy productivity areas (PPI below 1.0).

According to the calculated indices, the Kyakse village tract was the leading paddy producing area of Pyawbwe Township because it ranked first in paddy production (PPI 7.93). The second leading area of paddy production was the Chaungmagyi village tract which ranked the second in production (PPI 5.50). Moegaung with PPI 0.01 was the least productive area of paddy among the village tracts of the township. Batta and Hpaungdaw village tracts are the nil of paddy cultivation because these village tracts are located at the foothill of the Shan Highland.

According to PPI indices, the high level of paddy productivity was found in 12 paddy producing areas of Pyawbwe Township. They were Kyaukse, Chaungmagyi, Me Dee, Twinywa, Kontha, Sadaung, Seikgyo, Shwenyaungpu, Htadawgyi, Zagyantaung, Yindaw Myoma, and Wayindok village tracts.

The areas with the medium level of paddy productivity included 25 village tracts namely Htayanga, Theingon, Dahatgon, Pyawgon, Naunggon North, Thanakhadaw, Akaritgon, Gwebinyoe, Yanaung, Telaybin, Thapanchaung, Kyettee, Kangyi (North), Tawdwinhla, Kyoegon, Bawdigon, Myinde, Thapayoe, Ossanwe, Shan Su, Wetlet, Pebinshe, Kende, Taung Nyaunggon, and Sandaw village tracts.

The low level of paddy productivity areas was composed of 36 areas. They were Kyiywa, Kyeni, Thibin, Sugyigon, Phayagyi, Sabegon, Tamagon, Natsonehmaw, Kyaungywa, Hlaingpan, Mipayagon, Letthegyo, Shansugon, Pyinzin, Gegyi, Hlwebaukkon, Pinmyaing, Hpwethin, Magyigon, Moenangon, Yagyi, Ywarthin, Myenigon, Kantha, Nyaung Shwe, Gwezee, Kyudawwa, Thaphaypin, Seywa, Yindawywama, Ohnbin, Taungle, Wagon,

Hpettaw, Minlann, and Moegaung village tracts. The nil of paddy productivity areas was composed of 2 areas. They were Batta and Hpaungdaw village tracts. (Table -1 and Figure 3)

Table - 1 Paddy Productivity Level of Pyawbwe Township in 2018-2019

| No. | Village Tract | Output (baskets) | PPI* | PPL** |
|---|---|---|---|---|
| 1 | Kyaukse | 210506 | 7.93 | HIGH |
| 2 | Chaungmagyi | 145896 | 5.50 | HIGH |
| 3 | Me Dee | 120794 | 4.55 | HIGH |
| 4 | Twinywa | 109467 | 4.13 | HIGH |
| 5 | Kontha | 97718 | 3.68 | HIGH |
| 6 | Sadaung | 82690 | 3.12 | HIGH |
| 7 | Seikgyo | 71433 | 2.69 | HIGH |
| 8 | Shwenyaungpu | 67102 | 2.53 | HIGH |
| 9 | Htadawgyi | 65836 | 2.48 | HIGH |
| 10 | Zagyantaung | 60291 | 2.27 | HIGH |
| 11 | Yindaw Myoma | 55554 | 2.09 | HIGH |
| 12 | Wayindok | 52958 | 2.00 | HIGH |
| 13 | Htayanga | 52495 | 1.98 | MEDIUM |
| 14 | Theingon | 50771 | 1.91 | MEDIUM |
| 15 | Dahatgon | 50625 | 1.91 | MEDIUM |
| 16 | Pyawgon | 49738 | 1.87 | MEDIUM |
| 17 | Naunggon North | 49699 | 1.87 | MEDIUM |
| 18 | Thanakhadaw | 49646 | 1.87 | MEDIUM |
| 19 | Akaritgon | 49618 | 1.87 | MEDIUM |
| 20 | Gwebinyoe | 48135 | 1.81 | MEDIUM |
| 21 | Yanaung | 45591 | 1.72 | MEDIUM |
| 22 | Telaybin | 43679 | 1.65 | MEDIUM |
| 23 | Thapanchaung | 43507 | 1.64 | MEDIUM |
| 24 | Kyettee | 42522 | 1.60 | MEDIUM |
| 25 | Kangyi (North) | 41246 | 1.55 | MEDIUM |
| 26 | Tawdwinhla | 38593 | 1.45 | MEDIUM |
| 27 | Kyoegon | 37599 | 1.42 | MEDIUM |
| 28 | Bawdigon | 36185 | 1.36 | MEDIUM |
| 29 | Myinde | 34736 | 1.31 | MEDIUM |
| 30 | Thapayoe | 32928 | 1.24 | MEDIUM |
| 31 | Ossanwe | 32514 | 1.23 | MEDIUM |
| 32 | Shan Su | 32110 | 1.21 | MEDIUM |
| 33 | Wetlet | 30707 | 1.16 | MEDIUM |
| 34 | Pebinshe | 29356 | 1.11 | MEDIUM |
| 35 | Kende | 29122 | 1.10 | MEDIUM |
| 36 | Taung Nyaunggon | 28353 | 1.07 | MEDIUM |
| 37 | Sandaw | 26928 | 1.01 | MEDIUM |
| 38 | Kyiywa | 25988 | 0.98 | LOW |
| 39 | Kyeni | 25845 | 0.97 | LOW |
| 40 | Thibin | 24826 | 0.94 | LOW |
| 41 | Sugyigon | 24803 | 0.93 | LOW |

| | | | | |
|---|---|---|---|---|
| 42 | Phayagyi | 23939 | 0.90 | LOW |
| 43 | Sabegon | 23419 | 0.88 | LOW |
| 44 | Tamagon | 23068 | 0.87 | LOW |
| 45 | Natsonehmaw | 22387 | 0.84 | LOW |
| 46 | Kyaungywa | 21975 | 0.83 | LOW |
| 47 | Hlaingpan | 20732 | 0.78 | LOW |
| 48 | Mipayagon | 20488 | 0.77 | LOW |
| 49 | Letthegyo | 20449 | 0.77 | LOW |
| 50 | Shansugon | 19355 | 0.73 | LOW |
| 51 | Pyinzin | 19210 | 0.72 | LOW |
| 52 | Gegyi | 18716 | 0.71 | LOW |
| 53 | Hlwebaukkon | 16350 | 0.62 | LOW |
| 54 | Pinmyaing | 16209 | 0.61 | LOW |
| 55 | Hpwethin | 15731 | 0.59 | LOW |
| 56 | Magyigon | 14554 | 0.55 | LOW |
| 57 | Moenangon | 14304 | 0.54 | LOW |
| 58 | Yagyi | 13282 | 0.50 | LOW |
| 59 | Ywarhtin | 9937 | 0.37 | LOW |
| 60 | Myenigon | 8661 | 0.33 | LOW |
| 61 | Kantha | 8388 | 0.32 | LOW |
| 62 | Nyaung Shwe | 8284 | 0.31 | LOW |
| 63 | Gwezee | 8060 | 0.30 | LOW |
| 64 | Kyudawwa | 7475 | 0.28 | LOW |
| 65 | Thaphaypin | 7420 | 0.28 | LOW |
| 66 | Seywa | 7289 | 0.27 | LOW |
| 67 | Yindawywama | 3510 | 0.13 | LOW |
| 68 | Ohnbin | 3263 | 0.12 | LOW |
| 69 | Taungle | 2903 | 0.11 | LOW |
| 70 | Wagon | 2875 | 0.11 | LOW |
| 71 | Hpettaw | 1910 | 0.07 | LOW |
| 72 | Minlann | 766 | 0.03 | LOW |
| 73 | Moegaung | 333 | 0.01 | LOW |
| 74 | Batta | - | - | NIL |
| 75 | Hpaungdaw | - | - | NIL |

Source: Department of Agricultural Land Management and Statistics.

* Paddy Productivity Index ** Paddy Productivity Level

Paddy, a material that provides living things with the nutrients they need for energy and growth is a staple food and source of nutrients for local people of Pyawbwe Township. While a region produces an abundance of food, especially paddy, many people need the money to purchase enough food to meet their nutritional needs. If foods produced from a region do meet the needs of the local people, it will have food security. The annual per capita needs of paddy to meet nutritional needs is 13.5 baskets.

According to 2018-2019 data, the sown acre and output of paddy were 38,667 acres and 2,653,352 baskets while the total population of the township was 273,876 persons. As the annual per capita consumption of paddy was considered as 12 baskets for rural people and 15 baskets for urban people, the average annual per capita consumption of paddy was 13.5

baskets. Therefore, the needed amounts of paddy for consumption as a whole township were 3,697,326 baskets, of which 19,334 baskets were needed to fallow for seeds. As the total consumption of paddy was 3,716,660 baskets, the paddy productions were not sufficient for the whole township consumption with the needed amount of 1,063,308 baskets. (Table - 2)

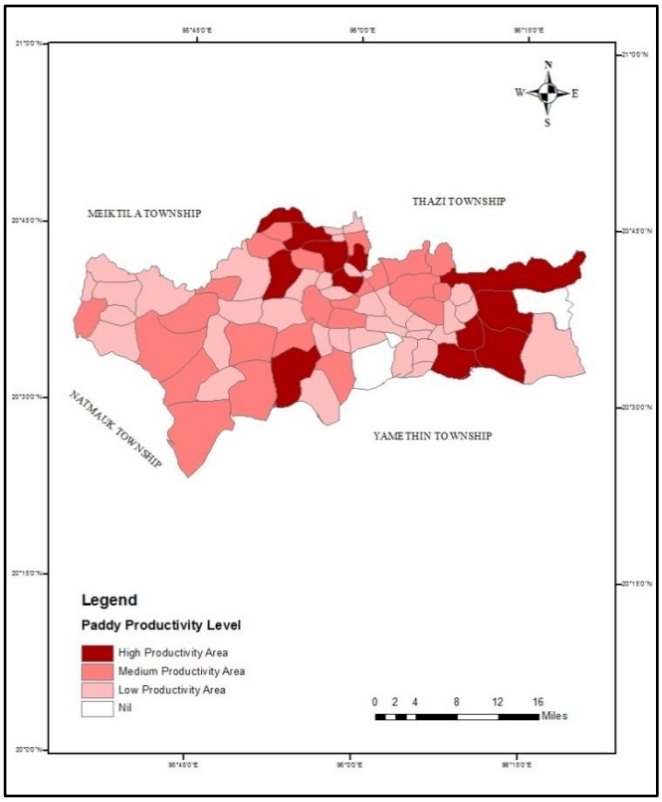


Figure – 3 Paddy Productivity Level of Pyawbwe Township

Source: Department of Agricultural Land Management and Statistics.

**Paddy Subsistence Sufficiency**

Table 2 Paddy Subsistence Sufficiency of Pyawbwe Township in 2018-2019

| Particular | | | Number | Unit |
|---|---|---|---|---|
| Paddy Production | Sown Area | | 38667 | Acres |
| | Output | | 2653352 | Baskets |
| Paddy Consumption | Population | | 273876 | Number |
| | per capita consumption | Rural | 12 | Baskets |
| | | Urban | 15 | Baskets |
| | Food Needed | | 3697326 | Baskets |
| | Fallow for Seeds | | 19334 | Baskets |
| | Total Consumption | | 3716660 | |
| Paddy Sufficiency | Needed | | 1063308 | Baskets |

Source: Compiled by Researcher.

**Suggestion and Conclusion**

Pyawbwe Township has already had suitable physical geographic bases for paddy cultivation. As compared to other dominant crops such as sesame, chili and pulses are also cash crops. The development of improved grain-crop varieties with higher yields, stronger pest resistance, and greater response to fertilizers has improved productivity throughout the township.

The majority of people living in the township are engaged in agriculture. To fulfill the needs of agricultural loans, fertilizers and pesticides are distributed by the government. The farmers have to buy the needs of private sellers. To improve and raise the yield per acre, new technologies, the available amount of fertilizers and pesticides are really needed. More and more machines and machinery should be delivered by the government more and more.

In the paddy growing seasons, the utilization of chemical fertilizers should be done sufficiently wherever necessary. In doing so, the yield per acres will be higher and higher. Farmers should have agricultural knowledge, cooperation, and awareness in the proper use of the agricultural method. The contribution of government institutions to agricultural development should be enhanced by taking several measures. One of the measures is to encourage private sector participation. Cooperation and coordination should be taken into account between farmers and departments of agriculture and irrigation.

The mechanization of agriculture is still in its early stages so that agricultural production mainly has to depend on human energy and the draught power of cattle as well. Agricultural mechanization can immeasurably contribute to farm productivity. Modernized crop cultivation may help meet the need for greater food production as the region's population increases. Thus, encouragement on modernized agriculture should be done by the local authority.

Besides, steps to successful rice production of Pyawbwe Township should be taken:

1. use a crop calendar,
2. choose the best variety,
3. use the best quality seed,
4. prepare and level the fields well,
5. plant on time
6. weed early
7. fertilize to maximize returns
8. use water efficiently
9. to control pests and diseases effectively
10. to harvest on time
11. to arrange the projects for research works in paddy cultivation, and
12. to plan the infrastructure development of the study area.

In analyzing the paddy production of Pyawbwe Township, it is found that the paddy subsistence sufficiency is not sufficient for the whole township consumption. Formerly, although much of the planting, harvesting, and threshing continues to be done by hand or with primitive equipment, the utilization of some agricultural mechanization is found today. To promote the paddy cultivation and production of Pyawbwe Township, more work was

needed to adapt superior varieties to local conditions and to solve human problems associated with their benefits.

Finally, it can be concluded that if the necessary steps to successful rice production can be provided to the local people and local authorities, the paddy cultivation can gain its momentum in Pyawbwe Township.

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# A Study of the Constitution of Myanmar in 1974

Tun Myat Zaw[1], May Than Oo[2]

## Abstract

Revolutionary Council attempted to establish a Socialist State. The Revolutionary Council Government laid foundations by nationalizing all economic enterprises and dissolved all the political parties after formation of Burma (Myanmar) Socialist Programme Party (BSPP) in order to adopt one party system. Burma (Myanmar) Socialist Programme Party attempted to draft new constitution and get affirmation of the constitution by referendum and formation of Socialist government.

Keyword: Revolutionary Council, Socialist Programme Party, Referendum, Constitution

## Introduction

General Ne Win led the Revolutionary Council, instituted by Myanmar Army. He had taken responsibilities to administer the country from 2 March 1962 to 2 January 1974. The Revolutionary Council administered by making use of some of the existing laws, issuing Ordinance, Declaration and Notification in the country. It attempted to maintain law and order in the country, to nationalize economic enterprises, to unify the country. The Revolutionary Council had taken the publication of Men and his environment as the concepts of Revolutionary Council and establishment of one party system in the country after formation of Burma (Myanmar) Socialist Programme Party. Next, the ways of drafting and approval of the constitution of Union of Socialist Republic of Burma (Myanmar) and institution of government of Socialist Republic of Burma (Myanmar) has been implemented by Revolutionary Council.

## Historical Background

General Ne Win, the chairman of the Revolutionary Council at the fourth conference of the BSPP, convened on 6 November, 1969, stated-"The Revolutionary Council was unavoidable holding the state power temporarily and in fact that the power should not be returned to its rightful possessors, the people".[3] At the conference it was decided to transform embryonic cadre party to the People' Party and draft a new constitution for the country.[4] At the first conference of BSPP in 1971, guidelines for drafting constitution of the country were formulated and set up Constitution Drafting Committee composed of 97 members. Brigadier San Yu was appointed Chairman of the Committee.[5] It took about two years, from 25 September, 1971 to 4 July 1973 in drafting first draft, second draft and third draft of the constitution. The first draft, the second draft and the third draft of the constitution had been placed before the public whether or not it was agreeable. It had been made till most of the people came to accept the draft.

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[3] *The Guardian*, 7 November 1969
[4](a) *တော်လှန်ရေးကောင်စီ၏လုပ်ဆောင်ချက်သမိုင်းအကျဉ်းချုပ်* (*The Summary of History of the Achievement of Revolutionary Council*), Yangon, Pyithu Hluttaw Office, p.24 (Hereafter cited as *The Achievement of Revolutionary Council*)
(b)*The Working People's Daily*, 2 March, 1972
[5] *The Mirror Daily*, 26 September 1971

At the second conference of the BSPP in October 1973, it was decided to submit the draft constitution to the Revolutionary Council. As Revolutionary Council had desired to adopt the draft constitution. It was decided to implement it when national referendum approved the constitution. Therefore the Revolutionary Council held the referendum on the New Constitution of the Socialist Republic of the Union of Burma (Myanmar) from 15 to 31 December, in 1973.[1] Since 90.19 percent of the voters had approved the new constitution, the Revolutionary Council by its proclamation number 110, on 3 January, 1974, adopted the 1974 constitution of the Socialist Republic of the Union of Burma (Myanmar)[2]

The Union of Socialist Republic of Burma (Myanmar) consisted of Preamble and 16 Chapters with 209 sections. In the preamble to constitution it was mentioned that the nationalities living in the Union had lived together solidarity, joining hands together through thick and thin for the good of the nation and defended the country. It was also mentioned how the nationalities had solidly taken part in national liberation, achievement of independent of the country and installation of democratic principles and establishment of socialist state. In addition, it had been mentioned that due to changing conditions of the country, with the hopes to establish socialist state, how the people had collectively drafted constitution and how it was affirmed and promulgated[3].

**Constitution**

Chapter (1), consisted of 4 sections, in which it was state about the institution of the state, the name of basic strata of the people; the nationalities collectively lived in the Union; defined the territory and the sovereign power of the state.

Chapter (2), consisted of 23 sections. It spoke about the objective of the state; the economic system to be established; the institution of socialist democracy practice; resisted of variety kinds of exploitation; what sort of class would be prevented by the state; the responsibilities of the state to foster the youth; Party system to be implemented by the state; the nature of descent of sovereign power and its distribution; Distribution of power that had descended from the people by Peoples' Hluttaw; Socialist democratic principles to be practiced by central and regional authorities; the electives of people, with drawal of power and the rights; duties of members of parliament for explaining their experiences in the Hluttaw to the voters of the constituency concerned; right of the people to take part in people's affairs personally; Nationalization of mode of production as state was the soul possessor of all resources in the country or to make cooperative to run such business; the right of establishment private establishment; freedom of worship for all nationalities; right of establishment of nationalities culture; to provide equal opportunities of all the citizen; to eradicate past misdeeds or guilt; to promulgate effective laws to protect the right and enjoyment of benefits granted by the constitution; to adopt independent foreign policy and; the constitution to be guide lines for the laws to be enacted.

Chapter (3), in the title institution of the state consisted of 13 sections. Which

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[1] *The Working People's Daily*, 16 December , 1973

[2] Ibid, 4 January, 1974

[3] *ပြည်ထောင်စုဆိုရှယ်လစ်သမ္မတမြန်မာနိုင်ငံတော်၏ဖွဲ့စည်းအုပ်ချုပ်ပုံအခြေခံဥပဒေ(၁၉۷۴)*, (*The Constitution of Union of Socialist Republic of Burma 1974*), First Edition, Yangon, Printing and Publication Corporation, 1973, P.3-5(Hereafter cited as *Constitution 1974*)

talked about democratic system to be practiced regional wise inhabitation of the people and structure of authoritative organization at different levels; re-institution of states and divisions; Names of 14 States and Divisions which instituted the state; to institute single chamber legislature; the objectives of formation of state council; central authoritative organization which would share the work of Pyithu Hluttaw; regional authoritative organization; different levels of Peoples' Council; staff of central and regional, re-demarcation of territory of the state; re-institution of State and Division and demarcation of respective territory; and restructuring of Townships and Villages jurisdiction in States and Divisions.

Chapter (4), in the title Pyithu Hluttaw consisted of 23 sections. Accordingly it was stated Pyithu Hluttaw as the highest authority body of the states; how Pyithu Hluttaw be instituted; life tenure of Hluttaw. It also mentioned about the power of legislation and right to entrust executive and judiciary powers to the central authoritative bodies. Moreover it is said that Pyithu Hluttaw had the right of legislation in relations to social and cultural needs of the nationalities. It had also the right to discuss and formulate economic plan, propose Budget bill, and also right to enact the acts in relations to revenue. It also mentioned about the method of voting in Pyithu Hluttaw. By this constitution the Pyithu Hluttaw had right to declare war and entered Peace Treaty. It had also right to hold referendum; right to how session of Pyithu Hluttaw and demand to convene Pyithu Hluttaw session; right to institute presidium and right to form committees such as committee for Deference and Security affairs, Committee for Peoples Inspector General, and other Committees. The Pyithu Hluttaw also had right to prescribe the rules and regulations. With the approval of 75 percent of the members of the Pyithu Hluttaw, it has the right to dissolve Pyithu Hluttaw and Peoples' Council.

Chapter (5) of the constitution consisted of 18 sections. It stated how State Council could be instituted. Accordingly the president of the council be President of the Union. It also define the life Tenure of the President and power of the President such as right to represent the country head of state, right to manage military affairs. In case of facing war disaster or natural disasters the state council had the right to handle the problems after expiration of life tenure of Pyithu Hluttaw and the chairman of the council had also the right to promulgate the laws in such a case. The appointment of staff of the state council was also mentioned in this chapter.

Chapter (6), was organized with 13 sections. It was titling as Cabinet. Accordingly it was stated that the Cabinet was highest executive body of the state which was responsible to Pyithu Hluttaw and State Council. Right of Appointment and dismissal of Deputy Ministers, the responsibilities of each ministers; Life tenure of officers of Ministers and Deputy Ministers; their right to manage public affairs at different levels were mentioned in this chapter.

Chapter (7), with 16 sections, titling Peoples' Judges institution had mentioned how People's Judges should be elected; how president of Peoples' Judges institution be elected; their Life tenure of office; how to institute Peoples' Judges at different level; how to conduct judiciary with jury system; how to establish military tribunal. It also urged to use Myanmar language in judicature. According to this chapter, Peoples' Judges Institute was the highest court of appeal. They were responsibility to the Pyithu Hluttaw.

Chapter (8), in the title Peoples' Attorney was organized with 7 sections which stated duties and responsibilities of Peoples' Attorney institution. Their life tenure of

office, their responsibility to Peoples' Hluttaw and State Council; the structure of organization of Peoples' Attorney general office and to assign Peoples' Attorney to different level of Peoples' Court and laid down the principles for assigned Attorneys.

Chapter (9), in the title Peoples' Inspectors General Organization. It was organized with 11 sections. In which it was stated how members of People Inspector General be selected, their duties and responsibilities how to direct affiliated committee to enable to perform their duties.

Chapter (10), in the title Peoples' Council was organized with 16 section. It talked about how to form different levels of People's Council; the life tenure of office of Peoples' Council at different levels. The duties and responsibilities and rights, how to convene meetings at different level of the institutions; how to elect executive members of Peoples' Council at different level, and how to elect respective president of the members of councils; and their responsible to submit their concepts and the issues the counter to higher authoritative councils.

Chapter (11), in the title duties and responsibilities of the people was organized with 28 sections. It talked about enactment of law relating to citizenship, how to be a citizen, and how to make withdrawal from citizenship; the right, benefits of the citizens; such as right of social, economic, health and education benefit, right of freedom of worship; right of voting and right of representing in election; right of belief; to express, to organize and to demonstrate freely. It also granted the security of properties, the right to inherited properties so long as abiding to the constitution.

Chapter (12), organized with 14 sections was titling as System of Election. It mentioned about the demarcation of constituencies; fixation of numbers of representatives to Pyithu Hluttaw and Peoples' Council; the qualification of electorates and contested members, and expenses of the contested members was to be paid by the government.

Chapter (13), in the title withdrawal, resignation, and interim election was instituted with 3 sections. It stated how and why an elected candidate be withdrew, how a candidate could be resigned and how into interim election be held to fill the vacancies.

Chapter (14) had 4 sections. It marked National flag, Emblem, National Anthem and city of the country.

Chapter (15), in the title Amendment of the constitution was organized only with 1 section. Accordingly amendment of the constitution could be made only when 75 members of Peoples Council members and representative members of the Pyithu Hluttaw approved.

Chapter (16), in the title General Provisions was organized with 15 sections. In which it was stated about the essence of the constitution; to prescribe Myanmar language as official language, and to use language of nationalities in case of requirement.

## Conclusion

If the constitution of 1974 is studied closely, it would be seen that three arms of the government like executive power, legislative power and judiciary power had been separated. Although it seemed to have Check and Balance Systems among the three arms of government in reality there is no such system. It is because of one party system. After all the constitution of 1974 was a very rigid constitution. Thus, it was

a hard task to amend the constitution along with the changing patterns of socio-economic condition of the country. Therefore, the constitution of 1974 could not be amended in time although U Ne Win had reminded the leaders of Party at the 1987 Pyithu Hluttaw Session to consider whether or not what they had done for the country was right. Because of rigidity of the constitution it could not be amended in time. Therefore national uprising in 1988 ended the reign of socialist government.

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# The *Maṅgala Sutta* in Myanmar Ways of Thinking

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## Abstract

The concept of *Maṅgala* has been part of Myanmar life since pre-Buddhist times. This paper attempts to solve the problem why an understanding of the *Maṅgala* concept can help to promote social welfare. Tentative solution for this problem is to provide evidence that the concept of *Maṅgala* can be applied to social and moral issues such as trafficking in persons and drugs and that it is a comprehensive moral guideline.The descriptive method will be used to clarify the principle of *Maṅgala* and the evaluative method based on the research principle of sustainability will be used to prove that the moral guidelines apply everywhere at any time. This paper will contribute to instill in the new generation of Myanmar youth a sense of morality as well as pride in their culture identity.

Key words: *Maṅgala*, *Maṅgala sutta*, society

## Introduction

The concept of "*Maṅgala*" has been part of Myanmar life since pre-Buddhist times, but it is the concept of *Maṅgala* as preached by the Buddha in the *Maṅgala Sutta* which has had the greatest impact on Myanmar society, both morally and socially. This important concept prescribes how a Myanmar should conduct himself or herself to live a good life both socially and morally. The Myanmar, irrespective of religious creed or race accept "*Maṅgala*" as an essential in one's life and abhors "*A-Maṅgala*" which is the opposite of *Maṅgala.*

The term "*Maṅgala*" was systematically organized and explained in the *Maṅgala Sutta*, an important sermon preached by the Buddha. It is a sermon to which Myanmar Buddhists have adhered to since ancient times.

It is said that society is an enlarged reflection of human nature. Man cannot live except in a society and can have a full life only within it. The ideal society is one in which all citizens are really good and which enables each to live life to the full. In building a nation into a peaceful, pleasant and developed one, success can be achieved only through the concerted efforts of all. Peace and development are two sides of a coin and cannot be separated. Without peace, there cannot be development and without development there can be no lasting peace.

The individual is the basic unit of a society. He is the most important factor for it is his conduct that will contribute to its development or collapse. For a society to flourish there is a need for wisdom, goodness, justice and temperance. Thus morality becomes the most important aspect of man in society. Man is not perfect by nature: he has to train himself to be good. For the greatest social welfare it is essential that a nation be made up of men of well-integrated and honorable character.

Without a spiritual background, man has no idea of moral responsibility and man without moral responsibility poses a danger to society. Every effort made for the spiritual well-being of man will benefit the future of society. No society can survive without a moral order and that there must be certain norms and laws of social behaviour. A system of moral

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and spiritual values is indispensable to group living. The development of moral and spiritual values is the basis of a society.

The concept of *Maṅgala* in Myanmar society demonstrates this reciprocity between morals and manners. It is thus the very foundation of both moral and social life. The concept of *Maṅgala* in relation to time may be a dimension of the future, a hope from the religious aspect. But emphasis was and still is placed on *Maṅgala* in the present because it is expected that its practice would benefit each individual and hold Myanmar society together and lead it towards progress, both spiritually and socially. It is to be noted that at no point in his Teachings did the Buddha neglect the social aspect of human life. He did not forbid accumulation of wealth through fair and just means.

A detailed study of the concept of *Maṅgala* will show how its practical application has been a valuable contribution towards preserving Myanmar society and Myanmar's cultural identity throughout its history. Due to the Teachings of the *Maṅgala Sutta* morals and manners were given added force. To speak the truth and refrain from rude speech; to be generous and hospitable; to be fearful and shameful of indecent behaviour; to care for one's parents and to respect the elders and to be hospitable, friendly and generous – all these and more are social and moral norms disseminated by the concept and ideals of *Maṅgala* that has guided Myanmar society since ancient times.

### *Maṅgala* as a Cultural Concept

*Maṅgala* is one of the most important fundamental concepts of Myanmar Theravada Buddhist Culture. It has played a central role in the formation of Myanmar culture and society. It is a social, moral and religious concept which has been significant in the shaping of the personality, attitudes and conduct of the Myanmar people.

### General Definition of *Maṅgala*

The term Maṅgala is defined in many ways by various scholars. In "The thirty-eight Blessings for World Peace- "*Maṅgalam papam Lunati chindatiti Mamgala*" – means that which is conducive to happiness and prosperity; that is, "*Mam*" (woeful state) "*ga*" (going), "*la*" (cut) which therefore means "that which obstructs the way to states of misery".

Myanmar religious scholar and monk, the Venerable Shin *Zanaka Bhivamsa* said that any deed whether, bodily, verbal or mental, if they are auspicious, or full of "*Maṅgala*", then prosperity and happiness will also be the fruits of such deeds. In other words only *Maṅgala* deeds will yield *Maṅgala* results and *A-Maṅgala* that is deeds that are inauspicious, will accordingly yield *A-Maṅgala* results. Thus when people act, speak or think, they must choose to act, speak or think in ways that are auspicious or "have *Maṅgala*."

*Maṅgala* means whatever removes evil or whatever is beneficial or whatever is auspicious or whatever gives happiness. In Myanmar culture the term *Maṅgala* is used in two versions. Firstly, it refers to ceremonies that mark significant events and rites of passage in the life of a human being. In the second sense it refers to a Buddhist canon or code of conduct known as the *Maṅgala Sutta*. All Myanmar scholars accept the *Maṅgala* criteria to judge deeds as good or bad, auspicious or inauspicious.

### *Maha Maṅgala* of the *Jatakas*

Myanmar is a country where Buddhism has long taken root and flourished. So the philosophy of Buddhism especially its principles of non-violence, tolerance, and loving kindness have greatly influenced our minds. Buddhism is a religion of free thought and it discourages blind faith and urges man to think freely. It also teaches that all men are born equal and are free to choose whatever is best for themselves. Buddhist teachings are basically

logical, scientific and can be understood through logical reasoning. But above all it is an ethical philosophy. Its emphasis is on living a good life with the ultimately sublime goal of attaining liberation from the round of *samsara.*

*Maṅgala Sutta* is one of the discourses in the *Pali* scriptures which contains many practical lessons for those who desire a blessed life and spiritual progress. But besides the *Maṅgala Sutta*, there are other *Maṅgalas* which are described in *Maha Maṅgala Jataka*. These *Maṅgalas* given in verse form differ slightly from those given in the *Maṅgala Sutta* and were but a prelude. These *Maṅgalas* constitute the answers given by the Buddha in his former existence as a *Bodhisatta.*

This account of certain kinds of *Maṅgalas* that are a necessary guide to conduct in daily life confirms the fact that mankind has been in search of *Maṅgala* (or in a sense, the Good) throughout the ages, even before the coming of the *Gotama* Buddha.

To sum up, in this J*ataka*, the *Bodhisatta* enumerated eight "*Maṅgalas*" as follows.

- Kindliness is a *Maṅgala* or a blessing – a virtue.
- Humility is a *Maṅgala* or a blessing – a virtue.
- To treat others equally or fairly is a virtue.
- Faith and loyalty are *Maṅgala* or virtue.
- Friendship and generosity are *Maṅgala* or virtues.
- To have a faithful and devoted wife is a blessing.
- To be the subject of a wise and just king is a blessing.
- To have faith in Truth is a virtue and to be a sage among men is a virtue.

A study of these *Maṅgala* will show that they provide guidelines to live a life of virtue. They were propounded before the advent of Buddhism. The would-be Buddha was still in one of the stages where he was trying to fulfill the *Parami* requirements (acquired Virtues) for the future. Nevertheless, he was already preaching the virtues of kindliness, humility, fairness, faith, and loyalty, friendship and generosity, and sagacity. These were later assimilated, organized, and systematized in the *Maṅgala Sutta*. To have a devoted wife and be fortunate enough to become subjects under the rule of a wise and just king were later found in writings by Buddhist monks of Myanmar such as *Caturinga Bala* in the *Lokaniti*. The ten kingly virtues accepted in Myanmar culture during monarchic times are also mentioned in the *Maha Maṅgala*. Nevertheless, the *Maha Maṅgala* of the *Jataka* was merely a prelude to the *Maṅgala Sutta* and failed to achieve its pre-eminence.

**The Thirty-eight Blessings of the *Maṅgala Sutta***

The *Maṅgala Sutta* is one of the most widely known of the Buddha's discourses. It is said to have been handed down by one of the Buddha's favourite disciples, Shin *Ananda* who heard the Buddha preach this sermon. It is always recited by monks at all auspicious occasions and religious functions in order to bring about the favorable effects suggested by its name. It is also one of the first lessons every Buddhist child has to learn either at home or at the monastic school.

The blessings that the Buddha enunciated in the *Maṅgala Sutta* are thirty-eight in number. They are graded from the most fundamental, and virtually culminate in the highest spiritual attainment, the realization of *Nibbana.*

They are as follows:

1. *Asevanā ca Bālānaṁ* - Not to associate with the foolish.
2. *Panditānañca sevanā* - To associate with the wise.
3. *Pūjā ca pujaneyyānaṁ* - To honour those worthy of honour.
4. *Patirūpadesavāso ca* - To reside in a suitable locality.
5. *Pubbe ca katapuññata* - To have done meritorious actions in the past
6. *Attasammāpanidhi ca* - To set oneself on the right course.
7. *Bāhusaccañ ca* - To have much learning.
8. *Sippañ ca* - To be skillful in handicrafts.
9. *Vinayo ca susikkhito* - To be well-trained in disciplines.
10. *Subhasita ca yāvā cā* - To be of good speech. (to be well-spoken)
11. *Mātāpitu upatthānaṁ* - To support one's mother and father.
12. *Puttadārassa saṅgaho* - To cherish wife and children.
13. *Anākulā ca kammantā* - To be engaged in peaceful occupation.
14. *Dānañ ca* - To be generous in giving.
15. *Dhammacariyā ca* - To be righteous in conduct.
16. *Ñātakanañca saṅgaho* - To help one's relatives.
17. *Anavajjani kammāni* - To engage oneself in social welfare activites.
18. *Ārati pā pā* - To loathe evil.
19. *Virati pā pā* - To abstain from evil.
20. *Majjapānā ca saṁyamo* - To abstain from intoxicants.
21. *Appamādo ca dhammesu* - To be steadfast in virtue.
22. *Gãravo ca* - To be respectful.
23. *Nivāto ca* - To be humble.
24. *Santutthi ca* - To be contented.
25. *Kataññutā* - To be grateful.
26. *Kālena dhammasākacchā* -To listen to the Dhamma on due occasions.
27. *Khantì ca* - To be patient and forbearing.
28. *Sovacassatā* - To be amenable to advice.
29. *Samanānañca dassanaṁ* - To meet often with sammanas (Monks).
30. *Kālena dhammasākacchā* - To frequently discuss the Dhamma.
31. *Tapo sa* - To practice self-restraint (Austerity).
32. *Brahmacariyāñ ca* - To live a chaste life.
33. *Ariyasaccāna dassanaṁ* - To have perception of the Noble Truths

34. *Nibbānasacchikiriyā ca* - To realize Nibbãna.

35. *Phutthasa Lókadhammehi cittam yassa na kampati* - To develop equanimity so that one's mind remains unshaken when touched by either pleasure or pain. The mind of a person who when confronted with worldly conditions, does not flutter, is sorrowless, stainless, and secure(Arahant).

36. Asokaṁ - To be free from sorrow.

37. Virajaṁ - To be cleansed of defilements.

38. Khemaṁ - To be liberated from fear and be at peace.

The concept of *Maṅgala* has played a central role in the life of the Myanmar people throughout the ages. It has been the determining factor in the conduct of the Myanmar people or in other words, the morals and manners of Myanmar society. To achieve a life of *Maṅgala* is in fact, both a secular and religious goal.

It was also pointed out that the concept and practice of Maṅgala was an ancient legacy of Brahmanism, but in actual fact many adaptations and modifications were made to suit the Myanmar personality, and Myanmar perception and attitudes. For the cheerful, optimistic, and fun-loving Myanmar people, the secular *Maṅgala* were a source of joy. The novitation, ear-boring, and marriage ceremonies are joyous occasions with music and dancing accompanied by a lot of laughter. With the advent of Buddhism, the concept of *Maṅgala* assumed greater social, moral, and religious significance.

**Western Ethical Views Applied to the Concept of *Maṅgala***

*Maṅgala* is an end, the good or auspiciousness at which all men aim. The *Maṅgala Sutta* is neither egoism nor altruism in the Western sense. The *Maṅgala Sutta* stresses the fact that "Virtue is Knowledge" in its very first two precepts as did classical Greek philosopher Socrates. But the Buddha goes farther to point out that man who lives in society should associate not with the foolish but with the wise, taking into account the fact that man is susceptible to his fellowmen and his surroundings.

From another point of view, people can say that some values in this human world are subjective, for they do have preferences based on their desires, emotions, and way of thinking. But there are also objective values which are not arbitrary. They may be ideals or norms formed by the mind from experience. These are the moral values that enable a person to be good and lead a good life. The precepts of the *Maṅgala Sutta* are such values which are instrumentally good for leading a good life as well as being good in themselves that is they also stand as intrinsic values.

It can be said with justification that the *Maṅgala Sutta* is a synthesis of the teleological and the deontological ethical views, of egoism and altruism and of instrumental and intrinsic values; it is a reasonable synthesis of opposing ethical positions in which the best of both are brought together most effectively, not simply theoretically but as a practical guide to a life of virtue.

The real point of the concept of *Maṅgala* especially as expounded in the *Maṅgala Sutta* from the secular point of view (or from the point of view of any moral system whatsoever), is to do good for oneself and for others and to create a moral society in which people may live in friendship and peace with a minimum of conflict. So, the *Maṅgala Sutta* is not an abstract theory; it is not meta-ethics. *Maṅgala* can be understood only in the context of

human experience and human relationships rather than in an abstract sense. It is normative, prescriptive, and pragmatic ethics at its best.

These are the reasons why the concept of *Maṅgala* and the *Maṅgala Sutt*a has upheld Myanmar society. A society flourishes only if the concepts on which it is founded are strong and capable of fulfilling the material and spiritual needs of its people. Man, who is not only a highly intelligent animal but also an ingenuous one __ one who has lifted himself out of the darkness of primitive life __ has always searched for ways and means to change the world in which he lives for the better. As he changed the world, his way of living with his fellow-beings also changed. New social and moral rules had to be found, and old rules had to be amended or made more comprehensive. Today science and technology have provided the knowledge and means to change the world around us as never before. It has improved our material environment beyond expectations. Life and society too have changed in many ways. Social conditions have changed; social norms have also undergone vast changes even in Myanmar which is still a developing country and is today in the process of democratization. These recent and accelerated developments in science and technology have added many major dimensions to human relationships and new ethical issues have arisen. It has raised many thorny ethical problems and concerns that need to be considered and addressed. This has led to general acknowledgement that ethics plays a critical role in this debate, that it can provide the wisdom and guidance such changes require for the good of humanity.

The concept of *Maṅgala* and the ethical principles of the *Maṅgala Sutta* are nearly three thousand years old and they have been the rock in the foundation of morals and manners in Myanmar society. In accordance with William James's Pragmatic Criterion, if the concept of *Maṅgala* and the *Maṅgala Sutta* no longer worked satisfactorily, they would have been discarded ages ago. But that has not been the case. "*Maṅgala*" and the "*Maṅgala Sutta*" still play an important role in Myanmar society.

## Conclusion

Buddhist ethics in general and the *Maṅgala* concept and the *Maṅgala Sutta* in particular can make a valuable contribution to modern ethical problems. The HIV/AIDS problem is one of the modern ethical problems and medical science has been in search of medicinal drugs and methods of treatment but has not yet succeeded a hundred percent. HIV/AIDS is a disease caused by sexual misconduct in more ways than one and drug abuse; or to put it another way from immoral behaviour due to ignorance.

In the case of Myanmar, the Government has spared no effort to prevent and control the spread of the disease and is coorperating fully with UN agencies and INGOs (International Non-government Organization) and local Non-Governmental Organizations, and with neighbouring countries to bring about behaviour change in those who are most vulnerable.

In carrying out such vital work to lessen risk behaviour and bring about behaviour change, the government has incorporated the moral teachings of Buddhism in general and the *Maṅgala Sutta* in particular, since the majority of the Myanmar people are Buddhists and since *Maṅgala* is a concept that is understood (and is also a goal) for all. The concept of *Maṅgala* as a cultural and moral value has been utilized to draw out a positive response from the people concerned and the results have been very favourable.

For example, the billboards put up at busy street corners not only in the cities and in towns in Myanmar contain exhortations such as "Be faithful to your spouse", "Amazing life without drugs". All this incorporate the essence of *Maṅgala.* "Be faithful to your spouse" is a modern interpretation of '*Puttadarassa saṅgaho'*, that is "To cherish wife and children." If

the husband does not cherish his wife and children he will find illicit sexual pleasure which could infect him with HIV/AIDS and he would then pass it on to his wife and his unborn children. As mentioned above, the majority of Myanmar are Buddhists. They all have some knowledge of Buddhist morality and the Law of *Kamma;* hence the incorporation of Buddhist norms with a modern social message. "An Amazing life without drugs" also informs young people liable to risk behaviour to refrain from drug abuse. The twentieth *Maṅgala* of the *Maṅgala Sutta " Majjapana ca saṁyamo",* to refrain from intoxicants is the original message in classical form. The Buddha foresaw the dangers of intoxicants which befuddles a man's mind leading him to wrong decisions, and unsocial behaviour that leads to unemployment, hence poverty and woe to the family. Modern-day scientists agree that liquors and drugs destroy not only a man's life but the social and economic life of his innocent family as well.

The moral teachings of the *Maṅgala Sutta* still lie in the hearts of the Myanmar people. If they could be made to see that they should put into practice what they only feel in a vague and superficial way then they would achieve a *Maṅgala* Way of Life. Efforts at bringing about behaviour change would work better and bring about more satisfactory results. In projects for the control and prevention of HIV/AIDS often attempts are made to educate and persuade vulnerable people to learn to take health precautions and promote prophylactic methods. Such courses of action, are necessary but do not cure the underlying causes, just the symptoms. Behaviour change can be successfully brought about only if there is also moral education and this requires changes in perceptions and attitudes. For example, young people should be cautioned not to keep a bad company in peer education lectures which is another form of advising them "not to associate with the foolish", that is '*Asevana ca balanaṁ'*; that they must resist sexual misconduct and intoxicants, and that they are the people most responsible, for what follows from "risk behavour", that is '*Attasammapanidhi* of the *Maṅgala Sutta*.

Social conventions may have changed over time, but the concept and ideal of *Maṅgala* lives on and still guides both social conventions ,and moral, and religious conduct and shall continue to do so as long as it works and continues to benefit each individual and Myanmar society itself.

The teachings from the *Maṅgala Sutta* which forms the kernel of social and moral conduct could also be successfully incorporated with methods of health and social care to make the people aware that we are ultimately responsible for what we do and that the *Maṅgala* Way is the best.

The world today is full of conflict and in a way, it is possible to say that such conflicts originate in human greed, hatred, anger, pride, and envy, which lead to immoral behaviour. As a result, there are injustices; for example, as the Myanmar saying goes some are so rich they don't know where to put their wealth, whereas some are so poor that they have nothing to pick up and eat.(ထားစရာမရှိအောင်ချမ်းသာသူနှင့် ကုန်းကောက်၍စားစရာမရှိသူ)"So there is the need to alleviate the misery of those living below the poverty line. But it is not enough to give aid and assistance. What is truly necessary is to overcome greed with moral awareness – of the dignity and value of human life. That is the goal of the *Maṅgala Sutta* – to light the way out of the darkness – to lead to understanding of the need for loving kindness (*Metta*), compassion (*Karuna*), joy in another wealth and success (*Mudita)* and the equanimity to face life's suffering *(Uppekha*). It is therefore up to people to spread this message across the world to ensure harmony, peace, and security.

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# A Study of the Concept of *WuWei* in Lao Tzu's Taoism

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## Abstract

The aim of this paper is to show that the concept of *WuWei* can be applied as a moral principle that contributes towards lessening the social and political issues rooted in human conduct. The research problem is "Why an understanding of the *WuWei* attitude can help to promote social and political welfare". The research finding is that by analyzing the concept of *WuWei* from the philosophical point of view, it can be shown that it is applicable to some social and political issues. To achieve the aim of the research, the descriptive and evaluative methods are used. Using the principle of not over-doing the answer to the problem would be proved and evaluated. As a contribution, it can be expected that the proper understanding of the concept of *WuWei* would support the appropriate ideas which can be applied in enhancing the social and political welfare.

Keywords: *WuWei*, not over-doing, social implication, political implication

## Introduction

This paper is an attempt to show that the concept of *WuWei* can be effective in resolving many problems in social, political, and economic fields in human society. In the social and economic fields, it can help alleviate poverty by preventing exploitation of poor farmers and cultivators by landlords and rich people; traders and brokers can also be controlled from making unfair profits. In the health sector, people can have an understanding that health depends on cleanliness and that over- eating or addiction to alcohol and drugs can shorten a person's life span. In political affairs understanding, *WuWei* can prevent misuse of power and oppression of citizens. All these problems are rooted in human conduct and *WuWei* is an ethical concept that is concerned with not over-doing. It can also be interpreted as avoiding excessive behavior.

Taoism is one of the most important religious and philosophical systems of China. It stands alongside Confucianism as a powerful stream of Chinese thought. Taoism, unlike Confucianism, opposes the conventional duties of society and is more focused on the transcendental world of spirit. The Confucian philosophers are often more concerned with facts and commonsense. But the early Taoist writings were full of mysticism and poetic vision. That is the reason why over centuries both Confucianism and Taoism developed as two main streams in Chinese Thought over centuries.

Taoist poetry and mysticism are essential aspects of Chinese literature and thought. However, because of this very preoccupation with the mystic world and its superstitious tendency they eventually lost credibility among the intelligentsia. However, most of the important teachings of Taoism were absorbed into Confucianism and Chinese Buddhism. So its teaching important teachings were not lost. Thus, it can be said that Taoism remained a significant doctrine, and its teachings are still applicable to living a good life. Lao Tzu maintains that the way to act for the one is to preserve nature, to avoid harm and danger as well as to live sagely in the world. The goal of human beings is to know the laws of nature and live accordingly. Therefore, by knowing and acting in accordance with the laws of nature a person is living and acting in accordance with the *Tao*. Lao Tzu taught that one should not

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go against nature but adapt to it. For some modernists, this would seem out of date and it must be admitted that science and technology have improved the material life of human beings. They have however been able to do this because they have understood how Nature works and adapted to its ways. Science would have not developed if it had gone against Nature. This is in a way what Lao Tzu taught nearly 1500 years ago.

For Lao Tzu, the right action for humans is based on the concept of *WuWei* (not over-doing). In this sense, *WuWei* means less activity (doing less) or to avoid artificiality (to restrict one's activities to what is necessary and natural). Thus, one should follow the concept of *WuWei* in order to live with *Tao* or the Way. Living in conformity with *Tao* means a human being must avoid having too much desire and too much knowledge. It means that human beings must avoid any kind of excess. Therefore, one should be in harmony with the fundamental laws of the universe and not act against them. This is the basic principle of Taoism. This point also is crucial. Today as stated earlier human life has changed materially in many respects. But human beings in their greed for more are not living in accordance with *WuWei*. In some ways they have acted against Nature for example by exhausting natural resources, polluting the earth, air, sea, and oceans which have led to climate change, global warming, and the devastation of the natural environment. They have violated the basic principle of Taoism and the world and all who depend on it are how faced with natural disasters.

The word '*Tao*' is one of the most important terms in Chinese philosophy. *Tao* literally means way or road. Ancient Chinese thinkers defined *Tao* as having three main parts: great *Tao*, natural *Tao*, and human or social *Tao*. Great *Tao* is the way of ultimate reality. It means that it is the ground of all that follows. In other words, *Tao* is the womb from which all life springs and to which all returns. 'Of all great things, surely *Tao* is the greatest.' Natural *Tao* is the way of the universe. It is the way things have constantly happened and will happen. Its meaning refers to the way to conduct ourselves in harmony with natural law. Human or Social *Tao* refers to the way of human life. Its expending efficiency is power, it supports wherever it is needed. In order to live with the principle of *Tao*, it is recommended that people live according to the principle of *WuWei*. Therefore, it can be said that *WuWei* is the most important and primary concept in Taoism.

So, the research problem in this paper is 'why an understanding of *WuWei* attitude can promote social and political welfare.' Before giving an answer to the research problem, it is reasonable to assume that social and political welfare cannot be achieved by overactivity alone. In other words, a good social relationship depends on the fact that members of society are able to understand how to avoid excessive behaviour and thus attain social and political stability. This requires proper understanding and practice of *WuWei* and its related to promote social and political welfare.

**What *WuWei* is**

The term *WuWei* is a composition of two Chinese characters. The first character *Wu* (無) means 'not' 'no' 'lack' 'nothing' 'not have' 'nothingness', and 'without' (in the sense of non-existence or non-presence) and the second *Wei* (為) means 'do' or 'act' 'be' 'make' 'probably' 'handle' 'serve as', effort, and 'govern'. The term is typically translated into English as 'non-action', although this translation can be misleading: rather

than meaning 'doing nothing', *WuWei* signifies spontaneous non-thinking action in the sense of 'absence of violent behavior,' 'unmotivated action' or 'acting naturally'.[1]

The concept of *WuWei* reflects the essence of Taoism. It can be regarded as a concept that is metaphysical, epistemological, and ethical. The basic principle of Taoism is that one should be in harmony with the laws of nature. Taoism provides a theoretical guideline for human beings to follow and the method that humans need to apply to follow the *Tao* is *WuWei*. *WuWei* does not mean to waste time or to delay time when doing but to avoid over-doing unnecessarily. In other words, the human must choose the proper time, place, and conditions to act using intelligence. Humans must not act before the proper time falls. Attempting or endeavoring before the right time comes is one extreme; it is a kind of wasting energy. But delaying or wasting time to act even when the proper time falls is another extreme. Knowing and doing in harmony with the laws of nature is applying *WuWei* in practice.

According to Taoists, the goal of humans is to seek to become one with nature and this is a virtue for all human beings. In fact, the planet earth came into being not only for human beings but also for other living beings including wildlife. Hence, in Taoism, human beings as well as all other beings in the ecological world are the same existence. The Taoist concept of *WuWei*, not over-doing, is used in discussions about controlling human's greed and conserving the environment. In this sense, *Wu* (無) means to avoid over-doing, and *Wei* (為) is doing what is necessary; in order to differentiate between what is necessary and what is not necessary to do one must know the laws of nature.[2]

To begin simply, applying *WuWei* refers to spontaneous, situationally appropriate, skillful action. This is an action that radiates effortlessly from the acting agent. Put differently, *WuWei* is what is often referred to as skill-knowledge. People use embodied and engaged forms of activity, consisting of the mastery of a set of practices that restructure both one's perceptions and values.[3] Beyond this practical significance, however, *WuWei* serves as an ethical or religious ideal. It refers to the state of existence or mode of activity of the Taoist sage.

### *WuWei* as Ethical Concept

Ethics investigates the guiding principles of human behavior. It is often called moral philosophy. Moral philosophy raises such questions as: How should we live? What sort of person ought we to try to become? What is our duty to others and to ourselves? What kinds of actions are right and what kinds are wrong? To reflect on such questions is to examine the principles on which our practical lives are based. The attempt to find acceptable answers to such questions is the aim of moral philosophy. The term ethics has acquired the sense of a field distinct from morals. Ethics means the study of morals and more deeply the study of value itself. What is valuable is what is desired or strictly moral; what is desirable is given some set of fundamental assumptions. At its most basic level, ethics considers appropriate mechanisms for choosing principles or values to guide our lives.

In Taoism, Lao Tzu enjoins the ethical principle of *WuWei*, translated as passive non-doing. The Taoists, believe that the universe is comprised of a single principle, the *Tao*,

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[1] . *Wu-Wei _New World Encyclopedia*. (2008). Retrieved on February 26, 2014 from https://www.newworldencyclopedia.org/entry/Wu-wei

[2]. Fun Yu-Lan. (1948). *A Short History of Chinese Philosophy*. New York: The Free Press.p.100.

[3]. E.i, Frank Kaufmann. (2008,August 29). *WuWe: New World Encyclopedia*. Retrieved February 26,2014, from http://www.newworldencyclopedia.org/entry/Wu-wei.

which is a balance of complementary principles striving for harmony. As the *Tao* or nature seeks its balance, humans live well if they follow nature's guiding principle of harmony rather than forcefully imposing an artificial system of control on nature.

To do what is natural and what is necessary means following one's *Te* or moral nature. But effort made to follow '*Te*' must not be unreasonable and arbitrary effort. One's innate skill requires careful cultivation and training. By doing so one's skill of *Te* will become a pair with *Tao-Te* because *Te* and *Tao* are not to be separated when *Tao-Te* is in harmony. This means one's behavior must correspond with an ethical ideal, *Tao*. In other words, without cultivating and training one's innate skill, one's existing *Te* skill cannot be in accordance with *Tao* nor can it follow *Tao*. When this ability is present then there can be a link between *Te* and *Tao*. By cultivating and training his innate skill, he can, therefore have 'power' that is the ability to link *Te* with *Tao*.

In Taoism, the ethical system is derived from the conception of *Ziran* (natural or spontaneous) which models itself on the ways of nature; it is one that defies human control and embodies 'spontaneous patterns, routines, cycles, rhythms, and habits.' In fact, it means that human beings should not do things contrary to Nature. The ethical response corresponding to a world of this sort is *WuWei*: that is non-interference or letting things be. It means one should not raise obstacles to natural processes. *Ziran* is the core value of Taoist ethics. He argues that this is a system in which interpersonal relationships are characterized by naturalness and peace and that, the ethic is reducible to the basic relationship between people and naturalness. It means people and particularly the ruler should emulate naturalness.[1]

Another interpretation of *Ziran* designates spontaneity. Unlike the previous one, it is grounded in a Taoist notion of self, one that is free to articulate itself within its environmental conditions. To be *Ziran* (natural) is to follow a prescribed path of development for that which is natural. In contrast, *Ziran* as spontaneity in the Taoist sense does not mean unfettered freedom. The idea of *Ziran* as self-so is not a philosophy promoting complete self-determination. In other words, as man is a rational being, he is likely to rely on his faculty of reasoning, and he can think himself as one who can make self-determinations without considering *Ziran* (natural or spontaneity). This leads to the separation between man and naturalness '*Tao*' and not following *Tao*. It is *Ziran* that does not remove man's rationality or reasoning power but understand naturalness and incorporates man's rationality within the naturalness. Thus it is *Ziran* that can relate man's innate skill with naturalness, without emphasizing self-determination. That is to say that by following *Ziran*, man's innate skill is sufficient enough to follow the *Tao*, and can be characterized as *Te* which does not deviate from naturalness and peace. In this way, it is not difficult to see how spontaneity can apply both to individuals as well as to states of affairs. In relation to the latter, it denotes the relationships between entities, the effects they have on each other, and their continuing mutual transformation. *Ziran*, therefore, is a core value that can contribute towards establishing or preserving harmony in human society.

**Lao Tzu's Conception of *WuWei***

Taoism is one of the great religious and philosophical systems of China. Taoism exists together with Confucianism as a powerful stream of Chinese thought. It opposes the conventional duties of society and holds a transcendental world of spirit. Taoists are the person who keeps themselves apart from others, attempting to work out a system of thought

[1]. Karyn L. Lai. (2008). *An Introduction to Chinese Philosophy*. New York: Cambridge University Press. p.105.

that would give meaning to their actions. But they are not ordinary recluses who escape the world, desire to maintain their personal purity.

The early Taoist philosopher was Lao Tzu (c.604–??? BCE). The *Tao Te Ching* is one of the great works of China's rich philosophical traditions. It focuses on both metaphysics and ethics. This book was written by the ancient Chinese philosopher Lao Tzu around the sixth century BCE.

In the *Tao Te Ching*, there are three important terms which can help to understand the concept of *Tao*. They are *Tao* (way), *Te* (power or virtue), and *WuWei*. Of the three, *WuWei* is an important concept and its literal meaning is non-action or non-doing.[1] It means that the goal of spiritual practice for the human being is the attainment of this natural way of behaving.

In the original Taoist texts, *WuWei* is often associated with water and its yielding nature. Water is one of *Lao Tzu's* famous symbols of *Tao*. This sense of *WuWei* can be seen in Chapter 8 of the *Tao Te Ching* as follows;

The best (man) is like water.
Water is good; it benefits all things and does not compete with them.
It dwells in (lowly) places that all disdain.
This is why it is near to Tao.
[The best man] in his dwelling loves the earth.
In his heart, he loves what is profound.
In his association, he loves humanity.
In his words, he loves faithfulness.[2]

The emphasis of the symbol 'water' is ethical rather than metaphysical. *Lao Tzu* preferred to learn moral lessons from it. The nature of *WuWei* is like the nature of water. Water benefits all things generously and without strife. Moreover, water represents humility as the earth for its dwelling.

In the opening phrase of the *Tao Te Ching*, Lao Tzu states there are three occurrences of the character '*Tao*'. Of these, the third *Tao* is qualified by *chang*. *Chang* has a number of possible meanings including 'lasting, unchanging, real and absolute.' *Chang Tao* means the *Tao* that asserts the singularity of *Tao* a term denoting reality. The important point is the natural evolution from the simple to the complex without any act of creation. Moreover, the above interpretation asserts that *Tao* is the underlying reality that evades transmission and perhaps even comprehension.

As a spiritual concept, *WuWei* is a challenge for action-orientated minds. The spiritual approach, in fact, is that of the *WuWei*, a key principle in realizing our oneness with the *Tao*. *WuWei* or non-doing is not considered to be inertia laziness or mere passivity. Rather it is a direct expression of this Taoist principle. *WuWei* implies the need to consciously experience ourselves as part of the unity of life that is the *Tao*. Lao Tzu notes that one needs to develop watchfulness and quietness of mind. The main feature of naturalness is a spontaneous graceful efficacy, a continual ability to act in ways appropriate to changing situations. The sage moves in and through the world with effortless action. This effortless action is called getting the right results without forcing them. In the Chapter 2

[1] . Wing-Tsit Chan. (1960). *A Source Book in Chinese Philosophy*. p. 137.
[2]. Ibid., p.143

of *Tao Te Ching*, the first reference to how *WuWei* is embodied in the skillfulness of the sage comes stated;

> ...the sage manages affairs without action (*WuWei*)
> And spreads doctrines without words…..[1]

*WuWei* is thus an activity that is neither conditioned by ingrained habits nor preceded by principle reasoning or axiomatic teachings that can be formalized and subsequently passed on. *WuWei* cannot be adequately articulated in a propositional form. Rather it is intuitive, body-based wisdom that allows us to smoothly negotiate the changing features of human existence. The following imperative is found in the Chapter 63 of *Tao Te Ching* as follows;

> Act without action.
> Do without ado.
> Taste without tasting……[2]

Both of the above- mentioned characterizations of *WuWei* illustrate the effortless manner through which the sage smoothly negotiates the world. This is accomplished by yielding to the given situation and responding accordingly.

The term *WuWei* is translated literally as the absence of doing. It is variously rendered 'doing nothing', 'no action', 'inaction', or 'actionless action'. It does not mean that one does nothing. Rather it means that one avoids unnatural action. Hence *WuWei* means that one performs all of one's actions with a natural, unforced attitude. Taoists avoid fussing because excessive action over trivial matters is an annoyance to both self and others.

This aspect of *WuWei* takes an ethical significance. If people have too much desire, they become harmful rather than good. Rather, it is first and foremost a mode of relating to the world that enables us to live ethically and effortlessly with one another by harmonizing with the natural rhythms of the Way.

The Taoists believe that the sage raises above all distinctions and contradictions. According to them, although the sage remains in the midst of human affairs, he accomplishes things by taking no unnatural action. Thus, the conduct of a sage is an example of *WuWei*. It means that the sage acts naturally. For such a sage, all life transformations are the same and one must not impose value judgments on them. In making decisions, the sage should have 'no deliberate mind of his own' but instead should respond to life events spontaneously, without any discrimination. In short, this means that the sage puts aside desires because they are corruptible and destructive. The sage's *WuWei* is not a strategy to diminish desire; it is evidence of the absence of desire, emptiness, or Non-Being.

In Taoism, the object of spiritual practice is to become one with the *Tao* or to harmonize one's will with Nature in order to live in accordance with *WuWei*. This involves meditative and moral practices. Therefore the goal for this practice is to obey the natural process which means living with *Tao* in order that it can be identified as the primary concept of Taoism.

The emphasis of Taoism is for human beings to live in harmony with Nature or to become one with Nature. This is an outlook that some Western ethical philosophers accept and support, especially those who are concerned about environmental conservation. According to them, the natural environment has been devastated because human beings have

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[1] Wing- Tsit Chan (1960). *A Source Book in Chinese philosophy*. p. 140.
[2]. Ibid., p. 169.

considered themselves to be 'apart' from Nature and that the natural resources of the Earth are inexhaustible and theirs to use and exploit. Human beings are considered by some to be "the masters and possessors of nature."[1]

This has led to the present natural disasters such as earthquakes, forest fires, flooding, and many other dangers. This is due to the fact that human beings have gone against Nature and violated their natural processes. This justifies the basic principle of Taoism; that one should live with *Tao*.

## Conclusion

This paper reflects why and how the concept of *WuWei* in Chinese thought has social and political implications that can be effectively put in practice if they are properly understood even in modern times because they can motivate human beings to be free from extreme behavior which leads to unethical conduct. It can also make them understand how to attain social and political stability. It can also be said that although the concept of *WuWei* is an ancient one, it is accepted by different Chinese thinkers in their own ways and that it is a key concept in Chinese thought because it is metaphysically, epistemologically and ethically significant concept. Due to the discussion about the concept of *WuWei* made in this paper, it can be understood that good social relationships, social stability, and political stability depend on how far people are able to do good and avoid doing bad, and to synthesize opposites or contradictions.

This is because this paper presents how metaphysical, epistemological, and ethical aspects are related to one another. It can be explained that by a thorough understanding of the metaphysical aspect of the concept of *WuWei*, one's ethical awareness as well as his or her ethical considerations for others can increase. On the other hand, to understand the metaphysical aspect of *WuWei* also leads to epistemological understanding. This is because metaphysical knowledge and epistemological one are in reciprocity. Without epistemological development which includes the knowledge of reality; 'is', 'ought', good conduct, bad conduct, the welfare of society cannot be obtained; social and political issues can hardly be resolved, and alleviating poverty can also be difficult.

As mentioned in this paper, according to Lao Tzu, a Taoist, *WuWei* can be represented as 'water' as its metaphor because of its 'flexibility' and 'dichotomous nature' such as 'soft' and 'hard', 'dynamic' and 'static'. Hence, a sage must practice as water for achieving his aim of transcending worldly affairs. It can be reinterpreted from the perspectives of the social implication that the one has to practice as water which can transform its shapes or directions in accordance with the needs of circumstances in the society he or she lives. Similarly, in political implication, it can be negotiate between opposite groups or attitudes by means of following the practice of 'water', as the metaphor of the concept of *WuWei*. In the Taoist thought, there is a need to understand how to know that not doing something necessary at the time when it should be done is not a proper action. Otherwise, doing something unnecessary at an improper time is also not a proper action. Both actions can be considered as 'over-doing' in Taoist thought.

However, if an individual as a member of society always does whatever based on self-interest alone, his or her conduct can be regarded as unsocial as well as unethical. This is because he or she lacks an understanding that acting based on self-interest alone is a form of extreme, bad behavior that can lead to social conflicts. If everyone in society is self-interested

[1] .John D. Petersen. (1990). *Ethics of Environment & Development*. London: Belhaven Press. p.78.

without regard for others then their behaviors can lead to the collapse of peace and stability. This kind of behavior is a form of 'over-doing' that deviate the principle of *WuWei*.

It can be remarked that contradictions in social relationships can take place when people are unable to understand root causes and are unable to understand those good social relationships can be attained through the ability to create a proper balance between one's self-interest and that of others'.

In fact, by analyzing the concept of *WuWei* from the philosophical point of view, it can be shown that it is applicable to some social and political issues. It can be expected that the proper understanding of the concept of *WuWei* would support the appropriate ideas which can be applied in enhancing the social and political welfare. Therefore, it is reasonable to maintain that Taoism considers *WuWei* not just as an abstract philosophical concept but one which plays a significant role in establishing and maintaining social and political harmony. Thus, it is proper to conclude that the concept of *WuWei* has been accepted, in different forms, by different thinkers of Chinese thought throughout the history of Chinese thought whereas it can be applied to ethical, social and political issues and that the concept of *WuWei* in Chinese thought has social and political implications. It is more than a theory. It is a practical guide to a good life.

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# Contributions Made to Western Intellectual Developments by Socrates and His Predecessors

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## Abstract

No knowledge and intelligence are perfectly born by itself. They are achieved by means of accumulation and collections of past knowledge which are based on beliefs, reasoning and experiences. In an examination of the Greek culture, from the ancient old traditional mythological world views, naturalistic thoughts were inherited, and later modified and expanded. This created new advanced World views and Theories, thus human being's intelligence is developed. This paper is aimed to show that this was the way intellectual development took place in the West. In order to prove this, it will put forward and answer the research problem "Why it can be asserted that Socrates and his predecessors contributed to Western Intellectual Development?" The tentative solution is that the western intellectual development has been brought about from the process of transformation of traditional old mythical intelligence to the newly developed naturalistic perspectives of age by age in the Greek and Western cultures. In this paper, the descriptive and evaluative methods will be used and the principle is reciprocity will be the criterion for evaluation. This paper will contribute that by accumulating the parts of knowledge gradually and patiently one can achieve complete one at the end and whatever one does he must have endeavored.

**Keywords:** Mythological thought, naturalistic solution, adaptation, creation.

## Introduction

Since ancient time, everybody had to face many challenges and threats in daily life by the force of nature from wildlife and from other human beings. So, in order to survive, they tried to understand nature and its phenomena as well as other living beings. That is how the research for knowledge began. At first their intellect had not yet fully developed about the mysteries of the natural world, with mythical tales about supernatural beings who had power over them. This led to the rise of myths. Human beings had not yet learnt to think logically. So, myths also gave rise to a form of worship, a primitive religion. This shows that in one respect myths arose out of human emotions such as fear and anger, and from feelings such as love and the beauty. For the ancients believed that there were supernatural beings that controlled not only natural phenomena, but also their lives and destiny. Therefore, in ancient times, mythological explanations were given to settle all arguments about the causes of natural phenomena and to moral, social and religious issues.

In the Western world, Greek philosophy formed the basis of all later philosophical speculation. Many of the moral ideas of Greek philosophers have been combined into Christian moral doctrine as well as in the ethical views of today's philosophers. Then, there is their contribution to mathematics which later becomes the language of science as well as their logic for computer science and technology. Without the contributions made by Greeks of learning and their philosophy, it cannot be the knowledge about the world. So, a study of the history of Western Intellectual Development must inevitably begin with the Greeks. This paper will contribute to the notion that how the Greek philosophy supports for the development of Western Intellectual Development by Socrates and his predecessors.

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## The Ancient Pre-Philosophic Ages of the Greece

When Pre-Socratic philosophies are studied, the religious mythologies have been already to be found in dominant positions. In every culture, religions were a powerful force in the formation of human nature and cosmological speculation. In the ancient Greek thoughts, religious gods were taking an important place in the formation of present and past lives of human conducts as well as thinking about the natural disasters. Greek religion in its anthropomorphic aspect makes development from the earliest times to the culmination of Greek civilization and to that of philosophy in the fifth and fourth centuries B.C.[1]

In the ancient Greek mythology, there were two famous religious world views. They are Homer (758 BC) and Hesiod (700 BC). Homer was famous for his epic tales and Hesiod who was the author of the *Theogony*, which describes how the hundreds of deities were originated at the beginning of the world.

The relations of philosophical and religious ideas are preceded from the beliefs of Zeus, who lives at the top of Olympic. Zeus is supreme among the gods and creator of fate. The Greek believed that the Homeric gods as creators of fate and they control the attitude of men's minds. Indeed, such works of Homer and Hesiod presented about the fate and structure of the universe through the works of deities. Thus, the diverse aspects of Greek culture are the mixed with poetry and the religion of the Olympian gods in the Homeric poems.[2]

The first philosophers of ancient Greece move beyond Homer's and Hesiod's traditional mythological explanations of the world. Myths are the result of pre-logical thinking. They tried to explain natural phenomena with supernatural causes. Their answers may be false and their methods wrong, but primitive mankind was also in search of knowledge and truth the questions that mankind has asked are; what is the nature of this world? How did it come into being? How did life originate or where did living beings come from? Myths give supernatural explanations to such questions. No systematized and no rational knowledge based on observation and experience myths gave primitive human beings guidelines on how to grow food, how to tame and breed livestock, how to avoid dangers both natural and human; how to live their lives and what right, wrong, good and right meant in the form of stories and folktales. Philosophical thinking began only when human beings began to look into nature itself for the causes of natural events, and reasoning based on observation and experience replaced mythological thinking.

## The Philosophic Age and Various Schools

When Pre-Socratic philosophers are examined, it is found that there are three distinct problems. Firstly, whether reality is *one* or *many*, second is the problem of *change* and *constancy*, and third is the problem of *relativism*. On the problem of the *one* and *many*, some philosophers hold that the world has an enormous variety of objects, some are living beings, but some are inanimate things and some are solid but the others are liquid. The problem to solve is that whether all living beings and inanimate things are the products of a common source or on staff or they all have many sources.

In the problem of *change* and *constancy*, some philosophers believed that in this world there are many inanimate things and animate beings. In them, some are seen to be stable, for example, rock, mountain, but the other seen to be changing and moving such as tree, animal, fire etc. The problem is that is the changing reality or is constancy reality?

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[1]. Frank Thilly; "***A History of Philosophy***", 1976: Allahabad, Central Book Depot.p.14.
[2]. Ibid, p.15.

The third problem of *relativism* is that whether there is determining principles and they are absolute or created by people. Some suppose that there is determining principle which is absolute. But some believed that all the principles and laws are created by men in accordance with given situations.

On the basis of those problems, there had been different outlooks in accordance with different philosophers, though out the period of pre-Socratic. Those philosophers are the first who search for the reality of cosmology by means of reason and natural principle instead of myth and religion. Among them, Milesian school also firstly attempted to find the roots of the universe.

**Milesian Schools**

The three philosophers of Miletus were Thales (625-545 BC), Anaximander (610-545 BC), and Anaximenes (585-525 BC), all of whom attempted to answer the question "What is the common stuff from which everything is composed?"[1]

The very first among the Milesian philosophers was Thales (625-545 BC) who was the born in Miletus, in the Ionian Islands of Asia Minor. He is historically recognized as the founder of Greek philosophy and in his time was considered one of the Seven Wise Men of Greece. They formed the foundations of what is now called "rational thinking". Thales became famed for his knowledge of astronomy after predicting the eclipse of the sun that occurred in (585 BC). He is also said to have introduced geometry in Greece. The Greeks already held to the view that there were four basic elements, namely, earth, air, fire and water. From these, Thales selected water as the primary stuff of nature, and Aristotle speculates about why Thales chose water species and others solidity and turn to slime or earth. But it would not be unfitting to call him the first philosopher and scientist in the history of Western Intellectual Development.

A more elaborate view was offered by Anaximander. According to him, "The boundless is the original material of existing things, and it is the source, from which existing things derive their existence, and to which they return at their destruction, according to necessity." The record gets a slightly better picture of his views from a comment made by later philosophers.

According to the above, the ultimate cause of things must be some invisible and limitless physical substance, which is capable of changing gradually and completely from one thing into another of all the physical things that we see.

The third of the founding philosophers from Miletus was Anaximenes, who held that condensed and expanded *air* is the source of everything. According to him, just as our soul, being air, holds us together, so do breathe and air surrounds the whole world as Anaximenes explain.

The importance of this is that Anaximenes was the first to suggest that reality could be measured. This provides a more scientific account of reality, particularly in comparison to Anaximander's theory which removed ultimate reality from the realm of what we can perceive.

Thales, Anaximander and Anaximenes started a philosophical trend and their thoughts based on the nature instead of mythological argument. By using the reasons, they sought the

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[1]. Frank Thilly; "***A History of Philosophy***", 1976: Allahabad, Central Book Depot.p.20.

natural problems by means of nature. From that time systematic philosophical reasoning had been formed in ancient Greece.

**Pythagoras (570-497 BC); Mathematical Relations**

Before pre-philosophic period of the Greek, from the belief of the god men began to consider about the world on which men live. That problem had been solved by naturalistic ways at the age of Milesian School. Though the outcome is different views they have same agreement about the problem which is the problem of substance or the stuff of which the world is composed. The problem they focused has given the same consent result which is very important in the history of philosophy. It is Monistic Materialism. But, at the age of the Pythagoreans School the Milesian Philosophy was challenged. The Pythagoreans School set up the philosophy of Pluralistic Idealism in the place of the Monistic Materialism of the Milesian School.

According to the Pythagoreans School the substance the ultimate reality is a number which is finite and unchangeable though the others of animate beings and inanimate things are changing. As Pythagoreans are mathematicians, they were interested in quantitative relations, which are measurable, and began to speculate upon the problem of the uniformity or regularity in the world. They attempted to explain the realities by means of the numbers and set up the principle of all beings. Pythagoras, who was a famous mathematician and philosopher, held that mathematical relations underlie reality. The Pythagoreans believe that there are forms and relations in the world. According to them, the measurement, order, and uniform recurrence can be expressed in numbers. Without number, there cannot be such relations and uniformities, no order, no law. Hence number must lie at the basis of everything. The number must be the true realities, the grounds of things, and everything else can be explained by means of number.[1]

Thus, according to the Pythagoreans, numbers are the principles of things and they are the substance or stuff of the universe, and things are the copies or imitations of numbers. The Number philosophy of the Pythagoreans influenced upon the Plato and Aristotle. According to Pythagoreans, there is a numerical relation between the length of the string and the pitch of the tone, they called the number. The number is only a symbol or expression of the relation, the cause of the relation. Thus, Pythagoreans placed number behind phenomena as their basic principle. For Pythagoras, Everything is related to mathematics that mathematical relations govern at all. The Pythagoreans placed the central fire in the center of the universe, and around it the planets revolve, turned by means of transparent moving spheres to which they are attached. The Pythagoreans' astronomical notions paved the way for the construction of the heliocentric theory.

**Heraclitus (540-480 BC); Change**

The Milesian philosophers were interested in the substantial nature of things, the Pythagoreans were in quantitative relations, order, harmony and number. But there was the next problem to have intention was the problem of change or becoming.

There were philosophers who wanted to make the concept of change central to the system. That kind of philosopher is Heraclitus. According to him change constitutes the very life of the universe and nothing is permanent. As for Heraclitus, the universe is in a state of

[1]Frank Thilly; "***A History of Philosophy***", 1976: Allahabad, Central Book Depot.p.28.

ceaseless change. “One cannot step twice into the same river, for fresh waters are ever flowing in upon you”.[1] Heraclitus chooses as his first principle which is the mobile substance; it is something that never seems to come to rest, the ever-living fire.

**Parmenides of the Eleatics School**

The most radical philosophical theory among the early Greeks was proposed by a group of philosophers from the city state of Elea, a Greek colony on the south-west coast of Italy. Parmenides (510 BCE) were the metaphysician of the Eleatic school. According to him, if being has become, it must either have come from non-being or from being.[2] Being is endowed with reason, eternal and immutable. All change is inconceivable, and the world of sense is an illusion. According to Parmenides, then, what we can say about reality is that it is an eternal, single, unmoving, and round thing.

Zeno (490- 430 BC), the target of Zeno’s work is the commonsense world of appearances that virtually everyone believes in. Empedocles (495-435 BC) held that there are four basic elements, namely earth, air, fire and water, which are organized by the two forces of love and strife. Anaxagoras (500-428 BC) held that the world is comprised of infinitely divisible portions of elements that are set in motion by a cosmic mind.

**Atomism**

The metaphysical problem, whether a being is the reality or nonbeing (becoming) is reality, is solved by the atomists because the atomists agree with their predecessors in the acceptance of both Being and non-being as realities. The atomists agree with the Eleatics that absolute change is impossible because reality is, in its essence, permanent, indestructible and unchangeable. At the same time, it cannot be denied that change is going on and the things are in constant motion.[3]

According to the atomists, motion and change would be unthinkable without empty space, or the void which Parmenides had call non-being. The atomists, thus, insist that non-being or empty space exists because it is the empty space in which the atoms move.

As for the atomist, all living beings and material bodies are combinations of atoms and then all human actions are determined by the laws that govern the movement of atoms. We noted already how atomism foreshadowed the general makeup of the universe held by modern physicists. Similarly, their commitment to materialism and determinism foreshadows views that dominate contemporary philosophy of mind.

If the ancient Greek philosophy is examined, the scholars' thoughts were free from mythology totaled. Thoughts are more philosophical rather than mythical. They solved the natural problems by means of nature by applying perceptions on experience and intellect by reasoning. Thus, later pre-Socrates' philosophies had an influence on the philosophies of modern times.

**Sophists**

Protagoras (490-420 BCE), the most famous of the Sophists, is remembered for his relativist statement that “man is the measure of all things”.[4] When pre-Socratic philosophies were examined, the philosophers interested the physical environment. They want to know the

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[1] . Frank Thilly; "***A History of Philosophy***", 1976: Allahabad, Central Book Depot .32.
[2]. Ibid, p.38.
[3]. Frank Thilly; "***A History of Philosophy***", 1976: Allahabad, Central Book Depot.p.47.
[4] . . Ibid,.p.57.

question of what is the ultimate reality of the universe. However, there had no common, simple and definite answer, but there had been disputes among them. Thus, at the age of Socrates the aim of philosophy had been turned in another direction. They believed that instead of thinking about the question of ultimate reality of the physical environment, which rendered no definite answer, it would be more effective and useful by the pursuing the right way of good living in community. Thus, the aim of philosophy moved toward ethical outlooks instead of metaphysical questions.

In pre-Socratic philosophy, the first social thoughts were brought by the Sophists. The Sophists were particularly good at rhetoric and politics, which appealed to the Greek parents who wanted their sons to be civic leaders. But the Sophists' education was occupied with egoistic philosophy and individualistic thought. Thus, to turn the youth's direction toward ethical, social and general truths Socrates appeared.

**Socrates**

In order to challenge the individual and egoistic doctrine of the Sophists, Socrates had to appear. According to Socrates, if human beings were emphasized on only empirical knowledge, it would be subjective and there would not be general and objective knowledge. In order to have general or objective knowledge, men must go beyond the experiences. Then men would find such knowledge. In order to achieve it, must hold the reasoning which will lead real and objective knowledge. Thus, Socrates said, "Knowledge is Virtue".[1]

By keeping the rational mind, Socrates urged the youths to follow the laws of the state, the principles of moralities and attempt to be good citizens. The value of Socrates' philosophy was adopted by his student Plato. Plato was the first philosopher who established metaphysics systematically, and elaborated Socrates' ideology of rational power of men. Plato's Republic, which was built on the basis of reasoning, had been popular not only in the Greek thought but also in the western world. Besides, it enriches the further western intellectual developments.

## Conclusion

Knowledge is achieved and intelligence to sharpen by gradual collections of ideas and facts obtained from the social or physical environments. No knowledge or intellect of human beings is perfect or complete in itself. Human beings have to learn to get knowledge beginning from the childhood. In the same way, western intellectual development in the form of philosophy began with the ancient Greeks. Knowledge and intellect have to be built up by conveying knowledge from generation to generations. Mistakes are often made and have to be corrected and modified. Thus, when the Greek culture is surveyed, it is found that it began with the ancient religious mythology based on imagination and feelings. It was only at the time of Thales that observation of nature and reasoning began to play an important role.

They began to learn that natural phenomena are caused only by natural events, and this led to various schools of philosophy in the Pre-Socratic Period. But at first, they were interested only in the external world. Their theories, from the point of view of modern science are not exact a systematic but they opened the way towards scientific developments. For example, the study of cosmology which originated in Greek philosophy. The Greek philosophers were interested in the cause of the earth and the universe and they began to

[1]Frank Thilly; "***A History of Philosophy***", 1976: Allahabad, Central Book Depot. p.70.

think about it. Since that time, the study of cosmology, physic and metaphysics began and developed. They can be called the first philosophers as well as scientists of that time who attempted to reveal the laws of nature. Some of the basic principles they formulated are still dominant in the present sciences. For example, the Democritus' atomic theory was of some influence up to the 18th century. After scientific revolution, the atom which has been held as the indivisible element has been divided into four particles. Up to the present time, the scientists are attempting developments. It means that the speculation of ancient Greek thought in 5th century B.C. Lasted up to the 18th century. In the same way, the ancient thought of Pythagoras' theory has been applied up to the present. Their theories were based on speculation, but without modern scientific instruments their insights were penetrating.

In social and political affairs, Socrates' mottoes, "knowledge is virtue'', "The unexamined life is not living", still has great influence in ethics, politics and social relations. Likewise, even though the philosophy of the Sophists like Protagoras has been severely criticized his individualism has done much to balance the benefit of the individual in society. The rights of the individual in modern democratic societies owe a debt of gratitude to the individualism of the Sophists.

It can therefore be concluded that the Greek philosophers of the Pre-Socratic Period followed by Socrates and the Sophists have contributed much not only towards the development of philosophy but to Western intellectual development as a whole.

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# A Critical Study of Pragmatist Ethics

San Win[1], Tin Tin Nyo[2]

## Abstract

This paper aims to show that each person is needed to moral responsibility and obligation for a good society. The ethical view of pragmatist is built on the principles of pragmatism. The research paper problem is that, why it can be said that the pragmatists' emphasis on the empirical and individual has resulted in the breakdown of moral, spiritual and social institutions. The research finding is that when the empirical and individual is taken to extreme it could improve the material welfare of people but has no way for making people better spiritually or morally. The contribution of this paper is thus to understanding the philosophic thought is intangible but it has far- reaching crucial consequences for the future of mankind. The research methods used the descriptive method and the evaluative method. An evaluation is made by the principle of induction in proving solution to the problem.

## Introduction

This paper aims to show that each person is needed to moral responsibility and obligation for a good society. The ethical view of pragmatist is built on the principles of pragmatism. Pragmatism is a fairly new philosophy, having its rise within the twentieth century. The word is derived from the Greek 'pragma', having almost the meaning of the word active, or efficient. It is a theory about the nature not truth, a new method of approach to philosophical problems. It is a revolt against the intellectualism or the rationalism of Absolute Idealism. Thus, pragmatism is a method of solving intellectual problems as well as a theory about the knowledge.

The pragmatic method was first enunciated by C.S. Peirce (1839-1914) Later William James (1842-1910) and John Dewey (1859-1952) in the U.S.A. Among the three pragmatists, James and Dewey are interested in every branch of philosophy but James is inherently a moralist, Dewey also a moral philosopher. In this paper, thus the ethical views of James and Dewey will be mentioned.

This paper problem is to show why the pragmatists' emphasis on the empirical and the individual has resulted in the breakdown of moral, spiritual and social institutions. The research finding is that when the empirical and individual is taken to extreme it could improve the material welfare of people but has no way for making people better spiritually or morally. The contribution of this paper is thus to understanding the philosophic thought is intangible but it has far- reaching crucial consequences for the future of mankind.

### The Ethical View of James

James focuses on the question of the objectivity of moral judgments, particularly of moral norms. The source of James' moral philosophy is his reverence for the individual. He asserts the indefeasible right to be precisely what one is, provided one is authentic. He more interested in the many truths that make up present beliefs than in the final truth. ***In the Moral Philosopher and the Moral Life,*** James argues that "there can be no final truth in ethics, any more than in physics, until the last man has had his experience and said his say".[3] It should not be forgotten that man is fallible hence he can never know that a belief their either in ethics or physics will not be successfully challenged in the future.

[1]Daw, Lecturer, Department of Philosophy, Myeik University.
[2]Daw, Lecturer, Department of Philosophy, Myeik University.
[3]William James. (1948). ***Essay in Pragmatism***. New York: Hafner Publishing Co.p.65.

James thinks many sentient beings are indifferent to one another. And such a demand will arise only if the sentient beings in the universe, rather than being indifferent to one another, respond to one another's demands. As James well knew, insignificant persons can have desires that make demands on the whole world. The people live neither in a moral solitude, nor in a moral multiversity, i.e. a universe of beings that are totally disinterest in one another. This may be a part of the moral life. For James, there can be a moral life only where people recognize each other as fellow members of a moral community, and wherever there is such recognition, there is a moral community.

James explains that a moral life is possible. One necessary condition for morality is indeterminism, although many philosophers attempt to show that determinism is compatible with moral responsibility. Another is that what moves him to do his duty, if man is so moved, is simply the fact that he recognizes it to be his duty. It means that James recognizes someone's demands as establishing an obligation. But inevitably, there will be conflicting demands, and thus man faces conflicting obligations. It is not also a world in which not all ideals can be realized, nor all demands satisfied.

According to James's version of pragmatism, the highest good can be achieved only by the help of a moral energy born of the faith. Faith in a moral universe is not only authentic but practically efficacious. Individual hypotheses and the acts to which they motivate us, are positive contributions which actually change human's environment. They create reality temporally. In so doing, they enrich or impoverish its moral or ideal values. Moral judgments are the expression of subjective preferences or desires, and ideals are imperative only in so far as they are felt to be so. Any ideals, therefore, makes itself valid by the fact that it exists.

Then James gives the definition of 'the good'. Goods are pluralistic, since value judgments derive from the interests of individual. There is thus an endless competition between conceived goods or ideals. Furthermore, people are born into a society whose ideals are already largely ordered, and this still further limits the possibility that any individual ideals may be realized, if they be revolutionary. In these circumstances, the guiding principle of ethics must be to satisfy as many demands as possible. Individualism is fundamental, but the maximum of social satisfaction is both the objective goal and the overruling principle of ethics. By following this principle, James holds,

> Society has shaken itself into one sort of relative equilibrium after another by a series of social discoveries quite analogous to those of science.[1]

This suggests that existing laws and usages are what yield the maximum collective satisfaction, and those ideals which accord with prevailing customs of the community are most entitled to support. But so universal a conformity, and so static a morality are fundamentally repugnant to James. He opposes it by holding that there is nothing final in any actually given equilibrium of human ideals. Just as the present laws and customs have fought and conquered antecedent ones, so in turn they will be displaced by any newly discovered order which eliminates the complaints that they still give rise to. Society is thus forever in flux, and every now and then an individual's revolutionary ideal or action may produce fruitful results.

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[1]. Lloyd Morris (1950). ***William James***: The Message of a Modern Mind, New York: Charles Scribner's Sons. P. 71

James is looking for a criterion by which to judge actual moral judgments, by how they work out in practice. It has been pointed out that James does not offer any guidelines for weighing demands against each other, although he speaks of weaker and stronger demands. Neither does James suggest the means to compare ideals, or how to count claims. The suggestion is that whenever faced with given a problem of conflicting moral or political demands, people sit down and reason together to find a solution fair to all parties and that is where moral objectivity can be found. The world keeps changing, new opportunities for human to flourish and new obstacles, new problems, will arise and new answers will have to be explored.

Some philosophers have held that there are moral facts that are radically independent of what any human being may think. Indeed, there is no such thing as human knowledge without human thinking. James concludes that the content of the best theories depend in part on cognitive and even moral value judgments made in the course of inquiry.

Some assume that there is nothing that corresponds in the moral case to experience. There is more to the moral life, than moral judgment there is action. Action and experience are the two ways in which the wed of human beliefs and human value judgments is anchored in the world. Experience is an interaction between human and the world, and conversely, every action is an experience, though the effect on the world may be vastly more important than the experience is for the agent. James believes philosophers have a social responsibility. A person's relation to this world, as a philosopher is not essentially different from his relation to it as a daily participant in the practical current of events.

James applies the pragmatic method to the solution of the important ethical problem free-will means novelties in the world, or that the future may not identically repeat and imitate the past. He does not accept the extreme from which denies the power of alternative choice. Thus, for James freedom is a moral postulate and a necessary basis for human action.

**The Ethical View of Dewey**

Dewey defines the problem of contemporary ethics as resulting from the dissimilarity between knowledge of physical nature and knowledge of human nature. He attempts to apply the methods of science to the problems of morality. It is because human behavior, especially in regard to moral value, has continued to follow the traditional conception of human beings as passive spectators in a fixed and unchanging universe. Thus Dewey reconstructs his ethical theory based upon the scientific method and the conception of the universe as evolutionary.

According to Dewey humans being are always making adjustments to the changing conditions that face them. With the dynamic aspect of the universe, he produces an ethical theory that "involves nothing less than the problem of directed reconstruction of economic, political and religious institution".[1] Dewey holds that only the use of pragmatic principles (scientific method and evolutionary process) in ethics can lead to the continuing adaption of values to changing human needs. It means that he accepts the use of active intelligence and the facts of experience in the conduct of moral life. However, the function of facts is no more than as instruments for the construction of value judgment.

In ethics, Dewey attacks two extreme: radical empiricism and rationalism. According to empiricists, moral values are identified with subjective experiences of likes and dislikes.

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[1] . T.C. Denise, N.P. White, S.P. Peterfreund. (2002). ***Great Traditions in Ethics***. U.S.A Wadsworth/Thomson Learning. P.230 .

But for Dewey, subjective experiences of likes and dislikes provide only the possibilities of values. Values (to sum up) may be connected inherently with liking, and yet not with every liking but only with those that judgment has approved, after examination of the relation upon which the object liked depends.[1]

It is found that value is not dependent on desire and satisfaction, which are antecedent to the action. One must know the conditions under which likes, desires and enjoyment take place. All such knowledge is essential for valuation. Valuation is experimental. Experimental valuation destroys its subjectivism because the emphasis is on the change of the objective environment.

Dewey then turns his attention from extreme empiricism to extreme rationalism. He criticizes it from the standpoint of scientific standards. Whereas empiricism fails to go beyond the mere facts of preference, rationalism in ethics is also far removed from the facts to be of practical use. Even in those cases where rationalism propose concrete values, they are tied to the dead past.

Dewey's ethical view is guided by the same principle as that of his metaphysics. He holds that the task of morals is to guide human nature. Conduct is an interaction between the elements of human nature and the environment, natural and social. A person is free to choose which trend of reactions against the environment he would adopt. Facts are not a barrier to his freedom. Dewey presents freedom as the ability to make intelligent choices, and to act upon them while acting from the base of one's own individuality. Concerning a view of moral life, Dewey greatly emphasizes intelligence. He admits the power of intelligence to imagine a future which is a picture of the desirable in the present, and to create the instrumentalities of its realization. So people are not under the control of blind circumstances. The future can be controlled intelligently. Intelligence is the key to freedom.

Moral ideas are hypothesis, which are to be tested and conformed or altered through consequences, which follow from them. According to Dewey, moral laws are not good themselves. Their values lie in the consequences that follow from them. They are useful only as an instrument for guiding man in his relation to his environment. As long as there is human life, there will always be a situation in which there are internal conflicts that demand judgment, decision and action. Anyhow a comprehensive factual investigation of the moral problem is necessary. What actually occur and how they occur, must be known. One must know the forces at work. Then only actions can be directed for improvement.

According to Dewey, ethical valuation is an inquiry, which likes all inquiries, presupposes a community of shared experience in which there are common norms and procedures and intelligent valuation is also a means for making such a community a concrete reality. This social philosophy of Dewey pictures him as a reformer or reconstruct or, not a revolutionary, since he was always skeptical of grand solutions for eliminating existing evils and injustices.

## Conclusion

It may be concluded that, the Pragmatists maintained that truth is not something to be debated, but to be practiced. To this extent the pragmatists were correct, but they failed to take into account the relation between truth and morality because of their emphasis on the

[1] . John Dewey. (1929). ***The Quest for Certainty***. New York: Minton, Balch and Co. p.264.

individual. From studying James' version of pragmatism, it is found that he substituted a subjective sense of work for an objective sense of work which Peirce employed. Moreover he accepted the fact there are no universal ways of handling situations. One has to live with and within the stream of experience which is always changing, ongoing and continuous. Therefore, it can be said that James' attitude constitutes a practical philosophy based on relative value.

Moreover, James' focus was on the individual alone. His principal goal was to refute the old metaphysical views and open the way to individualism in the social, moral and religious sphere. This emphasis on the individual taken to extremes can result in subjectivism which could lead to disharmony especially in society. What James failed to point out was that many human beliefs are unsound and that belief before they are pursued and applied to actual life should first be critically evaluated. Dewey introduces the social basis in the search for truth in order to circumvent over-emphasis on the individual of James' Pragmatism.

Furthermore, Dewey accepted the role of the individual as part of the social milieu, but did not accept the extreme individualism of the time. In his Pragmatic view, truth is sought for the individual, but the process of social and moral implications of life and society are not over looked. Thus it may be said that Dewey' Pragmatic approach to truth is individualistic but not subjective. Dewey used intelligence or knowledge as a tool for settling everyday problems and difficulties and for adaptation to the environment. It is only to settle and develop one's social moral life. He attempted to apply the methods of science the problem of morality. Science has better methods of improving the material welfare of people but has no method, (nor interest) for making people better spiritually or morally.

In addition, the Pragmatists emphasis on the empirical and the individual gave rise to a culture that emphasizes material welfare and the western attitude of each for him or herself. This may not have been their goal but it was one of the inevitable consequences of their philosophy. It may be concluded that, it has resulted in the breakdown of moral, spiritual and social institutions such as the family and school. This is not to say that western cultures, such as American culture, have discarded moral and social norms altogether, but accent on individual achievement, individual judgment and individual interest has come to the forefront for which Pragmatism in general and James' view in particular is partially responsible. Philosophy or philosophic thought is intangible but it has for reaching crucial consequences for the future mankind.

As for as pragmatism is concern, both the positive and negative consequences have been pointed out in this paper. Its positive effects are that in America it has led to an atmosphere that encourages creative thinking and a respect for individual rights and freedom. But the negative side is that when this is taken to extremes it could lead to a breakdown of moral values and erode the institution of family, respect for elders such as parents and teachers. And as Dewey pointed out it leaves young children who are ignorant and immature without any moral guideline.[1] The younger generation thus should be taught to be able to think multi-laterally and critically and do not rely too much an authority and testimony. The understanding of the philosophic thought is intangible but it has far reaching crucial consequences for the future of mankind.

[1] . Bryan Magee. (1987).The Great Philosophers. New York: Oxford University Press. P.297.

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# Sorption Properties of Clay Minerals in Bago Township

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## Abstract

This research deals with the studies on bleaching properties of some clay samples from three villages in Bago Township towards the used oil and sesame oil. Primarily physicochemical parameters such as colour, pH and moisture content of the raw or natural clay samples were determined. Then acid and heat activated clay samples were prepared. Changes in surface morphology, mineralogical composition and particle size of the clay samples after acid activation were investigated by SEM, EDXRF and XRD analysis. Acid activated clay samples show the more porous and smaller particle size than the natural clay samples. Bleaching capacity was also improved in acid activated clay samples.

**Keywords**: clay, bleaching property, SEM, EDXRF, XRD

## Introduction

Clays are lamellar aluminosilicates possessing a wide range of physicochemical properties such as swelling, adsorption, ion exchange and surface acidity. Natural clay minerals are gaining importance among low-cost adsorbents because of their easy and abundant availability and high adsorption capabilities for cations and polar molecular (Jiuhui, 2008).

A fine or grained deposit consists chiefly of clay minerals. It is characteristically plastic and virtually impermeable when wet and cracks when it dried out. In geology the size of the constituent particles is usually taken to be less than 1/256 mm. In solid science clay is regarded as a soil with particles less than 0.002 mm in size.

Clay minerals are very small particles, chiefly hydrous silicates of aluminium, sometimes with magnesium and/or iron substituting for all or part of the aluminium, that are the major constituents of clay materials. The particles are essentially crystalline with a layered structure, but may be amorphous or metalloidal. The clay minerals are responsible for the plastic properties of clay; the particles have the property of being able to hold water. The chief groups of clay minerals are: kaolinite, halloysite, illite, montmorillonite, and vermiculite. Clay minerals form in the presence of water and have been important to life, and many theories of abiogenesis involve them. They have been useful to humans since ancient times in agriculture and manufacturing (Newman, 1987).

## Materials and Methods

### Collection of Clay Samples

Clay samples were collected from three locations at the depth of 6 inches using plastic hand shovel. The locations are Myint Kyo village, Taungyi Kawe village and Wunbeinn village in Bago Region.

### Collection of Oil Samples

Sesame oil sample was purchased from retail market and used oil was collected from restaurant.

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### Preparation of Natural Clay Samples

The clay samples were air dried by spreading in highly ventilated room at a temperature not exceeding 40°C and foreign matters such as gravel, roots etc. were discarded. Afterwards, the samples were grinded and sieved through 65 mesh sieve. Then the clay samples were stored in air tight plastic bottles in desiccator for further use.

### Determination of Physicochemical Parameters of Natural Clay Samples

Moisture contents of clay samples were determined by using the oven drying method. pH of clay sample was measured with pH meter. Air-dried clay sample (10 g) was placed into a beaker and 100 mL of distilled water was added. The suspension was stirred and the pH of clay sample was measured after 18 hours of equilibrium.

### Activation of Clay Samples

Acid Activation

Air-dried clay samples were activated with 30% hydrochloric acid solution. The samples were agitated by magnetic stirrer at 90°C for 3 hours under continuous stirring. After activation the samples were filtered and washed with distilled water. The acid activated clays were dried initially at room temperature followed at 105°C, reground and sieved with 65 mesh sieve. The activated clay samples were stored in air tight plastic bottles in desiccator for further use.

Heat Activation

Air-dried clay samples were activated at 145°C for 30 minutes.

### Characterization of Raw and Acid Activated Clay Samples

The mineralogical composition of raw and acid activated clay samples were determined by Energy Dispersive X-ray Fluorescence (EDXRF) and X-Ray Dispersion (XRD) Spectrometry. Surface Morphology was determined by Scanning Electron Microscopic (SEM) Analysis at Universities Research Centre.

### Determination of Bleaching Properties of Clay Samples

Effect of clay dosage was determined by adding 0.5g, 1.0g, 1.5g and 2.0g of clay samples separately to 10 mL of used oil in a beaker. The beaker was placed in an oven, set to a temperature of 90°C for contact time of 30 minutes. For further study, 1.0 g of the raw, acid treated and heat treated clay samples were used. Bleaching of sesame oil and used oil with various clay samples was carried out according to the above procedure.

## Results and Discussion

### Physicochemical Parameters of Natural Clay Samples

Physicochemical parameters such as colour, moisture content and pH value of the natural clay samples were primarily determined and the results are shown in Table 1.

Colour signifies soil conditions and some important properties like availability of organic matter, colouring oxides etc. The colours of samples 1, 2 and 3 are light grey, light brown, and light yellowish brown respectively. This is due to different degrees of oxidation hydration and diffusion of iron oxides in the soil, which bring either red or yellow or brown colour.

Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and is measured in pH units. The pH range normally found in soils varies from 3 to 9. The United

States Department of Agriculture Natural Resources Conservation Service classifies soil pH ranges as follows: Ultra acid (<3.5), extremely acid (3.5-4.4), very strongly acid (4.5-5.0), strongly acid (5.1-5.5), moderately acid (5.6-6.0), slightly acid (6.1-6.5), neutral (6.6-7.3), slightly alkaline (7.4-7.8), moderately alkaline (7.9-8.4), strongly alkaline (8.5-9.0) and very strongly alkaline (>9.0) (Agbenin, 1995).

According to the pH value, the samples 1N and 3N were found to be slightly alkaline. Alkaline soils have a high saturation of base cations ($K^+$, $Ca^{2+}$, $Mg^{2+}$ and $Na^+$). This is due to an accumulation of soluble salts.

Highest moisture content (5.03%) was found in 1N and lowest content (2.12%) was found in 2N.

Table 1. Physicochemical parameters of natural clay samples

| **Sample** | **Physicochemical Parameters** | | |
|---|---|---|---|
| | **Colour** | **pH** | **Moisture** |
| 1N | light gray | 7.6 | 5.03 |
| 2N | light brown | 7.32 | 2.12 |
| 3N | light yellowish brown | 7.53 | 3.58 |

1N Natural clay sample from Myit Kyo Village

2N Natural clay sample from Thaungyi Kawe Village

3N Natural clay sample from Wunbeinn village

**Activation of Clay Samples**

The modification of clay which is itself a low-cost adsorbent derives the need for the development of a modification technique that is simple and cost-effective. Acid-activated clays are normally used in the refining of minerals and in the bleaching of vegetable oils for removing all kind of impurities. The structural features of the clay are modified by treatment with mineral acids. The acid activation of clays using hydrochloric acid is a two-step procedure in which splitting of particles within the octahedral sheet takes place. In the first step the exchangeable cations are replaced by $H^+$ ions. The second step involved the leaching of octahedral cations such as $Al^{3+}$ and $Fe^{3+}$. The octahedral $Al^{3+}$ cations could be more easily leached by acid attack than tetrahedral $Si^{4+}$ cations. After acid treatment, the colours of the natural clays (Figure 1(a)) were changed to whitish colour as shown in Figure 1(b). This could be due to the replacement of metal ions such as $Al^{3+}$, $Fe^{3+}$ and $Ca^{2+}$ in the clay with $H^+$. The colours of the heat activated clay samples (Figure 1(c)) were not significantly changed from raw samples.

Natural clay samples from Myit Kyo, Taungyi Kawe and Wunbeinn village were abbreviated as 1N, 2N and 3N respectively. Similarly acid activated samples were also abbreviated as 1A, 2A and 3A, heat activated samples as 1H, 2H and 3H.

(a) (b) (c)

Figure 1. (a) Natural clay samples (1N, 2N and 3N)

(b) Acid activated clay samples (1A, 2A and 3A)

(c) Heat activated clay samples (1H, 2H and 3H)

**Characterization of Clay Samples**

Surface Morphology of Clay Samples

Natural and acid activated clays were analyzed by Scanning Electron Microscope (SEM) to detect the change in surface morphology after activation process. SEM photograph of natural and acid activated clay samples were shown in Figures 2 and 3. It can be seen that clumps of uneven surface can be seen for acid activated clays with distribution pores on surface compared with flat flakes of low porosity for natural clay samples. The leaching of cations on acid activation creates voids in the clay making the clay surface more porous. The formation of smaller pores take place as the impurities are removed and the exchangeable cations are replaced by $H^+$ ions. These physicochemical reactions alter the morphology of the clay as the pores open up and the clay surface appears to be more porous and homogeneous.

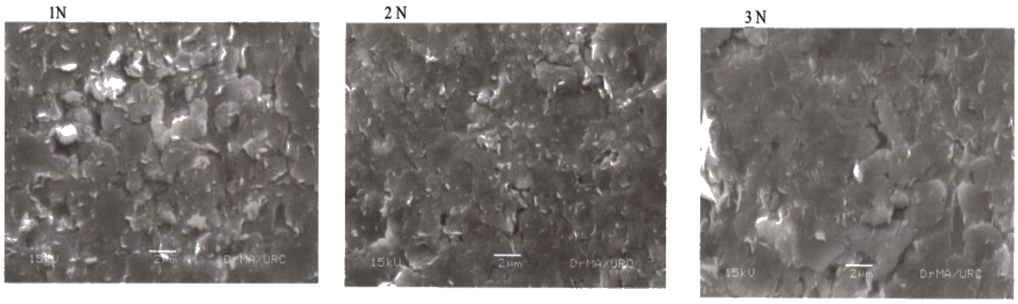


Figure 2. SEM photographs of natural clay samples

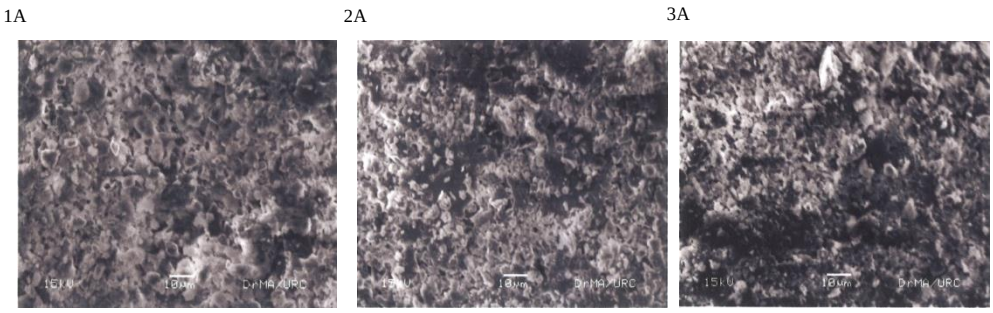


Figure 3. SEM photographs of acid activated clay samples

**Mineralogical Composition of Clay Samples**

Mineralogical composition of natural and acid activated clay samples were determined by Energy Dispersive X-Ray Fluorescence (EDXRF) and presented in Figures 4

and 5. According to the EDXRF results, the clay samples are composed of Si, Fe, K, Ca, Ti, Zr, Mn, Cr, Sr, Rb, Y and Zn. Some of the predominant mineral compositions in clay samples are shown in Table 2. This shows that Si is present in major quantities and Fe is the second abundant metal. After acid activation, the content of Si was observed to increase and that of Fe was decreased. It may be attributed that the octahedral sheet distribution passes the cations into the solution, while the silica generated by the tetrahedral sheet remains in the solid phase due to its insolubility. Thus, the chemical change that took place in the clay structure during the acid activation lead to vacancies in the crystal lattice, and this increases the adsorptive power of the activated clay mineral.

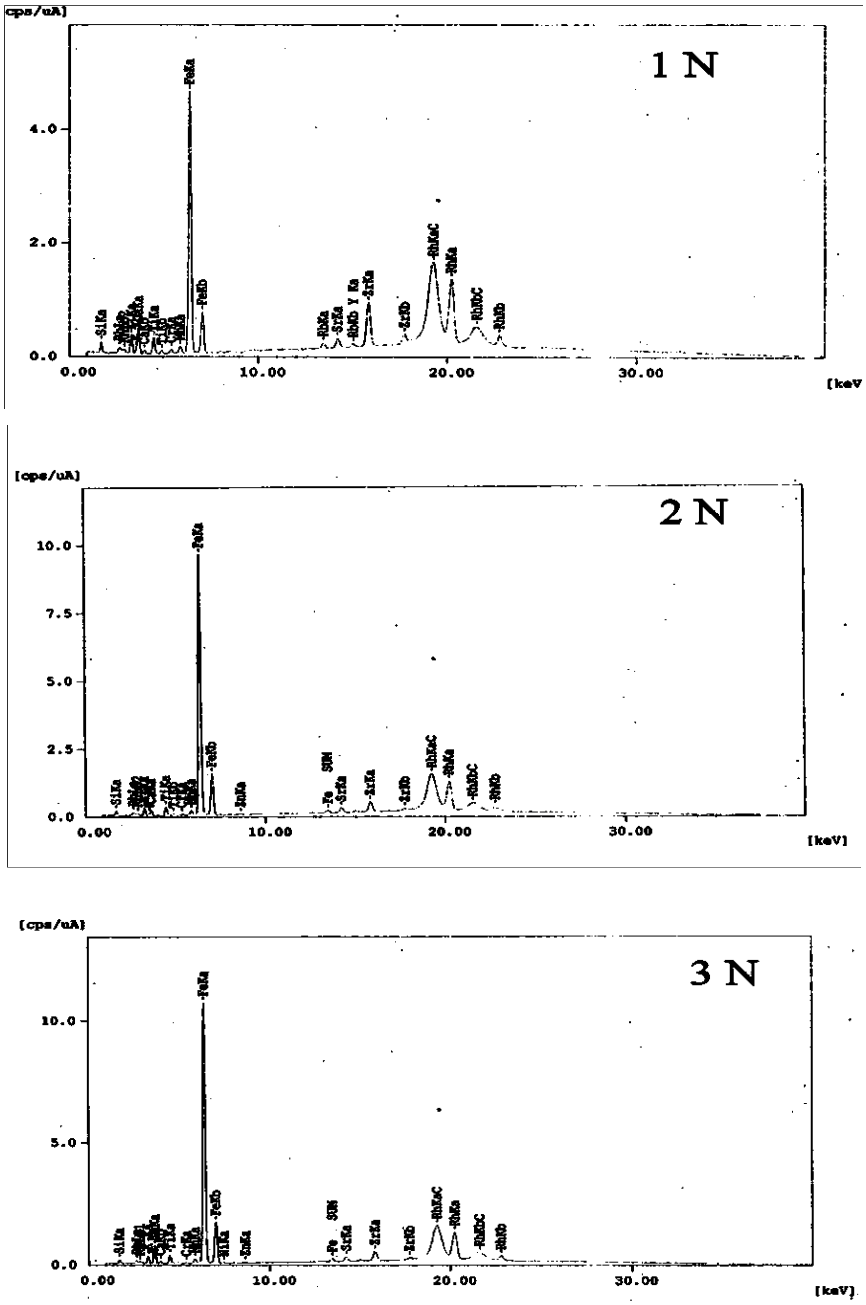


Figure 4. EDXRF spectra of natural clay samples

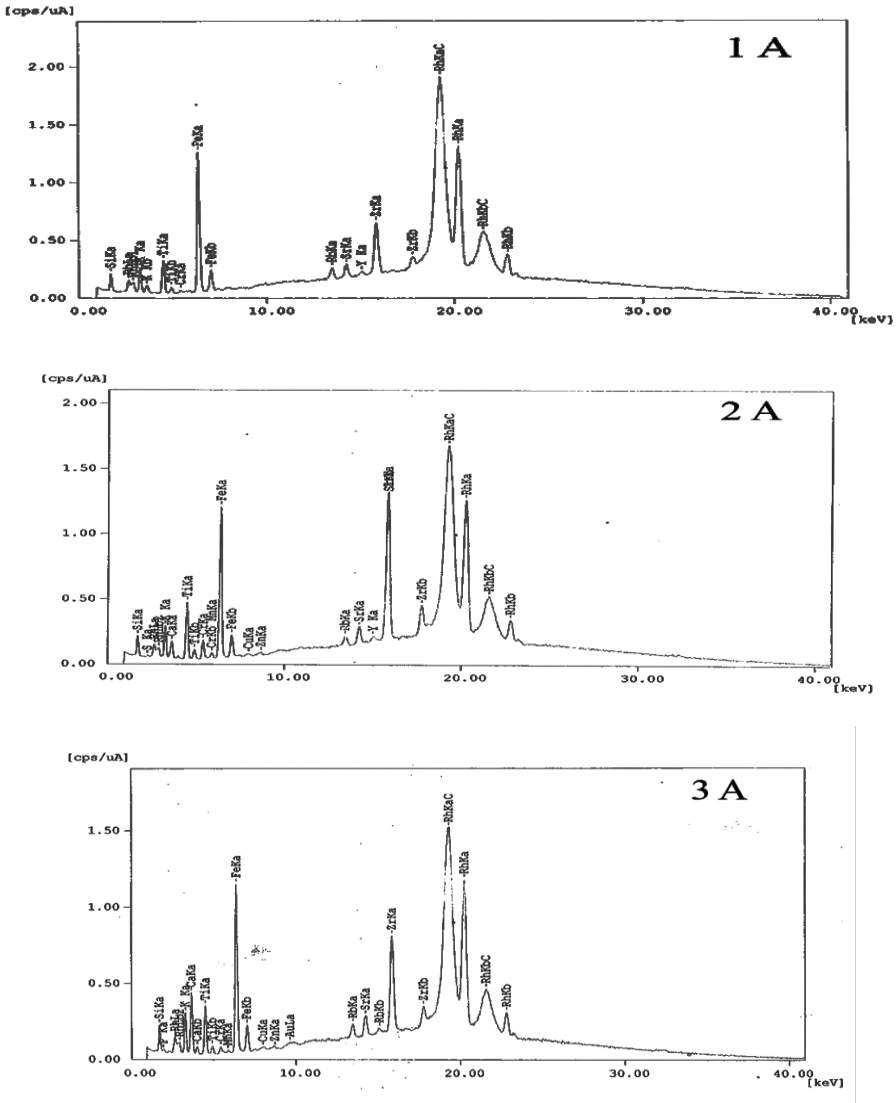


Figure 5. EDXRF spectra of acid activated clay samples

Table 2. Mineral composition of natural and acid activated clay samples

| Mineral (Relative abundance %) | Samples | | | | | |
|---|---|---|---|---|---|---|
| | 1N | 1A | 2N | 2A | 3N | 3A |
| Si | 63.594 | 76.467 | 58.552 | 70.555 | 51.755 | 64.549 |
| Fe | 14.576 | 6.105 | 27.405 | 5.297 | 28.631 | 4.543 |
| K | 9.036 | 11.499 | 7.163 | 10.233 | 6.105 | 9.797 |
| Ca | 8.175 | - | 2.974 | 3.977 | 9.521 | 9.434 |
| Ti | 2.759 | 4.472 | 2.437 | 5.988 | 2.437 | 4.037 |
| Zr | 0.630 | 0.475 | 0.345 | 1.068 | 0.332 | 0.518 |
| Mn | 0.512 | - | 0.630 | 0.122 | 0.638 | 0.076 |
| Cr | 0.445 | 0.199 | 0.218 | 1.192 | 0.220 | 0.307 |
| Sr | 0.146 | 0.123 | 0.192 | 0.137 | 0.171 | 0.199 |

**XRD Analysis of Clay Samples**

X-ray diffraction (XRD) technique is used to determine the mineralogical composition as well as the particle size distribution of the natural and acid activated clay samples. The XRD patterns of the natural clay samples (1N, 2N and 3N) and acid activated clay samples (1A, 2A and 3A) are shown in Figures 6 and 7. From peak ID report, it was observed the presence of quartz and trolleite in 1N, quartz, trolleite and scorzalite in 2N and 3N. After acid activation, presence of quartz in 1A quartz and scorzalite in 2A and quartz and trolleite in 3A was identified, indicating that quartz is resistant to acid attack.

The particle size of the natural and acid activated clay samples were determined by using Debye Scherrer equation and mentioned in Table 3. The particle sizes of the samples 1N, 2N and 3N were 79.52, 93.73 and 84.26 nm respectively. The particle sizes were decreased to 33.55, 63.10 and 77.60 nm when the samples were activated with HCl. It may be attributed that the acid activation caused the creation of new pores having lower diameter than those of the natural clays. The particle size distribution of the natural and activated clays showed the acid activation was strongly affected the particle size of the clays.

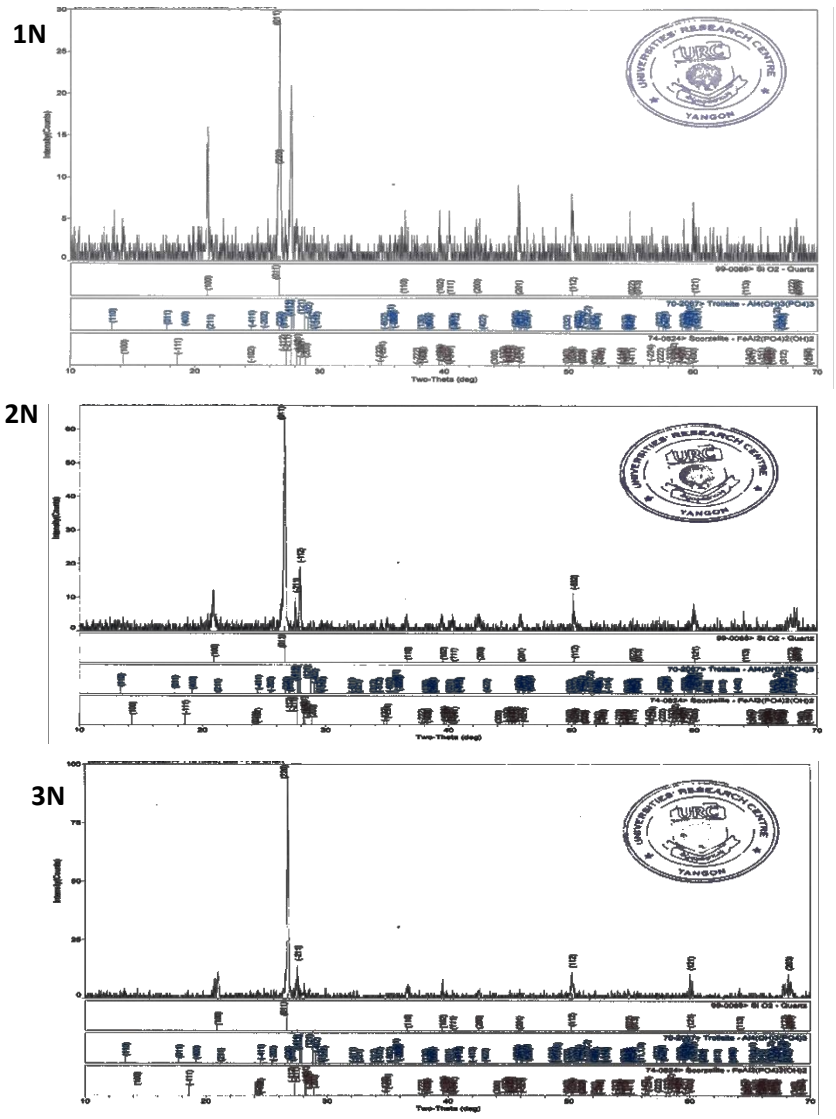


Figure 6. XRD patterns of natural clay samples

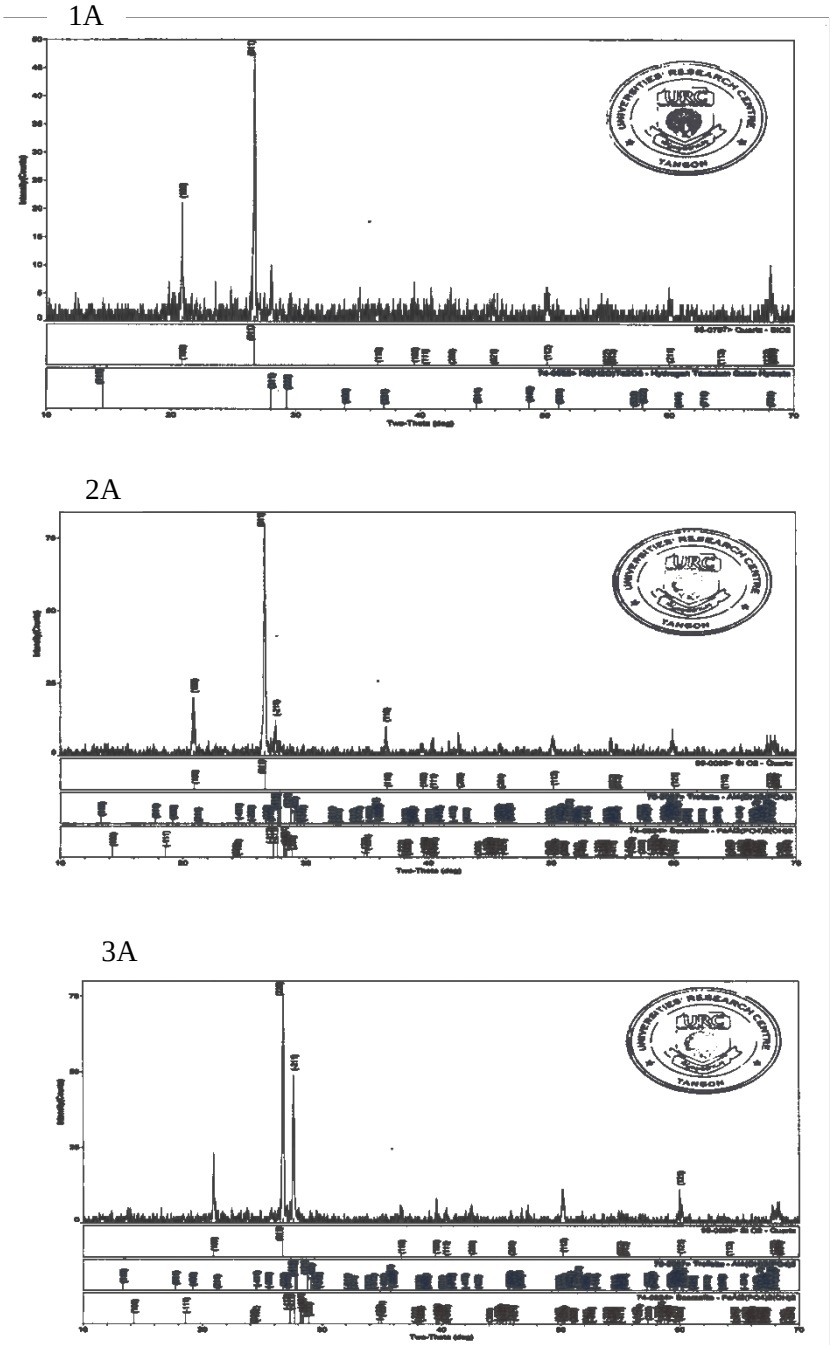


Figure 7. XRD patterns of acid activated clay samples

Table 3.Average crystalline grain sizes of natural and acid activated clay samples

| Sample | Average Crystalline Grain Size D (nm) |
|---|---|
| 1N | 79.52 |
| 1A | 33.55 |
| 2N | 93.73 |
| 2A | 63.10 |
| 3N | 84.26 |
| 3A | 77.60 |

**Bleaching Properties of Clay Samples**

The bleaching of edible vegetable oil involves the removal of a variety of impurities, which include phosphatides, fatty acids, gum, trace metals, etc., followed by decolourization (Foletto, *et al*., 2011). Bleaching process reduces colour pigments produced by compounds such as carotene, caroteniods, xanthophylls, and chlorophyll present in the oil to more acceptable levels (Salawudeen *et al*., 2014). It is generally thought to involve molecular-sieving properties, electrostatic-field strength interaction, catalytic action and equilibrium adsorption (Falaras, *et al*., 2000). The surface acidity, surface area and porosity, degree of acid activation and particle size of the clay play important roles in their bleaching activity (Taylor *et al*., 1989).

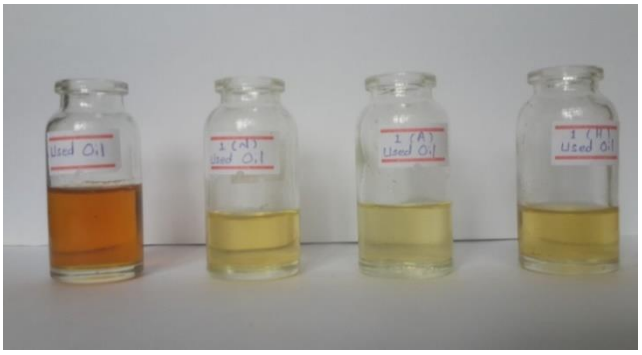


Figure 8. Colour reduction of used oil after bleaching with clay samples 1N, 1A and 1H

Figure 9. Colour reduction of used oil after bleaching with clay samples 2N, 2A and 2H

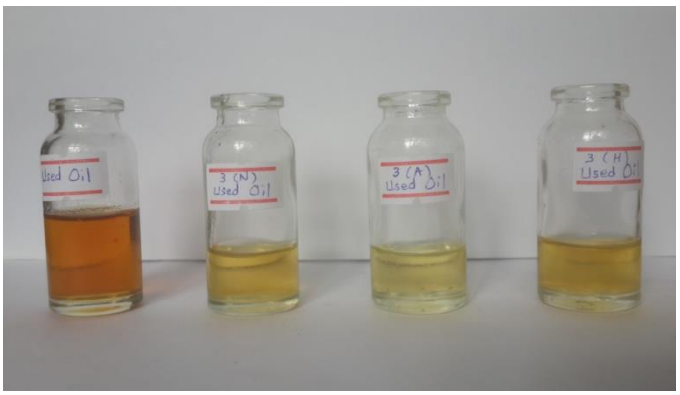


Figure 10. Colour reduction of used oil after bleaching with clay samples 3N, 3A and 3H

In present work, the used oil was bleached with different amounts (0.5g, 1.0g, 1.5g and 2.0g) of clay (1N). Although the bleaching ability increased from 0.5g to 1.0g of clay samples, colour reduction was not pronounced for further increase in clay dosage. Bleaching

capacity of various clay samples on used oil were studied and presented in Figures 8, 9 and 10. The acid activated clay samples show a slightly superior bleaching capacity than the natural clay samples. The improved performance as found in the acid-activated samples may be attributed to the improved physical characteristic such as pore size, particle porosity and increase surface area for adsorption as a result of leaching out of organic matters from the samples and impurities that cover part of the active sites are wash away by acid activation and the number of active site available for adsorption increased (Mustapha *et al*., 2013).

Bleaching capacity of various clay samples on sesame oil were also studied and shown in Figures 11, 12 and 13. Although the similar trend as the used oil was found, bleaching capacity was less pronounced towards the sesame oil than used oil. Bleaching capacity of heat activated samples was not significantly improved.

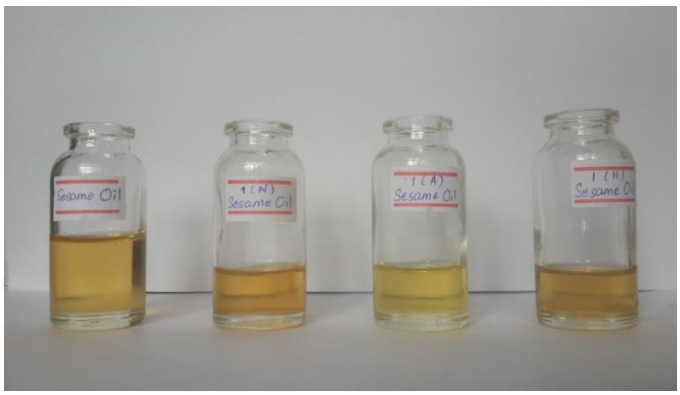


Figure 11. Colour reduction of sesame oil after bleaching with clay samples 1N, 1A and 1H

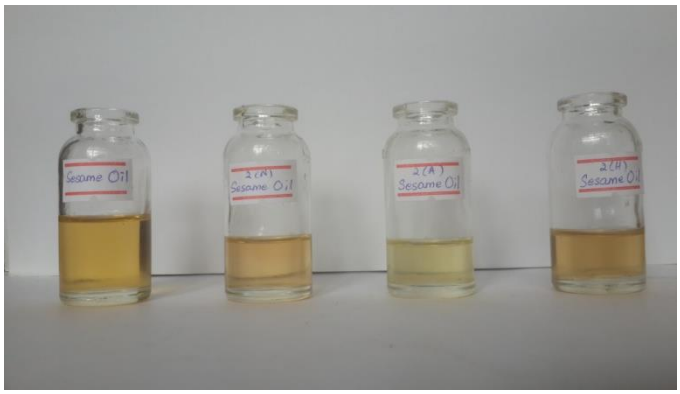


Figure 12. Colour reduction of sesame oil after bleaching with clay samples 2N, 2A and 2H

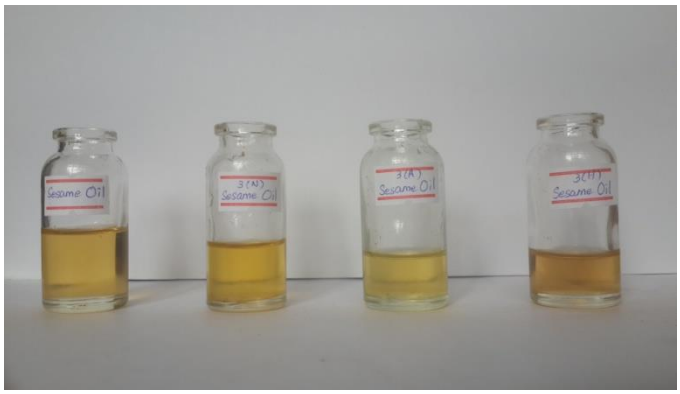


Figure 13. Colour reduction of sesame oil after bleaching with clay samples 3N, 3A and 3H

## Conclusion

Bleaching is an important process in vegetable oil refining process. It is well known that clay minerals can be used to decolourize oils because of its high adsorptive capacity. In order to enhance this adsorptive property, acid activation of clay is the most commonly used technique.

In the present research, physicochemical parameters of the raw or natural clay samples in Bago Township were determined. The pH values and moisture contents of the natural clay samples were found to be in the range of 7.32 to 7.60 and 2.12 to 5.03% respectively. And then natural clay samples were activated with 30% hydrochloric acid and heat separately.

Studies on surface morphology by SEM showed the acid activated clay samples were more porous and homogeneous than natural clay samples. From EDXRF spectrums, it was observed that Si is the most predominant mineral in natural and acid activated clay samples. After acid activation the relative abundance of Si was increased from 63.594, 58.552 and 51.755 in 1N, 2N and 3N to 76.467, 70.555 and 64.549 in 1A, 2A and 3A respectively. XRD patterns showed the presence of quartz and trolleite in 1N, quatrz, trolleite and scorzalite in 2N and 3N. The characteristic peaks corresponding to quartz were identified in all samples after acid activation due to the resistance of this mineral to acid attack. Particle sizes in nm were also decreased from 79.52, 93.73 and 84.26 in 1N, 2N and 3N to 33.55, 63.10 and 77.60 in 1A, 2A and 3A respectively.

Colour removal capacity of the natural clay samples were improved by acid activation. Colour reduction was more effective towards used oil than sesame oil and not significantly improved by heat activation. Consequently, it can be concluded that natural clay samples can be used with the advantage of bleaching of used oil via acid activation.

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# Seasonal Variation in Some Physicochemical Parameters of Water from the Renovated Mingalar Kan Taw Lake, Myeik

Mi Mi Lay[1], Aye Aye Mar[2], Min Aung[3], Sandar Win[4],Tun Oo[5]

## Abstract

In the present study, the seasonal variation of physicochemical parameters of water from the renovated Mingalar Kan Taw Lake, Myeik were studied from June 2018 to May 2020. Seasonal variation of physicochemical parameters such as pH, electrical conductivity, total dissolved solids, colour, turbidity, total hardness, total alkalinity, chloride contents, phosphate contents and nitrate-nitrogen contents were determined by conventional and modern techniques. Bacteriological parameters such as coliforms and *E.coli* for each water samples were also detected. The obtained values for each parameter were compared with the standard values set by the World Health Organization (WHO, 2011). According to the results, total dissolved solids, turbidity, total hardness, total alkalinity and chloride contents of water samples in all seasons were within the permissible values of WHO standard. Moreover, phosphate and nitrate-nitrogen contents of water samples were found to be very low concentrations because of the lack of eutrophication. The value of electrical conductivity in the hot season was higher compared with the WHO standard but coliforms and *E.coli*were not detected in water samples seasonally. Form standpoint of pH values, all water samples in all seasons were acidic medium as it may be based on acidified soil. Therefore, Mingalar Kan Taw lake water was not safe to drink but it can be used for domestic, industrial and agricultural purposes after treatment.

**Keywords:** Mingalar Kan Taw Lake water, physicochemical parameters, coliforms, *E.coli*

## Introduction

Water bodies come in many forms, huge oceans, large and small lakes and diversities of rivers and streams. Each of these ecosystems features a tapestry, of waterborne species that all depend upon a high degree of water quality (Chapman, 1992).

Waters for drinking and food preparation must be free from organisms capable of causing disease and from minerals and organic substances producing adverse physiological effects. To encourage man to drink this health-promoting liquid, the water must be aesthetically acceptable (Rodier, 1975).

In the period of Pe Taung Sar King, U Daung Min Lake was excavated. It is located in Myint Nge quarter, Myeik. Now, it is called as Yay Kan Baung Lake as well as Mingalar Kan Taw Lake. It is a historical lake through several increasing productivity stages undergo eutrophication, an ageing process. It ensues from the gradual accumulation of nutrients and sediment resulting in increased productivity and slow filling of the lake with silt and organic matter from the surrounding watershed. Over 200 years later, this lake was renovated in August 2017. It was created for drinking water, extinguishing fires, recreational purposes and

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landscaping scheme. Therefore, the present work was carried out to detect the water quality of the renovated Mingalar Kan Taw Lake for domestic use.

## Materials and Methods

The water samples were collected from the renovated Mingalar Kan Taw Lake, Myeik in July 2019 for the rainy season, in December 2019 for the cold season and in March 2020 for the hot season. The water samples were collected in clean plastic bottles. The bottles were filled completely and capped tightly. Samples were analyzed as soon as collection. The renovated Mingalar Kan Taw Lake is located in Myint Nge quarter, Myeik as shown in Figure 1.

Figure 1. Photograph of the renovated Mingalar Kan Taw Lake, Myeik

Water quality parameters can be classified as the physicochemical parameters such as alkalinity, BOD, COD, TDS, DO, pH, total solids, chloride, sulphate, nitrite, nitrate, etc., metallic constituents and microbiological quality, the measurement of pathogenic microorganisms.

To examine the water quality, two or more methods are available from the manuals for a parameter. However, a method may be suitable for a type of water (e.g. surface water) it may not apply to another type (e.g. wastewater) due to their fixed detectable concentration range. Therefore, the selection of method is important in water analysis. The methods used for this investigation are shown in Table 1.

Table 1 Methods used in determination of some physicochemical parameters of water from the renovated Mingalar Kan Taw Lake

| No. | Parameter | Method | Apparatus |
|---|---|---|---|
| 1 | pH | Direct measurement | pH meter (Hanna HI 9124) |
| 2 | Electrical conductivity | Direct measurement | Eutech CyberScan con 11 |
| 3 | Total dissolved solids | Direct measurement | Eutech CyberScan con 11 |
| 4 | Colour | Pt. Co. standard | Smart 3 colorimeter |
| 5 | Turbidity | Direct measurement (FAU) | Smart 3 colorimeter |
| 6 | Total hardness | Complexometric titration | |
| 7 | Total alkalinity | Acid base titration | |
| 8 | Chloride content | Argentometric titration | |
| 9 | Phosphate Content | Direct measurement | Smart 3 colorimeter |
| 10 | Nitrate nitrogen content | Direct measurement | Smart 3 colorimeter |
| 11 | Microbiological examination | MPN method | |

## Results and Discussion

### pH of Water Samples

In the present study, pH values of water samples were found to be 2.3 in the rainy season, 2.77 in the cold season and 2.63 in the hot season as shown in Table 2 and Figure 2. These results show that the water bodies of the study area were in the acidic medium. The permissible value of the WHO standard is 6.5-8.5. According to the WHO standard, water samples from the renovated Mingalar Kan Taw Lake do not agree with the permissible limits in all seasons. From the data, the water sample shows more acidic medium in the rainy season than that of in cold and hot seasons. This is usually due to not only the presence of organic matter (primarily humic and fulvic acids which are formed by the microbial degradation of dead plant matter) but also acid rain.

### Electrical Conductivity of Water Samples

In the present study, the electrical conductivity of water samples was found to be 985 **µ**S/cm in the rainy season, 1183 **µ**S/cm in the cold season and 1469 **µ**S/cm in the hot season as shown in Table 2 and Figure 3. The permissible value of the WHO standard is 1400 **µ**S/cm. According to the WHO standard, electrical conductivities of water samples in rainy and cold seasons fall within the permissible limits. Generally, electrical conductivity values of water samples in three seasons are high due to the presence of the high amount of salts of calcium and magnesium associated with sulphates, chlorides or nitrates (GWA, 2009).

### Total Dissolved Solids of Water Samples

In the present study, the total dissolved solids of water samples were found 494 ppm in the rainy season, 593 ppm in the cold season and 734 ppm in the hot season as shown in Table 2 and Figure 4. The permissible value of the WHO standard is 1000 ppm. According to the WHO standard, all water samples in three seasons fall within the permissible limits. Water sample in the hot season was observed higher total dissolved solids values than other seasons as the rate of chemical reaction generally increases and the concentration of substances in ionized forms increases (Meybeck, 1989).

### Colour of Water Samples

Many surface waters are coloured due primarily of decomposition of organic, metallic salts or coloured clays. High colour contains clay particles, sewage solids, silt and sand particles, organic and biological sludge. The colour of the water is extremely pH-dependent and variably increases as the pH of the water is raised. The data of colour of water samples show as 58 in the rainy season, 16 in the cold season and 32 in the hot season as shown in Table 2 and Figure 5. The permissible value of the WHO standard is 15. According to the WHO standard, colour values of all water samples were found above the permissible limits. The colour value of the water sample in the rainy season showed the highest value not only because of the presence of the high amount of colloidal substances but also because of some inorganic materials like acids, salts, nitrates and chlorine releasing from rocks by weathering (Meybeck,1989).

### Turbidity of Water Samples

From the data turbidity values of water samples were found to be 9.84 FAU in the rainy season, 0.97 FAU in the cold season and 2.84 FAU in the hot season as shown in Table 2 and Figure 6. The permissible value of the WHO standard is 5 NTU. According to the WHO standard, the turbidity value of the water sample in the rainy season was above the permissible limits but that of the remaining water samples fall within the permissible limits. It was indicated that the water body showed the suspended matters comprised of silt, clay, fine

particles of organic and inorganic matters. Moreover, it was found that the highest turbidity value of the water sample in the rainy season was confirmed by the highest colour number than those in other seasons (WHO, 2011).

**Total Hardness of Water Samples**

In the present study, the total hardness of water samples indicated 130 ppm in the rainy season, 240 ppm in the cold season and 278 ppm in the hot season as shown in Table 2 and Figure 7. The permissible value of the WHO standard is 500 ppm. According to the WHO standard, all water samples seasonally fall within the prescribed limits. In the hot season, the water sample showed the highest total hardness value than those in rainy and cold seasons which indicated that water sample in the hot season may be contaminated by dissolved salts of calcium and magnesium (Wurts, 2004).

**Total Alkalinity of Water Samples**

Acid-neutralizing ability in water was measured that is alkalinity. The main sources of natural alkalinity are rocks which contain carbonate, bicarbonate where the alkalinity exceeds the hardness; the basic salts, general sodium and potassium are present. If the alkalinity is less than the hardness, then salts of calcium and magnesium are present in association with sulphates, chlorides or nitrates. In the present work, the total alkalinity values of all water samples were not detected by titrimetric method seasonally as shown in Table 2. It can be concluded that all water samples seasonally cannot detect alkalinity because of very little of alkalinity value. The permissible value of the WHO standard is 120 ppm.

**Chloride Content of Water Samples**

According to the data, chloride contents of water samples were 13.59 ppm in the rainy season, 12.99 ppm in the cold season and 25.99 ppm in the hot season as shown in Table 2 and Figure 8. The permissible value of the WHO standard is 250 ppm. According to the WHO standard, chloride contents of water samples were found within the prescribed limits in all seasons. It was found that the chloride content of the water sample in the hot season showed the highest value of the others. This may be due to the more dissociation of natural minerals salts in the lake (e.g. sodium chloride and calcium chloride) in the hot season than that in the rainy and the cold seasons. Moreover, as all chloride contents seasonally showed very low concentration, that normally was not toxic. Otherwise, if it may become concentrate enough to lower water quality or adversely affect biological communities. Chloride concentration in water also indicated the presence of organic waste particularly animal origin (Nassema *et al.*, 2013).

**Phosphate Content of Water Samples**

In the present study, phosphate contents of water samples were 0.19 ppm in the rainy season, 0.09 ppm in the cold season, 0.05 ppm in hot season as shown in Table 2 and Figure 9. The permissible value of the WHO standard is 5 ppm. According to the WHO standard, the phosphate contents of water samples in all seasons were below the prescribed limits. Lower phosphate values of water samples seasonally were due to the lack of domestic sewage, detergents, agricultural effluents with fertilizers and industrial wastewater from the surrounding areas.

**Nitrate Nitrogen Content of Water Samples**

Inorganic nitrogen may be as free states as $N_2$ or nitrate, nitrite and ammonia forms. Nitrate reaction in water can cause oxygen depletion. Thus, aquatic organism depending on the supply of oxygen in the stream will die. Municipal and industrial wastewater, septic tanks, feedlots discharges, animal wastes (including birds and fish) and discharges from car

exhausts are the major routes of entry of nitrogen into the body of water. In the present study, nitrate contents of water samples were 0.03 ppm in the rainy season, 0.05 ppm in the cold season, 0.03 ppm in hot season as shown in Table 2 and Figure 10. The permissible value of the WHO standard is 50 ppm. According to the experimental data, the nitrate contents of water samples in all seasons were lower than the WHO standard. Lower nitrates were observed due to the decrease of degradation of organic matter by microbial activities, fertilizers and sewage.

**Coliforms and *E. Coli* Content in Water Samples**

In the present study, coliforms and *E.coli* were not detected in all water samples seasonally as shown in Table 3. The permissible value of WHO standard must not be detectable in any 100 mL sample (WHO, 2011).

Table 2 Seasonal fluctuation of the physicochemical properties of water samples from the renovated Mingalar Kan Taw Lake

| **No.** | **Properties** | **Rainy season** | **Cold season** | **Hot season** | **Permissible limit**, (WHO,2011) |
|---|---|---|---|---|---|
| 1 | Temperature (°C) | 30.3 | 30 | 29.1 | |
| 2 | pH | 2.3 | 2.77 | 2.63 | 6.5-8.5 |
| 3 | Colour (TCU) | 58 | 16 | 32 | 15 |
| 4 | Turbidity (FAU) | 9.84 | 0.97 | 2.84 | 5 |
| 5 | Electrical Conductivity (µS/cm) | 985 | 1183 | 1469 | 1400 |
| 6 | Total Dissolved Solid (ppm) | 494 | 593 | 734 | 1000 |
| 7 | Chloride (ppm) | 13.59 | 12.99 | 25.99 | 250 |
| 8 | Total Hardness (ppm) | 130 | 240 | 278 | 500 |
| 9 | Total Alkalinity (ppm) | ND | ND | ND | 120 |
| 10 | Nitrate Nitrogen (ppm) | 0.03 | 0.03 | 0.05 | 50 |
| 11 | Phosphate (ppm) | 0.19 | 0.09 | 0.11 | 5 |

Table 3 Coliforms and *E. coli* in water samples

| **Sampling Site** | **Coliforms** | ***E. coli*** |
|---|---|---|
| | **(cfu/mL)** | ***(*cfu/mL*)*** |
| Mingalar Kan Taw Lake | 0 | 0 |

The WHO standard- Must not be detectable in any 100 mL sample (WHO, 2011)

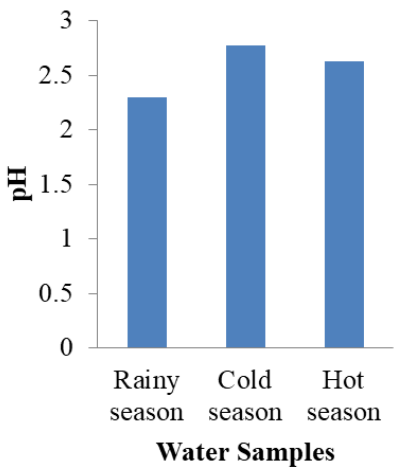


Figure 2 Seasonal variation of pH in water samples

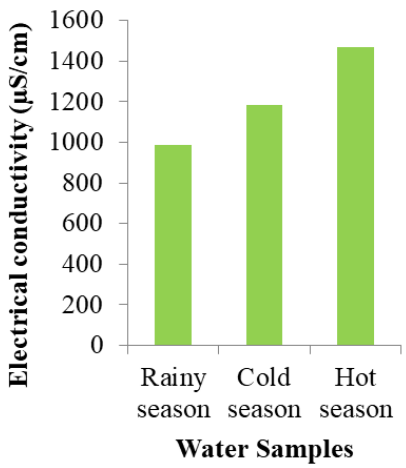


Figure 3 Seasonal variation of electrical conductivity in water samples

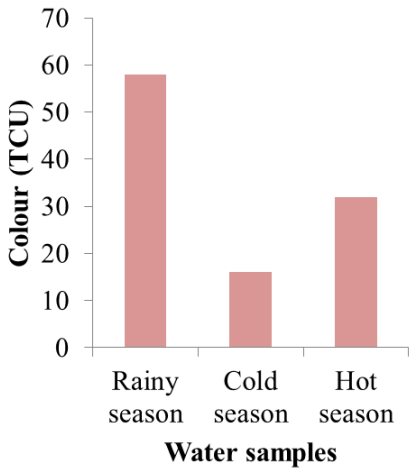


Figure 4 Seasonal variation of total dissolved solid in water samples

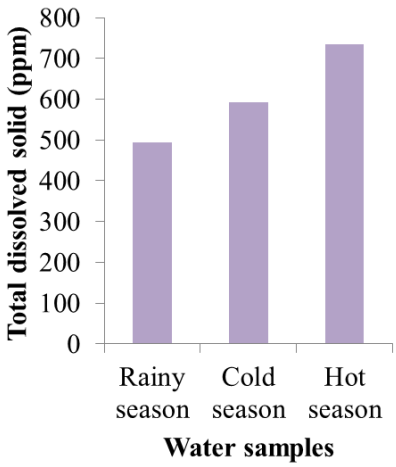


Figure 5 Seasonal variation of colour in water samples

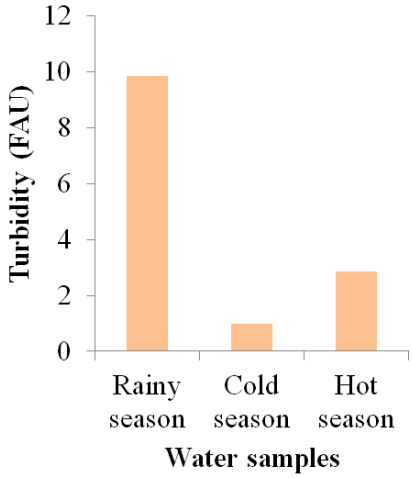


Figure 6 Seasonal variation of turbidity in water samples

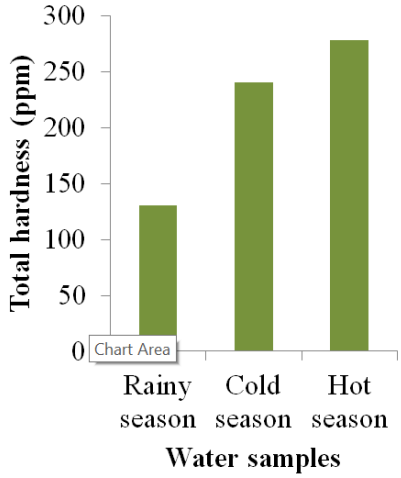


Figure 7 Seasonal variation of total hardness inwater samples

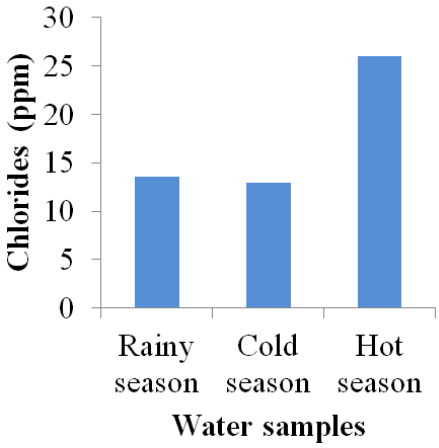


Figure 8 Seasonal variation of chloride content in water samples

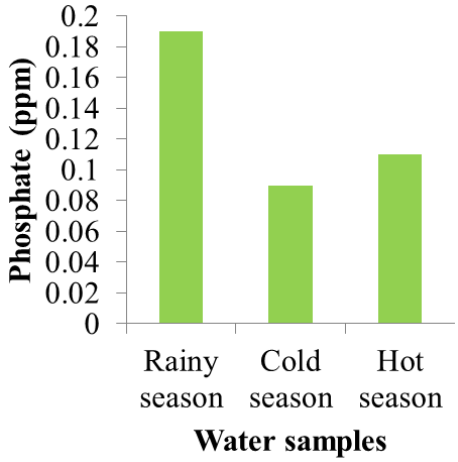


Figure 9 Seasonal variation of phosphatecontent in water samples

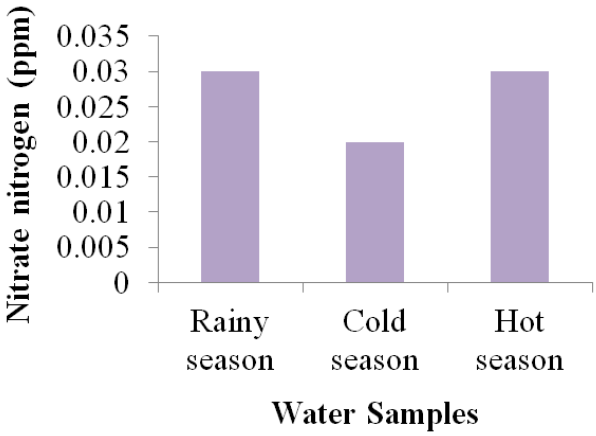


Figure 10 Seasonal variation of nitrate-nitrogen content in water samples

## Conclusion

According to the data, Minglar Kan Taw Lake water was acidic medium at ambient temperature in all seasons. Besides, the colour values of water samples were seasonally higher than that of the WHO standard. Moreover, values of electrical conductivity in the hot season were found the highest of all other seasons. Higher values of conductivity show higher concentrations of dissolved ions by the incidence of suspended particles such as clay, silt and finely divided organic matter. Also, phosphate and nitrate-nitrogen contents of water samples were found to be very low concentrations because of the lack of aquatic plants (algae), the intrusion of sewage and agricultural areas around the lake.

Some physicochemical parameters such as total dissolved solids, turbidity, total hardness, total alkalinity and chloride contents of water samples were seasonally within the permissible values of WHO standard. Coliforms and *E.coli* were not detected in all water samples. Therefore, it can be concluded that Mingalar Kan Taw Lake water was not safe to drink but it can be used for domestic, industrial and agricultural purposes after treatment. At present, Mingalar Kan Taw Lake water can be used in extinguishing fires.

## Acknowledgements

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We would like to express our sincere gratitude to Professor and Head Dr Myint Myint May, Professor Dr Thi Thi Aye and Professor Dr Kyaw Zan Aung, Department of Chemistry, Myeik University, for their kind provision of the research facilities.

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# Extraction and Characterization of Cellulose from Pineapple Leaf Fiber

Ohnmar Shwe[1], Myint Myint May[2], Khwar Nyo Zin[3]


## Abstract

Natural cellulose fibers are byproducts of agricultural crops which are inexpensive, abundant, annually renewable, and sustainable sources. In this research, cellulose was extracted from pineapple leaf, agriculture waste. Cellulose was prepared from pineapple leaf fiber by acid hydrolysis. Then, extracted cellulose was activated by using 5 % v/v sulphuric acid. Some physicochemical properties such as moisture content, ash content, pH, bulk density and surface area of the extracted cellulose (EC) and acid treated cellulose (ATC) were determined. The solubility of the extracted cellulose (EC) and acid treated cellulose (ATC) was determined by using different organic and inorganic solvents. The extracted cellulose (EC) and acid treated cellulose (ATC) were characterized by modern techniques such as XRD, EDXRF, FT IR, and SEM analyses.


**Key words:** Cellulose, Pineapple leaf, Acid hydrolysis, Modern techniques

## Introduction

Cellulose (Figure 1) is an organic compound with the formula $(C_6H_{10}O_5)_n$, a polysaccharide consisting of a linear chain of several hundred to many thousands of β (1→ 4) linked D-glucose units. Cellulose is an important structural component of the primary cell wall of green plants, many forms of algae and the oomycetes. Cellulose that is extracted from plants is referred to as native cellulose.

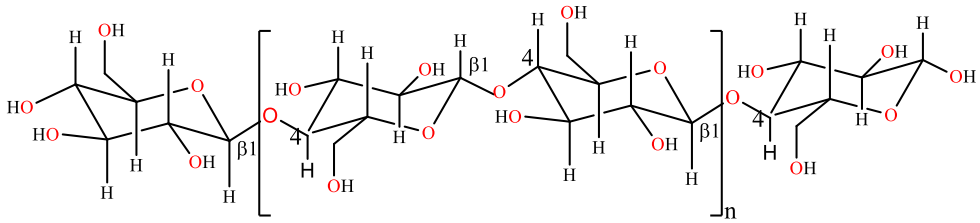

Figure 1. Structure of cellulose

Cellulose has no taste. It is odorless, hydrophilic, insoluble in water and most organic solvents, chiral and biodegradable. Cellulose can be broken down chemically into its glucose units by treating with concentrated mineral acids at high temperature. Compared to starch, cellulose has also much more crystalline nature. Several different crystalline structures of cellulose are known, corresponding to the location of hydrogen bonds between the strands (Langan *et al.*, 1999). Pineapple leaf fiber is the potential sources of cellulose. It contains $\alpha$-cellulose with a composition of 98.63% (Kendri *et al.*, 2016). In spite of its poor solubility characteristics, cellulose is used in a wide range of applications including composites, netting, upholstery, coatings, packing, paper etc. A great numbers of cellulose are used in different industries. So, the researchers are trying to focus on the production of cellulose from different natural fibers (Bartholomew, 2009). Each method of production possesses different advantages and drawbacks related to the amount or quality of cellulose (composition and final properties).

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This research work concerns with the preparation of cellulose and acid treated cellulose from pineapple leaf, determination of their physicochemical properties, and identification of these cellulose. Firstly, pineapple leaf was collected from Myeik University Campus. Cellulose was prepared from pineapple leaf fiber by acid hydrolysis using nitric acid. Then, acid treated cellulose was prepared using sulphuric acid. The physicochemical properties such as moisture content, ash content, pH, bulk density and surface area of the extracted cellulose and acid treated cellulose were also determined. The extracted cellulose and acid treated cellulose were identified by XRD, FT IR, SEM and EDXRF analyses.

## Materials and Methods

### Sample Collection of Pineapple Leaf

Pineapple leaves were collected from Myeik Township, Tanintharyi Region. The samples were collected during December 2018. The collected pineapple leaves were washed with distilled water to remove dust and impurities and then were chopped. They were dried in the drying cabinet and grounded by blender to obtain the fiber samples (Figure 2).

### Identification of Pineapple Leaf

The collected pineapple leaf was identified at the Department of Botany, Myeik University.

Scientific Name = *Ananas comosus* (L.) Merr.

Myanmar Name = Nanat

English Name = Pineapple Leaf

Family = Bromeliaceae

**(a)** **(b)** **(c)**

Figure 2. Photographs of (a) pineapple plant (b) pineapple leaf and (c) pineapple leaf fiber

### Preparation of Cellulose from Pineapple Leaf Fiber (PALF)

100 g of pineapple leaf fiber was weighed and mixed with 1.4 L of 3.5 % nitric acid ($HNO_3$) and 15 mg of sodium nitrite ($NaNO_2$).The mixture was placed in a beaker and then heated in a water bath at 90 ℃ for 2 h and the residue was added to 1 L of 2 % sodium hydroxide solution and 1 L of 2 % sodium sulfite. This mixture was heated at 50 ℃ for 1 h, filtered and bleached with 1.2 L of 3.5 % sodium hypochlorite (NaOCl) and 1.2 L of water (1:1) and then boiled for 10 min. The mixture was washed with water until clear filtrate, filtered and squeezed, and then dried at 60 ℃ in an oven to obtain cellulose. The dried sample was weighed and the yield percent was calculated.

**Preparation of acid treated cellulose from extracted cellulose by acid hydrolysis**

The dried cellulose (5 g) was weighed and this sample was immersed in 5 % sulphuric acid for 30 min, the sample was filtered. The resultant acid treated cellulose was washed several times with distilled water to obtain neutral pH. The sample was dried at 60 ℃ in oven for 6 h. The yield percent of obtained acid treated cellulose was calculated.

**Determination of Physicochemical Properties of Extracted Cellulose (EC) and Acid Treated Cellulose (ATC)**

Some physicochemical properties of extracted cellulose such as moisture content, ash content, pH, bulk density, and surface area were determined. The moisture content was determined by moisturizer (MOC 63u). The ash content was determined by using a Muffle furnace. The pH value was measured by pH meter and bulk density was determined by10 mL graduated cylinder and tapping box. The surface area of extracted cellulose was determined by the adsorption method.

**Characterization of Extracted Cellulose (EC) and Acid Treated Cellulose (ATC)**

The nature of the extracted cellulose and acid treated cellulose was characterized by X-ray diffractometer (XRD). The chemical constituents of the extracted cellulose and acid treated cellulose were confirmed by EDXRF analysis. The organic functional groups of the cellulose samples were identified by FT IR analysis, and the surface morphology of the prepared samples was characterized by SEM analysis.

## Results and Discussions

**Preparation of Cellulose from Pineapple Leaf Fiber**

In this research work, cellulose was prepared from pineapple leaf fiber by using the sodium hypochlorite solution to bleach the sample; sodium hydroxide was used for alkali treatment to remove lignin and hemicellulose. Nitric acid breaks down the hydrogen bonding and reduces the size of the chain. Then, acid treated cellulose was prepared using extracted cellulose (EC) and sulphuric acid by acid hydrolysis. The yield percent of extracted cellulose (EC) and acid treated cellulose (ATC) are 24.5 % and 25.1% respectively. The appearance of the extracted cellulose (EC) and acid treated cellulose (ATC) are shown in Figure 3.

**(A)** **(B)**

Figure 3. Appearance of (A) extracted cellulose and (B) acid treated cellulose

**Physicochemical Properties of Extracted Cellulose**

Some physicochemical properties of extracted cellulose and acid treated cellulose were shown in Table 1. It was found that acid treated cellulose (ATC) has higher moisture content and lower ash content than that of extracted cellulose (EC). The extracted cellulose

(EC) has slightly basic character but acid treated cellulose (ATC) has slightly acidic character. It was also found that acid treated cellulose (ATC) has higher bulk density than that of extracted cellulose (EC).

Table 1. Some physicochemical properties of extracted cellulose (EC) and acid treated cellulose (ATC)

| **Samples** | **Moisture (%)** | **pH** | **Ash (%)** | **Bulk density (g cm$^{-3}$)** | **Surface area (m$^2$g$^{-1}$)** |
|---|---|---|---|---|---|
| EC | 3.75 | 7.63 | 1.53 | 0.08 | 37.25 |
| ATC | 4.09 | 6.46 | 1.18 | 0.17 | 43.83 |

**Solubility of Extracted Cellulose and Acid Treated Cellulose**

The solubility of prepared samples (extracted cellulose and acid treated cellulose) was determined by dissolution method using various organic and inorganic solvents. According to the solubility test, prepared samples (extracted cellulose and acid treated cellulose) are insoluble in water, most organic solvents and inorganic solvents.

**Characterization of Extracted Cellulose and Acid Treated Cellulose**

The extracted cellulose and acid treated cellulose were characterized by modern techniques such as XRD, EDXRF, FT IR, and SEM.

X-ray Diffraction (XRD) Analysis

The diffractogram of XRD markedly shows the nature of the cellulose sample. Figure 4 and Figure 5 show the XRD diffractogram of extracted cellulose and acid treated cellulose. Two main peaks were observed from the XRD patterns and 2θ values are about 15 and 22. It is agreed with the literature reference of cellulose peak. According to the XRD pattern of cellulose samples, it was observed that extracted cellulose and acid treated cellulose have the semicrystalline nature.

Energy Dispersive X-rays Fluorescence (EDXRF) Analysis

The chemical constituents of extracted cellulose (EC) and acid treated cellulose (ATC) were detected by using EDXRF analysis.

According to the EDXRF spectra of extracted cellulose (EC) and acid treated cellulose (ATC), hydrocarbon was the main component and others were trace constituents. It was observed that extracted cellulose (EC) contained sulphur as impurity in trace amount which can cause the degradation of cellulose. But in the acid treated cellulose (ATC), sulphur was not detected. The results are shown in Figures 6 and 7 and the resultant data are presented in Table 2.

Fourier Transform Infrared (FT IR) Analysis

According to the FT IR spectra (Figure 8 and Figure 9), the characteristic peaks of cellulose were observed in both samples. The characteristic peaks of cellulose are (3336, 3337 cm$^{-1}$) due to the OH stretching, (2904, 2901 cm$^{-1}$) due to the CH stretching, (1634, 1640 cm$^{-1}$) due to the C-O-C stretching, (1054, 1053 cm$^{-1}$) due to the C-O-C symm:

stretching , (1031, 1030 $cm^{-1}$) due to the C-O stretching and 897 $cm^{-1}$ associated with the cellulosic β glycosidic linkage respectively (Table 3).

Scanning electron microscopic (SEM) analysis

Scanning electron microscopy has been used for the characterization of the extracted cellulose. According to the SEM micrographs, the extracted cellulose and acid treated cellulose were found to have fibrous nature.

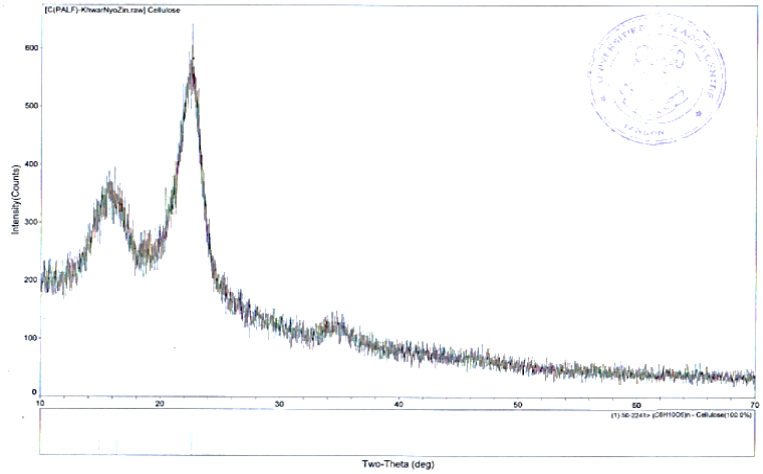



Figure 4. XRD diffractogram of extracted cellulose from pineapple leaf

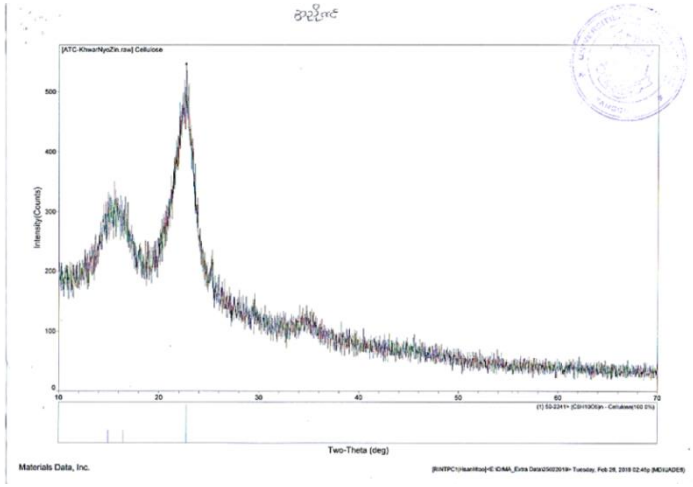



Figure 5. XRD diffractogram of acid treated cellulose (ATC)

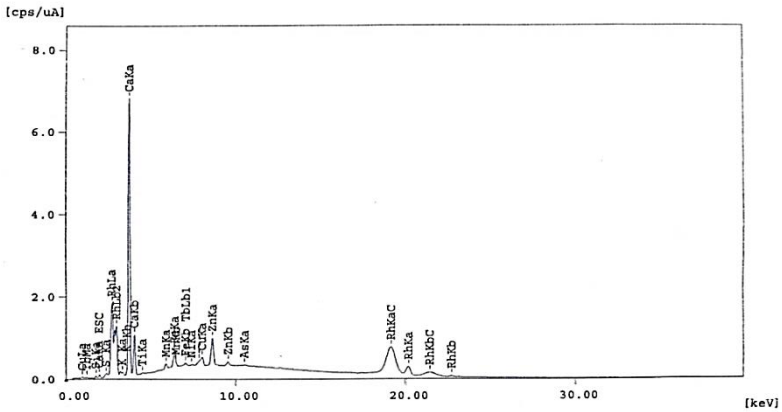



Figure 6. EDXRF spectrum of extracted cellulose from pineapple leaf

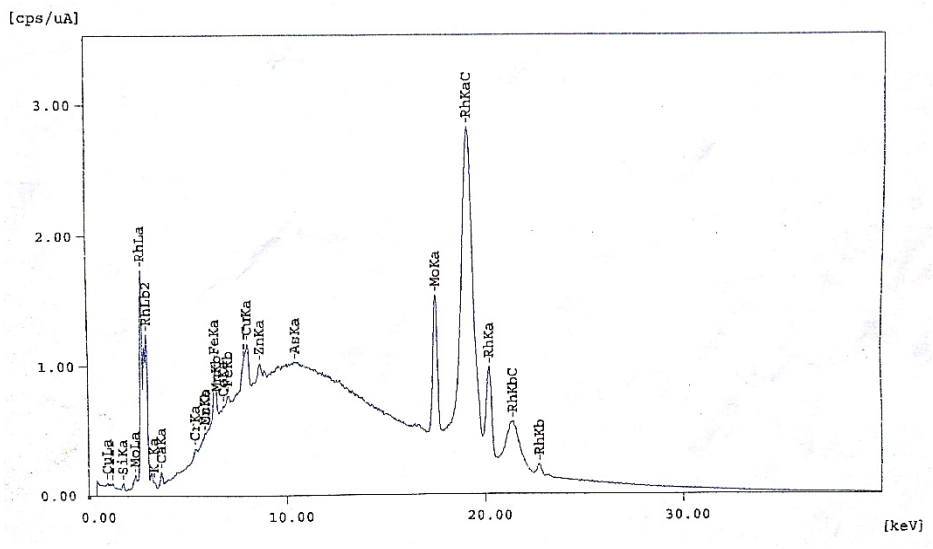



Figure 7. EDXRF spectrum of acid treated cellulose (ATC)

Table 2. Relative abundance of constituent elements in EC and ATC

| **Constituent elements** | **Relative abundance (%)** | |
|---|---|---|
| | **EC** | **ATC** |
| Ca | 0.277 | 0.004 |
| Si | 0.209 | 0.197 |
| S | 0.037 | - |
| K | 0.004 | 0.004 |
| Fe | 0.002 | 0.002 |
| Zn | 0.001 | 0.000 |
| Mn | 0.001 | 0 |
| Cu | 0.001 | 0.001 |
| Ti | 0.000 | - |
| Ni | 0.000 | - |
| Mo | - | 0.002 |
| Co | - | 0.000 |
| CH | 99.468 | 99.789 |

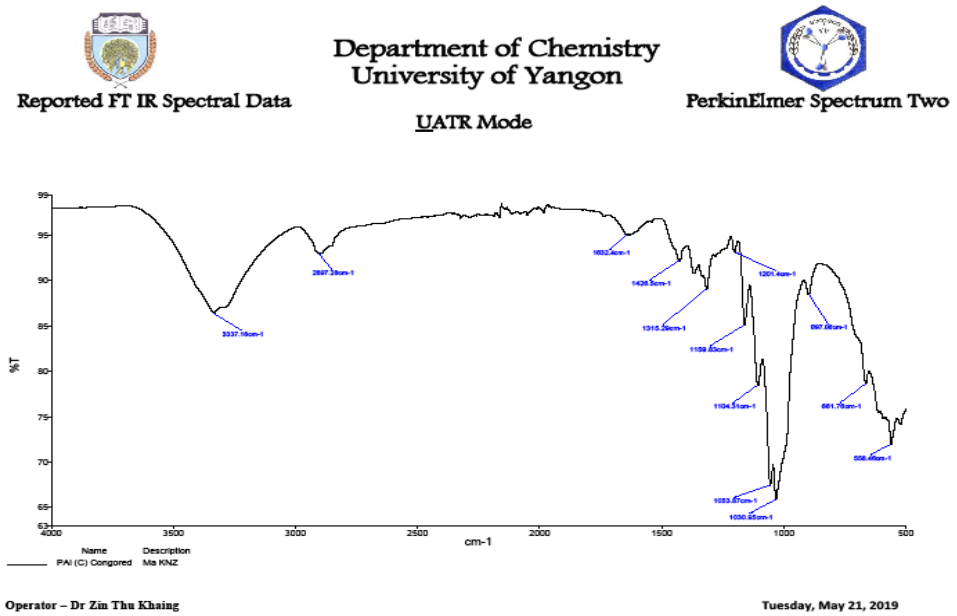



Figure 8. FT IR spectrum of extracted cellulose from pineapple leaf

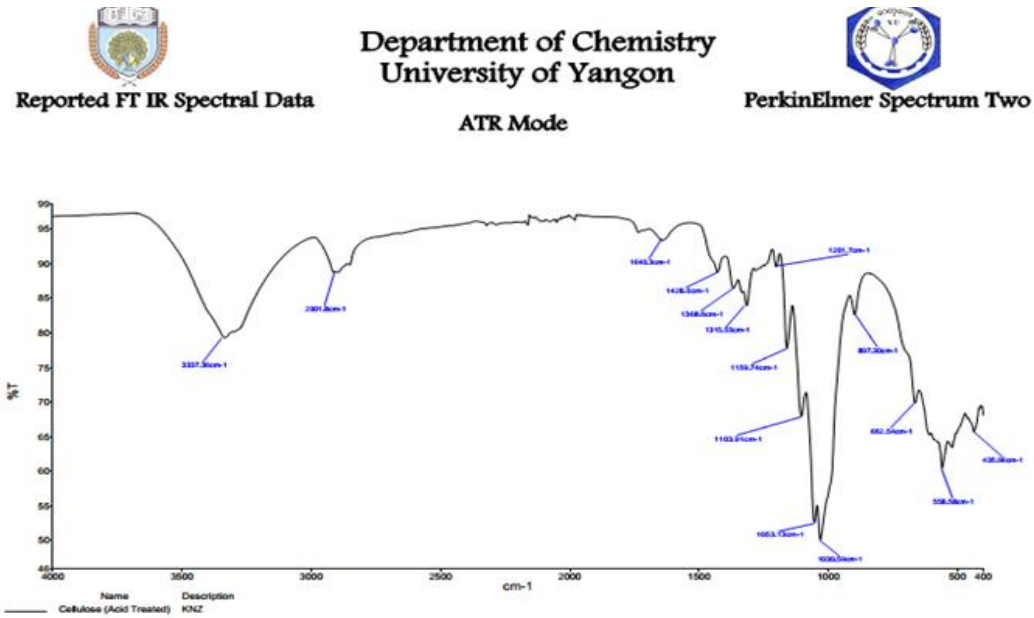
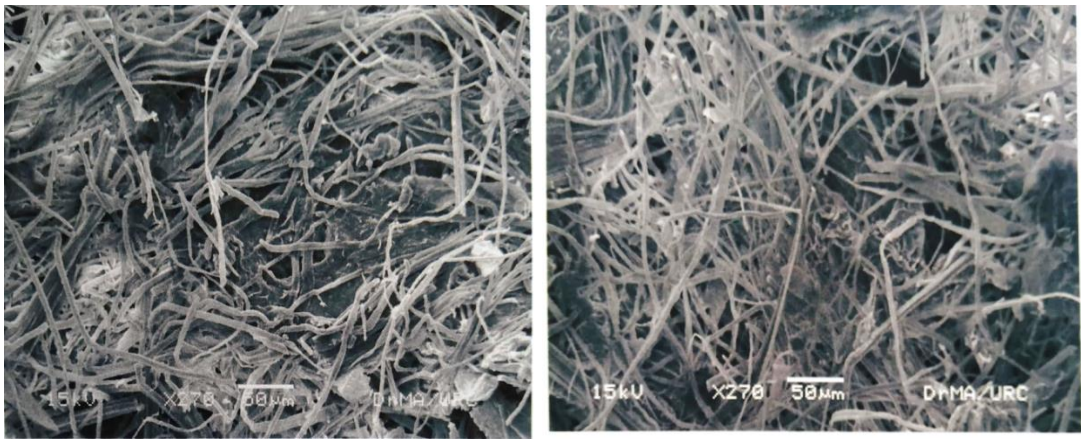



Figure 9. FT IR spectrum of acid treated cellulose (ATC)

Table 3. FT IR band assignment of extracted cellulose and acid treated cellulose

| **Observed wave number ($cm^{-1}$)** | | ***Literature wave number ($cm^{-1}$)** | **Band assignment** |
|---|---|---|---|
| **EC** | **ATC** | | |
| 3336 | 3337 | 3400-3200 | O-H stretching |
| 2904 | 2901 | 2990-2850 | C-H stretching |
| 1634 | 1640 | 1650-1550 | O-H bending |
| 1428, 1369 | 1428,1368 | 1450-1430 | $CH_2$ scissoring |
| 1315 | 1315 | 1390-1310 | C-O-H deformation |
| 1159 | 1159 | 1160-1120 | C-OH stretching |
| 1104 | 1103 | 1140-1100 | C-O-C sym: stretching |
| 1054 | 1053 | 1065-1015 | C-O stretching |
| 1031 | 897 | 1045-1015 | C-H in plane bending |
| 897 | 662 | 970-800 | C-C-O sym: stretching |
| 665 | - | 900-650 | CH out of plane deformation |

* Silverstein and Terence,1991




**(A)** **(B)**

Figure 10. SEM micrographs of (A) extracted cellulose (EC) and (B) acid treated cellulose (ATC)

## Conclusion

In this research, cellulose is extracted from pineapple leaf fiber using hypochlorite bleaching, alkali treatment and acid hydrolysis. There was slightly removal of lignin and hemicellulose during the extraction process with acid and alkali hydrolysis. Then, the lignin and hemicellulose were significantly removed after the bleaching process. Extracted cellulose (EC) was activated using 5 % (v/v) sulphuric acid. The yield percent of extracted cellulose (EC) and acid treated cellulose (ATC) were 24.5 % and 25.1 % respectively.

The physicochemical properties such as moisture content, ash content, pH, bulk density and surface area of extracted cellulose (EC) and acid treated cellulose (ATC) were determined. It was observed that acid treated cellulose (ATC) has more moisture content than extracted cellulose (EC) but extracted cellulose has more ash content. The pH value of EC was slightly basic character (7.63) and ATC was slightly acidic character (6.43). The bulk density and surface area of ATC was higher than that of EC. It was observed that the greater the bulk density, the more porosity of the sample and the larger the surface area of the sample.

According to the solubility test, both extracted cellulose (EC) and acid treated cellulose (ATC) are insoluble in water, most organic solvents and inorganic solvents.

According to the XRD diffractograms, EC and ATC have semi-crystalline nature. It was observed that the EC in this study was almost pure. From the EDXRF analysis, it was observed that EC contained sulphur as impurity in trace amount which can cause the degradation of cellulose. But in the acid treated cellulose (ATC), sulphur was not detected.

From the FT IR spectra, the functional groups of cellulose were observed in both samples (EC and ATC). The characteristic absorption band of O-H stretching, C-H stretching, O-H bending, C-O-C stretching and C-O stretching vibrations were observed in the FT IR spectra of extracted cellulose (EC) and acid treated cellulose (ATC).

The SEM micrographs of EC and ATC showed the same morphological textures of fibrous nature.

In this research, the very useful cellulose was successfully extracted from pineapple leaf fiber. The extracted cellulose will be used in the treatment of wastewater in future works because of its adsorption character.

## Acknowledgements

We would like to express our profound gratitude to Dr Ni Ni Oo, Rector, Myeik University and Dr Win Win Than, Pro-Rector, Myeik University, for their kind encouragement. We would like to express our thanks to Dr Myint Myint May, Professor and Head, Department of Chemistry, Myeik University, and Dr Kyaw Zan Aung, Professor, Department of Chemistry, Myeik University, for their valuable suggestion on this research paper and for their encouragement and provision of the Department facilities. Special thanks are extended to Dr Thi Thi Aye, Professor, Department of Chemistry, Hinthada University for her effective suggestion. We also wish to thank our colleagues and all persons who directly or indirectly contributed towards the successful accomplishment of this research paper.

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# A Comparative Study on Nutritional Values and Mineral Contents of Clams *(Meretrix)* from Different Locations (Kyun Su and Palaw Areas) in Tanintharyi Region

Tun Oo[1], Hnin Mya[2], Nway Shwan Oo[3]

## Abstract

This research deals with the comparative study of nutritional values and mineral contents of clams (*Meretrix)* from different locations (Kyun Su and Palaw areas) in the Tanintharyi Region, Myanmar. pH values of clam samples were determined by pH meter. The nutritional values such as moisture, ash, crude protein, crude fiber, fat, and carbohydrate of clams were determined by AOAC methods. Thus, elemental analysis by EDXRF showed that sulfur is present as a major element in the clam. According to these data, a higher amount of proteins and sulfur were observed in both samples. Protein in the clam is a compound that contained sulfur. Sulfur including protein such as methionine, homocysteine, cysteine, and taurine may be present in clams.

**Keywords:** Clams, pH,Nutritional values, EDXRF

## Introduction

Clams are great potential for food resources because of their high productivity, natural abundance, and worldwide distribution. They are commercially harvested as a human food resource due to its dense and fast growth. The clams were most often encountered on the beaches of mixed sand, gravel, and mud substrates. They were usually found in greatest abundance on the beach, especially stream channels or freshwater seepage through the beach.

Clam is one of the highly valued fishery resources in Myanmar. In Myanmar, they were found along the Tanintharyi coastal region, especially Dawei, Palaw, Myeik, Kyun Su, Bokpyin, and Kawthaung area. It was found abundantly in the Myeik district area, especially in Kyun Su and Palaw areas. Myeik district area is diverse of freshwater, marine, and estuarine fauna and flora resources. Among them, clams are considered as one of the high productivity of nutritional value and they have been traditionally eaten by many local people. So, it is a well-known seafood.

Seafood is a superb supply of protein with high biological value. Fish, shellfish, and other aquatic organisms are appropriate for the food. They are glorious sources of top quality proteins superior to those in red meat and poultry foods. Seafood in the diets has long been considered to provide health benefits and has the emphasis moved from ‘low fat, low calories and high protein' two different positive effects, such as prevention of blood clotting, make platelets less "sticky" and make red blood cell less rigid. It is promoting healthy diets. It also offers the most cost-effective protein as well as alternative nutrients for normal people (Bojan, 2003).

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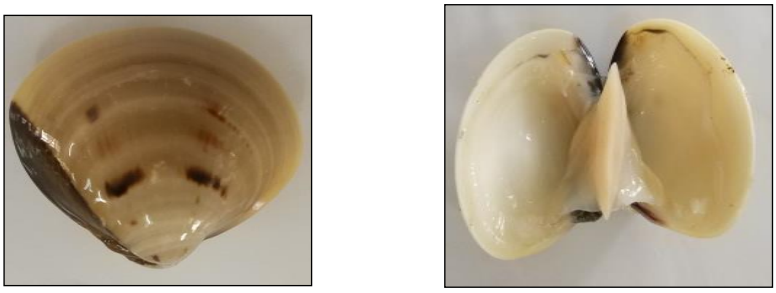
[3] Lecturer, Department of Chemistry, Myeik University

The zoological aspects are as follows:

| | |
|---|---|
| Phylum | : Mollusca Linnaeus |
| Class | : Bivalvia |
| Order | : Eulamellibranchia |
| Family | : Veneridae |
| Genus | : *Meretrix* |
| Species | : *M. meretrix* |
| Common Name | : Hard Clam |
| Local Name | : Shut |



(a) (b)

Figure 1. Photographs of (a) clam (b) fleshy part

In the present study, pH value, nutritional and mineral contents in clams (*Meretrix)* from different locations (Kyun Su and Palaw areas) were studied.

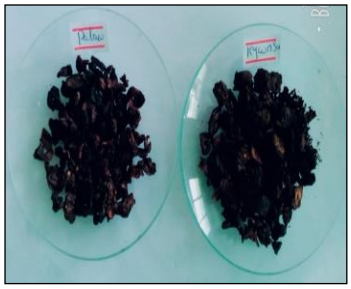
The objectives of this research work comprise the following:

- To collect the clam samples from Kyun Su and Palaw areas
- To determine the pH values of clams
- To determine the nutritional values in clams
- To analyze some elements in the sample by using EDXRF analysis

## Materials and Methods

The clams were collected from Kyun Su and Palaw areas in the Tanintharyi Region in June 2017. The collected samples were cleaned by washing with deionized water and air-dried at ambient temperature for two weeks. The air-dried samples were ground into powder using grinding mill and stored separately in an airtight container to prevent the moisture and other contaminations.

**(a)** **(b)** **(c)**



**(d)**

**(e)**

**(f)**

Figure 2. Preparation of samples (a) Clams (b) extracting of fleshy part from the shell (c) pure samples (d) dried samples (e) heating the samples by hot plate (f) pounded the samples for analysis

**Determination of pH Value of Clam Sample**

The powdered clam samples (*ca*.0.5g) was placed into a pyre 100 mL beaker and 50 mL of distilled water were added. The content of the beaker was heated at 80ºC for 30 min. The beaker and contents were gently shaken and the sample was filtered. The filtrate was cooled at ambient temperature and the pH of the sample was determined by a pH meter. The results are shown in Table 1.

**Determination of Some Nutritional Values of Clam**

Some nutritional values such as moisture, protein, fat, fiber, ash, and carbohydrate of the dried powdered sample were determined according to the appropriate reporter (AOAC, 2000) methods. The results are recorded and discussed in Table 2.

The moisture content of the dried powdered sample was determined by the oven drying method.

The total ash contents of the samples were determined by the muffle furnace method.

The crude protein of the sample was determined by the Macro-Kjeldahl method. Crude protein was calculated according to the following formula:

$$\text{Crude protein (\% )} = \frac{6.25 \text{ x } 100 \text{ x } 1.4 \text{ x A}}{\text{W x } 100}$$

where W = Weight of a substance taken

A = Volume of used 0.1 sulfuric acids to titrate $NH_3$.

The crude fiber of the sample was determined by the Fiber Cap method. Crude fiber content was calculated according to the following formula:

$$\text{Crude fiber (\%)} = \frac{\text{Weight of sample} - \text{Weight of residue}}{\text{Weight of sample}} \text{X } 100$$

The fat content was determined by the Soxhlet extraction method. Crude fat content was calculated according to the following formula:

$$\text{Fat (\%)} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \text{X } 100$$

The carbohydrate present in food includes starch (glycogen in animal tissue), dextrin and mono and disaccharide. The carbohydrate content was generally calculated from the difference between 100 and the sum of the percentage of moisture protein, fat fiber, and ash.

The energy value was calculated according to the following formula (Food and Drink Europe, 2013).

Energy (kcal) = (g Protein x 4) + (g Fat x 9) + (g Carbohydrate x 4)

**Determination of the Contents of Elements**

Ash sample (2.5 g) was fabricated into the pallet for EDXRF analysis. The sample was placed in the sample chamber of EDX-700 spectrometer that can measure the sixteen samples at a time. The chamber was pumped up to vacuum. The vacuum pressure was about 38 Pa and the detector temperature is about 170$^{o}$C. Therefore, liquid nitrogen needs to be added at the time of analysis. Rhodium target was used in the EDX-700 spectrometer. Each sample was run in a counting time of about 100 seconds and the spectrum obtained was stored and analyzed in PC based multichannel analyzer using EDX-700 software. From the resultant EDXRF spectrum, the relative abundance and normalized percents of some elements in the ash of clam from Kyun Su and Palaw areas were obtained and shown in Table 3.

## Results and Discussion

**pH Value of Clam from Kyun Su and Palaw Areas**

As shown in Table 1, pH values of clam from Kyun Su and Palaw areas were found to be 5.11 and 6.02 respectively. From this result, the pH value of the clam from the Palaw area is higher than that of the Kyun Su area.

Table 1. pH value of clam from Kyun Su and Palaw areas

| Samples | pH |
|---|---|
| (Clam) Kyun Su | 5.11 |
| (Clam) Palaw | 6.02 |

**Nutritional Values of Clam**

The nutritional values of clam samples were determined by AOAC methods. The resultant data of nutritional values such as moisture, ash, protein, fiber, fat, carbohydrate, and energy value (kilocalories) in the sample are presented in Table 2 and Figure 3. The experimental data pointed out that, the contents of protein, carbohydrate, and fat in the collected samples from Kyun Su and Palaw areas were 60.92%, 12.91%, 5.58%, and 58.89%, 14.36%, 6.70% respectively. Carbohydrates are one of the most important sources of energy in many foods. Protein is needed to grow the body and repair itself.

The contents of moisture, ash, and fiber were found to be present at 6.09%, 13.73%, 0.77% and 8.05%, 11.26%, 0.74% in the collected samples from Kyun Su and Palaw areas. Moisture content is the most commonly measured properties of food materials. It helps regulate body temperature. A good proportion of fiber that helps excretion and prevents constipation. The ash value of the sample represented the inorganic residue, after all, the organic matter had been burnt away. The energy content of the sample from Kyun Su was detected as 350 kcal/100g and that of the sample from Palaw was 355 kcal/100g. The energy obtained from carbohydrates, protein, and fat is called calories. Calories give energy that needs them to be able to do work and be active.

The contents of protein, ash, and fiber in the sample from the Kyun Su area were more than that of the sample from Palaw areas. But, it was found that the contents of moisture, carbohydrate, fat, and energy value in the sample from the Palaw area were more than that of the sample from the Kyun Su area.

Table 2. Comparison of nutritional values in clam from Kyun Su and Palaw areas

| No | Nutritional values | Contents (%) | |
|---|---|---|---|
| | | Kyun Su | Palaw |
| 1 | Moisture | 6.09 | 8.05 |
| 2 | Ash | 13.73 | 11.26 |
| 3 | Protein | 60.92 | 58.89 |
| 4 | Fiber | 0.77 | 0.74 |
| 5 | Fat | 5.58 | 6.70 |
| 6 | Carbohydrate | 12.91 | 14.36 |
| 7 | Energy (kcal/100g) | 350 | 355 |

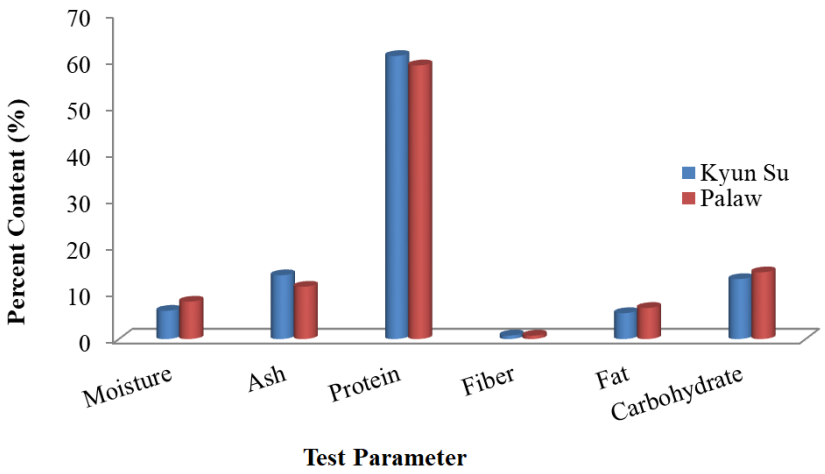



Figure 3.Comparison of nutritional values of clam from Kyun Su and Palaw areas

**Element Contents in Clam**

The elements present in Clam were qualitatively determined by EDXRF analysis. The resultant data were described in Table 3.

According to EDXRF spectral data, it was found that K, Ca, S, P, Fe, Ti, Mn, Zn, Rb, Cu, Sr, Cl, and Br are present in the clam. From this result, it can be inferred that S (1.719%), K (1.073%) and P (0.947%) were found to be present as a major component in the sample from Kyun Su area, whereas Ca (0.352%), Fe (0.151%), Ti (0.013%), Mn (0.012%), Zn (0.007%), Br (0.005%), Cu (0.002%), Sr (0.001%) and Rb (0.001%) were found to be the small amount.

From this result, it was found that Cl (4.122%), S (1.289%), P (0.979%) and K (0.620%) were found to be present as a major component in the sample from Palaw area, whereas Ca (0.287%), Fe (0.157%), Ti (0.011%), Br (0.009%), Zn (0.007%), Mn (0.007%), Cu (0.002%) and Sr (0.002%) were found to be the small amount.

Sulfur was found to be the highest. Sulfur supports insulin production and hormone synthesis. Potassium nourishes the heart, kidney, pancreas, muscle, and nerves. Calcium is essential for the production and activation of many enzymes and energy. It is also important in the psychological process. It was found that chlorine contents in clam from the Palaw area were (4.122%) but not in the sample from Kyun Su. Similarly, rubidium was found as a trace element (0.001%) in clam from Kyun Su only, but it was not found in Palaw because it may be for the building of ships as well as it may be in the earth.

It was found that sulfur and protein are present in highest amounts in clams from both areas. It may be due to the presence of sulfur-containing amino acids such as

methionine $-H_3N^+-CH(CH_2)_2-SCH_3-COO^-$ , homocysteine $-H_3N^+-CH(CH_2)_2-SH-COO^-$ , cysteine $-H_3N^+-CH(CH_2-SH)-COO^-$

and taurine - $H_3N^+(CH_2)_2-SO_3^-$ in proteins (BrosnanJ.T and Brosnan M. E, 2006). The pH value of clam from Kyun Su and Palaw area is higher than that of Palaw because the protein-containing sulfur amino acids are more amount of clam from Kyun Su than that of Palaw. Moreover, the nutrient elements such as (S, K, P, Cl, and Ca) were rich in the clam. It should be acceptable for consumption.

Table 3. Comparison of mineral contents in clam from Kyun Su and Palaw areas by EDXRF

| No | Element | Contents (%) | |
|---|---|---|---|
| | | Kyun Su | Palaw |
| 1 | S | 1.719 | 1.289 |
| 2 | K | 1.073 | 0.620 |
| 3 | P | 0.947 | 0.979 |
| 4 | Ca | 0.352 | 0.287 |
| 5 | Fe | 0.151 | 0.157 |
| 6 | Ti | 0.013 | 0.011 |
| 7 | Mn | 0.012 | 0.007 |
| 8 | Zn | 0.007 | 0.007 |
| 9 | Br | 0.005 | 0.009 |
| 10 | Cl | - | 4.122 |
| 11 | Rb | 0.001 | - |
| 12 | Sr | 0.001 | 0.002 |
| 13 | Cu | 0.002 | 0.002 |

## Cconclusion

In this research, the clams were collected from the Kyun Su and Palaw areas, in Tanintharyi Region, Myanmar. Some chemical investigations of clam were carried out in the present work. The pH value of clams from Kyun Su and Palaw areas was 5.11 and 6.02.

From the investigation of nutritional values, the contents of moisture, ash, protein, crude fiber, fat and carbohydrate in the collected samples from Kyun Su and Palaw areas

were found to be 6.09%, 13.73%, 60.92%, 0.77%, 5.58%, 12.91% and 8.05%, 11.26%, 58.89%, 0.74%, 6.70%, 14.36% respectively. The energy content of the sample from the Kyun Su area was detected as 350 kcal/100g and that of the sample from the Palaw area was 355 kcal/100g. Among these nutritional values, the highest amount of protein and carbohydrates were observed in these samples.

From quantitative analysis of clams by EDXRF, S (1.719%), K (1.073%), P (0.947%), Ca (0.352%), Fe (0.151%), Ti (0.013%), Mn (0.012%), Zn (0.007%), Br (0.005%), Cu (0.002%), Sr (0.001%) and Rb (0.001%)were found in the sample from the Kyun Su area. Cl (4.122%), S (1.289%), P (0.979%), K (0.620%), Ca (0.287%), Fe (0.157%), Ti (0.011%), Br (0.009%), Zn (0.007%), Mn (0.007%), Cu (0.002%) and Sr (0.002%) were also found in the sample from Palaw area. It was observed that both samples showed a high value of S content. It assists all skin and connective tissue and vital for the growth of hair and nails. Due to the presence of the highest amount of amino acids such as methionine, homocysteine, cysteine, and taurine in the protein of clam from the Kyun Su area are more than that of the Palaw area. The pH value of clam from the Kyun Su area is less than that of the Palaw area. Thus, it may be concluded that the nutrients and mineral contents in both samples are suitable for consumption.

## Acknowledgments

We would like to express our sincere thanks to Dr. Ni Ni Oo,Rector, Myeik University, and Dr. Win Win Than, Pro-rector for their kind encouragement and permission to work on this research topic. In addition, we would like to express our sincere thanks to Dr Myint Myint May, Head and Professor, Department of Chemistry, Myeik University for her advice to write this paper.

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# Isolation and Identification of Phenolic Compounds from Stem Bark of *Barringtonia acutangula* (L.) Gaertn. (Kyi ni)

Khin Myat Lin[1], Tin Htay Mu[2], Nyunt Nyunt Than[3]

## Abstract

This research deals with isolation and identification of some bioactive phytochemical constituents of the bark of *B.acutangula* (L.) Gaertn. (Kyi ni). The preliminary phytochemicals tests revealed the presence of alkaloids, glycosides, phenolic compounds, reducing sugars, saponins, tannins, flavonoids, steroids and terpenoids. By silica gel column chromatographic separation, compound 1 (0.034 %), compound 2 (0.022 %) and compound 3 (0.013 %) were isolated from EtOAc extract of Kyi ni bark. The type of isolated compounds was classified by their physicochemical properties and the structures of these compounds were identified by modern spectroscopic techniques such as UV-visible and FT IR spectroscopy.

**Key words:** *B.acutangula* (L.) Gaertn., phytochemicals, column chromatography, UV-visible and FT IR spectroscopy

## Introduction

Plants are invaluable sources of pharmaceutical products and plants are recognized for their ability to produce a wealth of secondary metabolite. Plants produce a diverse range of bioactive molecules making them a rich source of different types of medicine (Marini-Bettolo *et al*., 1981). Medicinal plants were used by humans of ancient cultures without knowledge of their active ingredients. All modern clinical drugs are of natural product origin and natural products play an essential role in modern drug development in the pharmaceutical industry (Maninderjit *et al*., 2013).

*Barringtonia acutangula* (L.) Gaertn. (Family-*Lecythidaceae*) is an important medicinal plant of India. It is a plant traditionally used for the cure and treatment of many ailments (Robinson, 1983). Various parts of *Barringtonia acutangula* has been used as a medicine for treating various ailments (Shriner *et al*., 1980).

Figure 1. Stem bark of *Barringtonia acutangula* (L.) Gaertn.

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[3] Lecturer, Department of Chemistry, Yenanchaung Degree College

## Material and Methods

### Collection and Preparation of the Sample

The stem bark of *Barringtonia acutangula* (L.) Gaertn.(Kyi ni ) was collected from Kyaung-Kone Village, Salin Township, Magway Region. The samples were identified at the Department of Botany, Magway University. The Kyi ni barks were air-dried in room temperature. They were ground to a powder and stored in an air-tight container.

### Preliminary Phytochemical Investigation of the Sample

The air-dried powdered sample was subjected to a preliminary phytochemical test to find out the types of phytochemical constituents such as alkaloids, flavonoids, glycosides, phenolic compounds, reducing sugars, saponins, steroids, tannins and terpenoids present in samples according to appropriate reported methods.

### Preparation of Crude Extracts by Successive Percolation Method

The dried powder sample (500 g) was extracted with 1500 mL of 95 % ethanol for about one week by percolation method and then filtered. The filtrate was concentrated by rotary evaporator to get ethanol extract. The ethanol extract was partitioned with pet-ether (200 mL) to give pet-ether extract was obtained. The defatted ethanol portion was then partitioning with 100 mL of ethyl acetate and then ethyl acetate crude extract was obtained. The dried pet-ether and ethyl acetate extracts were weighed, then stored and kept in the refrigerator for the isolation of phytochemical constituents and screening of some bioactivities.

### Separation and Isolation of Some Organic Constituents from EtOAc Crude Extract of Kyi ni Bark

5 g EtOAc extracts of Kyi ni bark were mixed with 5 g of silica gel. The resulting powdered mixture was added to the column using a small long-necked funnel. Some adsorbed gel sticking on the inner wall was washed down with the solvent. A piece of cotton wool was placed between the solvent and the column gel. The tap was opened and the fractions were collected at the rate of one drop per 4 seconds. Gradient elution was performed successively with PE: EtOAc solvent systems in the ratios of (9:1, 2:1, 1:2, 1:5, 1:9), EtOAc only and EtOAc: MeOH (1:5) v/v) and a total of 115 fractions were finally collected. The fractions gave similar appearance on TLC were combined and finally the seven main fractions: F (I) to F (VII) were collected. After removal of the solvents, F (IV) provided yellow crystals. The crystals were washed with pet-ether and purified by recrystallization from EtOAc, to give 0.034 % (0.1681 g) pure compound 1. The compound 2 obtained from F (VI) was purified by preparative thin-layer chromatographic separation and obtained as pure yellow crystals in 0.1090 g (0.022 %) of yield. The compound 3 obtained from F (VII) was purified by preparative thin-layer chromatographic separation and obtained as pure yellow crystals in 0.0655 g (0.013 %) of yield.

### Physicochemical Characterization of the Isolated Compounds

The isolated compounds were characterized by determination of $R_f$ values, solubility and reactions with some reagents such as Liebermann-Burchard reagent, 10 % lead acetate solution, 1 % $FeCl_3$ solution, $AlCl_3$ solution, KOH solution and $I_2$ vapour.

### Identification of Isolated Compounds by Modern Spectroscopy

The isolated compounds were structurally identified by studying their UV-visible and FT IR spectral data.

## Results and Discussion

### Phytochemical Investigation of Kyi ni Bark

Preliminary phytochemical screening was performed to investigate the plant materials in terms of their active constituents. According to these results, the bark of the *Barringtonia acutangula* (L.) Gaertn. (Kyi ni) contain alkaloids, glycosides, phenolic compounds, reducing sugars, saponins, tannins, flavonoids, steroids and terpenoids. Different phytochemicals have been found to possess a wide range of activities, thus extracts from the bark of Kyi ni could be seen as a good source for useful drugs.

Table 1. Results of phytochemical tests on the bark of the kyi ni

| No | Tests | Solvent Extracts | Test Reagents | Observation | Remark |
|---|---|---|---|---|---|
| 1. | Alkaloid | 1% HCl | Dragendorff's reagent | brown ppt | + |
| | | | Wagner's reagent | dark blue colour solution | + |
| 2. | Flavonoid | 95% EtOH | conc: HCl, Mg turning, conc: $H_2SO_4$ | deep reddish brown colour solution | + |
| 3. | Glycoside | Distilled water | 10 % lead acetate solution | pale brown gelatinous ppt | + |
| 4. | Phenolic Compound | Distilled water | 10% $FeCl_3$ | greenish blue colour solution | + |
| 5. | Reducing Sugar | Distilled water | Benedict's solution | yellowish brown ppt | + |
| 6. | Saponin | Distilled water | Distilled Water | Frothing | + |
| 7. | Steroid | 95% EtOH | acetic anhydride, con: $H_2SO_4$ | reddish brown colour solution | + |
| 8. | Tannin | Distilled water | 10 % $FeCl_3$, dil. $H_2SO_4$ | deep grey ppt | + |
| 9. | Terpene | 95% EtOH | acetic anhydride, con:$H_2SO_4$,chloroform | reddish brown ppt | + |

(+) = presence, (-) = absence

### Separation, Isolation and Purification of Phytochemical Constituents from Crude Extracts

Compounds 1, 2 and 3 from EtOAc extract of Kyi ni bark were isolated by silica gel column chromatographic separation. In this experiment, two phenolic compounds (1 and 2) and one anthraquinone derivative (compound 3) were isolated. The isolated compounds were firstly visualized under UV-visible light and then detected by spraying the TLC chromatograms with 1 % $FeCl_3$ solution. In this experiment, compound 1 (yellow crystals, 0.1681 g, 0.034 % yield, $R_f$ = 0.5), compound 2 (yellow crystals, 0.1090 g, 0.022 % yield,

$R_f$ = 0.5) and compound 3 (yellow crystals, 0.0655 g, 0.013 % yield, $R_f$ = 0.6) were isolated while eluting with solvent systems of 1:5 v/v PE:EtOAc, EtOAc only and 1:5 v/v EtOAc:MeOH respectively.

**Some Physicochemical Properties and Classification of Color Test of Isolated Compounds**

Before the identification of the structures of the isolated compounds, they were firstly characterized by determination of their physical properties such as $R_f$ value, solubility, and some chemical properties especially determined by colour tests. Thus, isolated compounds were also tested with Liebermann-Burchard reagent, 10 % Lead acetate solution, 1 % $FeCl_3$ solution, $AlCl_3$ solution, KOH solution and iodine vapour on TLC chromatograms. All of these observed physical and chemical properties of the isolated compounds are summarized in (Table . 2 and 3). Based on the colour tests, compounds 1, 2 and 3 were assigned as phenolic compounds because of grey colouration observed in the treatment with 1 % $FeCl_3$ solution. Moreover, compound 1 and 2 may be flavonoid because of yellow colouration observed in the treatment with $AlCl_3$ solution and compound 3 may be anthraquinone derivative because of brown colouration with KOH solution.

Table 2. Some physical properties of isolated compounds

| No. | Isolated Compounds | Physical State | Colour | $R_f$ values | Solubility | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | PE | EtOH | EtOAc | MeOH |
| 1. | 1 | solid | yellow | 0.5 (PE:EtOAc, 1:5 v/v) | - | + | + | + |
| 2. | 2 | solid | yellow | 0.5 (EtOAc only) | - | + | + | + |
| 3. | 3 | solid | yellow | 0.6 (EtOAc:MeOH , 1:5 v/v) | - | + | + | + |

(+) = soluble (-) = insoluble

Table 3. Some chemical properties and classification of isolated compounds

| No. | Isolated Compounds | Liebermann Burchard, Δ | 10 % Lead acetate | 1 % $FeCl_3$ | $AlCl_3$ | KOH | $I_2$ vapour | Types of compounds |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | - | - | + | + | - | brown | phenolic compound |
| 2 | 2 | - | - | + | + | - | brown | phenolic compound |
| 3 | 3 | - | - | + | - | + | brown | anthra-quinone derivative |

(+) = present (-) = absent

## Identification of Isolated Compound by Spectroscopic Techniques

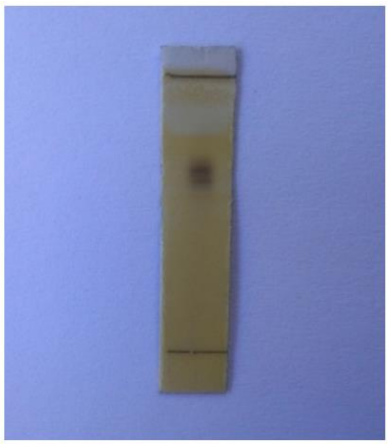
In this section, the structures of the isolated compounds were identified by modern spectroscopic methods such as UV-visible and FT IR spectroscopy.

### Compound 1

Compound 1 (yellow crystal) was isolated from ethyl acetate extract of Kyi ni bark. Grey spot appeared on TLC chromatogram after soaking in 1 % $FeCl_3$ solution suggested that compound 1 to be a phenolic compound. When tested with $AlCl_3$ solution, it gave a yellow colour spot on the TLC plate suggesting being a flavonoid. In the UV-visible spectrum of compound 1, it appeared the maximum absorption bands at $\lambda_{max}$ 240 nm (0.55) for $\pi \rightarrow \pi^*$ transitions and (0.19) for $n \rightarrow \pi^*$ transitions. In the presence of a few drops of NaOH, the absorption bands at 240 nm and 276 nm moved to 266 nm and 340 nm suggesting the presence of phenolic OH group. In $AlCl_3$, the absorption band at 240 nm and 276 nm moved to 283 nm and 385 nm suggesting the presence of phenolic OH group. The UV-visible spectrum of compound 1 was shown in (Fig. 3) and the band assignment was shown in (Table. 5). The FT IR (KBr) spectrum of compound 1 was shown in (Fig. 4) and the assignments of spectral data are shown in (Table . 6). According to its UV-visible, FT IR spectral data and physicochemical properties, compound 1 was identified as a flavonoid compound.

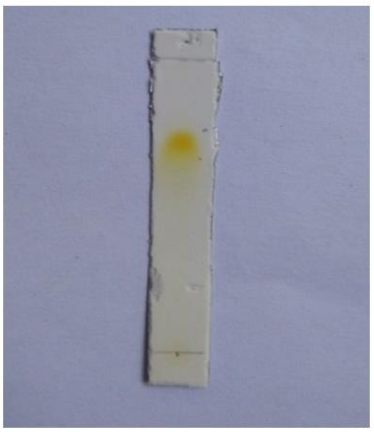
Table 4. Identification of isolated compound 1

| Experiments | Observations | Remarks |
|---|---|---|
| $R_f$ | 0.5 | PE:EtOAc (1:5 v/v) |
| UV (254 and 365 nm) | active | conjugated double bond present |
| 1 % $FeCl_3$ solution | grey | phenolic OH present |
| $AlCl_3$ solution (on UV 365 nm) | yellow | Flavonoid |



Solvent system = PE:EtOAc (1:5 v/v)

Spraying agent = 1 % $FeCl_3$ solution



Solvent system = PE:EtOAc (1:5 v/v)

Spraying agent = $AlCl_3$ solution

Figure 2. Thin layer chromatography of isolated compound 1

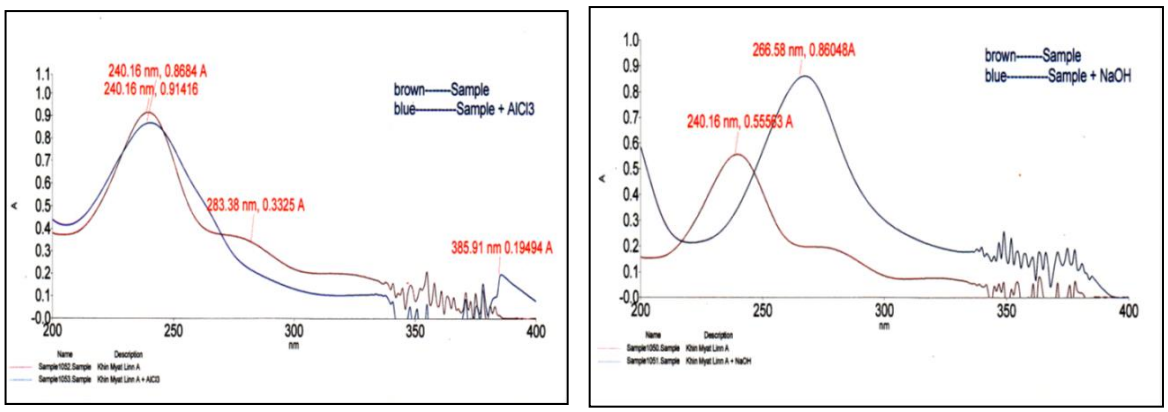



Figure 3. UV-visible spectrum of isolated compound 1 with NaOH and $AlCl_3$

Table 5. UV-visible spectral data of isolated compound 1

| Solvent | $\lambda_{max}$ (nm) | Remarks |
|---|---|---|
| EtOH | 240 (0.55) $\pi \rightarrow \pi^*$ transition<br>276 (0.19) $n \rightarrow \pi^*$ transition | K band for conjugated system |
| EtOH+ NaOH | 266 (0.86)<br>340 (0.20) | Bathochromic shift |
| EtOH + $AlCl_3$ | 283 (0.33)<br>385 (0.19) | Flavonoid compound |

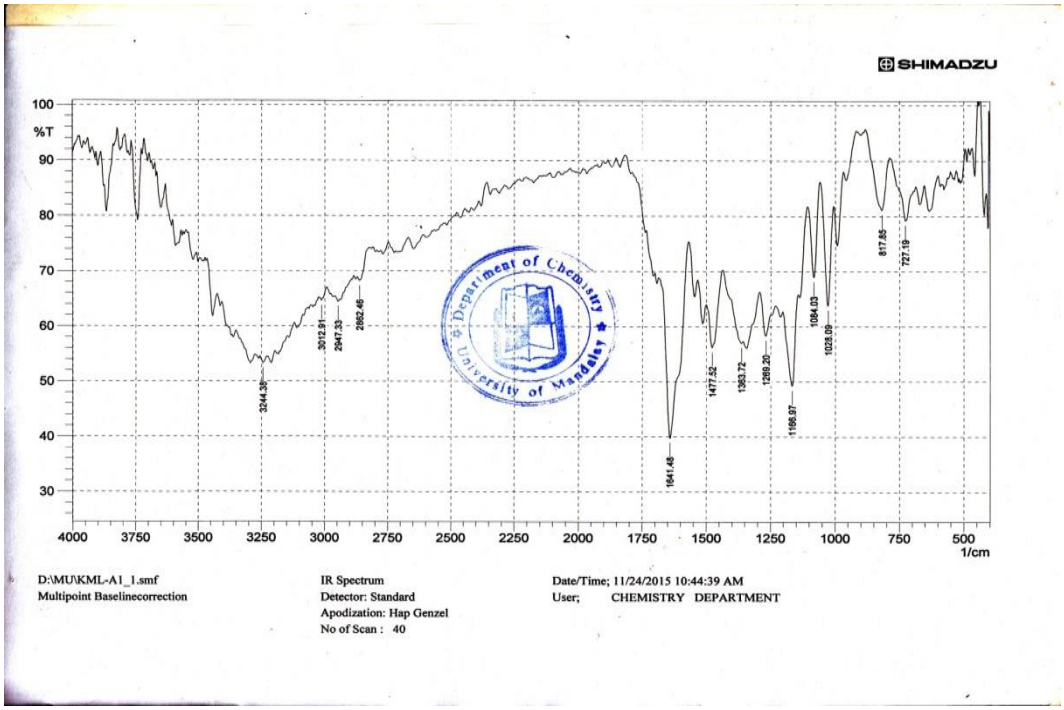



Figure 4. FT IR spectrum of isolated compound 1

Table 6. FT IR spectral data of isolated compound 1

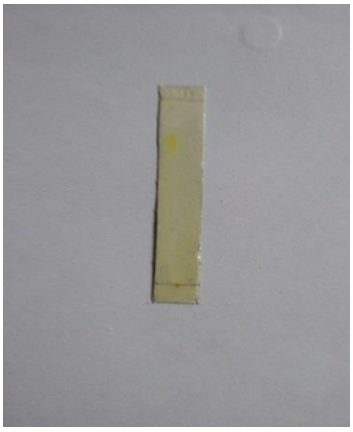
| Wave Number ($cm^{-1}$) | Assignments |
|---|---|
| 3300 | OH stretching vibration of hydroxyl group |
| 3012 | C-H stretching vibration of $sp^2$ carbon |
| 2947, 2862 | Asymmetric and symmetric C-H stretching vibration of $sp^3$ carbon |
| 1641 | C=C stretching vibration of alkenic group |
| 1520 | C =– C stretching vibration in aromatic ring |
| 1477 | C-H bending vibration of $CH_3$ and $CH_2$ |
| 1363 | O-H bending vibration of hydroxyl group |
| 1269, 1166, 1084, 1028 | C-O stretching vibration of –C-OH group |
| 817, 727 | out of plane C-H bending vibration of aromatic ring |

**Compound 2**

Compound 2, yellow crystals from ethyl acetate extract of Kyi ni bark. Grey spot appeared on TLC chromatogram after soaking in 1 % $FeCl_3$ solution suggested that compound 2 to be a phenolic compound. When tested with $AlCl_3$ solution, it gave a yellow colour spot on the TLC plate suggesting to be a flavonoid. In the UV-visible spectrum of compound 2, it appeared the maximum absorption bands at $\lambda_{max}$ 229 nm (0.07) for $\pi \rightarrow \pi^*$ transitions. In the presence of a few drops of NaOH, the absorption band at 229 nm moved to 241 nm suggesting the presence of phenolic OH group. In $AlCl_3$, the absorption band at 229 nm moved to 230 nm suggesting the presence of phenolic OH group. The UV-visible spectrum and the band assignment of compound 2 were shown in (Fig . 6) and (Table . 8). The FT IR spectrum and spectral data of compound 2 are shown in (Fig . 7) and (Table . 9). According to its UV-visible, FT IR spectral data and physicochemical properties, compound 2 was identified as a flavone.

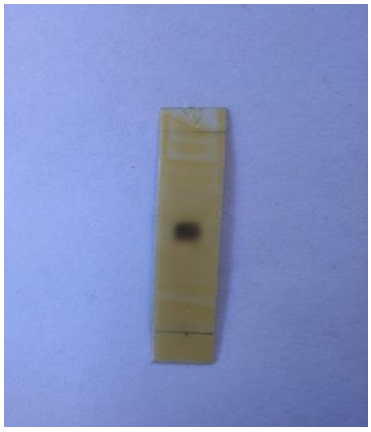
Table 7. Identification of isolated compound 2

| Experiments | Observations | Remarks |
|---|---|---|
| $R_f$ | 0.5 | EtOAc only |
| UV (254 and 365 nm) | active | conjugated double bond present |
| 1 % $FeCl_3$ solution | grey | phenolic OH present |
| $AlCl_3$ solution (on UV 365 nm) | yellow | Flavonoid |



Solvent system = ethyl acetate only

Spraying agent = 1 % $FeCl_3$ solution



Solvent system = ethyl acetate only

Spraying agent = $AlCl_3$ solution

Figure 5. Thin layer chromatography of isolated compound 2

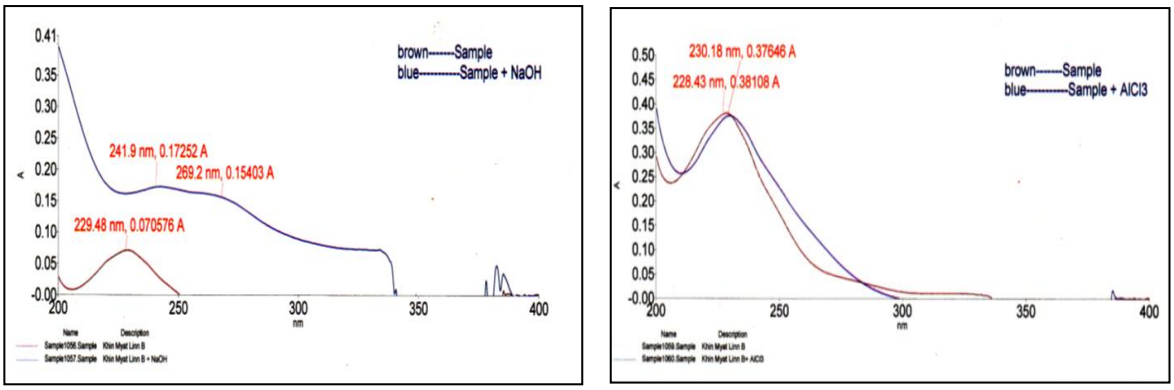



Figure 6. UV-visible spectrum of isolated compound 2 with NaOH and $AlCl_3$

Table 8. UV-visible spectral data of isolated compound 2

| Solvent | $\lambda_{max}$ (nm) | Remarks |
|---|---|---|
| EtOH | 229 (0.07) $\pi \rightarrow \pi^*$ transition | K band for conjugated system |
| EtOH + NaOH | 241 (0.17) $\pi \rightarrow \pi^*$ transition | Bathochromic shift |
| EtOH + $AlCl_3$ | 230 (0.37) | Flavonoid compound |

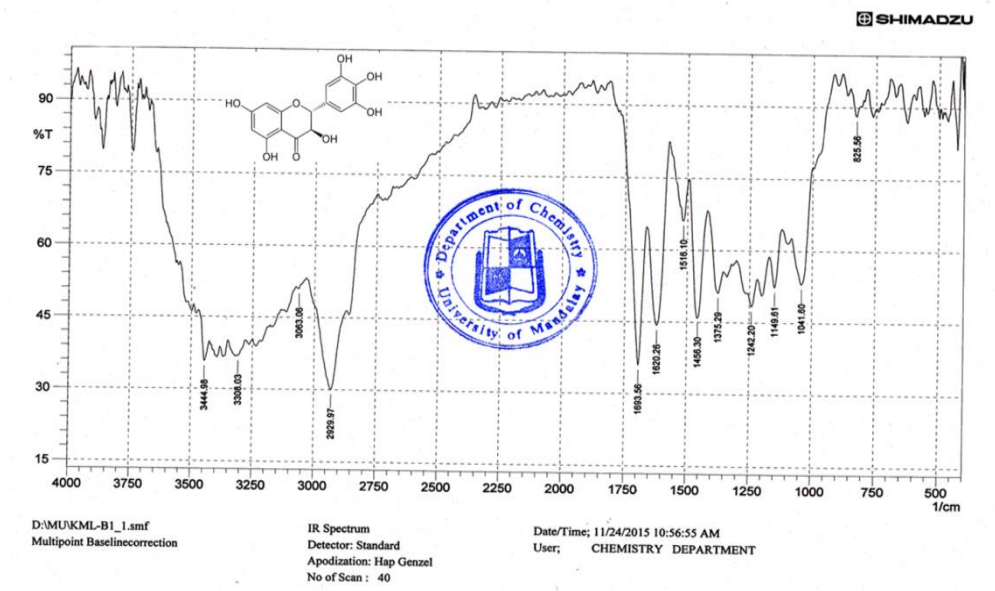



Figure 7. FT IR spectrum of isolated compound 2

Table 9. FT IR spectral data of isolated compound 2

| Wave Number ($cm^{-1}$) | Assignments |
|---|---|
| 3444 | OH stretching vibration of hydroxyl group |
| 3063 | C-H stretching vibration of $sp^2$ carbon |
| 2929,2865 | Asymmetric and symmetric C-H stretching vibration of $sp^3$ carbon |
| 1693 | C=O stretching vibration of carbonyl group |
| 1620, 1516 | C = C ring stretching vibration in aromatic ring |
| 1456, 1375 | C-H bending vibration |
| 1242 | C-O stretching vibration of phenol |
| 1149 | C-O stretching vibration of secondary alcohol |
| 1041 | C-O-C stretching vibration of ether |
| 825, 760 | out of plane CH bending vibration of aromatic ring |

**Compound 3**

Compound 3, yellow crystals from ethyl acetate extract of Kyi ni bark. Grey spot appeared on TLC chromatogram after soaking in 1 % $FeCl_3$ solution suggested that compound 3 to be a phenolic compound. When tested with a KOH solution, it gave a brown colour spot on the TLC plate suggesting to be anthraquinone derivative. The FT IR (KBr) spectrum of compound 1 was shown in (Fig . 9) and the assignments of spectral data are shown in (Table . 11) According to its FT IR spectral data and physicochemical properties, compound 3 was identified as an anthraquinones derivative.

Table 10. Some physicochemical properties of isolated compound 3

| Experiments | Observations | Remarks |
|---|---|---|
| $R_f$ | 0.6 | PE:MeOH (1:5 v/v) |
| UV (254 and 365 nm) | active | conjugated double bond present |
| 1 % $FeCl_3$ solution | grey | phenolic OH present |
| KOH, Iodine vapour | brown | anthraquinone derivative |

Solvent system = EtOAc:MeOH 1:5 v/v
Spraying agent = 1 %$FeCl_3$ solution

Solvent system = EtOAc:MeOH 1:5 v/v
Spraying agent = KOH solution

Figure 8. Thin layer chromatography of isolated compound 3

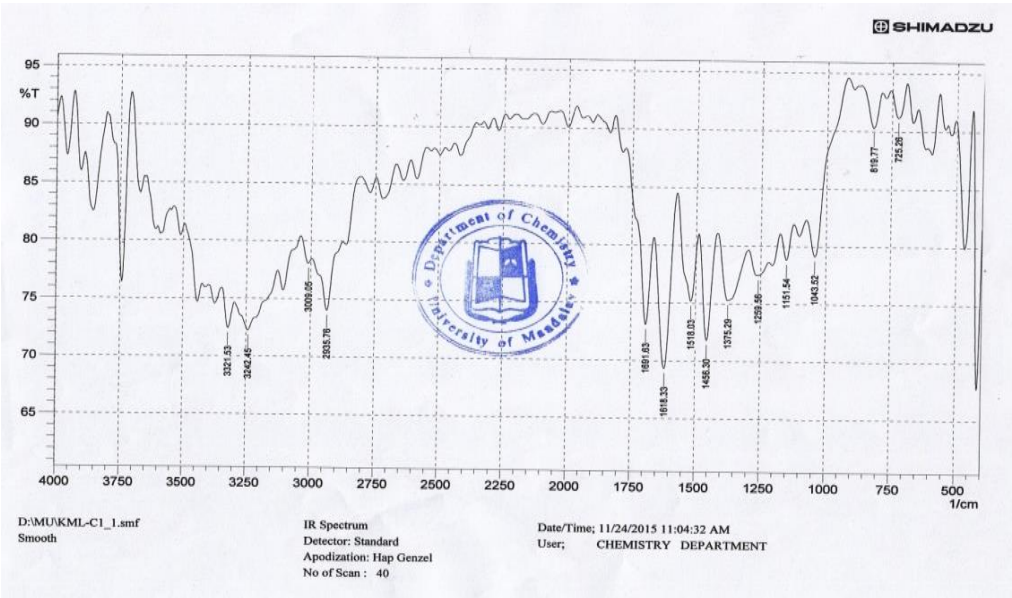



Figure 9. FT IR spectrum of isolated compound 3

Table 11. FT IR Spectral data of isolated compound 3

| Wave Number ($cm^{-1}$) | Assignments |
|---|---|
| 3440 | O-H stretching vibration of alcoholic and phenolic OH group |
| 3009 | C-H stretching vibration of $sp^2$ carbon |
| 2935 | Asymmetric and symmetric C-H stretching vibration of $sp^3$ carbon |
| 1691, 1618 | C=O stretching vibration of chelated carbonyl group |
| 1518 | C=C stretching vibration of olefinic group |
| 1151, 1043 | =C-O-H bending vibration of phenol |
| 725 | out of plane OH bending vibration of alcohol |

## Conclusion

From the overall assessments of the present work concerning with the chemical and biological investigation on the bark of Kyi ni, the following inferences could be deduced. The preliminary phytochemicals tests revealed the presence of alkaloids, glycosides, phenolic compounds, reducing sugars, saponins, tannins, flavonoids, steroids and terpenoids. By silica gel column chromatographic separation, compounds 1, 2 and 3 were isolated from Kyi ni bark. According to the physicochemical properties, UV-visible and FT IR spectroscopic assignments, the isolated compounds were flavonoid, flavone and anthraquinone derivative. On the basics of the results obtained it can be concluded that the chromatographic separation of EtOAc extract of Kyi ni bark gave medicinally important bioactive compounds and also contributed valuable results for Myanmar indigenous medicine in particular.

## Acknowledgements

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# Design and Development of Intelligence Vehicle Using Arduino

Aye Ngwe[1], Win Zaw[2], Moe Sanda[3], Myat Thu Zar[4], Moe Thidar Myint[5]

## Abstract

This paper describes the Intelligence Vehicle by using Arduino as a controller. The robotic mechanism, especially movement with the vehicle at industries, is more famous than remote-controlled type previously due to make in simple and innovative fitting types. This paper is going to present on how to make the design and assemble an intelligent vehicle for helping humans in the future by developing to be more useful. This intelligence vehicle included the sensors and wireless Bluetooth control.

**Key words:** Arduino, Ultrasonic, Line Tracking Sensor

## Introduction

The Intelligence Vehicle is designed to construct a two robotic function of avoiding obstacle vehicle by using the ultrasonic sensors and the line following robotic vehicle by using the line tracking sensors as long as its activity. Arduino Uno is mainly used as a central controlled operation. An Intelligence Vehicle is a robotic machine that can help the tasks of human's project automatically and can sense its surrounding conditions regarding atmosphere and navigation. And it also can respond without any human control. Generally, Robotics Vehicle is a combinational machine which is imaginative and environmental. The disciplines of programming are involved by computational intelligence. Bluetooth System is the most popular of using advanced technology systems such as the connections between the smartphone and other electronic devices which have been operated by the Bluetooth Wireless System. Nowadays, Robotics is a quick growing and interesting field in the world (Kalpana. S., 2005).

## Materials and Methods

The objective of this paper is to create the innovating design of a prototype an intelligence vehicle by applying the programming of Arduino which can collect and store the data. Arduino programming is contributed to use the display screen acting as desktop or laptop and control to the prototype working.

The major components such as Arduino UNO, Sensors, and other items were made the analysis and determination to buy any particular types of these components. When the components had already bought, all of these items were integrated, checked, and verified for working correctly. After these processes, the prototype was constructed with the microcontroller Arduino by the simulated programmable coding.

Firstly, as mentioned above, the autopilot system, where the car can drive on the same path or lane of the road without the help of the driver while using the aid of the sensors installed in the car. Another feature of the autonomous vehicle is its capability to avoid accidents. For instance, when the car is on the move and suddenly, something appeared in front of the car, it will come to a stop as soon as possible to avoid crushing with the object in front.

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For the vehicle to move accordingly to the users' desire, the most important part is the sensor. The sensors send the feedback to the computer where it will be processed. Further action will then be sent to the corresponding part of the vehicle (motor, wheels, etc.). The prototype has 3 sensors which are all computer-controlled. These are Line Tracking Sensor, Ultrasonic Sensors, and Bluetooth. The followings are the pictures of the sensors used in this paper (Kiran *et al*., 2014).

Figure 1. Line Tracking Sensor

Figure 2. Ultrasonic Sensor (HC-SR04)

Figure 3. Bluetooth Module (HC-05)

**Components of circuit**

(1) **Arduino Uno:** Arduino is an electronic component using for the structure of mechanical and electrical projects. The impressive abilities of the engineering projects have been developed by using the Arduino. It can be divided into the Arduino Software Integrated Development Environment and Arduino Hardware Board. The connection between these two portions is simple, and they needed the USB cable connection type to apply.

Arduino Hardware Circuit Board can help to upload the code easily because of the software is an open-source type. The software can activate any type such as Windows, IOS, and Linux. Arduino Board is a microcontroller that is implemented with a programmable circuit unit. Arduino UNO is shown in Figure (4).

In the technological world, Arduino Uno is used for manufacturing some microcontroller kits which is used to build the device that is digitally operated. Arduino boards consist of a USB port to connect with personal computers and can transfer the related programs. Integrated Development Environment (IDE) is a stand-in which the coding part of Arduino is done which includes the C++ and C Programming Languages.

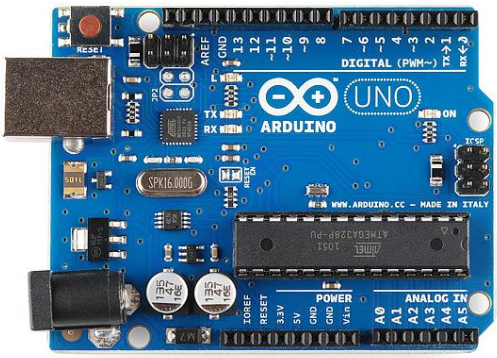


Figure 4. Arduino UNO Board

(2) **Dual Motor Driver:** The Dual Motor Driver shown in Figure (5) is established by the controller of L298N dual H-bridge which allows speed and direction control of the DC motors situated above directed toward 2A respectively with a voltage from 5V to 35V DC. The combination of motor rpm and rotation direction can be controlled by the dual motor driver. The motor rpm is controlled by the use of PWM input to ENA pins or ENB pins as long as the rotation direction is reserved by the power supplying of high and low

signals to EN1 and EN2 for the initial motor or EN3 and EN4 for the next motor.

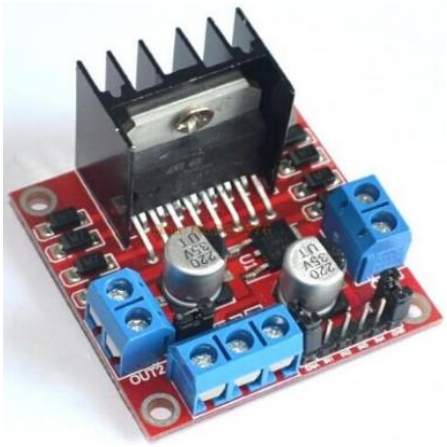

Figure 5. Dual Motor Driver (L298N)

(3) **Line Tracking Sensor:** Line Tracking Sensor shown in Figure (1) is a small piece of electronic device that can go guiding to the robot by telling black from white quickly and correctly. It is usually used in the Arduino robot project. Line Tracking Sensor can be divided into two types such as the black follower which takes the place of the black line and the next one is which pursues the white line. Line tracking senses to the highlighted line and passes over it.

(4) **Ultrasonic Sensor:** The Ultrasonic Sensor shown in Figure (2) is the distance sensor to that amount has been commonly used for avoiding the obstacles in the robotics projects. It supports the Arduino judgments for space perception and then it can avoid clashing. The HC-SR04 sensor type is mostly used with Arduino in many projects. The ultrasonic sensor of HC-SR04 can be connected directly by an Arduino or other types of microcontrollers after the software processes have already displayed on the computer. It can operate with 5 volts (Scott. C., 2018).

(5) **Bluetooth Module:** Bluetooth shown in Figure (3) is widely used in a large variety of purchaser productions. It is a well-known wireless pact networking for small point-to-point. Bluetooth Function has been assembled in the various laptop and smartphone. Bluetooth has the specific capabilities that can communicate from a computer or phone to the Bluetooth devices with low power and quickly.

Bluetooth Module namely HC-05 is an obvious type to use the Bluetooth Serial Port Protocol that is designed to set up the wireless connection. HC-05 Bluetooth module does be set as a transmitter or receiver (Schwartz. M., 2011).

(6) **Battery:** The model has 1.5 volts of 8 batteries packed at the rear-mid section of the body.

(7) Model body frame: This is the part that holds all the components together. The frame is bought with similarity to the real-life vehicle.

(8) Wheels, DC Motors and Wiring system.

**Description of Circuit Design**

In the world of intelligent vehicles, although all of them are computer-controlled with programs written in their system. There are many types of programs that can be installed.

Moving onto the next type of program is the obstacle sensibility. This program, in the project model, relies mostly on the ultrasonic sensors mounted at the front most of the

vehicle. As explained above, the sensors send out ultrasonic waves. When the waves hit an object, it gets reflected in the receiver part of the sensor. When the sensor detects the reflected wave, it then sends the data again to the system notifying it that there is an obstacle at a certain distance in front. Just like the way the line tracking system did, the corresponding system will return the feedback to the corresponding part (i.e. the brakes). Within a fraction of a second, a command will be sent to that part which then slows down the model eventually stopping it. The block diagram of the circuit is shown in Figure (6).

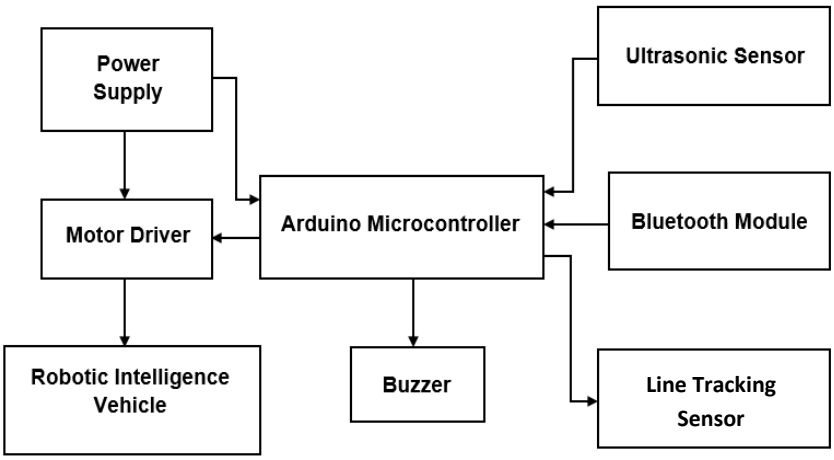


Figure 6. Block diagram of circuit

**Construction of the Vehicle**

Figure 7. Complete parts

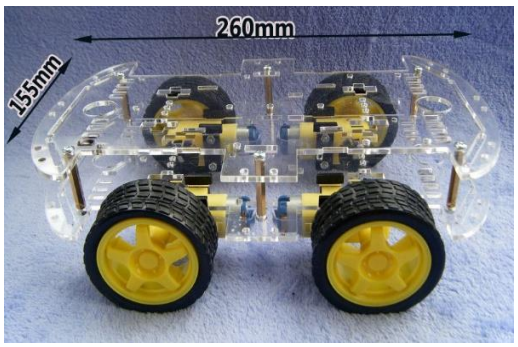


Figure 8. Finished the assembling of four wheels

In the first stage of the process, the unprepared pieces of four wheels car which made up of plastic, rubber, and metal shown in Figure (7) were fixed accurately and strongly because it is the most fundamental of the infrastructure in this prototype vehicle. After finished fixing the framework, the fixed four wheels car was assembled for working process by the electronic components such as Microcontroller Arduino UNO board, Dual Motor Driver (L298N), Line Tracking Sensor (SEN0017 – V5.0), Ultrasonic Sensor (HC-SR04), Bluetooth Module (HC-05), Wires, Perforated Board and the Battery and it is household. On the other hand, the four DC Motors had already included together with every four wheels.

According to this prototype, it has enough space to put the components as a result of the car's length is 260 mm and the width is 155 mm shown in Figure (8). Firstly, one element ultrasonic sensor was fixed in front of the top place at the vehicle. Next, the three pieces of line tracking sensors were fixed below the framework of the front side with the same distance.

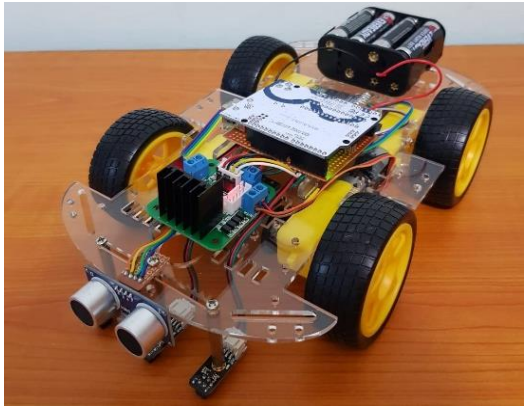

Figure 9. Completed assembling of the intelligence vehicle

**Software Setup**

The Arduino is used as a microcontroller for the functioning of intelligence vehicles. By using the method with USB cable is the best for connection because it can attach absolutely while the software from the computer is installing to the Arduino Hardware. Moreover, it can reduce errors and easily edit some mistakes.

**Connection with Dual Motor Driver (L298N)**

In the first stage, the Arduino has to connect the attachments of motor A and motor B on the L298N Dual Motor Driver. If the motors were being used for an intelligence vehicle prototype, it was required to make secure by the action of these motors have the same inputs.

Next, it connected to the power supply outside of positive to pin 4 and negative (GND) to pin 5 on the module. If the supply voltage is staying upward 12V, usually allow into the jumper 12V and jumper 5V will be acceptable on the module from pin 6. That can be encouraged to the Arduino 5V pin through the power it in distinction to the motor power.

One thing it is important to notice in the direction of connecting the Arduino, the pin 5 which had on the module has to be completed the circuit. It would necessary digital output 6 pins pieces on the running Arduino. It is the Pulse Width Modulation (PWM) pins and PWM pins are designated by the tilde number pin.

In the final stage, it is connected with the digital output pins of Arduino to the driver. Pins IN1, IN2, IN3, and IN4 will connect to the digital pins D9, D8, D7, and D6 respectively as long as they have two DC motors.

**Connection with Line Tracking Sensor (SKU: SEN0017-V5.0)**

Line Tracking Sensor has required some wiring to connect with all the grounds and the power together. Then, it was started by placing the sensors on the below of the car with some spacing in between them, so they won’t interfere with each other. The spacing was about half of inch. The user had some trouble trying to slab the pins of the sensor through the hole that is why in between the pins some kinds of plastic stick out. The completed assembling of the intelligence vehicle is shown in Figure (10).

For Arduino, line tracking sensors can search the white color lines in black space and black color lines in white space. The signals at the stale output can be provided by the single line tracking signals due to count on higher accurate and extra constant line. Line Tracking Sensors are being obvious to install the optional multi-channel mix.

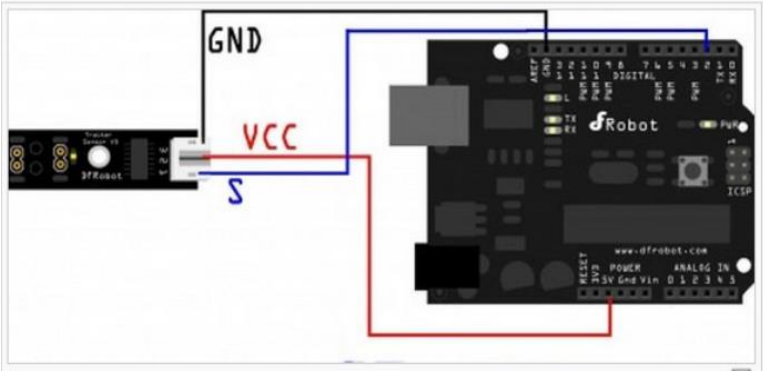


Figure 10. Connection diagram of line tracking sensor (SKU: SEN0017-V5.0)

**Connection with Ultrasonic SensoHC-SR04)**

HC-SR04, Ultrasonic Sensor makes the uses of sonar to determine the distance by an object. It diffuses an ultrasound at 40000Hz which transits pass over the air. The distance can calculate the considering of the movement time and the speed of sound.

There have 4 pins, $V_{CC}$, Ground, Trig, and Echo in the HC-SR04 of the ultrasonic module. Arduino Board has been required by the connection Ground and Vcc pins of the module and Ground and 5V pins respectively. The echo pins and trig are also needed to do connectives in any Digital I/O pin on the Arduino.

**Connection with Bluetooth Module (HC-05)**

The wireless connective element of the Bluetooth module namely HC-05 is operated on serial communication. Application for Android is sketched to transmit the serial data in the Arduino Bluetooth Module by the time the command words are typed on the application. Bluetooth Module of Arduino at the alternative end accepts the serial data and feeds it to the Arduino. When it connected to the RX pin of Arduino, the Bluetooth Module TX pin is passed through it shown in Figure (11). The programmable source code submitted to the Arduino UNO. After that checks and analyze the accepted data. If the accepted data is 1, the LED small light turns ON. Nonetheless, the LED small light turns OFF when the accepted data is 0.

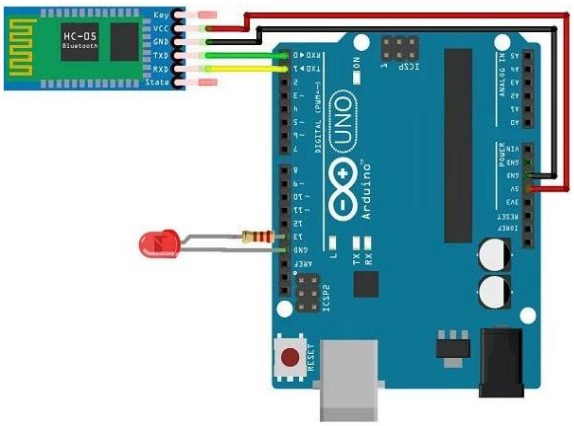


Figure 11. Connecting Bluetooth Module (HC-05) with Arduino UNO

### Installing the Application

- Download the **Bluetooth Terminal HC-05** application from Google Play Store or Safari and Application Store.
- Pair the appliance with HC-05 Bluetooth Module.
- Make scanning the smartphone to get the devices and Pair HC-05 by smartphone.

### Final Assembling

At the finishing stage of connections and parts assembling, the initial setup on the surface of the dual motor driver was searched from the whole working systems of the electronics devices and achieved by adapting the sensors. Mostly, testing was finished to realize convenient processing. The hardware assembling of each part and components was approved and then the software connections are also confirmed. Therefore, this prototype was ready to run after the final testing.

## Discussions

Focusing on the advancement in technology, almost everything is being controlled by computer programs. More and more complicated mechanics are made easier with the help of computers. Beginning with uses of the computer programs on a vehicle, programs like autopilot is programmed into the car along with several other sensors. The intelligent vehicle or autonomous vehicle could save lives and avoid accidents in several ways.

## Conclusions

To sum up, the improvement of intelligence vehicles with Arduino is a robotic mechanism prototype which is a useful, innovative, powerful, and necessary system for the traffic systems and industries. Many experiences about the designing and manufacturing of the product obtained as long as doing this individual project. After analyzing by testing of the error, the creative complete procedures and assembling stages of this project well-informed and taken the references to the other researches and innovations. Optimistically, this paper report must be beneficial for the fresher learner who is interested in the Intelligence Vehicle.

## Acknowledgement

We would like to thank Prof Dr Ni Ni Oo, Rector, Myeik University, and Prof Dr Win Win Than, Pro-rector, Myeik University for their permission to undertake this research.

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# Comparative Study of Elemental Concentrations from Different Peas Grown in Nyaung Oo Region Using EDXRF Technique

Phyu Phyu Moe[1], Cho Cho Thet[2], Moe Sanda[3], Khin Myo Ma Ma Saw[4]

## Abstract

The various kinds of peas are mostly grown in the upper part of Myanmar. They are mainly supplied as a daily food for Myanmar family. In this paper, the elemental concentrations of ten different peas known as Pe-singon, Pe-gya, Bocate, Myay-pe, Pe-boke, Pe-sa-u, Sultani, Mat-pe, Pe-disein and Pe-gyi from Nyaung Oo region were comparatively investigated and the effects of those contained elements in these peas were discussed. The pea samples were carried out by using the Shimadzu EDX–700 X-ray Fluorescence Spectrometer in order to compare their elemental concentrations. The qualitative results of elements and semi-quantitative results of elemental concentration in each sample were presented.

Keywords: peas, EDXRF, elemental concentration, Nyaung Oo

## Introduction

The X-ray fluorescent method is widely accepted analysis as a standard method for elemental analysis since it offers a unique combination of flexibility and accuracy. The EDXRF analysis supports qualitative and quantitative results of element contained in many biological samples. The mechanical stability of XRF spectrometer and the optimization of the excitation source lead to the versatile applications. The software available permits the quantitative determination of the elements within a short time. This method can be used to determine major or minor and trace elements in light matrix without the need for complicated sample preparation procedures.

Many essential minerals required for human beings are available from various meat, grains and vegetables. Among the minerals, iron (Fe) is required for the synthesis of hemoglobin, the pigment in red blood cells. Iron rich food is important for a person who is in iron-deficiency and insufficient to replenish the body's supply (Nazanin Abbaspour *et al.*, 2014). Potassium (K) is one of the most active metals and it can support the metabolism of the body. It can also support the tonic effect for the body. Moreover, it can supply the pharmaceutical necessity. Sulphur (S) is especially important for humans because it is part of the amino acid methionine, which is an absolute dietary requirement for people. The amino acid cysteine also contains Sulphur **(**Susan Hewlings and Douglas Kalman, 2019)**.** The majority of dietary sulfur is provided by the sulfur-containing amino acids methionine and cysteine, with an estimated requirement for young men of ~14 mg/day per kg body weight (van de Poll MC, et al., 2006).

Zinc (Zn) is an essential trace element and its necessary roles involve enzymes and enzymatic functions, protein synthesis and carbohydrate metabolism. It is necessary for normal growth and development in mammals. Zn is also an essential element for human being and about 25 percent to 40 percent of dietary Zn is absorbed into the body. The recommended dietary allowance for adult men is set at 15 mg/day, for adult women 12 mg/day, for formula-fed infants 5 mg/day, and for preadolescent children 10 mg/day (National Research Council, 1989; Cousins *et al.*, 1990). Calcium (Ca) is essential constituent

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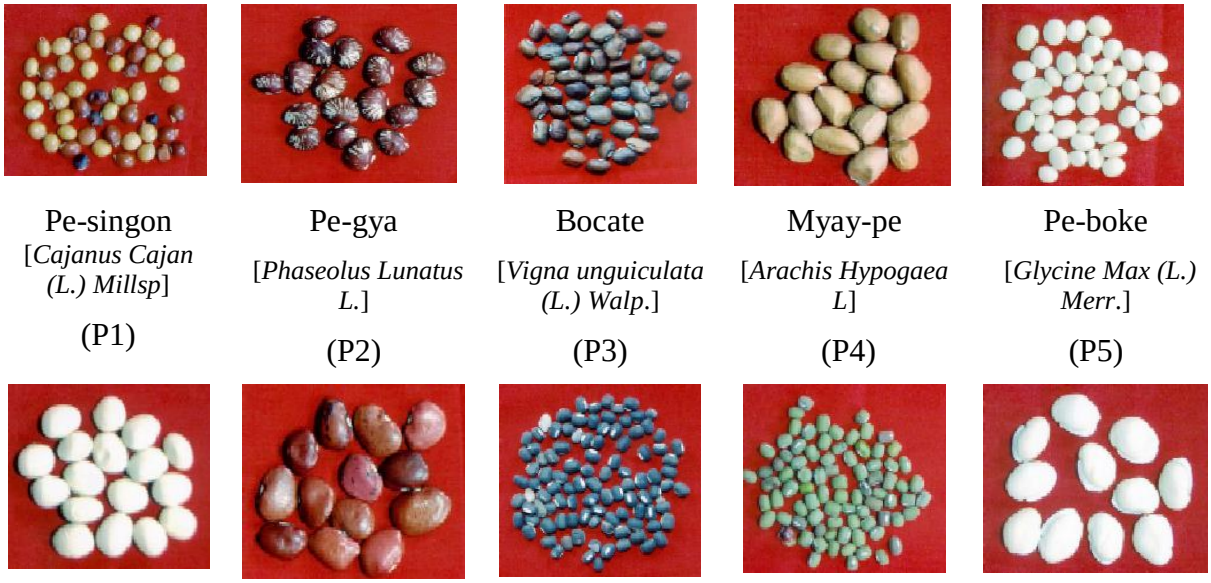
of bone and teeth of the body. The content of Ca in food can provide for nutrition. Long-term calcium deficiency can lead to osteopenia, which is a loss of bone density (Piste Pravina *et al.*, 2015). Rubidium (Rb) is fairly well absorbed from food. There is no evidence that Rb is toxic to man. Phosphorus (P) is an essential mineral which is naturally present in many foods and available as a dietary supplement. Phosphorus is a component of bones, teeth, DNA, and RNA (Heaney, 2101). Phosphorus is available in dietary supplements containing only phosphorus, supplements containing phosphorus in combination with other ingredients, and a few multivitamin and multimineral products (National Institutes of Health, 2019). Manganese (Mn) is an essential trace element that is naturally present in many foods and available as a dietary supplement. Mn is an essential element for medicine use. However, excess concentrations in the body can cause toxicity. A typical dietary intake for Mn is 8.8 mg/day.

In this research, ten different peas from Nyaung Oo area (drought) in upper Myanmar were analyzed by the energy dispersive X-ray fluorescence (EDXRF) spectrometer in order to investigate the elements contained in the peas and to determine their elemental concentrations. The fundamental parameter (FP) method was used to determine the concentration of elements that contained in the sample.



Pe-singon [*Cajanus Cajan (L.) Millsp*] (P1)

Pe-gya [*Phaseolus Lunatus L.*] (P2)

Bocate [*Vigna unguiculata (L.) Walp.*] (P3)

Myay-pe [*Arachis Hypogaea L*] (P4)

Pe-boke [*Glycine Max (L.) Merr.*] (P5)

Pe-sa-u [*Pisum Sativum L.*] (P6)

Sultani [*Phaseolus Lunatus L.*] (P7)

Mat-pe [*Vigna Mungo (L.) Hepper.*] (P8)

Pe-disein [*Vigna Radiata (L.) Wilczek.*] (P9)

Pe-gyi [*Lablab Purpureus (L.) Sweet.*] (P10)

Figure 1 Photos of ten different peas

The peas grown in Nyaung Oo region of Myanmar including Pe-singon [*Cajanus Cajan (L) Millsp*], Pe-gya [*Phaseolus Lunatus L.*], Bocate [*Vigna unguiculata (L.) Walp.*], Myay-pe [*Arachis Hypogaea L*], Pe-boke [*Glycine Max (L.) Merr.*], Pe-sa-u [*Pisum Sativum L.*], Sultani [*Phaseolus Lunatus L.*], Mat-pe [*Vigna Mungo (L.) Hepper.*], Pe-disein [*Vigna Radiata (L.) Wilczek.*] and Pe-gyi [*Lablab Purpureus (L.) Sweet.*]were used as raw materials. These ten pea samples were orderly denoted as P1, P2, P3, P4, P5, P6, P7, P8, P9 and P10 as shown in Figure 1 respectively. The samples were prepared at Universities' Research Centre (URC), University of Yangon. Firstly, the peas were air dried at room temperature before investigation by EDXRF technique. Then, dry peas were grinded by agate motor and pestle until to get fine powders. The fine powders were made as pallets having a 2.5 cm diameter.

After that, the samples were placed in the sample holder covered with cylindrical shape Miller sheet and the chambers of equipment were pumped up to vacuum by using Liquid Nitrogen. Sixteen samples were measured at one time of EDXRF running conditions. The measuring time for one sample was 100 s in vacuum condition.

Comparative studies of various peas of interests were undertaken using Shimadzu EDX-700 spectrometer manufactured by Shimadzu Corporation in Japan. Both of the qualitative and quantitative data of peas samples were conducted by the EDX–700 software based on the carbon-hydro (CH) compound balance method. The data showed the relative concentrations of elements contained in the samples of analysis. Rhodium (Rh) target X-ray tube, sample holder and chamber, Si (Li) detector kept at liquid nitrogen temperature (77 K), Multi-Channel Analyzer (MCA) attached to the computer were composed as an X-ray detecting system. Shimadzu EDX-700 software selected the measurement conditions to get quantitative and qualitative results from peas samples.

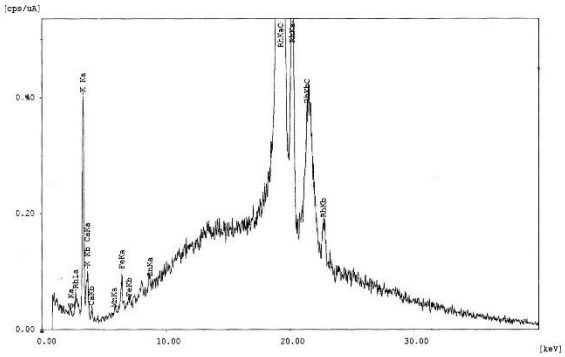
## Results and Discussion

The EDXRF spectra of pea samples and their graphs representing the qualitative and semi-quantitative results of each pea were shown in Figures 2 and 3. According to EDXRF analysis, the elements starting the atomic number 14 to the ending 38 including phosphorus ($_{15}$P), sulphur ($_{16}$S), potassium ($_{19}$K), calcium ($_{20}$Ca), manganese ($_{24}$Mn), iron ($_{26}$Fe), zinc ($_{30}$Zn), rubidium ($_{37}$Rb) and strontium ($_{38}$Sr) were detected. In sample 1 (Pe-singon), K was maximum and the other minerals such as S and Ca and Fe, Mn and Zn were also found except Rb, Sr and P. In sample 2 (Pe-gya), K, Ca, S, Mn, Fe, Zn and Rb minerals except P and Sr were observed. Maximum elemental concentration in Pe-gya was K. Similarly in sample 2, K, Ca and S were mainly contained in sample 3, Bocate. On the other hand, Sr and P were not detected. In sample 4 (Myay-pe), the main occurring minerals was Fe and the other trace elements were observed except P,S, K, Sr. In sample 5 (Pe-boke), K concentration was found out to be maximum and all other trace levels of minerals including S, Ca, Mn, Fe, Zn, Rb and Sr except P. In sample 6 (Pe-sa-u), only five minerals such as S, K, Ca, Fe, and Rb except P, Mn, Zn and Sr were contained. In sample 7 (Sultani), K, S and Ca were mainly contained and all other trace levels of minerals except P, Zn and Sr were not observed. In sample 8 (Mat-pe), the maximum trace level was K and second trace level was P. The other element such as Ca, Fe, Zn and Rb were also found except S, Mn and Sr. In sample 9 (Pe-disein), K, S and Ca were mainly contained. However, P, Mn, Rb and Sr were not observed. In sample 10 (Pe-gyi), K was the highest than any other minerals. In addition, Ca, Mn, Fe, Zn and Rb were also contained except P, S and Sr.

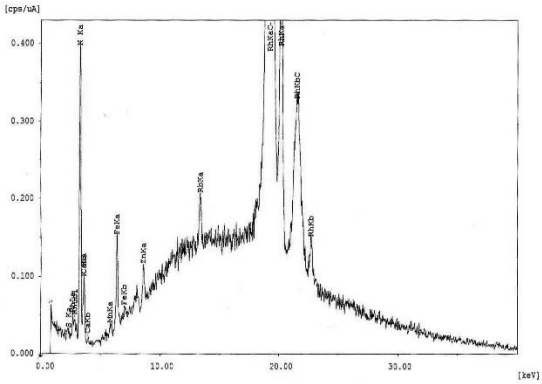
All elemental concentrations of each sample were compared in Figure 4. The phosphorus (P) was only found in P8 (Mat-pe). In contrast, P does not contain in all other pea samples. For the sulphur (S) content, they were found out in different seven pea samples such as P1, P2, P3, P5, P6, P7 and P9. On the other hand, S does not contain in P4, P8 and P10. However, the concentration distributions of sulphur (S) in these pea samples are not much different from average value. Potassium (K) contents were found in all pea samples of interest except P4 (Myay-pe). Among them, K content in P5 (Pe-boke) sample was the highest and that in P8 (Mat-pe) sample was the lowest. However, the concentration distributions of potassium (K) in these pea samples were not much different from average value.

Calcium (Ca) content was found in all pea samples. Among them, the highest concentration was found in Pe-boke (P5) and the lowest was occurred in Myay-pe (P4). But the concentration distributions of Ca in these pea samples are not much different from average value except Pe-boke (P5) sample. Manganese (Mn) content was found in all pea

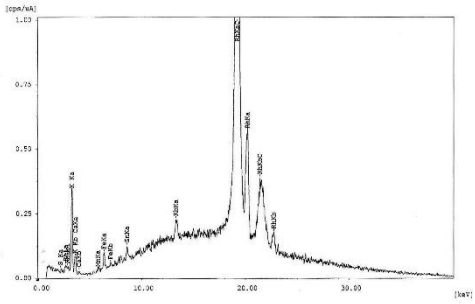
samples of interest except Pe-sa-u (P6), Mat-pe (P8) and Pe-disein (P9) samples. Among them, it was found that manganese (Mn) content in Pe-gyi (P10) sample was the highest and that in Pe-singon (P1) sample was the lowest. But the concentration distributions of manganese (Mn) in these pea samples were not much different from average value.



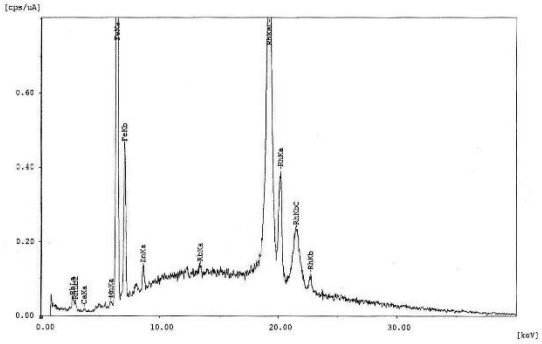
Pe-singon [*Cajanus Cajan (L) Millsp*] (P1)



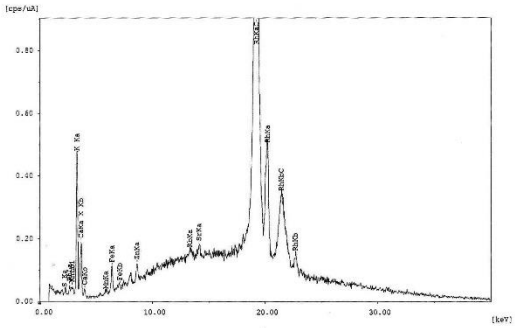
Pe-gya [*Phaseolus Lunatus L.*] (P2)



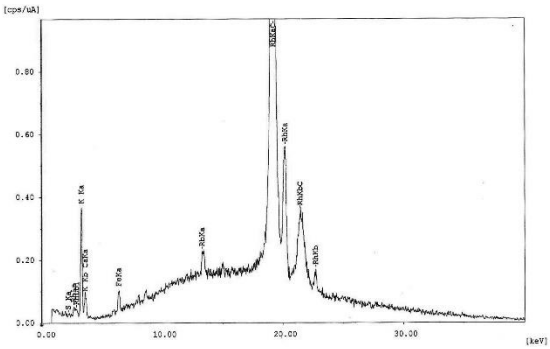
Bocate [*Vigna unguiculata (L.) Walp.*] (P3)



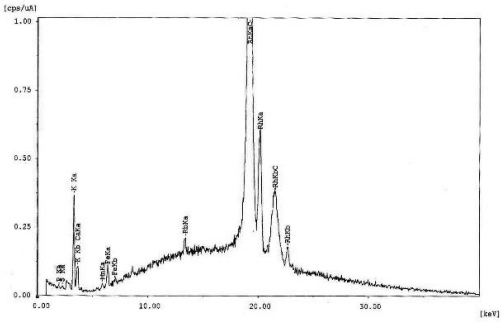
Myay-pe [*Arachis Hypogaea L*] (P4)



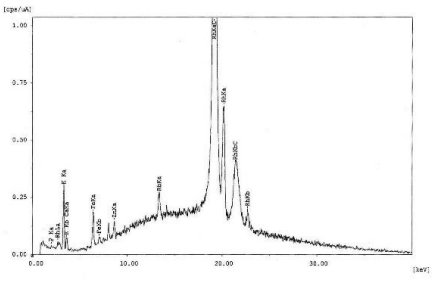
Pe-boke [*Glycine Max (L.) Merr*.] (P5)



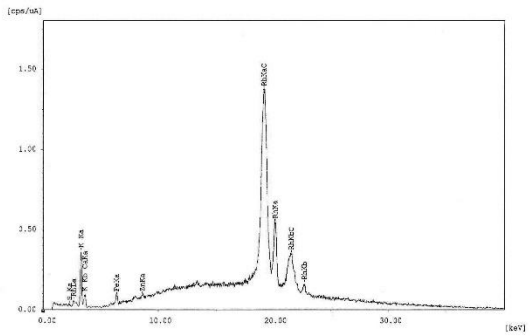
Pe-sa-u [*Pisum Sativum L.*] (P6)



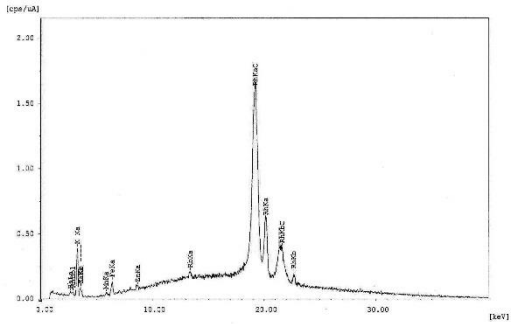
Sultani [*Phaseolus Lunatus L.*] (P7)



Mat-pe [*Vigna Mungo (L.) Hepper*.] (P8)

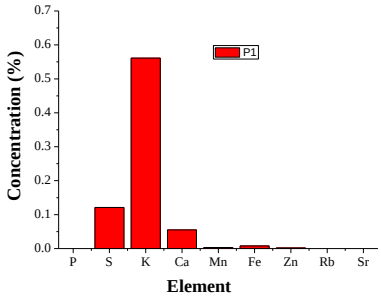


Pe-disein [*Vigna Radiata (L.) Wilczek*.] (P9)

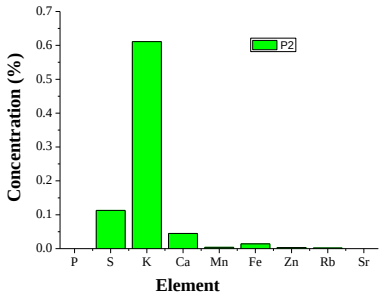


Pe-gyi [*Lablab Purpureus (L.) Sweet.*] (P10)

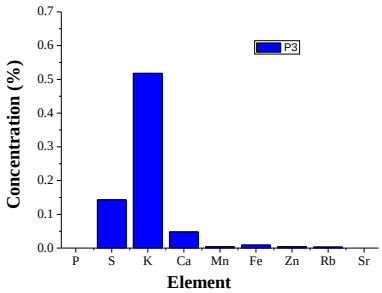
Figure 2 EDXRF spectra of different peas (P1 to P10)



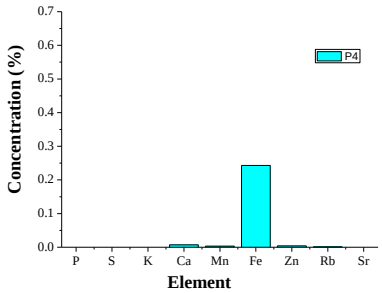

Pe-singon [*Cajanus Cajan (L) Millsp*] (P1)



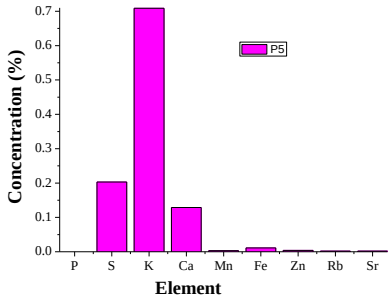

Pe-gya [*Phaseolus Lunatus L.*] (P2)



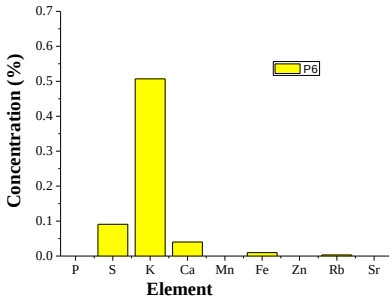

Bocate [*Vigna unguiculata (L.) Walp.*] (P3)



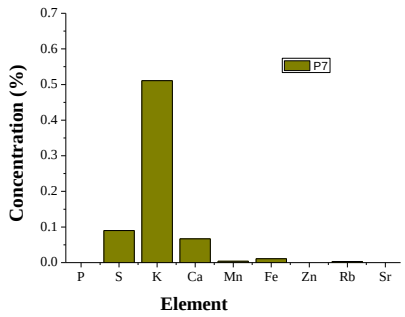

Myay-pe [*Arachis Hypogaea L*] (P4)



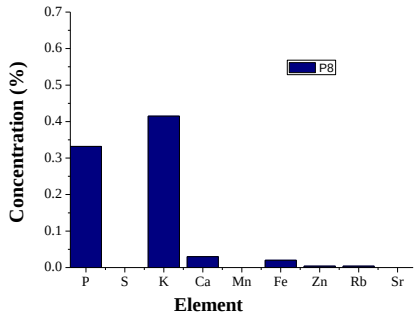

Pe-boke [*Glycine Max (L.) Merr*.] (P5)



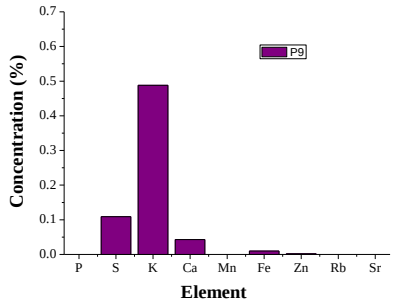

Pe-sa-u [*Pisum Sativum L.*] (P6)



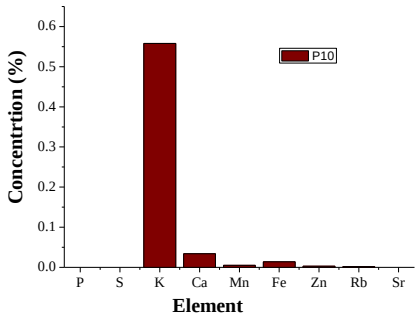

Sultani [*Phaseolus Lunatus L.*] (P7)




Mat-pe [*Vigna Mungo (L.) Hepper*.] (P8)




Pe-disein [*Vigna Radiata (L.) Wilczek*.] (P9)




Pe-gyi [*Lablab Purpureus (L.) Sweet.*] (P10)

Figure 3 Elemental concentration of various peas samples

Iron (Fe) content was found in all pea samples of interest. Among them, it was found that iron (Fe) content in Myay-pe (P4) sample was the highest and that in Pe-singon (P1) sample was the lowest. But the concentration distributions of iron (Fe) in these pea samples were not much different from average value except Myay-pe (P4) sample.

Zinc (Zn) content was found in all pea samples of interest except Pe-sa-u (P6) and Sultani (P7) samples. Among them, it was found that Zn content in Pe-boke (P5) sample was the highest and that in Pe-singon (P1) sample was the lowest. However, the concentration distributions of Zn in these pea samples were not much different from average value. Rubidium (Rb) content was found in all pea samples except Pe-singon (P1) and Pe-disein (P9) samples. Among them, it was found that Rb content in Mat-pe (P8) sample was the highest and that in Pe-gya (P2) sample was the lowest. But the concentration distributions of Rb in these pea samples were not much different from average value.

According to the Figure 5, content of carbon-hydrogen (CH) compound was found in all pea samples. Among them, it was the highest in Myay-pe (P4) sample and that in Pe-boke (P5) sample was the lowest. However, the concentration distributions of carbon-hydrogen (CH) compound in these pea samples are not much different from average value.

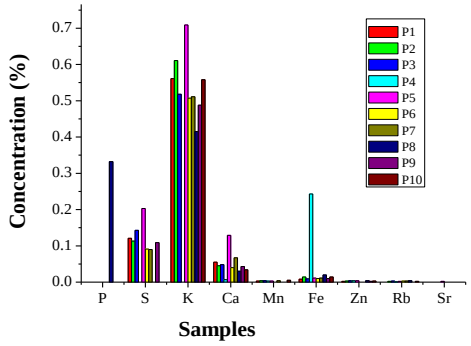



Figure 4 Comparative elemental concentration graph of various peas samples

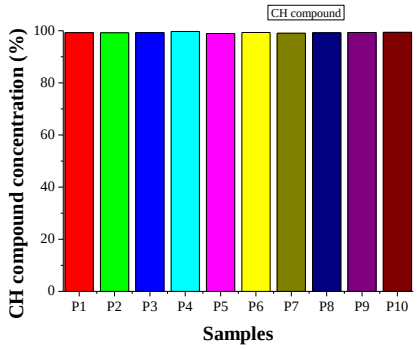



Figure 5 CH compound concentration graph of various peas samples

## Conclusions

The elemental concentrations of ten different peas grown in Nyaung Oo region were investigated by EDXRF technique. The qualitative results of the elements contained in each pea and the amount of their concentration, semi-quantitative results, were shown in this paper. By balancing the hydrogen-carbon (CH) compound methods, the results were comparatively presented. According to results, the essential minerals required for human beings such as potassium (K), calcium (Ca), zinc (Zn) were rich in Pe-singon, Pe-gya, Bocate, Pe-boke, Mat-pe, Pe-disein and Pe-gyi respectively. Potassium (K) does not contain in Myay-pe, however, iron (Fe) was the highest content in Myay-pe than any other peas. Therefore, the Myay-pe grown in Nyaung Oo (drought) was very good to support the hemoglobin. Mat-pe was very rich of phosphorus (P). Out of all elements contained in the samples of interest Fe, Mn and Zn are essential elements for human being; K, Ca, P and S can support the nutrition. It was remarkable to note that toxic heavy metals such as arsenic (As), mercury (Hg), cadmium (Cd) and lead (Pb) and copper (Cu) were not observed in all peas samples of interests.

## Acknowledgements

We sincerely thank to Prof. Dr Ni Ni Oo, Rector of Myeik University, for her permission to carry out this work. We do acknowledge to Prof. Dr Win Win Than, Pro-rector, Myeik University, for her encouragement to perform this research. We do specially thank to all of our teachers from the Department of Physics for their interesting and fruitful discussion for the research.

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# Construction of Orthonormal Bases

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## Abstract

Firstly, we provided some basic definitions and theorems on normed spaces and inner-product spaces with their properties. And then we also started some basic definitions and theorems on Hilbert spaces, which we need in this paper. Then, we presented an introduction to the concepts of orthogonal, studying the orthonormal system on Hilbert spaces. Moreover, we also examined the orthonormal bases on Hilbert spaces.

**Keywords:** normed space, inner product space, orthogonal, orthonormal, base

## Introduction

In this paper, we stated the definitions of orthogonal, orthonormal vectors, Gram-Schmidt orthogonalization process, methods of finding the orthonormal basis in Hilbert spaces. The well-known theorems will not be proved. The following definitions, theorems, and examples in this chapter are used by [1] and [4].

**Definition.** Let $X(F)$ be an inner product space and $\alpha, \beta \in X$.

$\alpha$ is said to be ***orthogonal*** to $\beta$ if $\langle \alpha, \beta \rangle = 0$.

$\alpha$ is orthogonal to $\beta \Leftrightarrow \langle \alpha, \beta \rangle = 0$

$\Leftrightarrow \langle \beta, \alpha \rangle = \overline{\langle \alpha, \beta \rangle} = 0$

$\Leftrightarrow \beta$ is orthogonal to $\alpha$.

So, we say that $\alpha, \beta \in X$ are orthogonal, if and only if, $\langle \alpha, \beta \rangle = 0$.

If $\overline{0} \in X$ is the zero vector then $\langle \overline{0}, \alpha \rangle = 0$ for all $\alpha \in X$. Therefore the zero vector is orthogonal to every vector in $X$ and $\overline{0}$ is the only vector in $X$ with this property.

Since $0 = \langle \overline{0}, \overline{0} \rangle$ for $\overline{0} \in X$, the zero vector in $X$ is orthogonal to itself.

**Theorem.**

If the vectors $\alpha, \beta$ of an inner product space $X(F)$ are orthogonal then (1) $a\alpha$ is orthogonal to $\beta$ and (2) $\alpha$ is orthogonal to $a\beta$ for any $a \in F$.

**Proof. See [1]**

**Theorem.**

The vectors $\alpha, \beta$ of a real inner product space $X(F)$ are orthogonal if and only if,

$\| \alpha + \beta \|^2 = \| \alpha \|^2 + \| \beta \|^2$.

**Proof. See [1]**

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**Orthonormal Sets of Inner Product Space**

**Definition.** Let $S$ be a non-empty subset of an inner product space $X(F)$. The set $S$ is said to be an ***orthogonal set*** if every pair of distinct vectors are orthogonal. Or, $S \subset X$ is an ***orthogonal set*** if

$\langle \alpha_i, \alpha_j \rangle = 0$, for all $\alpha_i$ , $\alpha_j \in S$ and $i \neq j$.

**Definition.** Let $S$ be a non-empty subset of an inner product space $X(F)$. The set $S$ is said to be an ***orthonormal set*** if (i) $\| \alpha_i \| = 1$ for each $\alpha_i \in S$ and (ii) $\langle \alpha_i, \alpha_j \rangle = 0$ for $\alpha_i, \alpha_j \in S$, $i \neq j$. $S \subset X$ is an ***orthonormal set*** if $\langle \alpha_i, \alpha_j \rangle = 1$ for $i = j$ and $\langle \alpha_i, \alpha_j \rangle = 0$ for $i \neq j$ where $\alpha_i, \alpha_j \in S$. That is $\langle \alpha_i, \alpha_j \rangle = \delta_{ij}$ (Kronecker delta)$S \subset X$ is an ***orthonormal set*** if and only if $S$ contains mutually orthogonal unit vectors. An ***orthonormal set*** is an orthogonal set with the property that each vector is of length 1. An orthonormal set does not contain a zero vector.

**Example (1).**

If $\alpha \in X$ is a nonzero vector then $\frac{1}{\| \alpha \|}\alpha$ is a unit vector. Therefore $\left\{ \frac{1}{\| \alpha \|}\alpha \right\}$ is an orthonormal set in $X$. Thus, every inner product space has an orthonormal subset.

(2) The standard basis of the inner product space $R^3$ or $X_3$ $(R)$ is the set

$\{e_1 = (1, 0, 0), e_2 = (0, 1, 0), e_3 = (0, 0, 1)\}$.

Then $\| e_1 \| = 1$, $\| e_2 \| = 1$, $\| e_3 \| = 1$ and

$\langle e_1, e_2 \rangle = 0$, $\langle e_2, e_3 \rangle = 0$, $\langle e_1, e_3 \rangle = 0$.

Thus the standard basis forms an orthonormal set.

**Theorem.**

In an inner product space, an orthogonal set of non-zero vectors is linearly independent.

**Proof. See[3]**

**Corollary.** In an inner product space, any orthonormal set of vectors is linearly independent.

**Corollary.** If $S$ is an orthonormal set of vectors of an inner product space $X(F)$, then

$\beta = a_1 \alpha_1 + a_2\alpha_2 + \ldots + a_n\alpha_n \Rightarrow a_i = \langle \beta, \alpha_i \rangle$ for $i = 1, 2, \ldots, n$.

**Theorem.**

Let $X(F)$ be an inner product space and $S = \{\alpha_1, \ldots, \alpha_m\}$ be an orthogonal subset of $X$ consisting non-zero vectors. If $\beta \in$ span

$S = L(S)$ then $\beta = \sum_{i=1}^{m} \frac{\langle \beta, \alpha_i \rangle}{\| \alpha_i \|^2} \alpha_i$.

**Proof.See[3]**

**Corollary.** Let $X(F)$ be an inner product space and $S = \{\alpha_1, \alpha_2, \ldots, \alpha_m\}$ be an orthonormal subset of $X$. If $\beta \in$ span $S = L(S)$ then $\beta = \sum_{i=1}^{m} \langle \beta, \alpha_i \rangle \alpha_i$.

**Proof. See[3]**

**Theorem.**

If $\{\alpha_1, \alpha_2, \ldots, \alpha_n\}$ is an orthonormal set in an inner product space $X(F)$ and $\beta \in X$ then $r = \beta - \langle \beta, \alpha_1 \rangle \alpha_1 - \langle \beta, \alpha_2 \rangle \alpha_2 \ldots - \langle \beta, \alpha_n \rangle \alpha_n$ is orthogonal to each of $\alpha_1, \alpha_2, \ldots, \alpha_n$.

**Proof. See[3]**

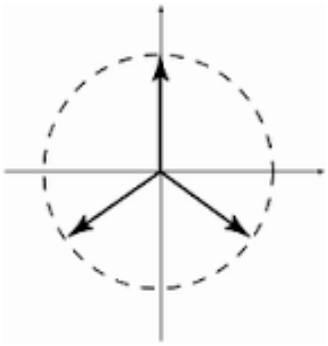


**Figure.(1) .Orthonormal bases**

We consider the set of three-dimensional vectors,

$S = \left\{ \left( \frac{1}{3}, -\frac{2}{3}, -\frac{2}{3} \right), \left( \frac{2}{3}, -\frac{1}{3}, \frac{2}{3} \right), \left( \frac{2}{3}, \frac{2}{3}, \frac{-1}{3} \right) \right\}$ is an orthonormal set in $R^3$ with a standard products.

We have to take

$$\alpha = \left[ \frac{1}{3}, -\frac{2}{3}, -\frac{2}{3} \right], \ \beta = \left[ \frac{2}{3}, -\frac{1}{3}, \frac{2}{3} \right], \ \gamma = \left[ \frac{2}{3}, \frac{2}{3}, -\frac{1}{3} \right].$$

$$\| \alpha \| = \sqrt{\frac{1}{9} + \frac{4}{9} + \frac{4}{9}} = 1, \ \| \beta \| = \sqrt{\frac{4}{9} + \frac{1}{9} + \frac{4}{9}} = 1,$$

$$\| \gamma \| = \sqrt{\frac{4}{9} + \frac{4}{9} + \frac{1}{9}} = 1,$$

$$\langle \alpha, \beta \rangle = \frac{2}{9} + \frac{2}{9} - \frac{4}{9} = 0, \langle \beta, \gamma \rangle = \frac{4}{9} - \frac{2}{9} - \frac{2}{9} = 0$$

and $\langle \gamma, \alpha \rangle = \frac{2}{9} - \frac{4}{9} + \frac{2}{9} = 0.$

Therefore, $S$ is an orthonormal set.

**Gram-Schmidt Orthogonalisation Process**

For a vector space, we have seen earlier the special role of basis. We have learned that, if $S$ is a basis of vector space $X(F)$ then $S$ is linearly independent and $L(S) = X$.

**Definition.** A basis of an inner product space $X(F)$ which is also orthonormal is called the ***"orthonormal basis"*** of the inner product space.

**Example**

**(1).** The basis $S = \{(1, 0), (0, 1)\}$ of an inner product space $R^2(R)$ is also orthonormal. So, $S$ is an orthonormal basis of $R^2(R)$.

**(2).** The basis $S = \{(1, 0, 0), (0, 1, 0), (0, 0, 1)\}$ of the inner product space $R^3(R)$ is also orthonormal. So, $S$ is an orthonormal basis of $R^3(R)$.

**(3).** For the inner product space $R^2(R)$, $\alpha\langle x, z\rangle + \beta\langle y, z\rangle$ is also an orthonormal basis.

**Definition.** A finite-dimensional vector space, in which an inner product is defined is called ***a finite-dimensional inner product space***.

We now establish that every finite-dimensional inner product space possesses an orthonormal basis. If $S$ is a basis of the finite-dimensional inner product space $X(F)$, we construct an orthonormal set $S'$ from $S$ such that $L(S) = L(S') = X$.

**Example.**

Let $X_2(F)$ be a 2-dimensional inner product space and $S = \{\beta_1, \beta_2\}$ be a basis. Then $S$ is linearly independent and $L(S) = X$.

Consider $S' = \{\alpha_1, \alpha_2\}$ where $\alpha_1 = \beta_1$ and $\alpha_2 = \beta_2 - a\ \beta_1$ where $a \in F$ chosen such that $\alpha_2$ is orthogonal to $\beta_1$. Then $0 = \langle \alpha_2, \beta_1\rangle = \langle \beta_2 - a\beta_1, \beta_1\rangle = \langle \beta_2, \beta_1\rangle - a\langle \beta_1, \beta_1\rangle$

$a = \dfrac{\langle \beta_2, \beta_1\rangle}{\langle \beta_1, \beta_1\rangle} = \dfrac{\langle \beta_2, \beta_1\rangle}{\|\beta_1\|^2}$. Thus $S' = \left\{\beta_1, \beta_2 - \dfrac{\langle \beta_2, \beta_1\rangle}{\|\beta_1\|^2}\beta_1\right\}$ is an orthogonal set of non-zero vectors such that $L(S) = L(S') = X$. Observe that each vector in $S' = \{\alpha_1, \alpha_2\}$ is a linear combination of $\beta_1$, $\beta_2$ of $S$.

**Theorem.**

Every finite-dimensional inner product space has an orthonormal basis.

**Proof. See[4]**

**Working Method for Finding Orthogonal Basis**

Let $\{\beta_1, \beta_2, \ldots, \beta_n\}$ be the given L.I basis of $X(F)$.

The ***orthogonal basis*** of $X(F)$, namely $\{\gamma_1, \gamma_2, \ldots, \gamma_n\}$ is given by the following relations:

$$\gamma_1 = \beta_1, \gamma_2 = \beta_2 - \frac{\langle \beta_2, \gamma_1\rangle}{\|\gamma_1\|^2}\gamma_1,$$

$$\gamma_3 = \beta_3 - \frac{\langle \beta_3, \gamma_1\rangle}{\|\gamma_1\|^2}\gamma_1 - \frac{\langle \beta_3, \gamma_2\rangle}{\|\gamma_2\|^2}\gamma_2, \ldots$$

$$\gamma_n = \beta_n - \frac{\langle \beta_n, \gamma_1 \rangle}{\| \gamma_1 \|^2} \gamma_1 - ..... - \frac{\langle \beta_n, \gamma_{n-1} \rangle}{\| \gamma_{n-1} \|^2} \gamma_{n-1}.$$

**Working Method for Finding Orthonormal Basis**

Let $\{\beta_1, \beta_2, \ldots, \beta_n\}$ be a given basis of a finite-dimensional inner product space $X(F)$. The vectors $\alpha_1, \alpha_2, \ldots, \alpha_n$ of the ***orthonormal basis*** of $X(F)$ are given by

$\alpha_1 = \dfrac{\beta_1}{\| \beta_1 \|}$, $\alpha_2 = \dfrac{\gamma_2}{\| \gamma_2 \|}$ where $\gamma_2 = \beta_2 - \langle \beta_2, \alpha_1 \rangle \ \alpha_1$, $\alpha_3 = \dfrac{\gamma_3}{\| \gamma_3 \|}$ where

$\gamma_3 = \beta_3 - \langle \beta_3, \alpha_1 \rangle \alpha_1 - \langle \beta_3, \alpha_2 \rangle \alpha_2, \ldots, \alpha_n = \dfrac{\gamma_n}{\| \gamma_n \|}$ where

$\beta_n = \beta_n - \langle \beta_n, \alpha_1 \rangle \alpha_1 - \langle \beta_n - \alpha_2 \rangle \alpha_2 - \cdots - \langle \beta_n, \alpha_{n-1} \rangle \alpha_{n-1}.$

**Example.**

Given {(2, 1, 3), (1, 2, 3), (1, 1, 1)} is a basis of $R^3$; construct an orthonormal basis.

We have to consider, $\beta_1 = (2, 1, 3)$, $\beta_2 = (1, 2, 3)$, $\beta_3 = (1, 1, 1)$.

By Gram-Schmidt orthogonalization process, an orthonormal basis = $\{\alpha_1, \alpha_2, \alpha_3\}$ is given by $\alpha_1 = \dfrac{\beta_1}{\| \beta_1 \|}$, $\alpha_2 = \dfrac{\gamma_2}{\| \gamma_2 \|}$ where $\gamma_2 = \beta_2 - \langle \beta_2, \gamma_1 \rangle \alpha_1$ and $\alpha_3 = \dfrac{\gamma_3}{\| \gamma_3 \|}$ where

$$\gamma_3 = \beta_3 - \langle \beta_2, \alpha_1 \rangle \alpha_1 - \langle \beta_3, \alpha_2 \rangle \alpha_2. = \left[ \frac{2}{\sqrt{14}}, \frac{1}{\sqrt{14}}, \frac{3}{\sqrt{14}} \right],$$

$$\langle \beta_2, \alpha_1 \rangle = 1 \cdot \frac{2}{\sqrt{14}} + 2 \cdot \frac{1}{\sqrt{14}} + 3 \frac{3}{\sqrt{14}} = \frac{13}{\sqrt{14}},$$

$$\gamma_2 = (1, 2, 3) - \frac{13}{\sqrt{14}} \left[ \frac{2}{\sqrt{14}}, \frac{1}{\sqrt{14}}, \frac{3}{\sqrt{14}} \right] = \left[ -\frac{12}{14}, \frac{15}{14}, \frac{3}{14} \right],$$

$$\| \gamma_2 \|^2 = \langle \gamma_2, \gamma_2 \rangle = \left[ -\frac{12}{14} \right]^2 + \left[ \frac{15}{14} \right]^2 + \left[ \frac{3}{14} \right]^2 = \frac{378}{196}.$$

Therefore $\alpha_2 = \dfrac{1}{\| \gamma_2 \|} \gamma_2 = \dfrac{14}{\sqrt{378}} \left[ -\dfrac{12}{14}, \dfrac{15}{14}, \dfrac{3}{14} \right] = \left[ -\dfrac{12}{\sqrt{378}}, \dfrac{15}{\sqrt{378}}, \dfrac{3}{\sqrt{378}} \right].$

$$\langle \beta_3, \alpha_1 \rangle = \quad 1.\frac{2}{\sqrt{14}} + 1.\frac{1}{\sqrt{14}} + 1.\frac{3}{\sqrt{14}}$$

$$= \frac{6}{\sqrt{14}}.$$

$$\langle \beta_3, \alpha_2 \rangle = \quad 1.\frac{-12}{\sqrt{378}} + 1.\frac{15}{\sqrt{378}} + 1.\frac{3}{\sqrt{378}} \quad = \frac{6}{\sqrt{378}}.$$

$$\gamma_3 = (1,1,1) - \frac{6}{\sqrt{14}}\left[\frac{2}{\sqrt{14}}, \frac{1}{\sqrt{14}}, \frac{3}{\sqrt{14}}\right] - \frac{6}{\sqrt{378}}\left[-\frac{12}{\sqrt{378}}, \frac{15}{\sqrt{378}}, \frac{3}{\sqrt{378}}\right]$$

$$= (1,1,1) - \left[\frac{12}{14}, \frac{6}{14}, \frac{18}{14}\right] - \left[-\frac{72}{378}, \frac{90}{378}, \frac{18}{378}\right] = \left[\frac{126}{378}, \frac{126}{378}, -\frac{126}{378}\right] = \left[\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}\right].$$

$$\|\gamma_3\|^2 = \langle \gamma_3, \gamma_3 \rangle$$

$$= \left[\frac{1}{3}\right]^2 + \left[\frac{1}{3}\right]^2 + \left[-\frac{1}{3}\right]^2 = \frac{1}{3}.$$

$$\alpha_3 = \frac{1}{\|\gamma_3\|}\gamma_3 = \sqrt{3}\left[\frac{1}{3}, \frac{1}{3}, -\frac{1}{3}\right] = \left[\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}\right].$$

Hence orthonormal basis is $\left\{\begin{array}{l}\left[\frac{2}{14}, \frac{1}{\sqrt{14}}, \frac{3}{\sqrt{14}}\right], \left[-\frac{12}{\sqrt{378}}, \frac{15}{\sqrt{378}}, \frac{3}{\sqrt{378}}\right], \\ \left[\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}\right].\end{array}\right\}$

**Example.**

To find an orthonormal basis of a vector space $X(R)$ of all real polynomials of degree not greater than 2, in which the inner product is defined as

$$\langle f(x), g(x) \rangle = \int_0^1 f(x)\, g(x)\, dx, \forall f(x), g(x) \in X \quad \text{and} \quad x \in [0, 1],$$

from a given basis $\{1, x, x^2\}$.

**Theorem.**

If $X(F)$ is a non-zero finite-dimensional inner product space of dimension in then $\gamma = \sum_{i=1}^{n} \langle \gamma, \alpha_i \rangle \alpha_i$ where

$\alpha_1, \alpha_2, \ldots, \alpha_n, \gamma \in X.$

**Proof. See [4]**

**Definition (Fourier Coefficients).** If $B$ is an orthonormal basis of a finite-dimensional inner product space $X(F)$ and $\beta \in X$ then the ***Fourier coefficients*** of $\beta$ relative to basis $B$ are the scalars $\langle \beta, \alpha \rangle$ where $\alpha \in B$.

**Example.**

Let $\mathrm{B} = \left\{\left[\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right], \left[\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right]\right\}$ be an orthonormal basis of $R^2(R)$.

Then the Fourier coefficients of $\beta = (3, 4) \in R^2$ relative to $B$ are as below:

Let $\alpha_1 = \left[\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right]$ and $\alpha_2 = \left[\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right]$.

The Fourier coefficients of $\beta$ with respect to $B$ are $\langle\beta, \alpha_1\rangle$ and $\langle\beta, \alpha_2\rangle$.

$$\langle\beta,\alpha_1\rangle = 3\left[\frac{1}{\sqrt{2}}\right] + 4\left[\frac{1}{\sqrt{2}}\right] = \frac{7}{\sqrt{2}};$$

$$\langle\beta,\alpha_2\rangle = 3\left[\frac{1}{\sqrt{2}}\right] + 4\left[\frac{-1}{\sqrt{2}}\right] = -\frac{1}{\sqrt{2}}.$$

**Bessel's Inequality and Parseval's Identity**

**(Bessel's inequality).** If $S = \{\alpha_1, \alpha_2, \ldots, \alpha_n\}$ is any orthonormal subset in an inner product space $X(F)$ and $\beta$ is any vector in $X$, then $\sum_{i=1}^{n} |\langle\beta,\alpha_i\rangle|^2 \le \|\beta\|^2$ .Further equality holds if and only if $\beta$ is in the subspace generated by $\{\alpha_1, \alpha_2, \ldots, \alpha_n\}$ or if and only if $\{\alpha_1, \alpha_2, \ldots, \alpha_n\}$ is a basis for $X$.

If $S = \{\alpha_1, \alpha_2, \ldots, \alpha_n\}$ be an orthogonal set of non-zero vectors in an inner product space $X(F)$ and $\beta$ any vector in $X$, then

$$\sum_{i=1}^{n} \frac{|\langle\beta,\alpha_i\rangle|^2}{\|\alpha_i\|^2} \le \|\beta\|^2.$$

**(Parseval's Identity).** If $B = \{\alpha_1, \alpha_2, \ldots, \alpha_n\}$ be an orthonormal basis of a finite dimensional inner product space $X(F)$ then $\langle\alpha,\beta\rangle = \sum_{i=1}^{n} \langle\alpha,\alpha_i\rangle\langle\alpha_i,\beta\rangle$ for all $\alpha, \beta \in X$.

**Example.**

In $R^4(R) = X_4(R)$ if (1, 0, 1, 1), (–1, 0, –1, 1), (0, –1, 1, 1) are three linearly independent vectors, then we want to compute the orthonormal set of these vectors. So, we have to put

$\beta_1 = (1, 0, 1, 1)$, $\beta_2 = (-1, 0, -1, 1)$, $\beta_3 = (0, -1, 1, 1)$.

If $\alpha_1$, $\alpha_2$, $\alpha_3$ are the orthonormal vectors then $\alpha_1 = \frac{\beta_1}{\|\beta_1\|}$, $\alpha_2 = \frac{\gamma_2}{\|\gamma_2\|}$ where

$\gamma_2 = \beta_2 - \langle\beta_2,\alpha_1\rangle\alpha_1$ and $\alpha_3 = \frac{\gamma_3}{\|\gamma_3\|}$ where $\gamma_3 = \beta_3 - \langle\beta_3 - \alpha_1\rangle\alpha_1 - \langle\beta_3,\alpha_2\rangle\alpha_2$.

$\|\beta_1\|^2 = \langle\beta_1, \beta_1\rangle = 1^2 + 0^2 + 1^2 + 1^2 = 3, \|\beta_1\| = \sqrt{3}$.

Therefore, $\alpha_1 = \frac{1}{\sqrt{3}}\beta_1 = \left[\frac{1}{\sqrt{3}}, 0, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right]$,

$$\gamma_2 = \beta_2 - \langle \beta_2, \alpha_1 \rangle \alpha_1$$

$$= (-1,0,-1,1) - \left[ -\frac{1}{\sqrt{3}} + 0 - \frac{1}{\sqrt{3}} + \frac{1}{\sqrt{3}} \right] \left[ \frac{1}{\sqrt{3}},\ 0,\ \frac{1}{\sqrt{3}},\ \frac{1}{\sqrt{3}} \right]$$

$$= (-1,0,-1,1) + \left[ \frac{1}{3},\ 0,\ \frac{1}{3},\ \frac{1}{3} \right]$$

$$= \left[ -\frac{2}{3}, 0, -\frac{2}{3}, \frac{4}{3} \right].$$

$$\| \gamma_2 \| = \sqrt{\frac{4}{9} + 0 + \frac{4}{9} + \frac{16}{9}} = \sqrt{\frac{24}{9}} = \frac{2\sqrt{6}}{3}.$$

Therefore, $\alpha_2 = \dfrac{1}{\| \gamma_2 \|} \gamma_2 = \dfrac{3}{2\sqrt{6}} \left[ -\dfrac{2}{3}, 0, -\dfrac{2}{3}, \dfrac{4}{3} \right] = \left[ -\dfrac{1}{6}, 0, -\dfrac{1}{\sqrt{6}}, \dfrac{2}{\sqrt{6}} \right].$

$$\gamma_3 = \beta_3 - \langle \beta_3, \alpha_1 \rangle \alpha_1 - \langle \beta_3, \alpha_2 \rangle \alpha_2$$

$$= \beta_3 - \left[ 0 + 0 + \frac{1}{\sqrt{3}} + \frac{1}{\sqrt{3}} \right] \alpha_1 - \left[ 0 + 0 + \frac{1}{\sqrt{6}} + \frac{2}{\sqrt{3}} \right] \alpha_2$$

$$= \beta_3 - \frac{2}{\sqrt{3}} \alpha_1 - \frac{1}{\sqrt{6}} \alpha_2$$

$$= (0,-1,1,1) - \left[ \frac{2}{3}, 0, \frac{2}{3}, \frac{2}{3} \right] - \left[ -\frac{1}{6}, 0, -\frac{1}{6}, \frac{2}{6} \right]$$

$$= \left[ -\frac{3}{6}, -1, \frac{3}{6}, 0 \right] = \left[ -\frac{1}{2}, -1, \frac{1}{2}, 0 \right].$$

Therefore, $\alpha_3 = \dfrac{1}{\| \gamma_3 \|} \gamma_3 = \sqrt{\dfrac{2}{3}} \left[ -\dfrac{1}{2}, -1, \dfrac{1}{2}, 0 \right]$

$$= \left[ -\frac{1}{\sqrt{6}}, -\frac{2}{\sqrt{6}}, \frac{1}{\sqrt{6}}, 0 \right].$$

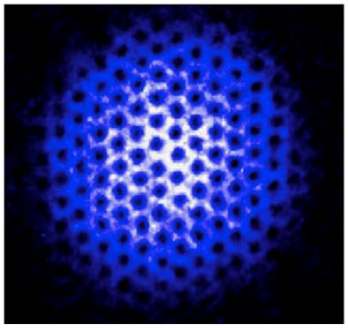
Hence,

$\{ \alpha_1, \alpha_2, \alpha_3 \} = \left\{ \left[ \dfrac{1}{3}, 0, \dfrac{1}{\sqrt{3}}, \dfrac{1}{\sqrt{3}} \right], \left[ -\dfrac{1}{\sqrt{6}}, 0, -\dfrac{1}{\sqrt{6}}, \dfrac{2}{\sqrt{6}} \right], \left[ -\dfrac{1}{\sqrt{6}}, -\dfrac{2}{\sqrt{6}}, \dfrac{1}{\sqrt{6}}, 0 \right] \right\}$ is the orthonormal sets of $\{ \beta_1, \beta_2, \beta_3 \}$.

## Conclusion

We have introduced the concept of orthogonal and gone through the basic definitions and important theorems. The real world ,of course, is in constructing orthonormal basis that can be used in applications. References (1) and (2) provide constructions of wavelet frames and windowed Fourier frames, which have already found great use in signal processing applications. The results we have presented about finite frames indicate that a normalized tight frame exhibits a great deal of symmetry, and that these finite normalized tight frames can be fully classified. The infinite dimensional analogue has not, to our knowledge, been fully explored; similar classification results for infinite dimensional normalized tight frames could give some insight into the concept of symmetry and "equidistribution" in the infinite dimensional setting.

We can extend the orthonormal bases to the frames and wavelets. Frames are useful for the field of technology and Myanmar art. Some handicrafts are used the orthonormal bases as follows;



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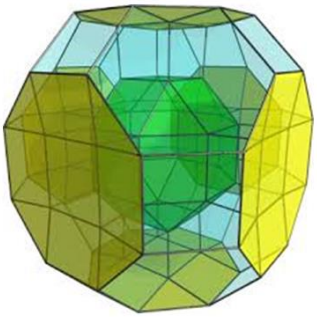

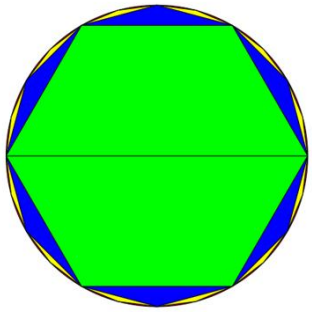

Do. Decahedron

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# A Study on Euclidean and Factorization Domains

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## Abstract

In this paper, divisibility in rings of generalized forms was described. Then some properties of Euclidean domains which will be applied to the ring of Gaussian integers and polynomial rings were discussed.

**Keywords:** Norm, Principal ideal domain, Euclidean domain, Gaussian integer, polynomial ring

## Introduction

It is well known that every Euclidean domain is a principal ideal domain. It is also usually stated that the converse is false. Commutative algebra is essentially the study of commutative rings and we shed some light on a highly important class of such rings – Euclidean domain. The following definitions are referred to [2].

**Definition.** Let $R$ be an integral domain. Any function $N : R \to \mathbb{Z}^+ \bigcup \{0\}$ with $N(0) = 0$ is called a ***norm*** on the integral domain $R$. If $N(a) > 0$ for $a \neq 0$ define $N$ to be a ***positive norm***.

The integral domain $R \subset \mathbb{C}$, the norm $N(\alpha) = \alpha\bar{\alpha} = |\alpha|^2$, which is multiplicative in the sense that $N(\alpha\beta) = N(\alpha)N(\beta)$.

**Definition.** Let $R$ be a commutative ring.

(a) For elements, $a, b \in R$, an element $d$ of $R$ is called a ***greatest common divisor*** of $a$ and $b$ if

(i) $d \mid a$ and $d \mid b$ and

(ii) if $c \mid a$ and $c \mid b$, for $c \in R$, then $c \mid d$.

(b) We say that $a$ and $b$ are ***relatively prime*** if $aR + bR = R$ or $(a, b) = 1$.

**Definition.** A ring $R$ with unit element is called a ***principal ideal ring*** if every ideal in $R$ is a principal ideal; i.e., if every ideal $A$in $R$ is generated by a single element $x$ in $R$. An integral domain which is also a principal ideal ring is called a ***principal ideal domain***.

The following theorem states that the necessary condition for a ring to be a principal ideal ring.

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**Theorem.[1]** Let $R$ be a ring. If for all pairs of nonzero elements $x$ and $y$ in $R$ with $N(x) \geq N(y)$, either $y|x$ or there exists $z$ and $w$ in $R$ with $0 < N(xz - yw) < N(y)$, then $R$ is a principal ideal ring.

**Proof:** Let $A \neq (0)$ be an ideal in $R$. Let $y$ be an element of $A$ with the minimal nonzero norm, and let $x$ be any other element of $A$. For all $z$ and $w$ in $R$, $xz - yw$ is in $A$ so that either $xz - yw = 0$ or $N(xz - yw) \geq N(y)$. Hence the assumed conditions on $R$ require that $y|x$; i.e., $A = (y)$.

The ring $R$ under consideration will now be shown to satisfy the hypotheses of theorem. Observe that $0 < N(xz - yw) < N(y)$ if and only if $0 < N[(x/y)z - w] < 1$. Given $x$ and $y$ in $R$, both nonzero and $y \nmid x$, write $x/y$ in the form $\left(a + b\sqrt{-19}\right)/c$ where $a$, $b$, $c$ are integers $(a, b, c) = 1$, and $c > 1$. First of all, assume that $c \geq 5$. Choose integers $d$, $e$, $f$, $q$, $r$ such that $ae + bd + cf = 1$, $ad - 19be = cq + r$, and $|r| \leq c/2$. Set $z = d + e\sqrt{-19}$ and $w = q - f\sqrt{-19}$. Thus,

$$(x/y)z - w = \left(a + b\sqrt{-19}\right)\left(d + e\sqrt{-19}\right)/c - \left(q - f\sqrt{-19}\right)$$

$$= r/c + \sqrt{-19}/c.$$

This complex number is not zero and has norm $\left(r^2 + 19\right)/c^2$, which is less than 1 since $|r| \leq c/2$ and $c \geq 5$. The only case that is not immediately obvious is $c = 5$, but then $|r| \leq 2$ so that $r^2 + 19 \leq 23 < c^2$.

The remaining possibilities are $c = 2$, 3, or 4. Consider these in order:

(i) If $c = 2$, $y \nmid x$ and $(a, b, c) = 1$ imply that $a$ and $b$ are of opposite parity. Set $z = 1$ and $w = \left[(a-1) + b\sqrt{-19}\right]/2$ which are elements of $R$. Thus, $(x/y)z - w = 1/2 \neq 0$ and has norm less than 1.

(ii) If $c = 3$, $(a, b, c) = 1$ implies that $a^2 + 19b^2 \equiv a^2 + b^2 \not\equiv 0 \pmod 3$. Let $z = a - b\sqrt{-19}$ and $w = q$ where $a^2 + 19b^2 = 3q + r$ with $r = 1$ or 2. Thus, $(x/y)z - w = r/3 \neq 0$ and has norm less than 1.

(iii) If $c = 4$, $a$ and $b$ are not both even. If they are of opposite parity, $a^2 + 19b^2 \equiv a^2 - b^2 \not\equiv 0 \pmod 4$. Let $z = a - b\sqrt{-19}$ and $w = q$, where $a^2 + 19b^2 = 4q + r$ with $0 < r < 4$. Thus, $(x/y)z - w = r/4 \neq 0$ and has norm less than 1. If $a$ and $b$ are both odd, $a^2 + 19b^2 \equiv a^2 + 3b^2 \not\equiv 0 \pmod 8$. Let $z = \left(a - b\sqrt{-19}\right)/2$ and $w = q$, where $a^2 + 19b^2 = 8q + r$ with $0 < r < 8$. Thus, $(x/y)z - w = r/8 \neq 0$ and has norm less than 1.

This completes the proof that $R$ is a principal ideal ring.

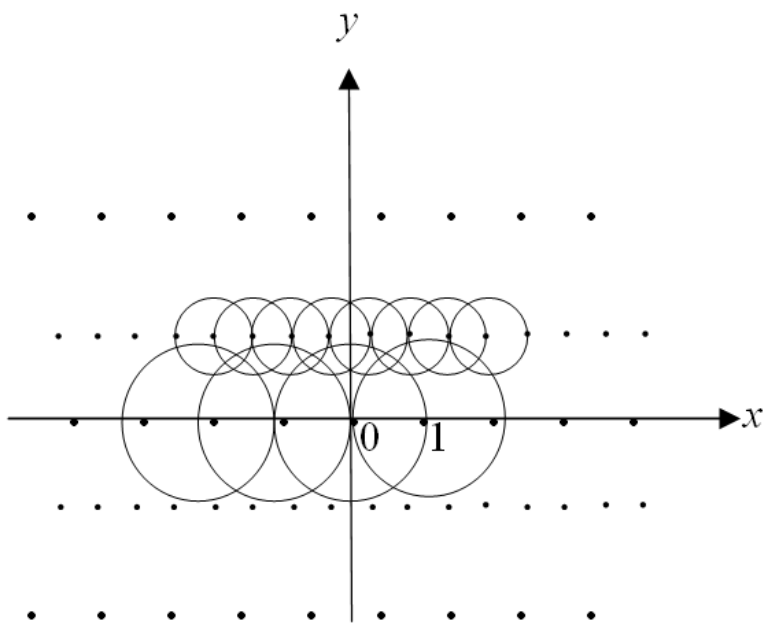


**Figure 1.** A graphical illustration of the proof that *R* is a principal ideal ring

**Definition.** Let *R* be a ring with identity. An element $\pi \in R$ is ***irreducible*** provided that $\pi$ is not a unit and if $\pi = ab$ for some $a, b \in R$ then *a* or*b* is a unit.

An element $p \in R$ is ***prime*** provided that *p* is not a unit and if $p|ab$ then $p|a$ or $p|b$.

**Example.** Ring $\mathbb{Z}/6\mathbb{Z} = \{\overline{0}, \overline{1}, \overline{2}, \overline{3}, \overline{4}, \overline{5}\}$, $\overline{3}$ is prime but it is not irreducible.

If $\overline{3}$ does not divide $\overline{1}\cdot\overline{1} = \overline{5}\cdot\overline{5} = \overline{1}$, $\overline{2}\cdot\overline{4} = \overline{4}\cdot\overline{5} = \overline{2}$, and $\overline{1}\cdot\overline{4} = \overline{2}.\overline{2} = \overline{2}.\overline{5} = \overline{4}.\overline{4} = \overline{4}$, then $\overline{3}$ is prime. On the other hand, $\overline{3}$ is not irreducible because $\overline{3} = \overline{3}\cdot\overline{5}$ and neither $\overline{3}$ nor $\overline{5}$ are units $\mathbb{Z}/6\mathbb{Z}$.

**Example.** Ring $\mathbb{Z}\left[\sqrt{10}\right] = \left\{a + b\sqrt{10} \,\middle|\, a, b \in \mathbb{Z}\right\}$, 2 is irreducible but it is not prime.

The map $N : \mathbb{Z}\sqrt{10} \to \mathbb{Z}$ given by $N\left(a + b\sqrt{10}\right) = a^2 - 10b^2$ has the properties that $N(\alpha\beta) = N(\alpha)\,N(\beta)$ for all $\alpha, \beta \in \mathbb{Z}\left[\sqrt{10}\right]$ and $N(\alpha) = \pm 1$ if and only if $\alpha$ is a unit.

Suppose that there exist $\alpha$ and $\beta$ in $\mathbb{Z}\left[\sqrt{10}\right]$ which are not units such that $2 = \alpha\beta$. Then we have $4 = N(2) = N(\alpha)\,N(\beta)$. Since $\alpha = a + b\sqrt{10}$ is not a unit, we have $N(\alpha) = a^2 - 10b^2 = \pm 2$. This shows that $a^2 \equiv \pm 2 \pmod 5$. However, neither 2 nor $-2$ is a quadratic residue modulo 5. We get a contradiction. Hence 2 is irreducible.

On the other hand, since $2\cdot 3 = 6 = \left(4 + \sqrt{10}\right)\left(4 - \sqrt{10}\right)$, we have $2\left|\left(4 + \sqrt{10}\right)\left(4 - \sqrt{10}\right)\right.$. Suppose that $2\left|\left(4 + \sqrt{10}\right)\right.$ or $2\left|\left(4 - \sqrt{10}\right)\right.$. By taking *N*, we have $4|6$ in $\mathbb{Z}$, which is absurd. Hence 2 is not prime in $\mathbb{Z}\left[\sqrt{10}\right]$.

**Euclidean Domains[2]**

**Definition.** Let $\mathbb{N}$ be the set of nonnegative integers and $R$ be a commutative ring. Then $R$ is a ***Euclidean ring*** if there is a function $\varphi : R \setminus \{0\} \to \mathbb{N}$ such that:

(i) if $a, b \in R$ and $ab \neq 0,$ then $\varphi(a) \leq \varphi(ab);$

(ii) if $a, b \in R$ and $b \neq 0,$ then there exists $q, r \in R$ such that $a = qb + r$ with $r = 0,$ or $r \neq 0$ and $\varphi(r) < \varphi(b).$ A Euclidean ring which is an integral domain is called a ***Euclidean domain***.

**Example.** The ring of $\mathbb{Z}$ integers with $\phi(n) = |n|$ is a Euclidean domain.

Given $p, q \in \mathbb{Z},$ we claim that there exists $r, s \in \mathbb{Z}$ such that $p = qr + s$ with $s = 0$ or $|s| < |q|.$

Consider the case, $q > 0.$ Let $r = [p/q]$ and $s = p - q[p/q],$ then $p = qr + s.$ It remains to show that $0 \leq s < q.$ We have

$$\frac{p}{q} - 1 < \left[\frac{p}{q}\right] \leq \frac{p}{q}.$$

Multiplying all terms of this inequality by $-q,$ we obtain $q - p > -q\left[\frac{p}{q}\right] \geq -p,$

and hence $0 \leq p - q\left[\frac{p}{q}\right] < q,$ which is precisely $0 \leq s < q$ as desired.

For the case $q < 0,$ use the similar argument above for $p$ and $-q.$ We find that there exist $r$ *and* $s \in \mathbb{Z}$ such that $p = (-q)r + s$ with $s = 0$ or $s < |q| = -q;$ so $-r$ and $s$ have the desired properties.

**Theorem.** Every Euclidean domain is a principal ideal domain.

**Proof:** Let $R$ a Euclidean domain and $I$ be an ideal of $R$. If $I$ contains only the element 0, there's nothing to prove. Otherwise, $I$ has an element $a_0 \neq 0.$ We choose the nonzero element $a$ in $I$ with the least $d$-value, i.e., with the least value of $d(a).$ Since the $d$-values are non-negative integers, this is always possible. We now show that all elements in $I$ are multiples of $a$. Since the very definition of ideal forces every multiple of $a$ to be in $I$, whence $I = (a).$

Let $b \in I$ be an arbitrary element. Then $b = qa + r,$ for some $q, r \in I,$ with $r = 0$ or $d(r) < d(a).$ Hence $qa$ and $b \in I$ also holds since $a \in I.$ So, by the definition of an ideal, $r = b - qa \in I$ too. But then, by our choice of $a,$ $d(r) < d(a)$ is impossible. So, $r = 0$ and $b = qa$ is a multiple of $a$.

**Corollary.** Let $R$ be a Euclidean ring and $x \in R.$ Then $x$ is a unit if and only if $\varphi(x) = \varphi(1).$

**Proof.** Let $\varphi(x) = \varphi(1).$ Suppose $x$ is not a unit, then by the definition of Euclidean, taking $a = 1, b = x,$ we get $\varphi(1) < \varphi(1.x).$ That is, $\varphi(1) < \varphi(x),$ a contradiction. Therefore, $x$ is a unit.

Conversely, let $x$ be a unit in $R$, then there exists $y \in R$ such that $xy = 1$. Now, by definition, $\varphi(x) \le \varphi(xy)$ and so $\varphi(x) \le \varphi(1)$. Also, $\varphi(1) \le \varphi(1.x)$ and so $\varphi(1) \le \varphi(x)$. Hence $\varphi(x) = \varphi(1)$.

**Example.** Let $\theta = \left(1+\sqrt{-19}\right)/2$ and $\mathbb{Z}[\theta] = \{a + b\theta \mid a,\, b \in \mathbb{Z}\}$ which be a subset of complex numbers .Then $\mathbb{Z}[\theta]$ is not a Euclidean domain.

$\mathbb{Z}[\theta]$ is clearly closed under addition and subtraction. Moreover, $\theta^2 = \theta - 5,\ \bar{\theta} = 1 - \theta.$ If $a + b\theta,\ c + d\theta \in \mathbb{Z}[\theta]$, then

$(a+b\theta)(c+d\theta) = ac + (ad+bc)\theta + bd\theta^2 = (ac - 5bd) + (ad + bc + bd)\theta \in \mathbb{Z}[\theta]$. Thus $\mathbb{Z}[\theta]$ is closed under multiplication and is a ring.

Since $\mathbb{Z}[\theta]$ is contained in the complex numbers, it is an integral domain.

Suppose that $\mathbb{Z}[\theta]$ is a Euclidean domain with $\varphi : \mathbb{Z}[\theta] \setminus \{0\} \to \mathbb{N}$ satisfies the Euclidean domain property.

Let $\alpha \in \mathbb{Z}[\theta]$ be an element such that $\varphi(\alpha) = \min\left\{\varphi(\lambda) \,\middle|\, \lambda \ne 0,\, 1,\, -1,\ \lambda \in \mathbb{Z}[\theta]\right\}$.

By the Euclidean domain property, there exists $\delta,\ \gamma \in \mathbb{Z}[\theta]$ such that $2 = \alpha\delta + \gamma$ with $\gamma = 0$ or $\varphi(\gamma) < \varphi(\alpha)$.

However, the definition of $\alpha$, this implies that $\gamma = 0,\, 1$ or $-1$. In other words, $\alpha\delta = 1,\, 2$ or $3$.

Any function $N : \mathbb{Z}[\theta] \setminus \{0\} \to \mathbb{N}$, the set of nonnegative integers. If $\beta = a + b\theta \in \mathbb{Z}[\theta]$, then $N(\beta) = a^2 + ab + 5b^2 \in \mathbb{N}$. Moreover, suppose $\beta \ne 0,\, 1$ or $-1$.

If $a = 0$, then $N(\beta) = 5b^2 \ge 5$ and if $b = 0$, then $N(\beta) = a^2 \ge 4$.

If $ab > 0$, then $N(\beta) = a^2 + ab + 5b^2 = (a-b)^2 + 4b^2 + 3ab \ge 4b^2 + 3ab \ge 7$

and if $ab < 0$, then $N(\beta) = a^2 + ab + 5b^2 = (a+b)^2 + 4b^2 - ab \ge 4b^2 - ab \ge 5$.

In conclusion, if $\beta \in \mathbb{Z}[\theta] \setminus \{0,\, 1,\, -1\}$, then $N(\beta) \in \mathbb{N}$ and $N(\beta) \ge 4$.

Since $N(\alpha\delta) = 1,\, 4$ or $9$, and $N(\alpha\delta) = N(\alpha)\,N(\delta)$, we have that $N(\alpha) \mid 1,\ N(\alpha) \mid 4$ or $N(\alpha) \mid 9$. The discussion above shows that $N(\alpha) \ne 1,\, 2,\, 3$. Hence we have that $N(\alpha) = 4$ or $N(\alpha) = 9$.

The Euclidean domain property shows that there exists $\delta',\ \gamma' \in \mathbb{Z}[\theta]$ such that $\theta = \alpha\delta' + \gamma'$ with either $\gamma' = 0$ or $\varphi(\gamma') < \varphi(\alpha)$.

Again, the definition of $\alpha$ implies that $\alpha\delta' = \theta,\ \theta - 1$ or $\theta + 1$.

Taking norms, we have $N(\alpha) \mid N(\theta),\ N(\alpha) \mid N(\theta - 1)$ or $N(\alpha) \mid N(\theta + 1)$.

However, $N(\theta) = 5,\ N(\theta - 1) = 5$, and $N(\theta + 1) = 7$.

Neither one of them can be divided by 4 or 9. We get a contradiction. Hence $\mathbb{Z}[\theta]$ is not a Euclidean domain.

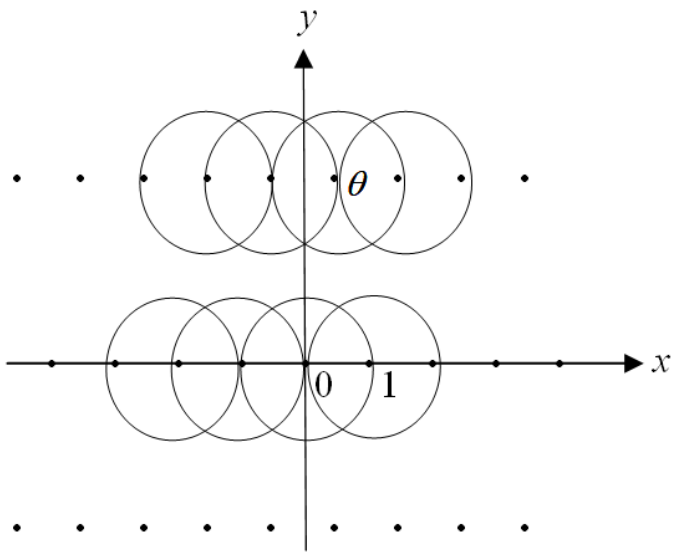


**Figure 2.** The proof that *N* is not a Euclidean function for *R*.

Above the example which is known that $\mathbb{Z}[\theta]=\{a+b\theta \mid a,\, b\in\mathbb{Z}\}$, where $a,\, b$ are both odd or both even, is a principal ideal domain but not a Euclidean domain.

**Gaussian integers and Polynomial rings[3]**

Now we give examples of Euclidean domains.

Let $\mathbb{Z}[i]=\{a+bi \mid a,\, b\in\mathbb{Z}\}$ be a subset of complex numbers. $\mathbb{Z}[i]$ is an integral domain called the domain of ***Gaussian integers***. Moreover, $\mathbb{Z}[i]$ is a Euclidean domain with $\varphi(a+bi)=N(a+bi)=a^2+b^2$.

$\mathbb{Z}[i]$ is clearly closed under addition and subtraction. Moreover, if $a+bi,\, c+di\in\mathbb{Z}[i]$, then $(a+bi)\,(c+di)=(ac-bd)+(ad+bc)i\in\mathbb{Z}[i]$.

Thus $\mathbb{Z}[i]$ is closed under multiplication and is a ring. Since $\mathbb{Z}[i]$ is contained in the complex numbers it is an integral domain.

It is clear that the norm defines a map from $\mathbb{Z}[i]$ to $\mathbb{N}$. Let $\alpha=a+bi,\ \beta=c+di\in\mathbb{Z}[i]$ and suppose that $\beta\neq 0$.

Consider $\dfrac{\alpha}{\beta}=\dfrac{a+bi}{c+di}=\dfrac{ac+bd}{c^2+d^2}+\dfrac{bc-ad}{c^2+d^2}i=s+ti.$

Choose integers $m,\, n\in\mathbb{Z}$ such that $|s-m|\le\frac{1}{2}$ and $|t-n|\le\frac{1}{2}$. Set $\delta=m+ni$ and $\gamma=\alpha-\beta\delta$. Then $\delta,\, \gamma\in\mathbb{Z}[i]$ and either $\gamma=0$ or

$$\varphi(\gamma)=\varphi\left(\beta\left(\frac{\alpha}{\beta}-\delta\right)\right)=\varphi(\beta)\,\varphi\left(\frac{\alpha}{\beta}-\delta\right)=\varphi(\beta)\left((s-m)^2+(t-n)^2\right)\le\frac{1}{2}\varphi(\beta)<\varphi(\beta).$$

**Theorem**. If $F$ is a field, then polynomial ring $F[x]$ is a Euclidean domain.

**Proof:** We have seen that $F[x]$ is an integral domain with unity.

For any $f(x) \in F[x],\ f(x) \neq 0,$ define $d\left(f(x)\right) = \deg f(x)$ which is a non-negative integer.

For any $f(x),\ g(x) \in F[x],$ since $f(x),\ g(x) \neq 0,$ we have

$$\deg\left(f(x)\,g(x)\right) = \deg f(x) + \deg g(x),$$

we get

$$\deg\left(f(x)\right) \leq \deg\left(f(x)\,g(x)\right), \text{ as } \deg\left(g(x)\right) \geq 0.$$

Therefore, $d\left(f(x)\right) \leq d\left(f(x)\,g(x)\right).$

Now, we show for any nonzero $f(x),\ g(x)$ in $F[x],$ there exists $t(x)$ and $r(x)$ in $F[x]$ such that $f(x) = t(x)\,g(x) + r(x),$ where either $r(x)$ is zero or $\deg r(x) < \deg g(x).$

If $\deg f(x) < \deg g(x),$ then $f(x) = 0 \cdot g(x) + f(x)$.

Assume that the result is true for all (nonzero) polynomials in $F[x]$ of degree less than $\deg f(x).$

Let $f(x) = a_0 + a_1x + \ldots + a_mx^m$ and $g(x) = b_0 + b_1x + \ldots + b_nx^n$. Suppose $\deg f(x) \geq \deg g(x).$ Define $f_1(x) = f(x) - a_mb_n^{-1}x^{m-n}g(x),$ then the coefficient of $x^m$ in $f_1(x)$ is $a_m - a_mb_n^{-1} \cdot b_n = a_m - a_m = 0.$ Therefore, either $f_1(x) = 0$ (zero polynomial) or $\deg f_1(x) < m.$

If $f_1(x) = 0,$ then $0 = f(x) - a_mb_n^{-1}x^{m-n}g(x).$ We get $f(x) = a_mb_n^{-1}x^{m-n}g(x) + 0.$ Taking $t(x) = a_mb_n^{-1}x^{m-n}$ and $r(x) = 0$ we get the required result. Suppose $f_1(x) \neq 0,$ then $\deg f_1(x) < m$ that is, $\deg f_1(x) < \deg f(x).$ By the induction hypothesis, $f_1(x) = t_1(x)\,g(x) + r(x)$ where either $r(x) = 0$ or $\deg r(x) < \deg g(x).$ Therefore,

$$f(x) - a_mb_n^{-1}x^{m-n}g(x) = t_1(x)\,g(x) + r(x)$$

or $f(x) = \left[a_mb_n^{-1}x^{m-n} + t_1(x)\right]g(x) + r(x)$

$$= t(x)\,g(x) + r(x)$$

where either $r(x) = 0$ or $\deg r(x) < \deg g(x)$ and hence $F[x]$ is a Euclidean domain (and also, therefore, a principal ideal domain).

**Example.** If $F$ is a field, then the ring of polynomials in one variable $F[x]$ is a Euclidean domain with $\deg(g) = \deg(f).$

Given $f,\ g \in F[x]$ with $g \neq 0,$ if $\deg(f) < \deg(g),$ then let $q = 0$ and $r = f.$ If $\deg(f) \geq \deg(g),$ then we proceed by induction on $\deg(f).$

If $\deg(f) = 0,$ then $\deg(g) = 0.$ Thus $f$ and $g$ are in $F$. Let $q = f \cdot g^{-1}$ and $r = 0.$ We have $f = gq + r$ with $r = 0$ as desired. Assume that the property for Euclidean domain is true for polynomials of degree less than $n = \deg(f).$ Suppose

$$f = \sum_{i=0}^{n} a_i x^i, \ \ g = \sum_{i=0}^{m} b_i x^i, \text{ with } a_n \neq 0, \ b_m \neq 0.$$

Let $f_1 = f - (a_n b_m^{-1} x^{m-n})g$. It is clear that $\deg(f_1) \leq n-1$. By the induction hypothesis, there are polynomials $q_1$ and $r_1$ such that $f_1 = gq_1 + r_1$ with $r_1 = 0$ or $\deg(r_1) < \deg(g)$. Let $q = a_n b_m^{-1} x^{m-n} + q_1$ and $r = r_1$. Then $f = f_1 + (a_n b_m^{-1} x^{m-n})g = g(q_1 + a_n b_m^{-1} x^{m-n}) + r_1 = gq + r$ with $r = 0$ or $\deg(r) < \deg(g)$ as desired.

## Conclusion

If an integral domain has norm preserving order, then the integral domain is a principal ideal domain. Prime element and irreducible element are not implying each other. Every Euclidean ring is a principal ideal ring. Not every principal ideal domain is a Euclidean domain. Gaussian integers and polynomial rings are the Euclidean domain. It follows that $\mathbb{Z}[x]$ is the ring of polynomials over $\mathbb{Z}$ which is an integral domain but is not a principal ideal domain.

In this study, the algorithm were used to establish other important results which lead up to the fundamental theorem of arithmetic. In this paper, everyday life applications have been discussed such as measuring circumference, area, and volume when we need to build or create something.

## Acknowledgements

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# Periodic Traveling Water Waves with Streamlines of Constant Pressure

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## Abstract

In this paper, trochoidal water waves in two-dimensional inviscid incompressible fluid are presented. Then, governing equations for this fluid are obtained. Finally, a theorem concerning with fluid having finite depth is discussed.

**Keywords**: Trochoid, Water Waves, Hydrodynamics, Differentiation, Integration

## Introduction

Trochoid means the plane locus of a point on the radius of a circle, or on the radius produced, as the circle rolls (in a plane) on a fixed straight line. The cycloid is the plane locus of a point that is fixed on the circumference of a circle, as the circle rolls upon a straight line. The cycloid is a special case of the trochoid.

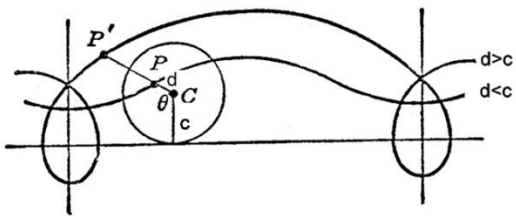


Figure 1. Trochoidal Curve

If c is the radius of the rolling circle, d is the distance from the center of this circle to the point describing the curve, and θ the angle ( in radians ) subtended by the arc which has contacted the fixed line in getting to the point under consideration then the parametric equations of the trochoid are given by $x = c\theta - d\sin\theta,\ y = c - d\cos\theta$.

## Trochoidal Water Waves [2]

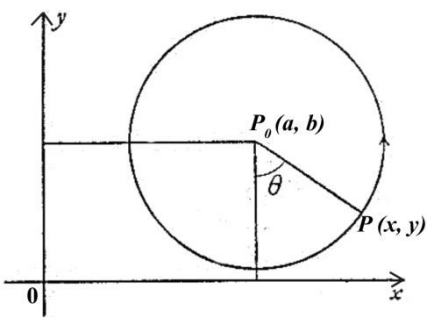


Figure 2. Illustrating the path of fluid particle

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Consider that the position of a particular fluid particle in two-dimensional inviscid incompressible fluid at a time t is given by

$$x(t) = a + \frac{e^{mb}}{m}\sin m(a-ct), \quad y(t) = b - \frac{e^{mb}}{m}\cos m(a-ct), \tag{1}$$

where $c > 0$ is the speed of the surface wave, $m \geq 0$ is the number of waves and the position of the particle at a time $t = 0$ is given by $(a, b)$. Since $x(t)$ and $y(t)$ are periodic functions of t, the equation (1) is a possible motion with period $\frac{2\pi}{mc}$. From equation (1), we get the pressure

$$\frac{p}{\rho} = \text{constant } -gb + \frac{g}{2m}e^{2mb}, \tag{2}$$

where $\rho$ is the density of the fluid and g is the gravitational acceleration. Considering a moving frame of reference by making the change of variables $(x, y) \to (x - ct, y)$, $m = 1$ and $\rho = 1$, the paths of the fluid particle are given by

$$x(s) = s + e^{b}\sin(s), \quad y(s) = b - e^{b}\cos(s), \tag{3}$$

which are the trochoidal equations. From equation (3), we get

$$\cos\left[\sqrt{\left(e^{b}\right)^{2} - (b-y)^{2}} \pm x\right] = \frac{b-y}{e^{b}}. \tag{4}$$

**Governing Equations [1]**

Let $u(x, y, t)$ and $v(x, y, t)$ be the horizontal and vertical velocities respectively. The governing equations are the Euler equations

$$u_t + uu_x + vu_y = -P_x, \quad v_t + uv_x + vv_y = -P_y - g, \tag{5}$$

where $P(x, y, t)$ is the pressure, and g is the gravitational acceleration. In general, for traveling waves moving to the right at a speed $c > 0$, equation (5) becomes

$$-cu_x + uu_x + vu_y = -P_x, \quad -cv_x + uv_x + vv_y = -P_y - g, \tag{6}$$

while the free surface condition is

$$v = -c\eta_x + u\eta_x \tag{7}$$

on $y = \eta(x, t)$, where $\eta$ is the free surface.

**Theorem [1]**

If $u, v, \eta$ and P are twice continuously differentiable, $2\pi$ periodic functions that solve equations (6), (7), and the pressure P is constant along the streamlines $\psi = P$, then $\eta = 0$.

Proof. Let $h(q, p) = y + d$ be the height above the flat bottom. Then,

$$v = -\frac{h_q}{h_p}, \quad u = c - \frac{1}{h_p}, \quad \partial_x = \partial_q - \frac{h_q}{h_p}\partial_p, \quad \partial_y = \frac{1}{h_p}\partial_p. \tag{8}$$

Define the functions S and T such that

$$S(q,p) = \frac{1}{h_p}, \quad T(q,p) = -\frac{h_q}{h_p}. \tag{9}$$

Then, we get

$$S\,S_p + \frac{T^2 S_p}{S} + \frac{TS_q}{S} + T_q = \gamma, \quad \frac{S^2 + T^2}{2} + gh + P - \Gamma = 0, \tag{10}$$

where $\gamma$ is the circulation in an elementary fluid and $\Gamma$ is the circulation in the circuit.

From $h_{pq} = h_{qp}$, we get

$$S_q + TS_p - ST_p = 0, \quad T_q + TT_p + SS_p = \gamma. \tag{11}$$

Differentiating equation (10) with respect to p and using equation (11), we get $P_p = T_q - gh_p$. Multiplying this equation by T and using equation (9), we see that $P_p T = TT_q - gh_p T = TT_q + gh_q$. Combining this with the relation obtained by differentiating equation (10) with respect to q, we get $P_p T + SS_q = 0$. If we divide this by S and use equation (9), we have $\partial_q\left(P_p h - \frac{1}{h_p}\right) = 0$. Integrating this, we get

$$\frac{1}{h_p} = hP_p + \beta, \tag{12}$$

where $\beta$ is some function. We know from equations (9) and (10) that

$$\frac{h_q^2 + 1}{2h_p^2} + gh - \Gamma + P = 0\ . \tag{13}$$

In combining with equation (12), we find

$$h_q^2 = -\frac{2(gh - \Gamma + P)}{(\beta + P_p h)^2} - 1. \tag{14}$$

Differentiating equation (14) with respect to p, and using equations (12) and (13), we obtain $2(gh - \Gamma + P)(\beta_p + P_{pp}h) = g - \gamma(\beta + P_p h) + 2P_p(\beta + P_p h)$. From the above equation, we get the polynomial equation

$$b_2 h^2 + b_1 h + b_0 = 0, \tag{15}$$

where $b_0 = -2P_p\beta + 2P\beta_p - g - 2\Gamma\beta_p + \gamma\beta$, $b_1 = 2g\beta_p - 2P_p^2 + \gamma P_p - 2\Gamma P_{pp} + 2PP_{pp}$ and $b_2 = 2gP_{pp}$.

Differentiating equation (15) with respect to q yields $2b_2 hh_q + b_1 h_q = 0$. If $h_q \neq 0$, we can divide by $h_q$ and differentiate again to obtain $2b_2 h_q = 0$. Since $h_q \neq 0$, this shows that

$b_2 = 0.$ Consequently, equation (15) reduces to $b_1 h + b_0 = 0.$ Differentiating this with respect to q, we find that $b_1 h_q = 0.$ Finally, equation (15) yields that $b_0 = 0, b_1 = 0$ and $b_2 = 0.$ From $b_2 = 0,$ we obtain

$$P_p = C, \quad P = C_p + D, \tag{16}$$

where C and D are constants. Using $b_1 = 0,$ we obtain

$$2g\beta_p - 2C^2 + \gamma C = 0. \tag{17}$$

Using $b_0 = 0,$ we get $h = \frac{1}{\beta} p + k,$ with k periodic. From equation (17),

$$\beta = -\frac{C}{2g}\Gamma + \frac{C^2}{g} p + E_0, \tag{18}$$

for some constant of integration $E_0$. Using equation (12), equation (13) becomes $h_q^2\left[h^2 + \frac{2h}{C}\beta + \frac{\beta^2}{C^2}\right] + \frac{2gh}{C^2} - \frac{2}{C^2}\Gamma + \frac{2P}{C^2} + h^2 + \frac{2h\beta}{C} + \frac{\beta^2}{C^2} = 0.$ Since $h_q \neq 0,$ the previous relation forces the existence of $K(p) \neq 0$ with $K^2 = \frac{g^2}{C^4} - \frac{2}{C^2} D + \frac{1}{C^2}\Gamma + \frac{2g}{C^3} E_0,$ where equation (18) is used. Letting $H = h + \frac{\beta}{C} + \frac{g}{C^2},$ we get

$$K^2 = h_q^2\left(h + \frac{\beta}{C}\right)^2 + \left(h + \frac{\beta}{C} + \frac{g}{C^2}\right)^2,$$

$$K^2 = H_q^2\left(H - \frac{g}{C^2}\right)^2 + H^2,$$

$$\frac{H_q^2\left(H - \frac{g}{C^2}\right)^2}{K^2 - H^2} = 1,$$

$$\frac{H_q\left(H - \frac{g}{C^2}\right)}{\sqrt{K^2 - H^2}} = \pm 1. \tag{19}$$

Integrating equation (19) with respect to q, we obtain

$$\pm q = \int_{H_0}^{H} \frac{H}{\sqrt{K^2 - H^2}} dH - \frac{g}{C^2}\int_{H_0}^{H} \frac{1}{\sqrt{K^2 - H^2}} dH.$$

Whenever the height h depends on $x = q,$ then the streamlines are given locally by a trochoid which can be written in parametric form. Therefore, we take

$$\pm q = \frac{g}{C^2}\left[\cos^{-1}\frac{H}{K}\right] - \sqrt{K^2 - H^2}. \tag{20}$$

If we let $\frac{C^2}{g}\left[\sqrt{K^2-H^2}+q\right]=s,$ then $\left(q-\frac{g}{C^2}s\right)^2=K^2-H^2,$

$$1=\left(\frac{q-\frac{gs}{C^2}}{K}\right)^2+\left(\frac{H}{K}\right)^2,$$

$$\sin^2 s+\cos^2 s=\left(\frac{q-\frac{gs}{C^2}}{K}\right)^2+\left(\frac{H}{K}\right)^2.$$

Since $\cos s=\frac{H}{K}$, $\sin^2 s=\left(\frac{q-\frac{gs}{C^2}}{K}\right)^2$ .Then, $\sin s=\frac{q-\frac{gs}{C^2}}{K}$ and $\cos=\frac{H}{K}$. From $\sin s=\frac{q-\frac{gs}{C^2}}{K}$, then $q=\frac{gs}{C^2}+K\sin s$ and $h=-\frac{g}{C^2}-\frac{1}{C}\beta-K\cos s$. To show that this is not possible if the depth of the fluid is finite, we will show that the equation of continuity is not satisfied. The evolution of a particle is given by the composition $\tau\tau_0^{-1}$, where the two mappings are given by

$$\tau_0\begin{pmatrix}s\\p\end{pmatrix}=\begin{pmatrix}\frac{gs}{C^2}+K\sin s\\-\frac{g}{C^2}-\frac{1}{C}\beta-K\cos s\end{pmatrix},$$

$$\tau\begin{pmatrix}s\\p\end{pmatrix}=\begin{pmatrix}\frac{g}{C^2}(s-t)+K\sin(s-t)\\-\frac{g}{C^2}-\frac{1}{C}\beta-K\cos(s-t)\end{pmatrix}.$$

The incompressibility of the fluid can be expressed by the condition that the map $\tau\tau_0^{-1}$ is area-preserving. But the Jacobians are given by

$$J_0=-\frac{g}{C^3}\beta'-KK'-\left(\frac{g}{C^2}K'+\frac{1}{C}\beta'K\right)\cos s,$$

$$J=-\frac{g}{C^3}\beta'-KK'-\left(\frac{g}{C^2}K'+\frac{1}{C}\beta'K\right)\cos(s-t).$$

It is plain that $JJ_0^{-1}$ will depend on t unless $K'+\frac{C}{g}\beta'K=0.$ Suppose if possible $K'+\frac{C}{g}\beta'K=0.$ Solving this equation for K gives $K=K_0e^{\frac{C}{g}\beta}$ for some constant $K_0$ and $\beta$ is

given by the equation (18). Since it was assumed that $\gamma = \Gamma_p$ is continuous up to the boundary, $\Gamma$ cannot be logarithmic. Thus the dependence of K on p is exponential, so that all streamlines are given by nontrivial trochoids. In particular, this contradicts the requirement that the flat bottom at finite depth is a streamline. Therefore, $K' + \frac{C}{g}\beta' K \neq 0.$ Therefore, the only possible flow is a shear flow with a flat surface $\eta = 0.$

## Application

Given that the position of a particular fluid particle in two-dimensional inviscid incompressible fluid at a time t is

$$x(t) = a + \frac{e^{mb}}{m} \sin m\left(a - \sqrt{\frac{g}{m}}t\right),\ y(t) = b - \frac{e^{mb}}{m} \cos m\left(a - \sqrt{\frac{g}{m}}t\right). \tag{21}$$

The equation (21) is a trochoidal water wave. Therefore, the above theorem is applied with the equation (21).

## Conclusion

In conclusion, the theorem is proved for not only finite depth but also infinite depth of fluid having constant density with many trochoidal waves. In addition, this theorem is concerning the terms water wave, free surface, trochoidal curve, velocity, pressure, streamlines, circulation, periodic function, differentiation, integration and so on. Therefore, this paper is useful for physical applied mathematics as a teaching course.

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# Investigation of butterfly species in Pathein Environs

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## Abstract

The study area is around the Pathein environ. The three study sites were chosen to record the butterfly species. Tall trees mixed with shrubs for site I, bushy places for siteII and blended areas of shrubs and bushes for site III were determined. In the present work, a total of 16 species belonging to 12 genera under five families were identified and followed after Kinyon, 2003. The highest amount from site II and lowest from site III were noticed as 69 and 22 individuals respectively. Among them, the highest number of species was found to be (37.5 %) in family Peridae while the lowest number (6.3 %) in family Papilionidae. Distinctive characters of recorded species were also presented.

**Keywords:** butterfly species, Pathein environ, highest and lowest

## Introduction

Myanmar is famous for its rich biodiversity, it is home to animals and plants species, many of which are endemic or unique to this country. New species of plants, mammals, birds, reptiles, amphibians, and insects are constantly being discovered, many of which are found nowhere else in the world. All of them, butterflies and moths are the most abundant species in the world. Butterflies are probably popular because they are diurnal and are renowned for their bright and showy colors, patterns, and graceful flight (Carter, 1992).

Some of the biggest and most beautiful species belong to family Papilionidae. It is widely distributed. Many species have tailed hind wings and are called as swallowtail. Swallowtail butterflies can be recognized by their large, striking wings and three fully developed pairs of legs. By the fact that they are usually strong fliers (Carter, 1992).

A huge family, Nymphalidae comprised of over 5,000 species. Out of which some are the world's most beautiful and spectacular butterflies. The most important characteristic that separates from other butterfly species is by possessing a pair of underdeveloped front legs (Cater, 1992).

The distribution of a species is dependent not only on the geography of the area and the ability of the species to move around within it but also on the ecological demands of the species. Each species of butterfly has its own set of clearly defined preferences concerning the environment in which it lives. Even within the rain forest, those are marked differences in the species found in lowland and highland or mountain forests. (Vane-Wright and Ackery, 1984). Pathein environs have many flora and fauna. Different habitats are supported by the butterfly species. The previous record was not observed in these environments. So, to study the butterfly species and their distribution in different study sites were aimed.

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## Materials and Methods

### Study area and Study sites

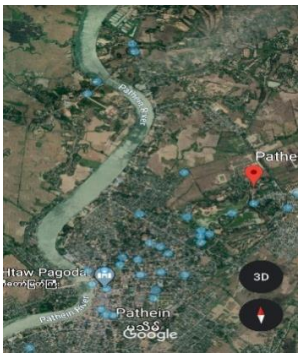
The study area is around the Pathein environ. The three study sites were chosen to record the butterfly species. A site I (near the Pathein rope bridge) is located between N 16˚49' 35.970″and 094˚ 44'41.296″ E. Site (II) (near the Department of Myanmar building is located between N 16˚ 48′ 12″ and E 094˚ 45' 17.496″ E. Site (III) (Kan Thar Yar Amusement Park) is located between N 16˚ 47' 41.870″ and 094˚ 45' 04.037″ E. Site (I) has many shrubs and tall trees, which were mixing. Site (II) has many bushes andSite (III) has bushes and shrub mixing place. The study period lasted from June 2017 to September 2017.

Insect net, hand lens, plastic boxes, cotton wool, and chloroform were used. To know the location of latitude and longitude Global Positional System was used.

The best collection time was 8:00 AM to 10:00 AM and 2:00 PM to 4:00 PM. Catching butterflies with a net fall into two methods. One was the swift stroke in the direction of the oncoming butterfly and the other was the low sweep which was visually employed in catching butterflies at rest.

The captured specimens were anesthetized by chloroform. The wings of the anesthetized specimen were spread and the center of the thorax was pinned on the setting board. A narrow strip of papers was placed across the basis of the wing on either side, each and every side for security, and also to avoid injury.

They were exposed to sunlight for dry. The dried ones were then properly maintained in insect boxes for later further studies. External morphology and coloration were also noted and photographed with the scaled ruler for each specimen. Identification and classification were made done by Kinyon (2003) and Corbet and Pendlebury (1992). Recorded data were tabulated and shown by histograms and pie graphs




Source: Google earth, 2020

Global Positional System

Fig 1. Location Map of the study area

(A) Site I

(B) Site II

(C) Site III

Plate 1. Three different study sites

(A) Butterfly catching net

(B) Plastic Boxes

(C)Pindowning the specimen

(D)Hand Len

(E) Collecting the butterflies

Plate 2. Materials and methods used in butterfly collection

## Results

A total of 16 species belonging to 12 genera under five families were recorded during the study period. The systematic position of recorded butterfly species was followed after Kinyon, 2003.

*Papilio polytes* (Linnaeus,1758)

The common name is the common Mormon, the wingspan of a male is 87 mm long. The forewing black color with a series of marginal double white spots, decreasing inside toward the apex. Hind wing with a complete discal band of elongate white spots on the upper side. The underside is similar to above, but duller and more opaque black ground color.

The wingspan of females is about 91 mm. Upperside is black on the forewing, somewhat darker and velvety on the hind wing. Fore wing darker at the base and along the outer margin and with dark intercellular streaks that extend into the cell, a submarginal curved series of red lunules. The underside is similar to the upperside. Hindwing with a complete series of outer marginal spots, the anterior ones white. (Plate 3 A & B)

*Appias libythea* (Fabricius, 1775)

The common name is Striped Albatross. The wingspan is 50 mm. The upper side of both sexes of A. libythea somewhat resembles *A. lyncida* but the black markings are less extensive in the female. At the underside, hindwing without broad, brown marginal area. Apex of forewing cell very acute. (Plate 4 A& B)

*Appias lyncida* (Cramer,1777)

The common name is the Chocolate Albatross. The wingspan is 68 mm. The upperside is Ground-colour white. Both wings with an outer marginal black border, more or less dentate on its inner margin. The forewing with brownish-black costal and outer marginal border, broad in the apical area at the underside. Hindwing yellow, with a broad chocolate brown marginal border. (Plate 4 C)

*Ixias pyrene* (Linnaeus, 1764)

The common name is Yellow Orange Tip. The wingspan is 57 mm. In the Malayan hills, at altitudes above 3,000 feet, occurs the subspecies *alticola* Pendlebury, which is marked on the upper surface like birdi except that the ground color is white. The under surface is more ochraceous and more heavily speckled with black striae. (Plate 4 D)

*Hebomoia glaucippe*(Linnaeus, 1758)

The common name is the Great Orange Tip. The wingspan is 86 mm. The upper side of its body is creamy white. On the forewing, the orange-red sub-apical patch bounded exteriorly by four of the five submarginal orange-red spots fond singly in space 2-6 and the broad black margin. Hindwing termen bordered with inwardly dentate black and a series of large post-discal balck spots with their pointes ends directed to the base. The color of the underside is white. The sub-apical patch on the fore wing reddish brown. The hindwing with brownish crepe markings. (Plate 4 E)

*Catopsilia pomona*(Cramer, 1770)

The common name is the common Emigrant. Its wingspan is 65 mm. Upperside is ground color chalky white with the proximal yellow area were a greenish, closely mottled with fine green lines on the underside.(Plate 4 F)

*Eurema hecabe*(Linnaeus, 1758)

The Wing Span of Common Grass Yellow is 8 mm. On the forewing the black border with two large excavations, the lower of them forming a right angle with the dorsum below vein 2. Hindwing with marginal black border. In the underside, yellow without black border, forewing cell with two basal spots, and a disc ocellular spot. (Plate 4 G)

*Danaus genutia*(Cramer, 1779)

It is the common tiger. The wingspan is 82 mm. Both wings golden yellow with all veins broadly black. Forewing with a black margin and sub-apical white band. Two series of white spots at the outer margin hind wing in upperside. Similar color and pattern, but paler in the underside. (Plate 5 A)

*Danaus limniace*(Cramer,1775)

Its common name is the Blue Tiger. The wingspan is 99 mm. On the Upperside, black with bluish-white semihyalline spots and streaks, five obliquely placed preapical streaks, and somewhat irregular subterminal and terminal series of spots, the later the smaller. The number of scattered unequal subterminal and terminal spots. On the underside, basal two-thirds of forewing dusty black, the apex and hindwing olive-brown, the spots and streaks much as on the upper side.(Plate 5 B)

*Euploea core* (Cramer,1780)

TheViolet Tipped Crow is its common name. The wingspan is 87 mm. The upperside is dark brown; apical area dusted with bluish-white. Two series of white spots run to allow the outer margins of all the wings. The inner series on the hindwing is composed of elongated spots and the outer series is of circular spots. The underside is paler brown, two or three discal spots, and an apical spot in the cell. On the hind wing five discal spots. (Plate5 C)

*Melanitis leda*(Linnaeus,1758)

The common name is The Evening Brown. The wingspan is 48 mm. The upperside is dull brown. Forewing with a large prominent black spot in interspace 3 and another smaller one in 4, both with white pupils. Hindwing area 2 is marked with a submarginal dark white-

centered ocellus. On the underside, forewing motted dark with very narrow, blackish-brown margin and black blotches. Hindwing covered with dark brown striated lines followed by a series of small ocelli. (Plate 6 A)

*Elymnias hypermnestra*(Linnaeus,1763)

It is known to be common Palm Fly. The wingspan is 68 mm. On the upperside, the forewing orange-brown with a whitish subapical band. Forewing with a curved white band running from mid-costal to tornus. Both wings with tremens prominently scalloped. On the underside, forewing with the usual Elymnias striations. (Plate 6 B)

*Junonia lemonias*(Linnaeus,1758)

The common name is Lemon Pansy. The size of the wingspan is 55 mm. The upperside is brown with lemon yellow markings especially on the forewing cell and surrounding the black centered ocellus. Hindwingocellus extends to spaces 5 and 6. Sub marginal orange-red segmented line on both the wings. The underside; the wet-season form is yellowish-brown and dry-season form is reddish or brownish in leafy appearance. (Plate 7 A)

*Junonia atlites* (Linnaeus,1763)

The common name is The Gray Pansy. The wingspan is 60mm. The upperside is very light brown with brown markings. From space 2 to 6 a series of postdiscalocelli which are well-marked in space 2 and 5 and to a lesser extent in 6. Transverse jagged lines in the cell. The underside is much paler, and there is a tendency towards the obsolescence of the post-discalocelli.(Plate 7 B)

*Euthalia adonia*(Cramer, 1779)

It is commonly known as White-Banded Red Baron. The wingspan is 73 mm. On upperside forewings is a dark brown cell space filled with individual transverse patches of white. The hindwings are ground color, a post-discal series of bright red spots bordered inwardly with black. The forewings are dull brown and the hindwings are very pale brown, the tornal area light bluish-green on the underside.(Plate 7 C)

*Euthalia aconthea* (Cramer, 1777)

The Baron is the common name. The wingspan is 72 mm. On the upperside, dark brown with the basal region darker, forewing with postdiscal white spots while generally paler with more clearly defined markings at the underside. (Plate 7 D)

(A)*Papilio polytes*(Male) (B)*Papilio polytes*(Female)

Plate3. Recorded butterfly species of family Papilionidae

(A) *Appias libythea*(Male)

(B)*Appias libythea*(Female)

(C)*Appias lyncida*

(D) *Ixias pyrene*

(E) *Hebomoia glaucippe*

(F)*Catopsili apomona*

(G)*Eurema hecabe*

Plate 4. Recorded butterfly species of family Pieridae

(A)*Danaus genutia*

(B) *Danaus limniace*

(C)*Euploea core*

Plate 5. Recorded butterfly species of family Danidae

(A)*Melanitis leda* (B) *Elymnias hypermnestra*

Plate 6. Recorded butterfly species of family Satyridae

(A) *Junonia lemonias* (B) *Junonia atlites*

(C) *Euthalia adonia* (D) *Euthalia aconthea*

Plate 7. Recorded butterfly species of family Nymphalidae

Table 1. Recorded butterfly species under respective family

| Sr. No. | Scientific Name | Common Name | Family |
|---|---|---|---|
| 1 | *Papilio poyites* (Linnaeus, 1758) | Common Mormom | Papilionidae |
| 2 | *Appias libythea* (Fabricius, 1775) | Striped Albatross | Pieridae |
| 3 | *Appias lyncida* (Cramer, 1764) | Chocolate Albatross | |
| 4 | *Ixias pyrene (Linnaeus, 1764)* | Yellow Orange Tip | |
| 5 | *Hebomoia glaucippe* (Linnaeus, 1758) | Great Orange Tip | |
| 6 | *Catopsilia pomona*(Cramer, 1970) | Common Emigrant | |
| 7 | *Eurema hecabe* (Linnaeus, 1758) | Common Grass Yellow | |
| 8 | *Danaus genutia* (Cramer, 1779) | Common Tiger | Danaidae |
| 9 | *Danaus limniace*(Cramer, 1775) | Blue Tiger | |
| 10 | *Euploea core* (Cramer, 1780) | Violet Tipped Crow | |
| 11 | *Melanitis leda* (Linnaeus, 1758) | Common Evening Brown | Satyridae |
| 12 | *Elymnias hypermnestra* (Linnaeus, 1763) | Common Palm Fly | |
| 13 | *Junonia lemonias* (Linnaeus,1758) | Lemon Pansy | Nymphalidae |
| 14 | *Junonia atlites* (Linnaeus,1763) | Grey Pansy | |
| 15 | *Euthalia adonia* (Cramer,1779) | White-Banded Red Baron | |
| 16 | *Euthalia aconthea* (Cramer, 1777) | Baron | |

Table 2. Recorded numbers of butterflies in three study sites

| Sr. No. | Scientific Name | Site I | Site II | Site III | Total | Abundance status in nature |
|---|---|---|---|---|---|---|
| 1 | *Papilio polytes* | 11 | 2 | | 13 | C |
| 2 | *Appias libythea* | 3 | 4 | - | 7 | C |
| 3 | *Appias lyncida* | - | 1 | - | 1 | C |
| 4 | *Ixias pyrene* | 2 | 5 | - | 7 | C |
| 5 | *Hebomoia glucippe* | 4 | 4 | 2 | 10 | C |
| 6 | *Catopsilia pomona* | 6 | 12 | 6 | 24 | C |
| 7 | *Eurema hecabe* | 18 | 3 | 8 | 29 | C |
| 8 | *Danaus genutia* | 1 | 16 | - | 17 | C |
| 9 | *Danaus limniace* | 1 | 10 | 3 | 14 | C |
| 10 | *Euploea core* | 2 | 1 | - | 3 | C |
| 11 | *Melanitis leda* | 2 | - | - | 2 | C |
| 12 | *Elymnias hypermnestra* | 2 | 3 | - | 5 | C |
| 13 | *Junonia lemonias* | 5 | 4 | 2 | 11 | C |
| 14 | *Junonia atlites* | 1 | 1 | 1 | 3 | C |
| 15 | *Euthalia adonia* | 2 | 2 | - | 4 | UC |
| 16 | *Euthalia aconthea* | 2 | 1 | - | 3 | C |
| | No.of individuals | 62 | 69 | 22 | 153 | |
| | No. of species | 15 | 15 | 6 | 16 | |

C = Common species, UC = Uncommon species (Source:Kinyon 2003)

**Species composition of different families in the study area**

The abundance of butterflies in the study sites

Totally 16 species and 153 individuals were recorded. The number of butterfly species was to be highest in Site I and II (15 species each) and those of lowest (6 species) in Site III.

Among the study sites, the highest number was recorded in Site II (69 individuals) followed by Site I (62 individuals) and the least in Site III (22 individuals). The percentage of recorded species was found to be Papilionidae (6.3%), Pieridae (37.5%), Danaidae (18.7%), Satyridae (12.5%), and Nyphalidae (25.0%). The most abundant species as *Eurema hecabe* (29 individuals), *Catopsilia Pomona* (24 individuals), and *Danaus genutia* (17 individuals) were observed in all Sites. Two rare species, *Appias lyncida* (1 individual) and *Melanitis leda* (2 individuals) were recorded (Table 3andFig 2).

Table 3.Species composition and percentage of recorded butterfly families in the study area

| No | Family | Species | Percentage (%) |
|---|---|---|---|
| 1 | Papilionidae | 1 | 6.3 |
| 2 | Pieridae | 6 | 37.5 |
| 3 | Danaidae | 3 | 18.7 |
| 4 | Satyridae | 2 | 12.5 |
| 5 | Nymphalidae | 4 | 25.0 |
| | Total | 16 | 100% |

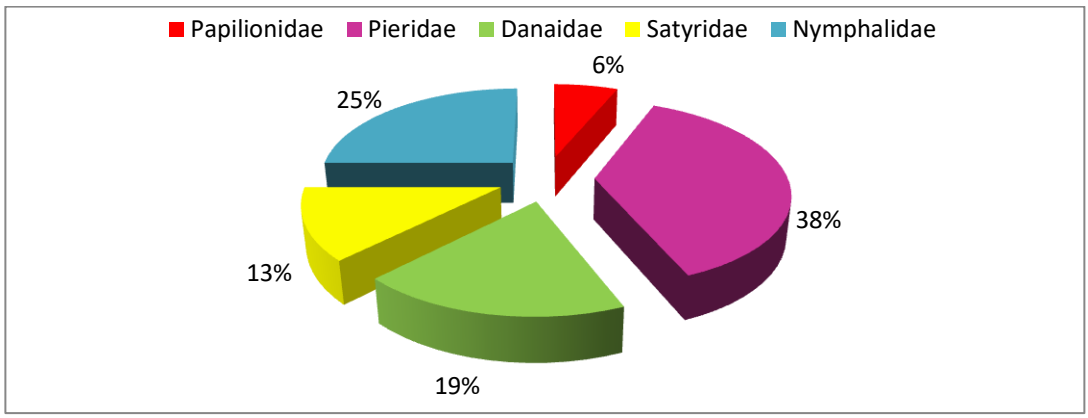



Fig 2. Species composition of recorded butterfly families in study area

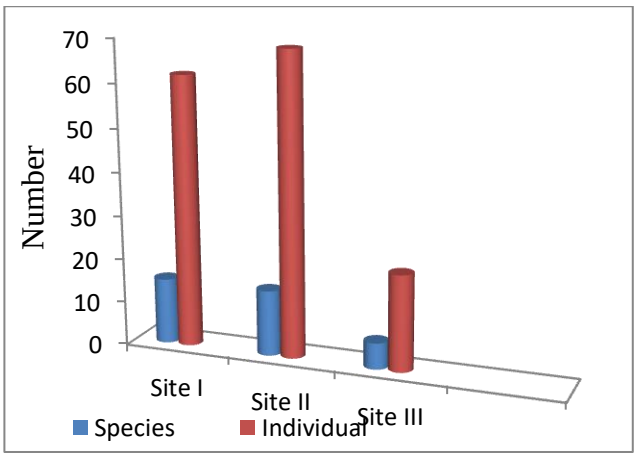



Fig 3. Recorded butterflies in all study site

## Discussion and Conclusion

According to Kinyon 2003, ten families suborder Lepidoptera such as Papilionidae, Pieridae, Danaidae, Satyridae, Acraeidae, Nymphalidae, Amathusiidae, Libytheidae, Riodinidae and Lycaenidae, and 1197 species were recorded in Myanmar.

In the present work, 16 species of butterflies belonging to 12 genera and five families were recorded. Among them, the highest number of species was found to be (37.5 %) in family Pieridae while the lowest number (6.3 %) in family Papilionidae.

Shwelai win (2004) recorded that 21butterfly species from seven quarters of the Taunggyi area were observed. Out of these, seven species namely *Papilio polytes, Danaus genutia, D. limniace, Euploea core, Junonia atlites, Catopsilia pomona, Eurema hecabe* were recorded in this study area. Therefore, those mentioned species may have a wide range of distribution.

Nu Nu San (2005) reported that 82 species in Longlon Township, Dawei Distinct, Tanintharyi division. Eleven species such as *Papilio polytes, Appias libythea, Ixias pyrene, Hebomoia glaucippe, Catopsilia pomona, Eurema hecabe, Danaus genutia, Danaus limniace, Elymnias hypermnestra, Junonia lemonias,* and *Junonia atlites* were collected in this study. The findings were agreed with Nu Nu San.

Kyaw Myo Naing (2005) stated that 45 species in Monywa environs. Out of them Papilio polytes, *Hebomoia glaucippe, Melanitis leda, Junonia lemonias,* and *Junonia atlites* were recorded in the present study.

Naw Cho Cho Aye (2013) recorded 33 species in Zwegabin hill, Kayin State. Of these, only three species *Eurema hecabe, Danaus genutia,* and *Danaus limniace* were recorded in the present study.

In the present findings, *Eurema hecabe, Catopsilia pomona, Danaus genutia* were abundantly recorded whereas *Appias lyncida* and *Melanitis leda*, were rarely recorded in this area. Occurrence status of butterfly species in nature by Kinyon 2003, only one species Euthalia adonia was uncommon and the remaining recorded ones were common. This is slightly agreed with Kinyon.

Comparing the butterfly species of three study sites, Site III has the lowest species and number of butterflies than the other two sites. It may be associated with the scarcity of food sources.

Sexual dimorphism was found in *Papilio polytes* and *Appias libythea*. Male and female of these species were dissimilar not only in marking, coloration but also in wing pattern.

Habitat degradation and climate change are altering the distribution and abundance of butterflies and plants. Thus, some butterflies are now considered endangered species. International protective measures are therefore necessary to protect these butterflies from extinction as stated by Kunte (2000).

Vane-Wright et.al (1984), stated that some butterflies can change their color in relation to seasons. The change of climate and altered condition of food produced two forms of dissimilar marking, coloration, and shape. So, climate condition is a factor to be considered in the identification of butterfly species.

One of the most important functions of butterflies is to pollinate flowers and for this, they are beneficial to nature and agriculture. Due to limited time and unfavorable weather conditions, this study is impossible to cover all the butterfly species of Pathein environs. But the present study will surely provide information for future research.

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# Effects of Different Habitats Types on Occurrence of Bird Species Diversity in Myeik University Campus, Myeik Township

Theingi Soe Myint[1], Aye Aye Myint[2], San Maung Maung Theint[3], Swe Swe Oo[4] and Win Win Than[5]

## Abstract

The aim of this research was examined to measure bird species diversity in Myeik University Campus from December 2019 to June 2020. The present study was conducted to assess bird species diversity in relationships and with their habitat types. The total numbers of 70 species were recorded under 29 families and 12 orders in four study sites. Among them, 65 species of 42 genera belonging to 26 families and nine orders were recorded as a terrestrial bird while five species of five genera belonging to three families and three orders were known to be water birds. Out of the total, eight migratory birds and 62 resident birds were recorded during the study period. In the present study, the highest number of species and under three orders Passeriformes, Cuculiformes, and Accipitriformes were recorded. Six habitat types were selected in four study sites according to feeding, breeding, and roosting behavior. Species numbers were highest as 67 and lowest as in sites I and III were respectively. Bird species were more abundant in the area of a scattered tree than that grassland. All recorded bird species were not determined under the IUCN red list.

**Keywords:** Species diversity, Terrestrial birds, Water birds, Habitat types

## Introduction

Tanintharyi Region is one of the provinces of Myanmar, lies at the southern end of Myanmar. It is located close to the sea, a major part of its economy. Tanintharyi Region is enriched with natural resources including seafood products. Tanintharyi Region has a lowland wet evergreen forest which is distributed in an area of high mean annual rainfall and low seasonality. Therefore, this division was rich in fauna and flora. Birds are useful indicators of the state of the environment and also for key species of education and public awareness. The current classification of living birds in a hierarchical arrangement of roughly 29 orders, 187 families, over 2000 genera and over 9600 species (Gill, 1990). There are 10,451 bird species in the world. In Myanmar, there are about 1,116 species.

Birds are generally diurnal (active during the day), some are nocturnal (active during the night), some crepuscular (active during twilight hours) and some nocturnal and crepuscular both. Based on their habits, birds can also be categorized as terrestrial birds and water birds. Birds can be found in various kinds of habitats. Depending upon the habitats, different kinds of birds are evolved. Myanmar possesses great wealth and diversity of wetland habitats. The major ecosystem in Myanmar can be grouped into the forest, grassland, freshwater, coastal, and marine (Van Der Ven and Thet ZawNaing, 2005).

Estimating the bird diversity in Myeik University Campus is an important tool to understand the avian assemblages and the current status of habitats, for effective conservation and better management in the future. The detailed information about habitat use of bird species in Myeik University Campus is not presented yet. No detailed study has been carried out in the study area to determine the diversity of bird species about habitat types. Thus, the present work is conducted to study bird species diversity in Myeik University Campus.

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The objectives of this study are:

- to record the bird species diversity in the study site and
- to assess the bird species and habitat types with their relative

## Materials and Methods

Myeik University campus was chosen as a study site. The study site of Myeik University is situated between Latitude 12º 18´ 00" N and Longitude 98º 36´44" E. West site of Myeik is open sea including islanding islands, north is Kywe Ku river with mangrove forest near the estuary, and south is Boke Chaung, therefore, Myeik is one of the enriched biodiversity coastal city in Tanintharyi Region (Fig.1).

### Study Sites

Site I –Paduak road

Site II – Khayae road

Site III- Adipadi road

Site IV- Sein pann road

### Study Period

The study period lasted from December 2019 to June 2020.

### Field Techniques

The weekly observation was conducted point count method. The field survey was accessed by footpath diverging from the base camp (Pale Day We Hostel). The observed birds differentiated into water birds and terrestrial birds. Habitat types were also recorded.

### Bird Census Techniques

Bird watching was divided into two parts per day (6:30 am to 10:30 am and 3:00 to 6:00 pm). Bird watching, identifying, and analyzing were done during the study period. Observation of bird species was carried out by using a camera and binocular. Birds were identified to the species level and their taxonomic groups were properly categorized based on field guide of Robson (2016). All birds which or heard were counted for 20 min at each point. Bird surveys were conducted up to 4 hours after sunrise in the early morning and 3 hours before sunset in the evening. The survey was not carried out on rainy or windy days. Habitat types were also recorded.

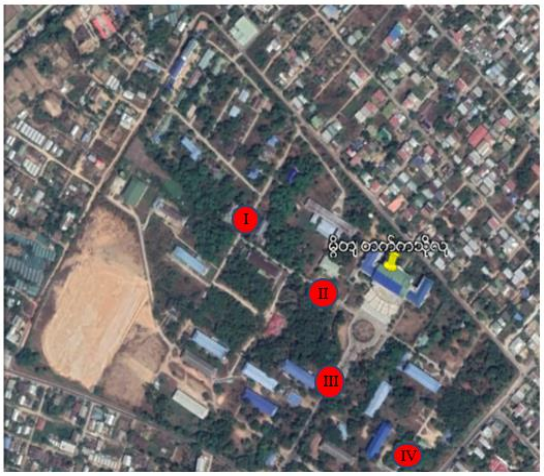



Fig.1 Map of the study site

## Results

### Species composition

During the study period 70 species of 47 genera belonging to 29 families and representing 12 orders were recorded in four study sites. Among them, 65 species of 42 genera belonging to 26 families and representing nine orders were recorded as a terrestrial bird while five species of five genera belonging to three families and representing three orders were recorded to be water bird. Out of the total, eight migratory birds and 62 resident birds were recorded during the study period (Table 1).

### Recorded bird species in Site I (Paduak Road)

According to the result, 67 bird species belonging to 29 families under nine orders were recorded in the site I (Fig.4). In the site I, bird species diversity was observed in the highest number than other study sites (Fig.4). Many big trees were observed along with the site. Some bird species are common in different habitat types.

### Recorded bird species in Site II (Khayae Road)

Recorded bird species numbers were 39 belonging to 17 families under of six orders in site II. Bird species of order Columbiformes were common but some from order Passeriformes were also observed.

### Recorded bird species in Site III (Adipadi Road)

During the present study, 30 bird species belonging to 17 families under six orders were recorded. Migrated bird species of *Circus melaleucas*, *Anastomusoscitant*, *Hirundorustica* were also found in this area.

### Recorded bird species in Site IV (Sein pann Road)

In site IV, 41 species belonging to 20 families and representing eight orders were recorded. Bird species of family Pisttaculidae was noticed in site IV only. Some common bird species as *Corvussplenden* House Crow, *Columba livia* Rock Pigeon, and *Acridotherestristis* Common Myna have abundantly occurred in this site.

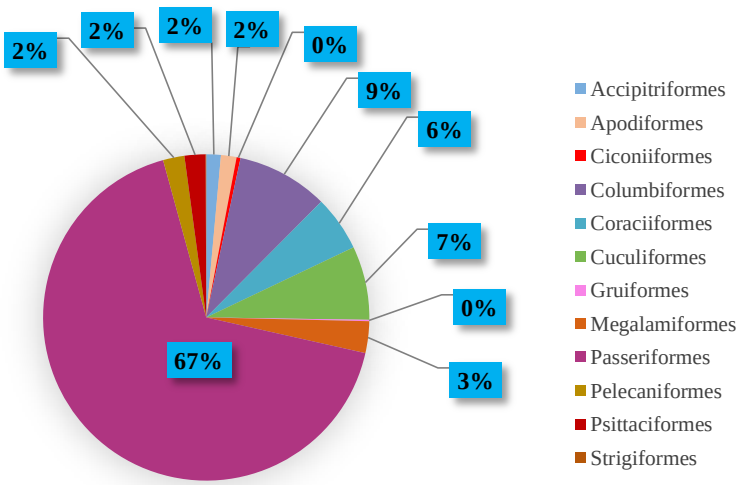



Fig. 2 Percentage of species composition in different orders

*Accipiter badius*

*Haliastur indus*

*Columba livia*

*Streptopelia chinensis*

*Streptopelia orientalis*

*Coracias benghalensis*

*Centropus bengalensis*

*Centropus sinensis*

*Eudynamys scolopacea*

*Phaenicophaeus tristis*

*Amauromis phoenicurus*

*Megalaima haemacephala*

*Megalaima lineata*

*Miraframi croptera*

*Orthotomus atrogularis*

*Orthotomus sutorius*

*Prinia flaviventris*

*Prinia hodgsonii*

*Prinia inomata*

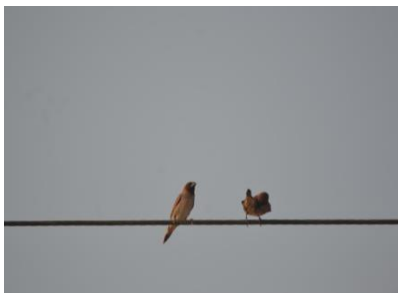
*Corvus macrorhynchos*

*Corvus splendens*

*Dicaeum cruentatum*

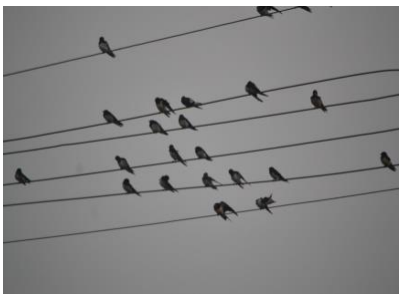
*Dicaeum ignipectus*

*Dicrurus leucophaeus*



*Lonchura punchura*

*Lonchura striata*



*Hirundo rustica*

*Lanius collurioides*

*Lanius cristatus*

*Ficedula hyperythra*

*Oriolus tenuirostris*

*Passer domesticus*

*Passer montanus*

*Pycnonotus finlaysoni*

*Pycnonotus goiavier*

*Acridotheres fuscus*

*Acridothere stristis*

*Gracular religiosa*

*Ardeola grayii*

*Casmerodius albus*

*Psittacula alexandri*

*Glaucidium cuculoides*

Plate1. The occurrence of bird species in the study site

Table 1. Recorded of bird species and their habitat types

| Sr.no | Order | Family | Scientific name | Common name | Local name | Habit type | Kind of bird |
|---|---|---|---|---|---|---|---|
| 1. | Accipitriformes | Accipitridae | *Accipiter badius* | Shikra | Gyo Thein/Thein | Open Area | TB |
| 2. | | | *Aviceda leuphotes* | Black Baza | | Scattered Tree | TB |
| 3. | | | *Circus melanoleucos* | Pied Harrier | Thein Kyar | Open Area | TB |
| 4. | | | *Haliastur indus* | Brahmany Kite | Sawn Khaung Phyu | Open Area | TB |
| 5. | | | *Milvus migrans* | Black Kite | Swan | Scattered Tree | TB |
| 6. | Apodiformes | Apodidae | *Aerodramus fuciphago* | Edible Nest Swiftlet | Zee Wa Zoe | Open Area | TB |
| 7. | Ciconiiformes | Ciconiidae | *Anastomus oscitans* | Asian Openbill | Khayu Soake | Scattered Tree | WB |
| 8. | | | *Mycteria leucocephala* | Painted Stork | Hnget Kyar | Open Area | WB |
| 9. | Columbiformes | Columbidae | *Columba livia* | Rock Pigeon | Khao | Human Habitat | TB |
| 10. | | | *Streptopelia chinensis* | Spotted Dove | Gyo Le Pyauk | Electric Wire | TB |
| 11. | | | *Streptopelia orientalis* | Oriental Turtle Dove | Gyo Pain Too | Electric Wire | TB |
| 12. | | | *Treron phoenicoptera* | Yellow Footed Green Pigeon | Bon Matee Hnget | Scattered Tree | TB |
| 13. | Coraciiformes | Coraciidae | *Coracias benghalensis* | Indian Roller | Hnget Khar | Human Habitat | TB |
| 14. | | Meropidae | *Merops leschenaulti* | Chestnut Headed Bee Eater | Hnget Pazin Hto Yin War | Scattered Tree | TB |
| 15. | | | *Merops philippinus* | Blue Tailed Bee Eater | Hnget Pazin Hto Myee Pyar | Scattered Tree | TB |
| 16. | Cuculiformes | Cuculidae | *Centropus bengalensis* | Lesser Coucal | Boat Hnan | Scattered Tree | TB |
| 17. | | | *Centropus sinensis* | Greater Coucal | Boat Hnget | Scattered Tree | TB |
| 18. | | | *Cacomantis merulinus* | Plaintive Cuckoo | | Scattered Tree | TB |
| 19. | | | *Cuculus micropterus* | Indian Cuckoo | Yauk Pha Khawe Khall | Bush | TB |
| 20. | | | *Eudynamys scolopacea* | Asian Koel | Oak Aw | Scattered Tree | TB |
| 21. | | | *Hierococcyx varius* | Hawk Cuckoo | | Scattered Tree | TB |
| 22. | | | *Phaenicophaeus tristis* | Green Billed Malkoha | Wah Phat Lay | Scattered Tree | TB |
| 23. | Gruiformes | Rallidae | *Amauromis phoenicurus* | White Breasted Waterhen | Yae Kyet Ma | Bush | WB |
| 24. | Megalamiformes | Megalamidae | *Megalaima haemacephala* | Coppersmith Barbet | Hnget Pa Dein | Scattered Tree | TB |
| 25. | | | *Megalaima lineata* | Lineated Barbet | Phoe Khaung/ Bo Tode | Scattered Tree | TB |

Table 1. continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 26. | Passeriformes | Alaudidae | *Mirafra microptera* | Burmese Bush Lark | | Grass Land | TB |
| 27. | | Cisticolidae | *Cisticola juncidis* | Zittig Cisticola | | Bush | TB |
| 28. | | | *Orthotomus atrogularis* | Dark Necked Tailorbird | | Scattered Tree | TB |
| 29. | | | *Orthotomus sutorius* | Common Tailorbird | | Scattered Tree | TB |
| 30. | | | *Prinia flaviventris* | Yellow Bellied Prinia | | Scattered Tree | TB |
| 31. | | | *Prinia hodgsonii* | Grey Breasted Prinia | | Bush | TB |
| 32. | | | *Prinia inomata* | Plain Prinia | Hnget Letma | Bush | TB |
| 33. | | Corvidae | *Corvus macrorhynchos* | Large Billed Crow | Taw Kyee Kan | Scattered Tree | TB |
| 34. | | | *Corvus splendens* | House Crow | Kyee Kan | Electric Wire | TB |
| 35. | | | *Dendrocitta vagabunda* | Rufous Treepie | Nga Phar Kyee | Scattered Tree | TB |
| 36. | | Dicaeidae | *Dicaeum concolor* | Plain Flowerpecker | | Scattered Tree | TB |
| 37. | | | *Dicaeum cruentatum* | Scarlet Backed Flowerpecker | | Scattered Tree | TB |
| 38. | | | *Dicaeum ignipectus* | Fire Breasted Flowerpecker | | Bush | TB |
| 39. | | Dicruridae | *Dicrurus aeneus* | Bronzed Drongo | | Scattered Tree | TB |
| 40. | | | *Dicrurus leucophaeus* | Ashy Drongo | Hnget-Taw Lin Mee Zew | Scattered Tree | TB |
| 41. | | | *Dicrurus macrocercus* | Black Drongo | Hnget-Taw Lin Mee Zew | Scattered Tree | TB |
| 42 | | | *Dicrurus paradiseus* | Greater Racket Tailed Drongo | Hnget-Taw Mee Shae | Open Area | TB |
| 43. | | Estrildidae | *Lonchura punctulata* | Scaly Breasted Munia | Sar Wadee | Electric Wire | TB |
| 44. | | | *Lonchura striata* | White Rumped Munia | Sar Wadee | Bush | TB |
| 45. | | Hirundinidae | *Hirundo rustica* | Barn Swallow | Pyan Hawar | Electric Wire | TB |
| 46. | | Laniidae | *Lanius collurioides* | Burmese Shrike | Hnget Belu | Scattered Tree | TB |
| 47. | | | *Lanius cristatus* | Brown Shrike | Hnget –Da-Zart | Scattered Tree | TB |
| 48. | | Muscicapidae | *Ficedula hyperythra* | White Eyed Slaty Flycatcher | | Scattered Tree | TB |
| 49. | | Nectariniidae | *Aethopyga siparaja* | Crimson Sunbird | Hnan Pyi Soke | Scattered Tree | TB |
| 50. | | | *Nectarinia asiatica* | Purple Sunbird | Hnan Pyi Soke | Scattered Tree | TB |
| 51. | | | *Nectarinia jugularis* | Olive Backed Sunbird | Hnan Pyi Soke | Scattered Tree | TB |
| 52. | | Oriolidae | *Oriolus tenuirostris* | Slender Billed Oriole | Hnget Wah | Scattered Tree | TB |
| 53. | | Passeridae | *Passer domesticus* | House Sparrow | Sar | Bush | TB |

Table 1. continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 54. | | | *Passer montanus* | Eurasian Tree Sparrow | Sar | Human Habitat | TB |
| 55. | | Phylloscopidae | *Phylloscopus fuscatus* | Dusky Warbler | | Scattered Tree | TB |
| 56. | | | *Phylloscopus plumbeitarsus* | Two Barred Warbler | | Scattered Tree | TB |
| 57. | | Pycnonotidae | *Pycnonotus atriceps* | Black Headed Bul Bul | Bowt | Scattered Tree | TB |
| 58. | | | *Pycnonotus cafer* | Red Vented Bul Bul | Bowt Hpin Ni | Open Area | TB |
| 59. | | | *Pycnonotus finlaysoni* | Stripe Throated Bul Bul | | Scattered Tree | TB |
| 60. | | | *Pycnonotus goiavier* | Yellow vented Bul Bul | | Bush | TB |
| 61. | | | *Pycnonotus jocosus* | Red Whiskered Bul Bul | Bowt Ka Lone | Electric Wire | TB |
| 62 | | Sturnidae | *Acridotheres fuscus* | Jungle Myna | Taw Zayet | Human Habitat | TB |
| 63. | | | *Acridotheres tristis* | Common Myna | Zayet | Human Habitat | TB |
| 64. | | | *Gracular religiosa* | Hill Myna | Thar Lie Kar | Human Habitat | TB |
| 65 | | Vangidae | *Hemipus picatus* | Bar Winged Flycatcher | | Scattered Tree | TB |
| 66. | | Zosteropidae | *Zosterops palpebrosus* | Oriental White Eye | | Scattered Tree | TB |
| 67. | Pelecaniformes | Ardeidae | *Ardeola grayii* | Pond Heron | Byine Out | Scattered Tree | WB |
| 68. | | | *Casmerodius albus* | Great Egret | Byine | Open Area | WB |
| 69. | Psittaciformes | Psittaculidae | *Psittacula alexandri* | Red Breasted Parakeet | Kay Ku La Ma | Scattered Tree | TB |
| 70. | Strigiformes | Strigidae | *Glaucidium cuculoides* | Asian Barred Owlet | Zee Kwyet | Scattered Tree | TB |

Open Area

Scattered Tree

Human Habitatation

Electric Wire

Grass Land

Bush

Plate 2.Different types of habitats

**Habitat utilization of bird species**

During the study period, the highest numbers of bird species 70 were observed in study sites. 40 bird species utilized on the scattered tree, nine species utilized in the bush, eight species in an open area, six species in human habitations, electric wire, and one species utilized in grassland were observed for using as feeding and roosting sites (Plate.1). There

was greater variation in species composition between terrestrial birds and water birds (Table1).

**Open Area**

Eight species of terrestrial and water birds were observed in this area. Among them, terrestrial birds were higher than water birds (Table 2, 3).

**Scattered Tree**

A total of 40 species were counted during the study period. Terrestrial bird species were belonging to 19 families under eight orders. Two species of water birds from two families under were observed two orders (Table 2, 3).

**Human Habitation**

All terrestrial bird species inhabit in this area six species of four families under the three orders were recorded (Table 2, 3).

**Electric Wire**

Six terrestrial bird species under two orders and five families were found during the study period (Table 2, 3).

**Grass Land**

Only one resident terrestrial bird was observed in this grassland (Table 2, 3).

**Bush**

Only one water bird species were recorded as one family and one order in bush type. Eight terrestrial bird species belonging to six families under two orders were also occurred (Table.2, 3).

Table 2. The occurrence of bird species in different habitat types

| Habitat Types | Number of Order | Number of Family | Number of Species |
|---|---|---|---|
| Open Area | 6 | 6 | 8 |
| Scattered Tree | 10 | 21 | 40 |
| Human Habitat | 3 | 4 | 6 |
| Electric Wire | 2 | 5 | 6 |
| Grass Land | 1 | 1 | 1 |
| Bush | 3 | 7 | 9 |

Table 3. The occurrence of bird species in different sites

| Sites | Number of Order | Number of Family | Number of Species |
|---|---|---|---|
| Paduak road | 9 | 29 | 67 |
| Khayae road | 6 | 17 | 39 |
| Adipadi road | 6 | 17 | 30 |
| Seinpann road | 8 | 20 | 41 |

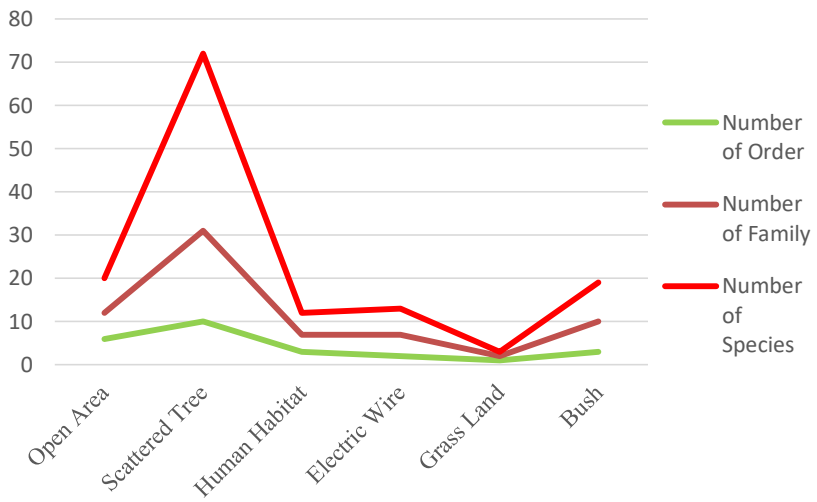



Fig.3 Prevalence of observed bird species in different habitat types

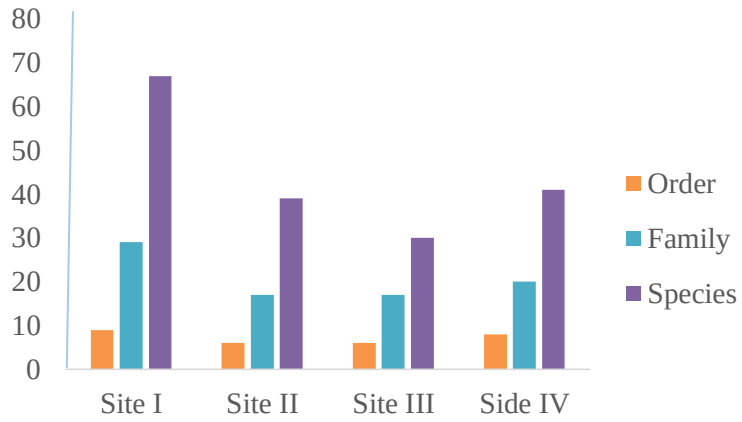



Fig 4: Prevalence of observed bird species in study site

## Discussion

The diversity of bird species in this area was investigated to assess the species composition and habitat utilization of some bird species at the site of Paduak road, Khayae road, Adipadi road, and Sein pann road in Myeik University Campus. In the present result, 65 species of terrestrial and five species of water birds were recorded according to Robson (2005 and 2008). The terrestrial bird species were abundant in the scattered tree, open area, and bush. Thus terrestrial bird species preferred such kind of habitats than others. Population abundance of bird species was directly related to habitat and their favorable condition.

In the terrestrial bird, *Acridotheres tristisr* (Common Myna) was recorded to be the highest number of birds. These species are found in human habitation. Another species of *Columba livia* (Rock Pigeon) was recorded only in human habitation. Terrestrial bird species of *Megalaima lineate* (Lineated Barbet) was recorded on a scattered tree and its song may be heard from the edge of the tree. Another species of *Corvus macrorhyncho* (Large Billed Crow) was common. In the family Dicruridae, the four Drongo species were recorded in the study period. The one species of *Dicrurus paradiseus* (Greater Racket Tailed Drongo) was recorded only in an open area. The rest two were recorded on the scattered tree.

Soe Naing (2019) reported that 40 terrestrial birds and four water birds were found in Myeik University Campus. This finding is not agreed with the present study that 65 terrestrial birds and five water birds were recorded. In this study, the abundant species belong to order Passeriformes. This coincides with the report of SoeNaing (2019) that Passeriformes was the highest species number and population.

The water bird species, *Casmerodus albus* (Great Egret) was recorded only in the rainy season. Colour changing in bill and leg of this species was found only in the breeding period. In the present study, the result showed that species richness and population abundance of the birds depending on the food availability, seasonal conditions, and habitat type. It may be assumed that Myeik University Campus has microhabitats and food sources possible and all provide appropriate save roosting sites.

## Conclusion

Birds occupy a very significant position in human society and of course, a sensitive indicator of environmental change. Birds used in various kinds of habitats. The study site of Myeik University Campus has the richness of bird species. This forest type supports sufficiently for many species around the year. Forest ecosystem supports some threatened elements of biodiversity in Myanmar, including the majority of globally threatened plant and animal species Myeik University Campus, supports many bird species for food, shelter and breeding place. The present study site was suitable for the faunal survey first and needs to conduct the ecological study of the bird fauna and the result will be essential for the conservation of the habitat and the fauna.

## Acknowledgements

We would like to thank Dr. Ni NiOo (Rector) and Dr. Win Win Than (Pro-Rector), Myeik University, for allowing us to do this term paper. We are grateful to Professor Dr. Aye AyeMyint, Head of Zoology Department, Myeik University for her constant guidance and encouragement of this work. We are also indebted to Professor Dr. Aye Aye Cho, Professor of Zoology Department, Myeik University, for her contribution to invaluable suggestions. Finally, we would also like to thank my colleagues for their support in this field.

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# Characterization of Mitochondrial genome and Cytochrome *b* DNA of *Rattus exulans* from Pathein environs

San Maung Maung Theint[1], Khin Myat Myat Zaw[2], Khin Mg Saing[3],Thidar Lay Thwe[4]

## Abstract

In Myanmar, the rodent family Muridae is of great diversity and biomedical importance. The taxonomy and distribution of the genus *Rattus* are poorly known, despite recent recognition of two extra endemic species. In this study, each 50 rat specimens from three study sites, Ka Law Khon village site (A), Ka Lat Chi Gon village site (B), and Kim Ba Lin Kyun township site (C) in Ayeyarwaddy Division were collected by trapping. This performed Morphological and morphometric parameters analyses for identification on rats belong to family Muridae collected from Pathein Environs. All specimens were dissected and the liver of each collected specimens was extracted and preserved in 70% ethanol until the contents were examined. *Cytb* gene and mtDNA were reported to be 2.05 kb (428 bp) and 1140 bp in size for *R.exulans* which is concordant with the expected size of the target fragment. The results will be used to determine the genetic distance between populations of *R.exulans* on either side of the Rakhine Yoma range which might be a geographical barrier for *R.exulans*. The genetic relationship for *R. exulans* from Pathein to the species in other parts of Myanmar and neighboring countries could also be analyzed.

**Keywords:** *Rattus*, Morphometric characters, *Cytb* gene

## Introduction

The family Muridae is comprised of 730 species from 150 genera of rodent groups, exhibiting the highest percentage (60%) of species within the order Rodentia (Musser and Carleton, 1993). The subfamily Murinae (Old World mice and rats) is the largest taxonomic group of mammals, comprising well over 500 species and 113 genera (Musser and Carleton, 1993) within Muridae. Among the members of the genera within Murinae, the largest in species numbers is genus *Rattus* and its related genera, comprising 167 species (Pages *et al*., 2010), and hence contributing significantly to the prominent diversification in the eutherian mammals. These genera are found on all continents of the earth, dominating granivore and omnivore niches. They also exhibit diversity in morphology, such as body size ranging from 24 to 45 cm.

The Muridae (Old World mice and rats) are the largest family of mammals, comprising well over 730 species and 150 genera (Musser and Carleton, 2005). The majority of rodents are ground dwellers, digging tunnels in the earth with the help of their incisors but other live on top of the ground well-protected from natural enemies. Some live in trees. According to their ecological preferences, they are divided as species that appear only on river banks and that prefer to dig burrows with a submerged entrance, species that live almost exclusively under the soil, living in a system of tunnels or burrows (Aplin *et al.*,2003).

The Polynesian rat, *Rattus exulans* (Peale, 1848), is one of the smallest rats in size within the genus *Rattus* and was first described from Tahiti, Society Islands. This species is widely distributed from East and Southeast Asia to Pacific Islands: stretching from the eastern region of Bangladesh to Easter Island in the Pacific Ocean for the East-West range,

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and from New Zealand to Miyakojima Island in Japan for the South-North range (Corbet and Hill, 1992; Musser and Carleton, 1993; Motokawa *et al.*, 2001).

Molecular divergences pattern is relating to molecular and morphological divergence. It is widely used to reconstruct Phylogenetic history. Patterns of divergence depend on selection acting on the DNA, ranging from functional genes under strong stabilizing selection slowing down the rate of evolution rodents (Order Rodentia) analyze for both morphology and molecules (Drummond *et al.*,2005). In this study, *Rattus exulans* and *Rattus rattus* were being analyzed by molecular Phylogenetic approach from genes that consist of one rapidly evolving mitochondrial markers; Cytochrome *b* and control region for clarifying the taxonomic position of *Rattus* and to understand the evolutionary history of *Rattus* species. The objective of this study is to record the morphometric characters of *Rattus exulans* in populations of the Pathein Environs and to amplify and characterize *Cytb* gene DNA from the extracted mitochondrial genomes of the collected species.

## Material and Methods

### Study site and study period

Sample collection trips were conducted at three sites; Ka Lat Chi Gon (Lat, 16º: 56':46"N and Long, 94º:35': 13"E), forest and paddy field (Site A); Ka Law Khon (Lat, 16º: 56':15"N and Long, 94º:36': 09"E), human habitat (Site B); and Kin Ba Lin Kyun (Lat, 16º: 47':53"N and Long, 94º:45': 43"E, human habitat (Site C) Pathein area in Ayeyarwady Region (Fig 1). This research was conducted from June 2014 to May 2018.

### Sample collection

Our average estimated relative abundance measures the capture sampling over one month during December 2014 were 50 traps for *Rattus species*. Each of the most abundant woody species at two different study sites was tested for their vulnerability to rats by placing dry fish in one of the treatments on the forest floor: open-trap (23 × 15 × 15 cm; length ×width × height) that excluded all potential vertebrate seed predators and dispersers (e.g., rodents, cats, mongoose). Trapping time is at 5:00-5:30 pm and harvesting at 7:00–7:30 am. The collected rat's specimens were brought to the laboratory of the Zoology Department, Pathein University to identify the tentative species.

### Identification of species

All captured rats were labeled, identified, sexed, and weighed individually. *Rattus* sp. were measured and photographed. Morphometric measurements are used symbol, total length (TL), tail length (T), body weight (WT), hindfoot length with nail (Hf-cu), hindfoot length without nail (Hf-su), ear length (E), respectively (Shimada *et al*.,2009). The methodology followed Aplin *et al*., (2003), Lundrigan *et al.*, (2002), Suzuki *et al.*, (2013), Steppan *et al*., (2005).

### Preparation for DNA extraction

After weighing and measuring the rats, they were immediately anesthetized and dissected for tissues to prepare for DNA extraction. The liver was removed from individual specimens and placed in the70% ethanol of sample tubes and labeled of serial number YUZ. The remaining bodies of the rats were kept in a plastic bottle containing 70% ethanol for reference.

**Genomic DNA extraction**

Whole genomic DNA from liver tissue was extracted using (QIAamp DNA Mini Kit, 250) according to the manufacturer's protocol (Plate II). At the last step of the protocol, the extracted DNA in the total value of 100 µl of the TE buffer was stored at -20 ºC in a refrigerator.

**Measuring extracted DNA concentration**

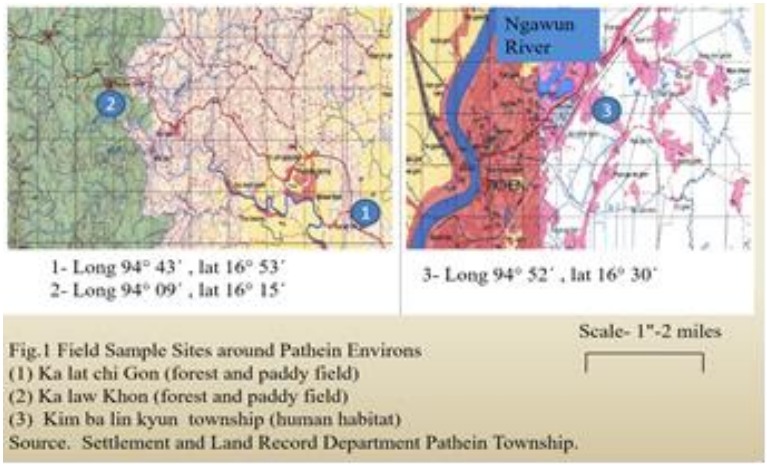
Each extracted genomic DNA sample was measured its concentration and purity by NanodropOne Spectrophotometric machine (Table 2) (Plate (II)).

**Gel electrophoresis**

The extracted DNA and PCR products were separated and visualized by electrophoresis on 1% agarose gel containing TAE Buffer. 2µl of the extracted DNA solution was mixed with 1µl gel loading buffer (Blue Dye) and 2µl marker. After, transfer the mixed solution to a well. And run the electrophoresis at 135 V for 15 min using the 1x TAE. Stain the gel with ethidium bromide 15 min for visualization and photographed in a UV light transilluminator. The selected PCR products were subjected to sequencing and were analyzed by Plate (II).

**PCR amplification**

For PCR, 1µl of the extracted DNA mixing with 1µl primer, 10µl of the polymerase, 6µl distill water were prepared for both upper and lower part primers. The PCR conditions consisted of an initial denaturation at 95˚C for 10min, followed by 30cycles of denaturation at 95˚C for 30sec, annealing at 52˚C for 30 sec, and a final extension at 72˚C for 30 sec for the two-hour duration.



Lat Chi Gon village

(sites A)

Ka Law Khon village

(site B)

Kin Ba Lin Kyun village

(site C)

Plate. I Trapping Sites A, B and C in the studied villages

Tissue sample for DNA

QIAamp DNA Mini Kit (250)

Marker

Primer

Microcentrifuge

ProFlex PCR System

Electrophoresis machine

UV Transluminator

3500 Genetic Analyzer

Plate II. A tissue sample from livers, Kit for DNA and some equipment used in the present study

## Results

A total of 50 samples of *Rattus* species, were randomly collected from three sample sites (A, B, and C) in Pathein environs. The trapping success rate was highest in site A (52%) among three sites; site B (18%), site C (30%) (Table 1). Genomic DNA of liver tissue was extracted from 50 individuals, using the QIAamp DNA Mini Kit, 250. A sufficient amount of genomic DNA was successfully extracted, more than 25 mg each from liver tissue of all specimens. Agarose gel electrophoresis showed genomic DNA bands of 2.05 kb (428 bp) and 1140 bp in size for *R. exulans* (Plate III). The concentrations of extracted genomic ranged from *the Cytb* gene were reported 13.356ng/µL to 324.282ng/µL (Table 2). The purity values ranged from 1.66 to 2.01 at the wavelength ratio of A260/A280nm, and 0.87 to 3.12 for A260/A230nm, indicating the fine quality of DNA solution for PCR reaction (Table 2). Out of 50 genomic DNA, 31fragments of the C*ytb* gene were successfully amplified by PCR for both upper and lower parts. Agarose gel electrophoresis shows PCR product bands between 400 and 500 bp in size, which is concordant with the expected size of the target fragment (Plate III and IV).

Table 1. Trapping success (% of total) at different sampling sites

| Sr. No. | Sampling site | Trapping sites | No. of traps with catch | | (%) of total |
|---|---|---|---|---|---|
| **1.** | A | Forest and Paddy field (Ka Lat Chi Gon) | Catch<br>No catch | 26<br>24 | (52.00%)<br>(48.00%) |
| **2.** | B | Forest and Paddy field (Ka Law Khon) | Catch<br>No catch | 9<br>41 | (18.00%)<br>(82.00%) |
| **3.** | C | Human habitation ( Kin Ba Lin Kyun) | Catch<br>No catch | 15<br>34 | (30.00%)<br>(70.00%) |
| **No. of traps= 50 per site** | | | | | |

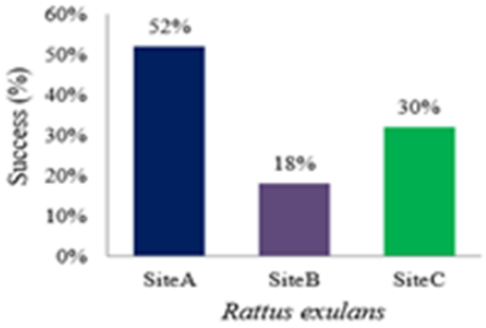



Fig.2. Trapping success (catch %) of *R. exulans* at different sites

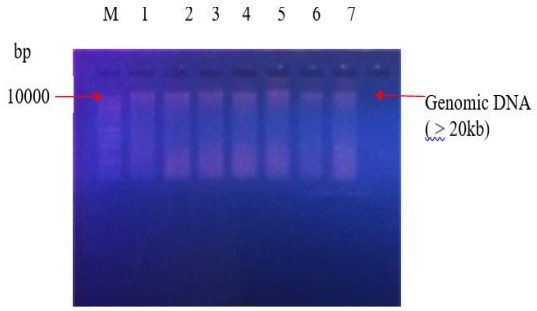



Plate.III Electrophoretogram of genomic DNA extracted from liver tissues of *R.exulans*.1 % agarose gel, 135 VCD, 15 mins, TAE 1x. Ethidium bromide stained and visualized under UV illumination (365nm).

Lane1-7: YUZ 144,124,125,126,127,128,131

M:CSL-MDNA 1Kb marker

bp= base pairs, kb= kilo base pairs

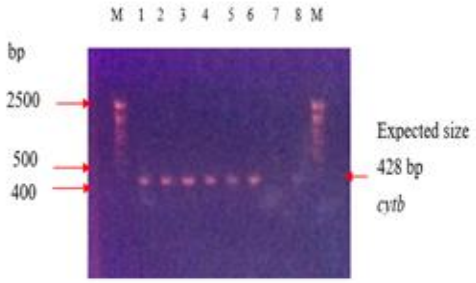



Plate. IV. Electrophoretogram of PCR of *cytb* gene (upper part) from liver tissues of the*R.exulans*.1 % agarose gel, 135VCD, 15mins, TAE 1x. Ethidium bromide stained and visualized under UV illumination (365nm).

Lane 1-8:YUZ125- 132

M: CSL- MDNA 100bp Marker

bp= base pair

Table 2. Concentration and purity of extracted genomic DNA from liver tissue samples (25mg) of some specimens

| Sr. No. | Specimens code | Nucleic Acid(ng/µL) | A260/A280 | A260/A230 |
|---|---|---|---|---|
| 1. | YUZ 125 | 284.354 | 2.06 | 2.335 |
| 2. | YUZ 25 | 13.356 | 1.661 | 0.874 |
| 3. | YUZ 115 | 324.282 | 2.021 | 2.137 |
| 4. | YUZ 116 | 152.868 | 2.012 | 2.09 |
| 5. | YUZ 118 | 75.578 | 2.048 | 3.127 |
| 6. | YUZ 119 | 241.144 | 2.05 | 2.192 |
| 7. | YUZ 120 | 126.333 | 2.068 | 2.095 |
| 8. | YUZ 121 | 164.251 | 2.051 | 2.18 |
| 9. | YUZ 122 | 107.358 | 2.078 | 2.238 |
| 10. | YUZ124 | 107.358 | 2.078 | 2.238 |

1.8= pure DNA at A260/A280nm

2.0= pure DNA at A260/A230nm

A260/A280 = Protein contamination

A260/A230 =Organic contaminants

## Discussion

A total of 50 individuals of *R. exulans* were collected from three sites of Pathein environs, Ayeyarwady Region in West Myanmar; Ka Lat Chi Gon (Site A, paddy field), Ka Law Khon (Site B, paddy field) and Kim Ma Lin Kyun (Site C, human habitation). The trapping success rate was highest in Sites A (52%) among three sites; Site B (18 %), Site C (30%). The largest number of captured individuals was recorded in Site A, Ka Lat Chi Gon, the west bank of Ngawun River outside Pathein City, where the crop had been harvested in paddy fields were at the time of sampling. The second number of rats were captured in Site C, in Kim Ma Lin Kyun, the east bank of Ngawun River, inside Pathein City, where the human population was dense and vegetables were cultivated. In contrast, in Site B, Ka Law Khon village, the west banks of Ngawun River, outside Pathein City area, paddy fields were seemed less abundant and vegetables were dominantly cultivated. The trapping result suggests that the paddy field is a favorable habitat of *R. exulans*.

Mitochondria genomic DNA (mtDNA) and first and second parts of *Cyt-b* gene DNA were successfully extracted, amplified by PCR, and identified by λ HindIII DNA marker from liver tissues of *R. exulans.* *Cyt-b* gene and mtDNA were reported to be 16.315kb and 1143bp in size respectively for rats (NE Schlick, 2006). In this study, *the Cytb* gene was reported 2.05 kb (428 bp) and 1140 bp in size for *R. exulans*, which is concordant with the expected size of the target fragment.

In the present study, the morphometric characteristics and genomic DNA extraction of *Rattus exulans* from three study sites are presented. The study of genetic characteristics and molecular phylogeny of this species will support a better understanding of the ecology and geographic distribution of *R. exulans*.

## Conclusion

The results obtained in this study showed that the genomic size of the mtDNA and the *Cyt-b* of the collected specimens were within the standard size of *Rattus* spp. We could confirm the purification of extracted DNA to use in the next step for the sequencing of *Cyt-b* DNA from the studied species. The Sequence data will be aligned with *Cyt-b* gene sequences in murine databases in Japan by BLAST search (NCBI Databank) and the results of *Cyt-b* DNA will be utilized to construct Phylogenetic trees for the recorded two rat

species (*R.rattus* and *R. exulans*) about other *Rattus* spp. The genetic relationship for these species from Pathein to the species in other parts of Myanmar and neighboring countries could also be analyzed.

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# Utilization of Fishing Gears with Target species recorded at Ayeyarwady River segment between Kyauk Myaung and Yae Taw village, Sagaing Region

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## Abstract

The present study was conducted of Ayeyarwady River Segment Kyauk Myaung and Yae Taw villages, Kyauk Myaung Township Shwebo district Sagaing region. A total of nine kinds of fishing gears were recorded in the fishing operation of the area. The main gears are seine net, set gill net, hook and lines, falling gears, and various types of the fish trap. Hmyones and Nga-hmya-tan were mostly used in the rainy season. Active gear of small cast net ( Let-pyit-kun) and passive gear of set gill net (Tan-paik) were used throughout the year. Among them, passive gears are more effective than others in the present work.

**Keywords**: Active gears, Passive gears, Target species.

## Introduction

Of the 21,723 fish species known to science, over 40% live in freshwaters and the majority of them live in tropics (Talwar and Jhingran,1991).

Myanmar is enriched with biodiversity and the highest producers of freshwater products including fish and shrimp. Fishes are rich in protein, vitamins, and mineral salts and are also known as valuable protective food. Fish forms an important item of the diet in many areas of the world. The fisheries sector plays a vital role in the culture and soci-economic life of Myanmar Traditionally Myanmar people prefer freshwater fish to marine fish. Fish and rice from the basic for the food security for Myanmar people, with an average fish consumption of 21kg per caput per year (Win Oo,2011).

Inland fisheries are the most heavily exploited aquatic resources in the world. It produces about one-quarter of the world 's food fish. Most inland fishes are consumed locally, marketed domestically, and often contribute to the subsistence and livelihood of people in rural areas.

Fishing methods are officially classified in the Myanmar Fisheries Manual into 57 categories. Many different methods of fishing and type of fishing gear have emerged over the centuries and are still in use, however and further development has taken place to meet local conditions (Win Aung 1995).

Traditional gears are often deployed with a great degree of sophistication, which is based on a deep knowledge of the local conditions and the behavior of the target species. The choice of appropriate method and gear is important to catch a particular species in a particular area. (Welcomme,2001).

Fish capture methods can be divided into two groups active and passive. Passive methods rely on the movement of fishes for their capture and have often proved useful for the study of fish migration. Active methods are those that effectively pursue the fish or one moved in order to capture them. These methods are particularly effective at catching

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[5] Dr, Lecturer,Department of Zoology, Myeik University

sedentary species (Aung Lwin,2008). –The aim was to study some fishing gears used in the study area and their target species.

## Material and methods

### Study area

The study is located in between 22˚34′ 30″ to 22˚ 36′ 59″ N and 95˚ 56′ 06″ to 95˚ 57′ 54″ E. It extends approximately 4.02 km in length and the total area is about 1.88 square kilometers and lies Sint Ku Township in the east and Kyauk Myaung Township in the west.

The total area of study site, Yae Taw village, is about 1.17 square kilometers. It is situated between 22˚ 35′ 37″ to 22˚ 36′ 49″ N and 95˚ 37′ 2″ to 95˚ 56′ 34″ E.

### Study period

Feberuary 2019 to January 2020

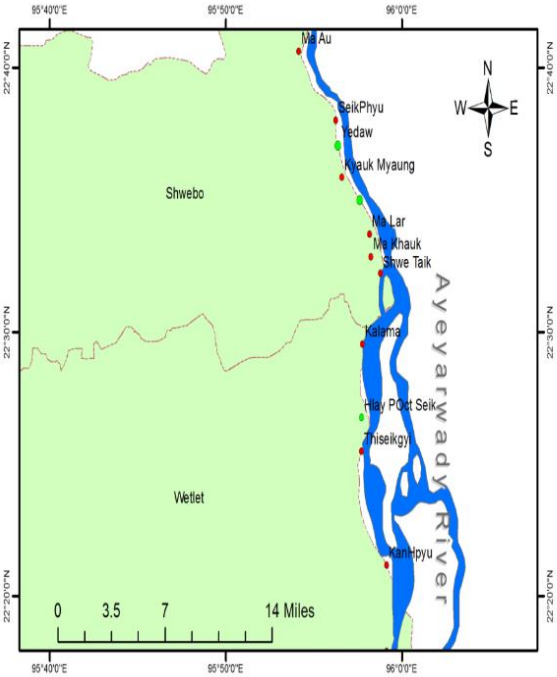


Fig 1. Location of the study area

(source from Geography Department, Shwebo University)

## Results

### Fishing Gears and Questionaries' Survey Works

A detailed study was conducted on each gear and the dimension of each gear part was also taken into consideration. Fishing operations and target species by each gear were also investigated and recorded.

Fishermen were interviewed to get as much formation on the fishery process including gears, employed the number of fish caught per day and target species and fishing method. The local name of each gear was also recorded. Terminology and Classification of the fishing gears were followed by FAO, (2005) and Khin Maung Aye et al. (2006).

**Fishing Gears Utilized in the study area**

Fishing methods utilized in the study area were categorized according to FAO (2005) and Khin Maung Aye et al. (2006). Nine kinds of fishing gears were used in the study area.

Fishing gears used in the study area can be classified into two main types, active gear, used mainly in active pursuit of fish, and the passive gear, the stationary, or fixed gear that "waits" for the fish. The various types of fishing gears commonly used in the study area are as follow;

**Active gears**

1. Seine nets

(a) Encircling gill net (Wei-paik)

(b) Double stick net (Yet Thet)

(c) Portable hand lift net or Dyne-kwin (Gaw)

2. Falling gears

(a) Small cast net (Let-pyit-kun)

**Passive gears**

3.Nets

(a) Set gill net (Tan-paik)

4.Line (with Hooks)

(a) Rod and line (Nga-hmya- tan)

5.Fish trap

(a) Vertical fish trap or Twin fish trap (Yin-kwe-hmyone)

(b) Rectangular trap (Ze-Le hmyone)

(c) Cylindrical fish trap (Nga-mway-doe-hmyone)

1. Seine nets

This type of net has very long wings and a towing rope. The nets are of various lengths and come with or without collecting bags for catching and collection of fishes and are locally called Swei-paik. The size of the mesh depends upon the size of the fish to be caught.

Encircling gillnet (Wei-paik)

Encircling gillnet is gillnet set horizontally in shallow water. This gear is mainly used for bottom dwellers and the species caught depend on the depth of water. This gear is used from October to May (Plate IA)

a. Double stick Net (yet-thet)

A double stick net is commonly called Yet-thet. This gear is used throughout the year, especially in the raining season. It is mainly used to catch the small fishes (Plate IB)

b. Portable hand lift net or Dyne –kwin (Gaw)

It is locally called Gaw or Dyne –Kwin. Dyne-Kwin were dipped into the water and fishes that come in the net are scooped up. This gear was used in the raining season (June to September). Target species are small fishes (Plate IC)

2. Falling gears

Falling gear is traditional fishing gear and is commonly used by many small scale fishermen in inland fisheries. The gear can be classified into two group; portable cast net ("let- pyit-kun") and giant cat net ("Met-kun"). The portable cast net is generally operated in ponds, lakes, and rivers.

a. Small cast net (let-pyit –Kun)

It is a common net in Myanmar. This net is commonly called let-pyit-kun. The net is used in shallow water. It is used throughout the year (Plate ID)

3. Net

Various mesh sizes are used depending on the size of the fish of their selective choice. This gear is used throughout the whole year.

a. Set gillnet (Tan-paik)

Set gillnet is also called Tan –pike. This net is used onto the surface of the water. Fishes that swim into the net are caught by their gills. This net was used throughout the whole year. Target species are different depending on the mesh size (Plate IE)

4. Line (with Hooks)

a. Rod and line(Nga-hmya-tan)

This gear is used especially in the dry season (November to March) when the water level is low (Plate IF)

5. Fish trap (Hmyone)

It is constructed with bamboo strips made into square shaped-cage with a one-way entrance. A valve attached to the entrance prevents the fishes that went into the cage from escaping. The fish trap is commonly called Hmyone. The design of the fish trap varies.

a. Vertical fish trap or Twin fish trap(Yin-kwe-hmyone)

This trap is locally called yin-kwe-hmyone). It is a double cylindrical-shaped trap. This trap is made of numerous bamboo strips. The opening is used to take out of the fish from the traps. This trap is usually used in running water, from July to August (Plate IG)

b. Rectangular fish trap (Ze-le-Hmyone)

The rectangular trap or Ze-le-hmyone is made up of bamboo strips. The trap is an opening on top of this trap with a mesh door that can be closed and open again to take out the entrapped fish. The meshing of the cage is larger than Yin – Kwe – hmyone and is meant for medium-sized fishes. It is usually kept upright in the water and used from July to October (Plate IH)

c. Cylindrical fish trap (Nga – mway –doe – hmyone )It is locally called Nga-mway- doe-hmyone and is made of bamboo and cane. The gear is usually operated when river water flowed into the lake. It is used from August to October (Plate 1 i)

A. Encircling gill net or (Wei-paik)

B. Double stick net (Yet-thet)

C. Potable hand life net Dyne–kwin (Gaw)

D.Small cast net (Lat-pyit –kun)

E. Set gill net (Tan-paik)

F. Rod and line (Nga-hmya-tan)

G. Vertical fish trap

H. Rectangular fish trap

I.Cylindrical fish trap

Plate I. Different fishing gear and fish trap utilized in the study area

Table 1. Monthly utilization of fishing gear and target species recorded in the study area **(2019 - 2020)**

| Sr. No. | Type | Local name | Feb | Mar | Apr | May | Jun | July | Aug | Sep | Oct | Nov | Dec | Jan | Target species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.<br>a. | Seine net<br>Encircling gill net | Wei-paik | √ | √ | √ | √ | X | x | x | X | √ | √ | √ | √ | *Labeo labeo, Mystus-micropthalmus, Sperata aor, Pangasius pangasius, Wallago attu, Silonia silondia* |
| b. | Double stick Net | Yet-thet | X | x | x | X | √ | √ | √ | √ | √ | x | x | x | *Labeo stoliczkae, Glossogobius giuris, Aspidoparia morar, Salmophasia sardinella, Xenentodon cancila, Mastacembelus dayi* |
| c. | Portable hand lift net or Gaw | Dyne-kwin | X | x | x | X | X | √ | √ | √ | √ | √ | x | x | *Channa punctatus, C. oreientalis, Amblypharyngodon attkinsonii, Aspidoparia morar, Osteobrama cunma, Tetraodon cutcutia* |
| 2.<br>a. | Falling gears<br>Small cast net | Let-pyit-kun | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | *Puntius chola, P. sarana, Labeo boga, Aspidoparia morar, Amblypharyngodon atthinsonii, Parambassis ranga, Glossogobius giuris, Salmophasia sardinella* |
| 3.<br>a. | Net<br>Set gill net | Tan-paik | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | *Notopterus notopterus, Catla catla, Labeo rohita, Osteobrama belangri, Oreochromis sp. Xenetodon cancila* |
| 4.<br>a. | Line (with Hooks)<br>Rod and line | Nga-hmya-tan | √ | √ | √ | √ | √ | √ | √ | √ | x | x | x | x | *Sperata aor, Mystus micropthalmus, Silonia silondia, Wallago attus, Pangasius pangasius* |
| 5.<br>a. | Fish trap<br>Vertical trap | Yin-kwe-hmyone | X | x | x | X | √ | √ | √ | √ | √ | √ | √ | √ | *Ompok pabo, Labeo boga, L. angra, Puntius chola, Gagata cenia, Prawns* |
| b. | Rectangular trap | Ze-le-hmyone | X | x | x | X | √ | √ | √ | √ | x | x | x | x | *Labeo angra, L. boga, Mystus pulcher, M. cavasius, Puntius chola, Clarias batrachus, Prawns* |
| c. | Cylindrical trap | Nga-mway-doe-hmyone | X | x | x | X | √ | √ | √ | √ | √ | √ | √ | √ | *Mastacembelus armatus, M. dayi, M. zebrinus, Botia berdmorei, B. histrionica, Acantopsis chrorhynchus, Heteropneustes fossilis.* |

## Discussion

It was noted during the study, Encircling gill net (Wei-pike), Double stick net (Yet-thet), Portable hand lift net, or Dyne –kwin (Gaw)were employed in the study area. The active method appeared to be more successful in the cool season when fishes are less mobile whereas passive technique was observed to work best in the hot season when fishes are more active. The fishing gears included seine net, gillnet, and longline and various types of fish trap, out of which gillnet, cast net, bamboo trap, and seine net were the main fishing gears utilized by the fishermen.

Shallow water seine netting is adapted to suit many situations and as the net is small, it is efficient in terms of cost and labor. With a large net, the method quickly becomes expensive and labor-intensive. Gill nets are relatively cheap and long-lasting, although regular maintenance is necessary, cast and push netting are simple to perform and easily repeatable after one has acquired some practice.Hmyone and Nga-hmya-tan were mostly used in the rainy season. Active gear such as small cast net (Let-pyit-kun) and passive gear set gill net (Tan-paik) was used throughout the year.

During the present study, it was found that passive gear was found extensively used to catch fish on a commercial scale. Some fishermen applying gill nets and beach seines with extremely small mesh size has led to the destruction of large quantities of juvenile fish.

During the study, it was found that fishermen not only used whole or parts of an animal as bait on hooks and in traps but also used different fruits or part of fruits, with strong fragrance as bait such as banana, jackfruit, and mangoes to lure and catch certain species of fish. Moreover, it was surprising to find that some fishermen were used scented pieces of soap as bait.

The gears are quite effective, selective, and easy to use. Quality of fishing gear used for harvesting of the resources is one of the most important factors for fishery development.

In the study area, fishermen mainly used the traditional gears and specific fishing gears are employed depending on target fish (fish size) and also season-wise. However, fishermen had to use alternative gears or activities, to provide enough income to support their families. therefore, the study area provides an important food source for the consumers and therefore needs to be maintained for long term preservation of the species to maintain the maximum sustainable yield.

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# Ecological studies on frugivorous bat species, *Pteropus hypomelanus* (Temminck,1853) in Myeik environs of Southern Coastal Tanintharyi Region, Myanmar

Thi Mar Win[1], Aung Aung[2], Aye Aye Myint[3],Thandar Aye[4]

## Abstract

The present study was conducted to record the fruit bats that occurred Myeik environs, Tanintharyi Region. The study period took place from June 2019 to February 2020. It was emphasizing on roosting trees and emergence time of fruit bats, *Pteropus hypomelanus* which were studied by direct observation showed that were silent during roosting as solitary and colonial to the active manner with the propped up position. Emergence behavior was observed both in the individual pattern in a group or cluster type. Identification of flying fox was followed after Bates and Harrison (1997) and Francis (2008). The study aimed to record the fruit bat species in the study area, to relate the emergence time of bats with local sunset time, and to investigate the day roosts characteristics of fruit bat, roosting pattern and behavior changed in association with their reproductive status and season.

**Keywords**: Frugivorous bat, Ecology, Roosting trees, Myeik environs.

## Introduction

The Union of Myanmar is situated in the North-West of the Indochina Peninsula, and is the largest country in mainland Southeast Asia (676,553km) (Forest Dept,2000). *P.teropus giganteus* is one of the largest bats in the world (Simmons, 2005). Island flying foxes are likely to be particularly important players in island ecosystems where they often serve as principal pollinators and seed dispersers were maintaining their numbers at high densities is necessary for the survival of plant communities. (Cox *et al*. 1991).The island flying fox also known as the variable flying fox, roosts gregariously, forming colonies of 10 to several hundred individuals. It is a widespread insular species.

*Pteropus hypomelanus* is generally a colonial species and roosts in large trees often in an area with topographic features that offer protection from strong winds, assist in thermoregulation and provide access to updrafts for easier flight. In Myanmar, this species is confined to small offshore islands of southern Tanintharyi (Mergui island). Among the fruit bats, the genus *Pteropus*, also known as a small island the flying fox, includes 62 species, which are considered keystone species for tropical forest functioning (Kunz *et al*. 2011). In Myeik environs, the existing information of regarding the roosts of *Pteropus* species insufficient to records of such behavior for flying fox, such as seasonal changes in roost composition relating to population density and food availability. Besides, there is no exclusive study on their activity patterns with behavior controlled by endogenous rhythms.

## Materials and Methods

The study area is Myeik environs, 12˚10´12"N and 98˚50´09"E in Tanintharyi Region. The present study lasted from June 2019 to February 2020. The collected specimens were preserved in 70% ethanol. It was followed after Bates and Harrison (1997) and Francis (2008). The time of bats emergence was observed during September 2019. The emergence time of *Pteropus hypomelanus* was observed with ranging from 5:48 pm to 7:00 pm. Though

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the bats were altered their time of emergence according to their day length. They fly out individually during emergence without cluster patterns. However, initial emergence was undertaken by one or a few individuals.

The survey for the day roost investigation was conducted monthly. The following parameters such as species, family, number, height, circumference, and DBH (diameter at breast height) of roost trees were taken at each roost site. The roost information such as the location of roost; duration of occupancy; species, family and number of nearby non-roost trees; colony size; water body, and association with human habitations were recorded. The measurement of roost tree height was taken using a digital clinometer. The circumference of the roost tree was taken with the help of a measuring tape and diameter at breast height (DBH) was calculated from the circumference. The colony size was assessed by direct roost count of roosting bats during day hours at their roosts, following Kunz *et al*, 1996.

**Direct roost count and emergence time count**

Direct roost count was carried out by using a pair of binoculars and tally counter as stated by Thomas and La Val (1988). Photographs were taken to support the estimated number. Along with some local community members, conducted a bi-weekly preliminary census via an emergence count in September 2019 starting at dusk when the bats first leave the roost until all had completed they are exist by following Barlow (1999).

**Diurnal Behavior Study**

The general daytime behavior of the bats was observed from 6:00 am to 18:00 on a total of 12 days at each study location. Observation days were spread across June, July, August, September, October, and November. There are 44 roost trees at Myeik environs, a single branch (clearly visible and with few bats) on a single roost tree was purposively sampled for studies of daytime behavior. The same branch was observed for all of the 12 observation days. All bats roosting on the branch were observed and their behaviors were observed and noted.

The scan sampling (Altmann 1974; Koju and Chalise 2010), to scan the subjects for two out of every twelve minutes, was used to note the behavior of the bats. Thus, two minutes of observation was followed by ten minutes during which no observations were made. All two-minute scan periods summed to a total of 26 h of direct observation (60 min, two-minute scan periods each day, in total 720 minutes; two-minute scan periods) at each study location. Air temperature at the study locations was recorded from morning to late afternoon following Connell *et al*. (2006)

**Data Analysis**

The primary data regarding population sizes and behavior of bats were compiled in MS-Excel. The compiled data were analyzed using MS-Excel and presented in bar diagrams. The most frequency of the behavior, sleeping is the eyes closed and wing wrapped around a body, grooming is the licking and scratching body and/or head, wing spreading is wing wide open, extended on the side or in front of body and wing flapping is fanning body with wing and was calculated by dividing the number of observations of the particular behavior by the total number of observations. The time of day was categorized into five different parts to understand the roosting activities in response to the time of day, i.e. early morning (6-9 am), morning (9–11 am), noon (11 am to 1 pm), afternoon (1–3 pm) and late afternoon (3–6 pm). The air temperature was divided into various classes, i.e. \10 C, 10–15 C, 15–20 C, 20–25 C, and 25 C.

## Statistical Analysis

The statistical Package for the Social Sciences (SPSS) Statistics 17.0 software was used for data analysis. Roosting sites were visited monthly throughout the study period from June 2019 to February 2020.

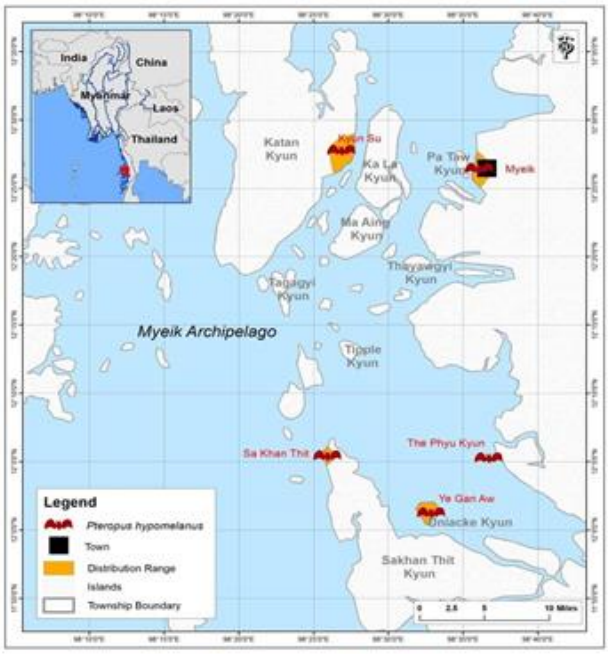


Fig 1. Map showing the study area

Plate.1 The apparatus used in direct observation

## Results

The time of bats emergence was observed during September 2019. The colony of *Pteropus hypomelanus* was observed with ranging from 5:48 pm to 7:00 pm. Though the bats were altered their time of emergence according to their day length. They fly out individually during emergence without cluster patterns. However, initial emergence was undertaken by one or a few individuals. As being social and colonial species, *P. hypomelanus* colonies were observed in several diurnal roosts with hundreds of individuals. *P. hypomelanus* colonies were observed to roost mainly in rain tree (Kokko) dominated all roost side trees.

All-day roosts harbor a total of 156 trees only 44 trees belonging to 7 families, 8 genera and 11 species were observed as roost trees (Table 1). The colonies of *P. hypomelanus* were usually roosted in larger and taller trees with dense canopy such as *Albizia saman, Xylia dolabriformis), Ficus bengalensis, Ficus religiosa, Ficus glomerata, Mangifera*

*indica*, *Durio zibethinus*, and *Artocarpus heterophyllus* respectively. The DBH of roost trees ranged from 13.47 cm (*Areca catchua*) to 146.72 cm (*Ficus benghalensis*). Heigh of the roost trees ranged from 10 m (*Mangifera indica* (tha yet)) to 46m (*Sandoricumkoetjape (thit-to*)) (Table 2). *P. hypomelanus* preferred to roost in larger *Albizia saman* (Kokko), *Ficus* tree species, and *Mangifera indica (tha-yet)* compared to other trees species.

The maximum number of bats (n=11110) was found to roost in six trees of *Albizia saman* (Kokko), located on the government building in Myeik civic center. There was a positive correlation between colony size and DBH of roost trees in two study sites (Kyun su and Thae phyu kyun), and also three study sites (Kyun su, The phyu kyun and Ye kan aw) slightly a positive correlative with colony size and height of the roost trees expect in Myeik and Sa khan thit (Fig.5 to 14). The DBH of roost trees influences the roosting habit of *P. hypomelanus* and also the height of roost trees (Fig. 5 to 14).

A total of 21246 individuals were directly counted in roost colonies of *P. hypomelanus*. The colony of bats per tree ranged from 60 to 1852 individuals. The highest population of bats (16130 individuals) was recorded in road side of a government building at Myeik while lowest population (978 individuals) in a near the water bodies roost at Sa khan thit (Fig 3). The most of roost trees (n=18) were located in the government building of Myeik civic center (Fig.1 and Table.2).

Table 1. Detail of day roosts used by *P. hypomelanus* in Myeik archipelago

| Sr.no | Location of the roost | Family | Name of Tree | Local name | No. of roost | No.of non roost Tree | Total no. of tree |
|---|---|---|---|---|---|---|---|
| 1 | Myeik | Combretaceae | *Terminalia bellerica* | Thit-seik | 3 | 4 | 7 |
| | | Mimosaceae | *Albizia saman* | Kokko | 6 | 2 | 8 |
| | | | *Xylia dolabriformis* | Pyin-ka-doe | 5 | 2 | 7 |
| | | Moraceae | *Ficus benghalensis* | Pyi-nyaung | 3 | 1 | 4 |
| | | | *Ficus glomerata* | Ye-tha-phan | 1 | 8 | 9 |
| 2 | Kyun Su | Arecaceae | *Areca catechu* | Kun-thee | 3 | 2 | 5 |
| | | Malvaceae | *Durio zibethinus* | Duyin | 2 | 3 | 5 |
| | | Meliaceae | *Sandoricum koetjape* | Thit-to | 2 | 1 | 3 |
| 3 | The Phyu Kyun | Anacardiaceae | *Mangifera indica* | Tha-yet | 2 | 12 | 14 |
| | | Mimosaceae | *Albizia saman* | Kokko | 3 | 2 | 5 |
| | | Moraceae | *Ficus benghalensis* | Pyi-nyaung | 1 | 1 | 2 |
| | | | *Ficus religiosa* | Bodi-nyaung | 1 | 1 | 2 |
| 4 | Ye Khan Aw | Anacardiaceae | *Mangifera indica* | Tha-yet | 2 | 1 | 3 |
| | | Mimosaceae | *Albizia saman* | Kokko | 2 | 1 | 3 |
| | | Moraceae | *Artocarpus heterophyllus* | Pein-ne | 1 | 24 | 25 |
| 5 | Sa Khan Thit | Anacardiaceae | *Mangifera indica* | Tha-yet | 3 | 2 | 5 |
| | | Mimosaceae | *Albizia saman* | Kokko | 2 | 3 | 5 |
| | | Malvaceae | *Durio zibethinus* | Duyin | 2 | 42 | 44 |

Table 2. Roost tree and Roost characteristics of *P. hypomelanus*

| Roost Sites | Name of Tree | Circumference (cm) | DBH (cm) | Height of roost Tree (m) | No. of roost tree | No. of Bats per Tree | Total No. of Bats |
|---|---|---|---|---|---|---|---|
| Myeik | *Terminalia bellerica* (thit-seik) | 350.67± 66.43 | 111.67 ± 21.15 | 29.66± 1.53 | 3 | 271.33 ± 45.39 | 814 |
| | *Albizia saman* (kokko) | 398.33± 24.06 | **126.85 ± 7.66** | 22.83 ± 5.71 | 6 | 1851.67 ± 871.44 | 11110 |
| | *Xylia dolabriformis* (pyin-ka-doe) | 145.2 ± 19.36 | 44.24 ± 9.15 | **29.8 ± 3.34** | 5 | 678.4 ± 390.78 | 3392 |
| | *Ficus benghalensis* (pyi-nyaung) | 461 ± 9.54 | **146.72 ±2.82** | 21.33± 2.51 | 3 | **90.67 ± 53.78** | 272 |
| | *Ficus glomerata* (ye-tha-phan) | 364.89 | 116.21 | 16 | 1 | 542 | 542 |
| Kyun Su | *Areca catechu* (kun-thee) | 42.33 ± 4.93 | **13.47 ± 1.57** | 21.67 ± 2.08 | 3 | 215 ± 29.82 | 645 |
| | *Durio zibethinus* (duyin) | 152.5 ± 10.60 | 48 ± 3.38 | 23 ± 1.41 | 2 | 208 ± 36.77 | 416 |
| | *Sandoricum koetjape* (thit-to) | 329 ± 13.44 | 105 ± 4.24 | **46 ± 1.41** | 2 | 250.5 ± 23.33 | 501 |
| The Phyu Kyun | *Mangifera indica* (tha yet) | 180.5 ± 7.78 | 57.49 ± 2.48 | 9.5 ± 2.12 | 2 | **89 ± 43.84** | 178 |
| | *Albizia saman* (kokko) | 330 ± 42.33 | 105.09 ± 13.48 | 22 ± 5.57 | 3 | 255.33 ± 109.29 | 766 |
| | *Ficus benghalensis* (pyi-nyaung) | 424 | 135 | 14 | 1 | 256 | 256 |
| | *Ficus religiosa* (bodi-nyaung) | 392 | 124.84 | 16 | 1 | 326 | 326 |
| Ye Khan Aw | *Mangifera indica* (tha yet) | 178 ± 5.65 | 56.68 ± 1.80 | **10 ± 1.41** | 2 | 82.5 ± 9.19 | 165 |
| | *Albizia saman* (kokko) | 326.5 ± 53.03 | 103.98 ± 16.88 | 23.5 ± 2.12 | 2 | 402 ± 6.36 | 803 |
| | *Artocarpus heterophyllus* (pein-ne) | 96 | 31 | 24 | 1 | 82 | 82 |
| Sa Khan Thit | *Mangifera indica* (tha yet) | 184.33 ± 9.29 | 58.70 ± 2.96 | 9.33 ± 1.26 | 3 | 71.66 ± 9.29 | 215 |
| | *Albizia saman* (kokko) | 291 ± 9.89 | 92.68 ± 3.14 | 21 ± 4.24 | 2 | 321.5 ± 60.10 | 643 |
| | *Durio zibethinus* (duyin) | 151 ± 4.95 | 47.90 ± 1.55 | 20 ± 1.41 | 2 | **60 ± 11.31** | 120 |

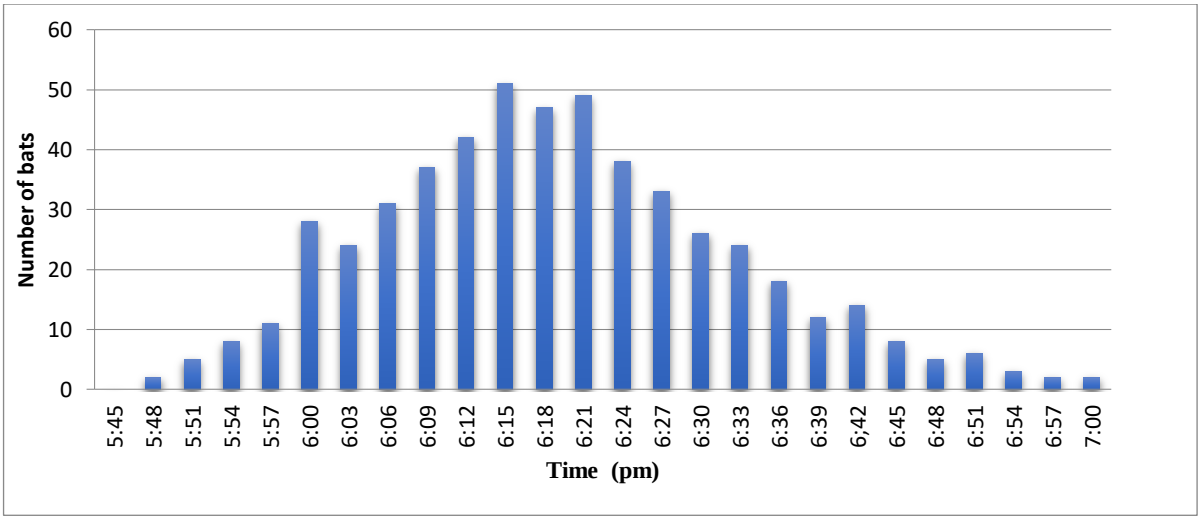


Fig 2. Emergence time of *Pteropus hypomelanus* in September, 2019

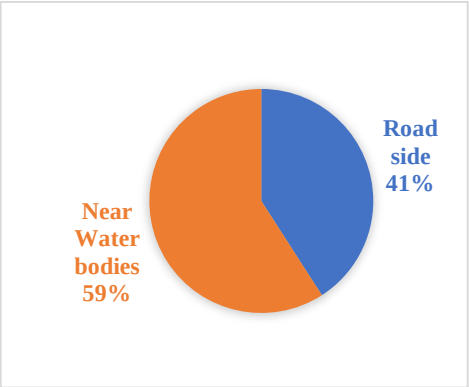


Fig 3. Characteristics of the surrounding areas of *P. hypomelanus* day roost sites

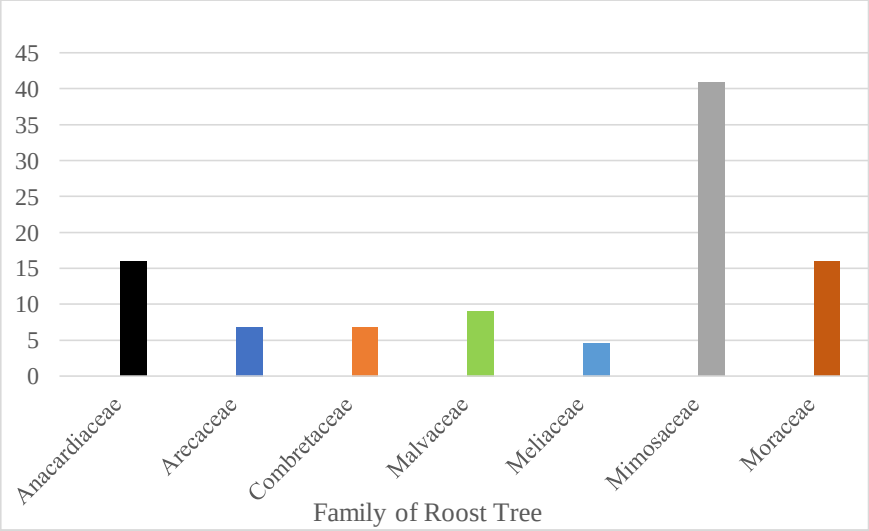


Fig 4. Tree families that were used by *P. hypomelanus* as roost trees

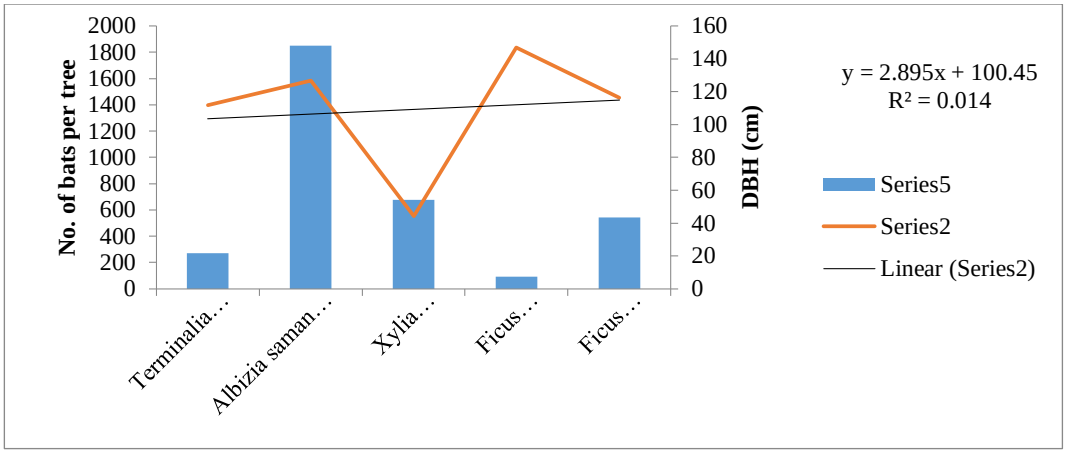


Fig 5. The roost trees preference of *P. hypomelanus* based on DBH in Myeik

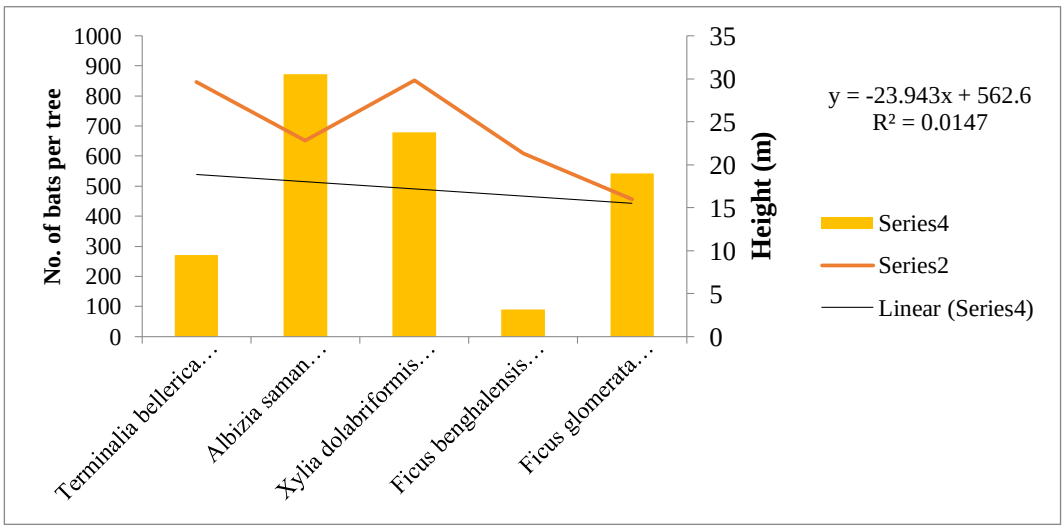


Fig 6. The roost trees preference of *P. hypomelanus* based on height in Myeik

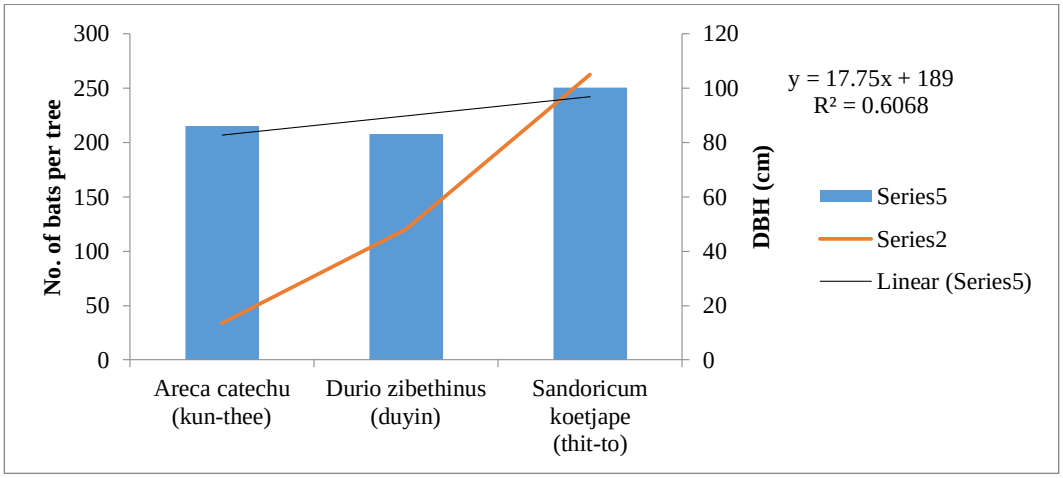


Fig 7. The roost trees preference of *P. hypomelanus* based on DBH in Kyun-su

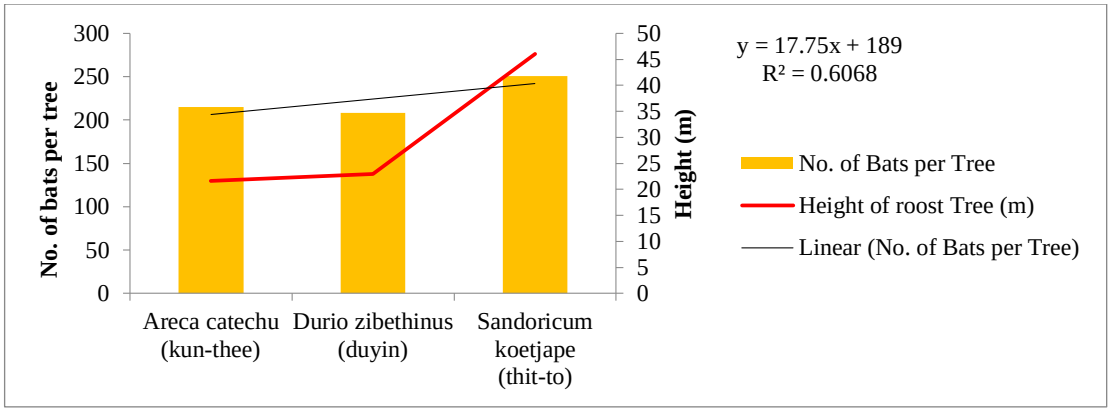


Fig 8. The roost trees preference of *P. hypomelanus* based on height in Kyun-su

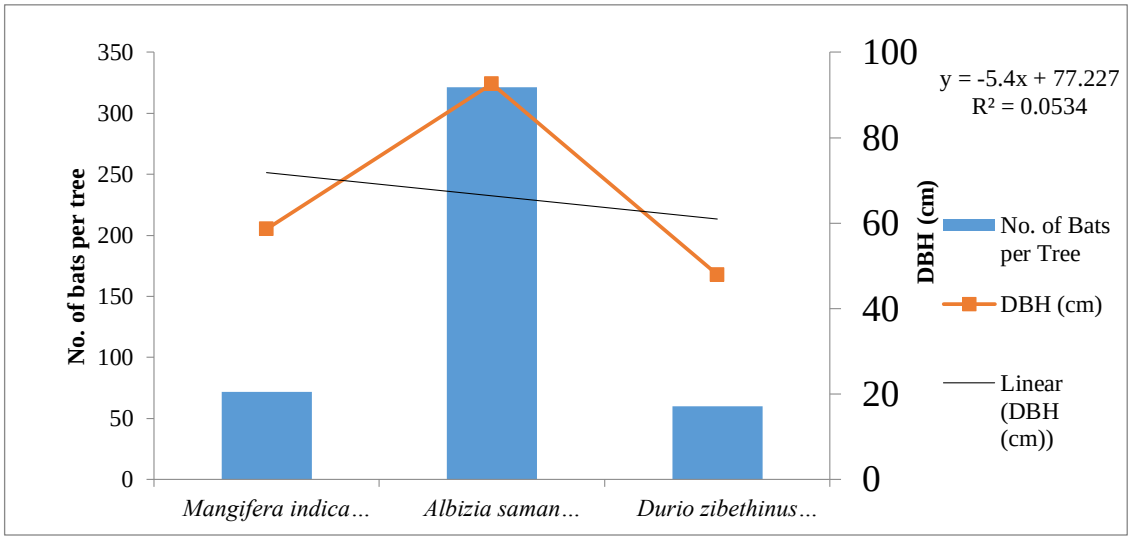


Fig.9 The roost trees preference of *P. hypomelanus* based on DBH in Sa-khan-thit

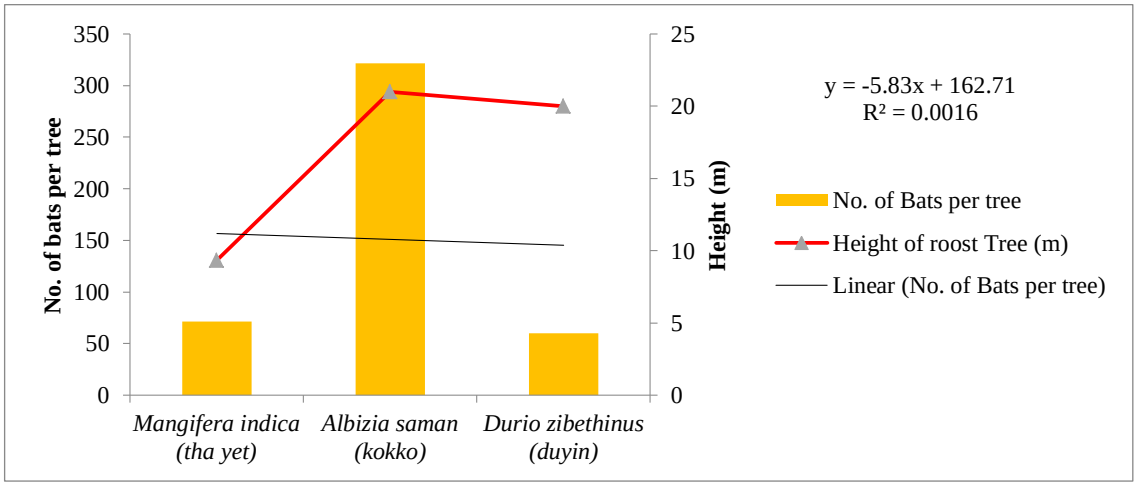


Fig.10The roost trees preference of *P. hypomelanus* based on height in Sa-khan-thit

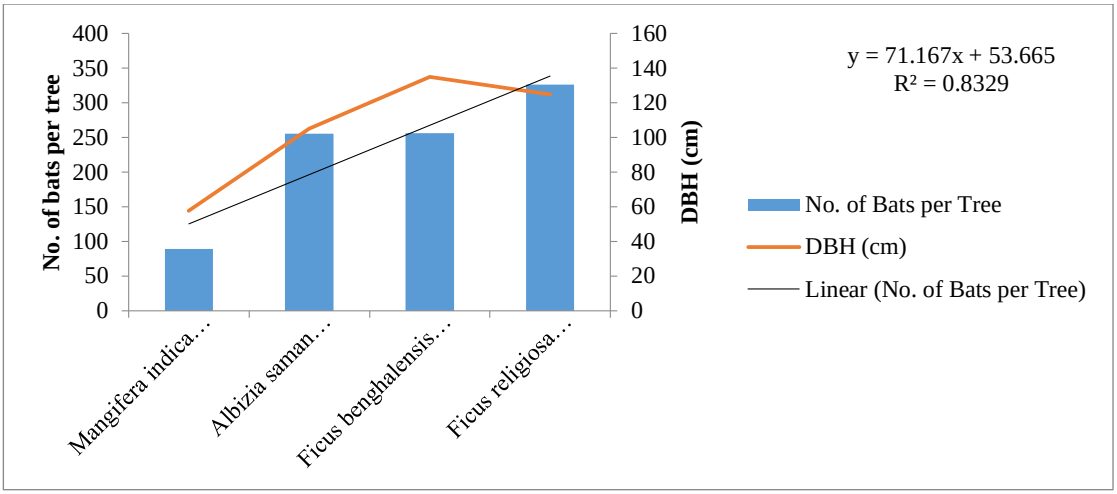


Fig. 11 The roost trees preference of *P. hypomelanus* based on DBH in Thae-phyu-kyun

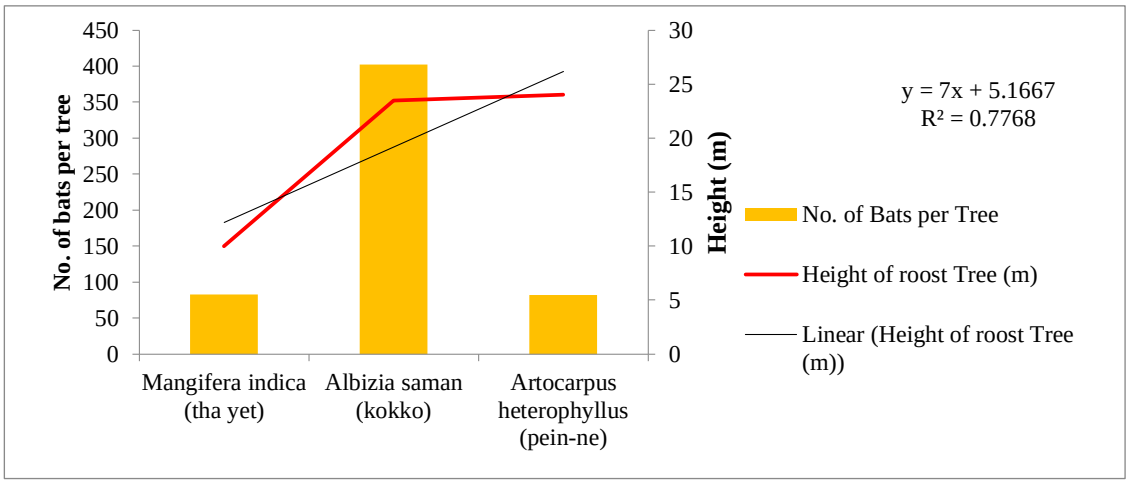


Fig.12 The roost trees preference of *P. hypomelanus* based on height in Thae-phyu-kyun

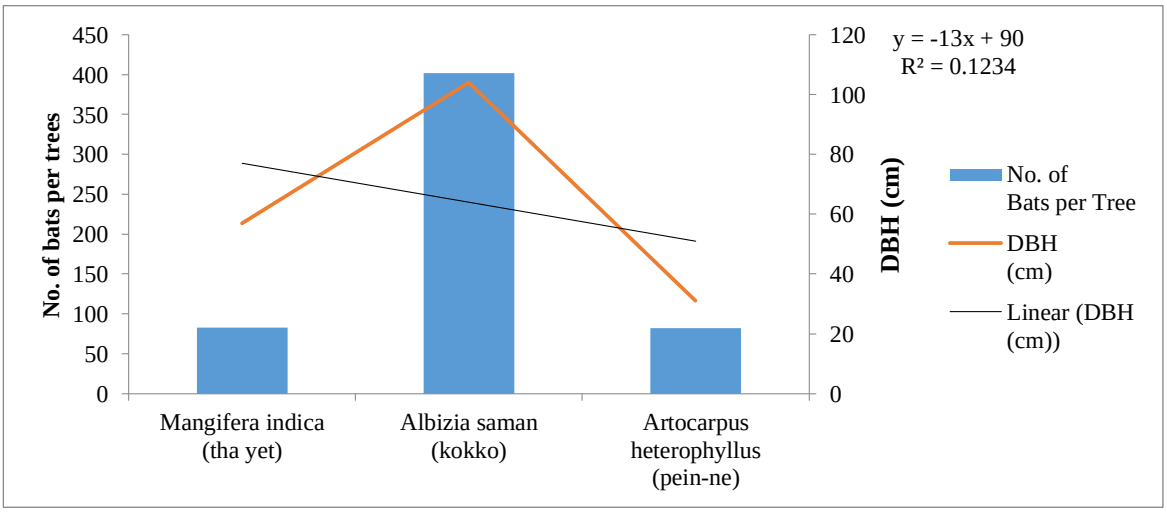


Fig.13 The roost trees preference of *P. hypomelanus* based on DBH in Ye-kan-aw

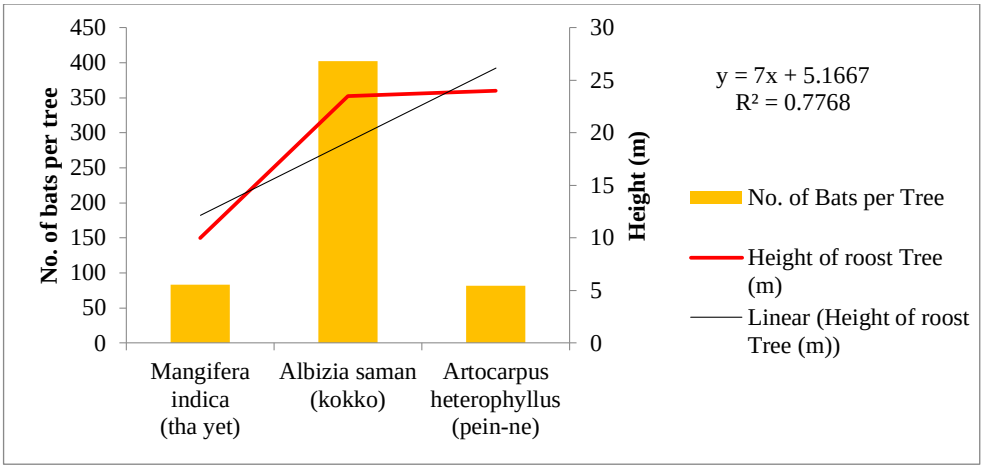


Fig.14 The roost trees preference of *P. hypomelanus* based on height in Ye-kan-aw

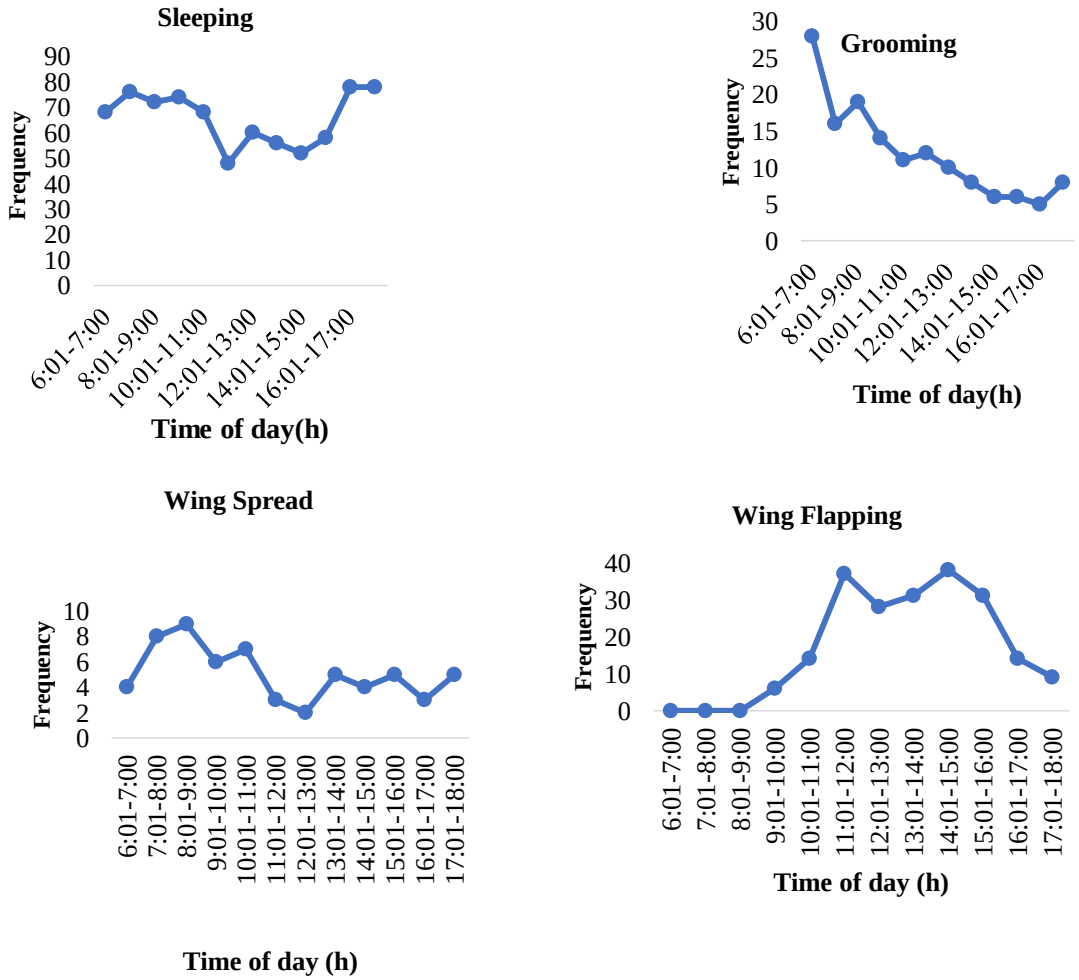


Fig.15 The percentage of bats performing sleeping, grooming, wing spread and wing flapping behaviors between 6:00 am and 18:00 pm.

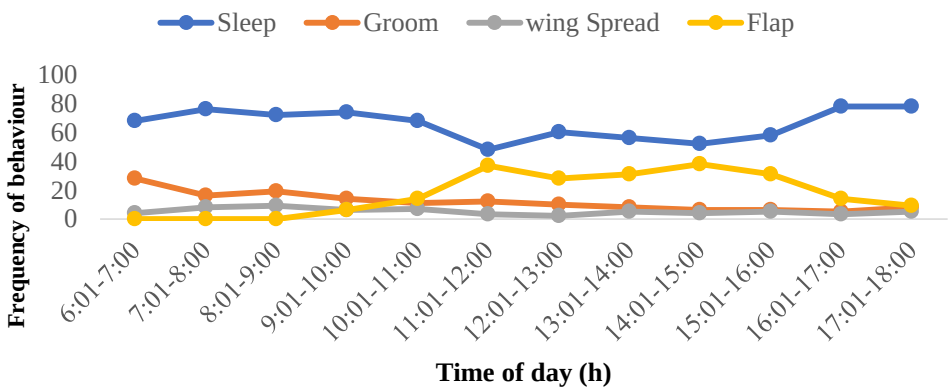


Fig.16 The percentage of diurnal behavior patterns of sleeping, grooming, wing spread and wing flapping between 6:00 am and 18:00 pm.

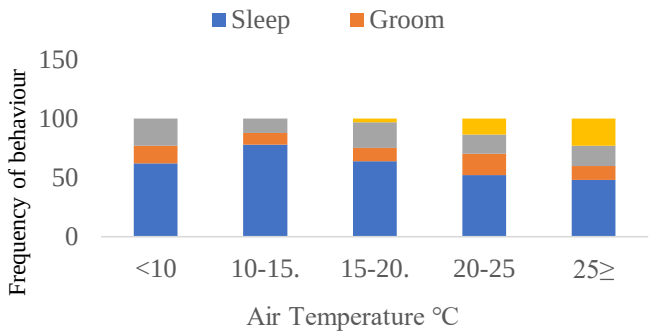


Fig.17 Frequency of behavior at different air temperature

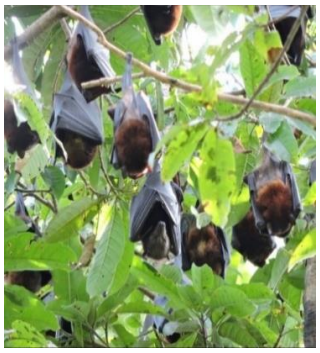

Plate 2. Solitary and colonial roosting of *P.hypomelanus*

Plate 3. Emergence time

## Discussion

*Pteropus hypomelanus* species belonging to one genus, one family, and one order was recorded in Myeik environs. The number of *Pteropus* species and the roost trees selected varied in each of the eight months in which studies took place. This condition of *Pteropus* species was considered to be seasonal migration. Roost individually or in colonies 10 to several hundred individuals (Rickart *et al*.,1993). In the present study, roosts as a colony of about 100 to 1000 individuals in trees. According to the study sites, *Pteropus* colony of 800 to 1000 numbers roost in the Rain trees (Kokko) and human villages. The observation clearly showed that the emergence of *Pteropus* depends on the time of sunset. The spatial dispersion of *P. hypomelanus* species was recorded according to the

tree species, the food sources and their abundance are sufficiently habitats in *Pteropus* has rarely been reported from mainland areas**.**

Emergence patterns of bats are of two patterns that seem throughout the study time. The first emergence in a small number and gradually larger till peak emergence is reached after half of the total emergence time. The bats exhibited pre-emergence activities such as wing stretching, squawking, grooming, and short flight around the roosts possibly to advertise the time of emergence to the roost mates.

The results showed that *P. hypomelanus* preferred to roost in larger trees having dense canopies such as rain tree (*Albizia saman*), hardwood (*Xylia dolabriformis*), Gular (*Ficus glomerata*), Mango (*Mangifera indica*) and Peepal (*Ficus religiosa).* Roost tree preference by *P. hypomelanus* was analyzed and concluded that larger trees (greater DBH, height, and dense canopy) facilitate bats to gain good protection from human interference, enable them to take off and land more easily and also to evade predators rapidly.

The larger trees are more stable and long-lasting. They protect bats in times of natural disasters such as high-velocity wind, torrential rain, hailstorm, and high-intensity sun rays. The large colony size of *P.hypomelanus* was found in large roost trees such as *A. saman F. Benghalensis F. glomerata,* and *F. religiosa.* The larger size of trees is one of the important factors for colony size. Larger the size of trees larger the colony size of bats. The current study concluded that there were three important factors such as roost trees (roadsides, human habitations, and water) that influenced the population size of bats in their day roosts. Human habitations and water bodies were of almost constant factors whereas roost trees were variable factors. Therefore, the felling of roost trees or destruction of habitat adversely affect the bat population and caused its decline. On the other hand, the colony size of bats in a particular tree species depended upon a combination of two factors out of the three variable factors such as DBH, height, and canopy of the roost tree.

These bats preferred to roost either on trees with greater DBH and dense canopy or with greater height and DBH or with greater height and dense canopy. Destruction of large and taller roost trees adversely affected the colony size of the bats. Therefore, the current study revealed that the roost tree preference of the bats depends on the height, DBH, and canopy of the tree. Island flying fox exhibited various behaviors during daytime with fluctuation in the frequency. Sleep, groom, and wingspread were the most frequently occurring behaviors of Grey-headed Flying Fox (Connell *et al*. 2006). Similarly, among the behaviors observed, more time was spent in rest, groom, flap, and wingspread (Koju 2008). The present study also revealed similar results. Arbitrarily, island flying fox was observed spending most of the day for sleep as they are nocturnal inhabit. The wet season occurs from Jun to July during which bats clean their body frequently after rain.

The grooming behavior may occur for the removal of ectoparasites from their body. The brightness of the sun and the air temperature are higher during the wet season. So, wing spread was frequently recorded. The increasing frequency of wingspread which may be a consequence of nuisance created due to air and noise pollution from their roost sites. Wing flapping of Grey-headed Flying Fox was recorded frequently especially during periods of higher temperatures and strong sunlight (Connell *et al*. 2006). Likewise, wing flap of island flying fox was frequently recorded from August to September. In the present study at both locations, wing spread occurred frequently with a rise in air temperature. When the air temperature rises, the intensity of heat of the sun becomes higher, so to keep them cool, therefore, wing flap was recorded maximum. In between10 ℃ and 15 ℃, their wings were wrapped around themselves to protect their body from cold. At higher temperatures, their

wings were found spread. Island Flying fox's population and the number of trees occupied by the bats varied with the study sites of Myeik environs.

## Acknowledgements

I would like to thank Dr. Ni Ni Oo, Rector, Dr. Win Win Than, Pro- rector, Myeik University for their permission to conduct this research. I would to extend her deepest obligation to Dr. Aye Aye Myint, Professor, Head of Zoology Department, and Dr. Aye Aye Cho, Professor, Zoology Department, Myeik University for allowing me for their help and suggestions.

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# Occurrence of *Escherichia coli* in Various Foods from Hlaing Township, Yangon Division

Tin Tin Mar[1], Aye Aye Myint[2], Sandar Aye[3]

## Abstract

Myagandamar market situated in ($16^0$ 51′ 51″ N and $96^0$ 07′ 15″ E), Hlaing Township, Yangon Division was chosen to contamination of bacteria (especially *Escherichia coli*) in various foods. *E. coli* includes in coliform bacteria and commonly found in foods as the contamination of fecal matter. Isolation and identification of *E. coli* were conducted during the period from November 2017 to September 2018. Seven types of food samples as fish sauce, raw milk, sugar cane juice, sushi, spring roll, hamburger, and bean sprout were chosen for *E coli* research and examined for total viable bacterial counts. The total bacterial cell counts of all tested foods were showed the various levels within $10^7$cfu/mL to $10^8$ cfu/mL. The food sample of sushi had the highest number of cell count was $1.46\times10^8$ cfu/mL The recorded cell count from all tested food samples were noticed as the unsatisfactory status by Microbiological Goodline for food (FSAI, 2016). A total of among 140-gram negative isolates, six *E. coli* isolates were recorded from raw milk, sushi, and spring roll by using morphological, cultural and biochemical properties (Buchanan and Gibbons, 1974).The other food samples of fish sauce, sugar cane juice, hamburger, and bean sprout have not detached the presence of E coli but were occurred the existence of coliform bacteria. Therefore, fresh and healthy foods must be carefully chosen for food consumption.

**Keywords**: Myagandamar market, seven food types, coliform bacteria, *E. coli*, cfu/mL

## Introduction

Food is any nutritious substance that contains proteins, carbohydrates, essential fats, vitamins, and minerals to maintain growth, metabolic functions, and life processes. A balanced diet is not only vital for good health and wellbeing but also helps weight control, reduces the risk for chronic diseases, prevents depression and anxiety. Although food and water are essential for life, they act as vehicles for the transmission of microbial diseases. The raw milk and meats, dairy products, eggs, vegetables, bean sprout, fresh fruits, and fruit juice are the principal media of human foodborne diseases (Molla e*t al*., 2003). Common food-borne diseases are diarrhea, dysentery, cholera, typhoid, hepatitis, and food poisoning. Many of these diseases are caused by coliform bacteria (Jay *et al*., 2015).

Coliform bacteria are the normal flora of the intestine of man and animals. Coliforms include *Escherichia coli, Salmonella, Shigella, Enterobacter, Klebsiella* and *Citrobacter* (Doyle and Erickson, 2006). They are gram-negative rods, facultatively anaerobic, non-sporulating, and thermo-tolerant bacteria (Burro *et al*., 2006). *E coli* normally lives in the intestine and gut of man and animals. Most types of *E coli* are harmless, but some strains can cause diarrhea, food poisoning, pneumonia, Shiga toxin, some urinary tract infection, and breathing problem (Champman and Robinson, 2002). Different strains of *E. coli* can cause various diseases.

Enterohemorrhagic *E. coli* strains (including serotype O157: H7 and others) cause bloody diarrhea; hemolytic-uremic syndrome. Enterotoxigenic *E. coli* strains can cause watery diarrhea, particularly in infants and travelers. Enteroinvasive *E. coli* strains can take place inflammatory diarrhea. Enteropathogenic *E. coli* strains are the source of watery

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diarrhea, particularly in infants. Enteroaggregative: *E. coli* strains are persistent diarrhea in patients with AIDS and children in tropical areas (Nataro *et al.,* 2006), (Hebbelstrup *et al.,* 2017).

Other *E coli* strains are capable of causing extraintestinal infection if normal intestinal anatomic barriers are disrupted (eg, ischemia, inflammatory bowel disease, or trauma), in which case the organism may spread to adjacent structures or invade the bloodstream (EFSA, ECDC., 2012). The microbial examination of food samples enables us to estimate the quality and safety of food supply in a market, canteen, restaurant, and factory.

The present research was conducted with aims to access the microbial proofing of *E coli* in different foods from Myagandamar market under the following objectives:

- to examine the bacterial contents in different foods
- to determine the presence of *E. coli* in collected foods
- to study the bacterial colony, cell morphology, cultural and biochemical properties of isolated *E. coli.*

## Materials and Methods

### Study area and site

Myagandamar market situated in ($16^0$ 51′ 51″ N and $96^0$ 07′ 15″ E), Hlaing Township, Yangon Division was chosen to examine the contamination of *E coli* in different foods. The collected food samples were brought to Microbiological Laboratory in the Zoology Department of West Yangon University (Fig.1).

### Study period

The present study lasted from November 2017 to September 2018.

### Equipment, media, and chemicals

The standard microbiological glassware and equipment such as autoclave, drying oven, incubator, digital balance, stirrer hot plate, clean bench, micropipettes were used. Media were Nutrient agar, Nutrient broth, MacConkey agar, Triple Sugar Iron (TSI) agar, Eosin Methylene Blue (EMB) agar, Plate count agar and chemicals with peptone, yeast extract, glucose, sucrose, fructose, mannitol, mannose, and maltose were employed

### Sample collection

Seven food samples of fish sauce, raw milk, sugar cane juice, sushi, spring roll, hamburger, and bean sprout were purchased from the Myagandamar market. Each sample was packaged in a sterile plastic bag and brought to Microbiological Laboratory, Zoology Department, West Yangon University (Plate 1).

### Cultural procedure

Each of the food samples of 1 mL or 1 g was mixed with 9 mL of distilled water and made tenfold serial dilution up to $10^8$ concentration which was used for bacterial isolations and plate counts. For bacterial isolation, 1µL of each sample dilution was spread on the nutrient plate by standard method of Cheesbrought (1985). Then these plates were labeled and incubated at 37ºC for 24 hours. After an incubation period, gram-negative colonies on agar plates were chosen, collected, and subcultured on MacConkey agar, EMB agar, TSI agar plates to obtain a pure culture of *E coli* isolates and incubated at 37ºC for 48 hours (Cheesbrought, 1985).

**Enumeration of total viable count**

Ten mL of serially diluted sample was thoroughly mixed with plate count agar by the method of Fawole and Qro, 2001. These plates were incubated for 24 hours. Then the incubated plates containing 30 – 300 colonies were chosen, counted, and calculated to show the colony-forming unit (cfu/mL).

**Morphological, Cultural and Biochemical Identification**

**Colony morphology**

The morphological characters of a selected Gram-negative bacteria colonies were observed on nutrient agar plates of seven different food samples and the resulted data were recorded.

**Cell morphology**

The cells from Gram-negative pure strain culture were smeared and fixed on glass slide according to the Gram staining procedure and examined under a microscope as described by Bisen and Verma, 1998.

**Cultural identification**

The collected Gram-negative *E. coli* isolates of food samples were cultured on MacConkey agar, EMB agar, and TSI agar media for further identification according to Oyeleke and Manga (2008).

**Biochemical identification**

The collected *E. coli* isolates were examined by Indole test, Methyl Red test, Voge's-Proskauer test, Citrate utilization test, Nitrate reduction test, Urease test, Catalase test, Gelatin Liquefaction test, Motility test, and Sugar Fermentation test. The resulted data were checked according to Buchanan and Gibbons (1974).

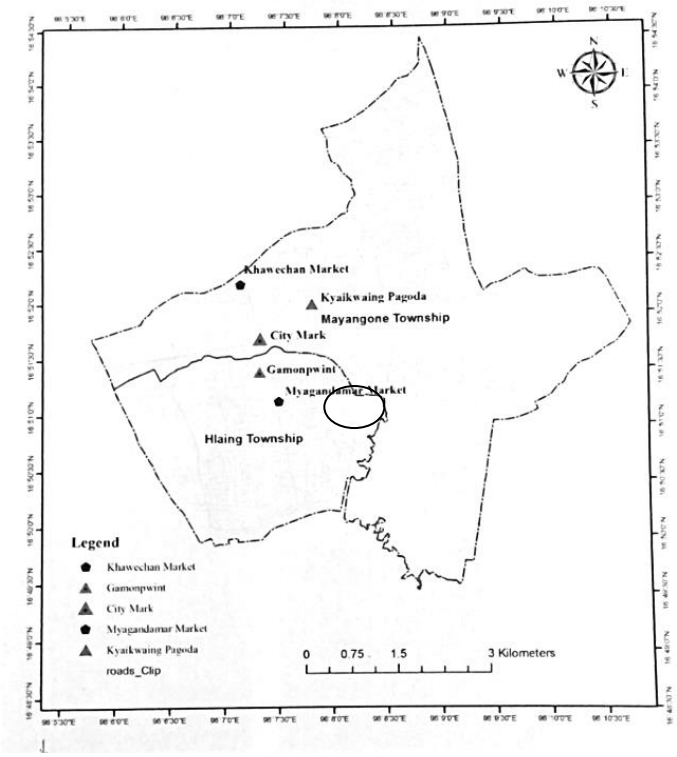



Fig.1 The Map of the study area (source: Geography Department)

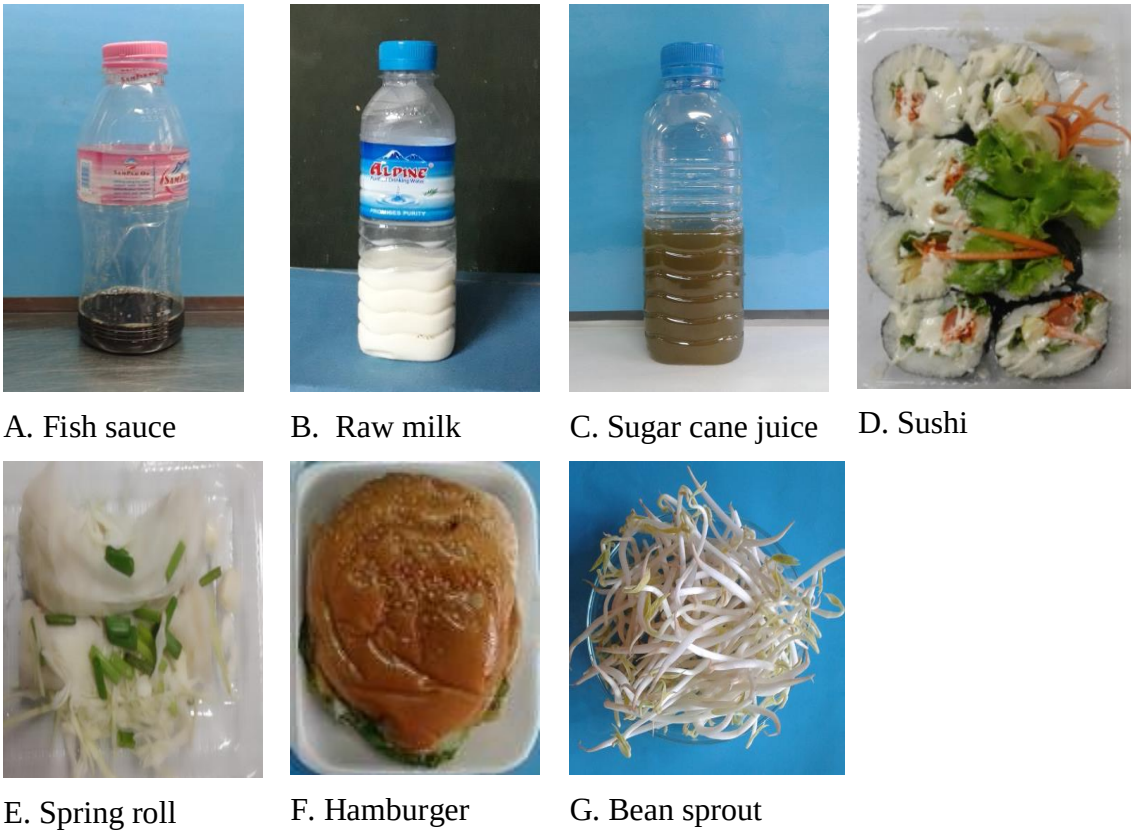



Plate 1. Collected food samples from the study area

## Results

A total of 140 Gram-negative bacteria isolates were obtained from food samples of fish sauce, raw milk, sugar cane juice, sushi, spring roll, hamburger, and bean sprout, out of which 6 isolates (4.28%) were identified as *Escherichia coli*. (Fig. 2).

Total viable cell counts from the fish sauce were 3.37 x$10^7$, raw milk was 5.05 x$10^7$, sugar cane juice 2.99 x$10^7$, sushi, 1.46 x$10^8$, the spring roll was 8.8 x$10^7$, hamburger and bean sprout were 2.34 x$10^7$,and 1.5 x$10^7$ (Table 1 and Fig. 3).

Two isolates from raw milk, 2 isolates from sushi, and 2 from spring roll were identified as *E. coli*. The food samples of fish sauce, sugar cane juice, hamburger, and bean sprout did not collect *E. coli* strain but occurred in the presence of coliform bacteria like *Salmonella* sp, *Shigella* sp, and *Proteus* sp. Morphological, cultural, and biochemical properties of isolated *E coli* strains were presented in Plate 3 and Tables 2, 3, 4, 5, 6.

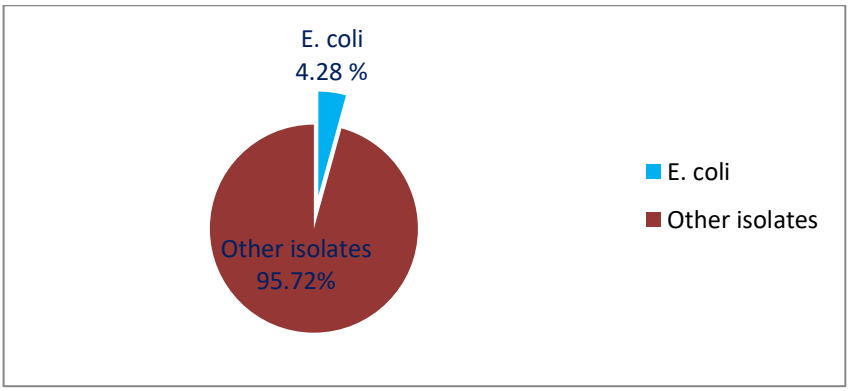



Fig. 2. Occurrence of isolated *E. coli* (% of total 140 isolates) from food samples

Table 1. Total bacterial cell count of different food samples

| Samples | Fish sauce | raw milk | sugar cane juice | sushi | spring roll | hamburger | bean sprout |
|---|---|---|---|---|---|---|---|
| cfu/ mL | $3.37 \times 10^7$ | $5.05 \times 10^7$ | $2.99 \times 10^7$ | $1.46 \times 10^8$ | $8.8 \times 10^7$ | $2.34 \times 10^7$ | $1.5 \times 10^7$ |

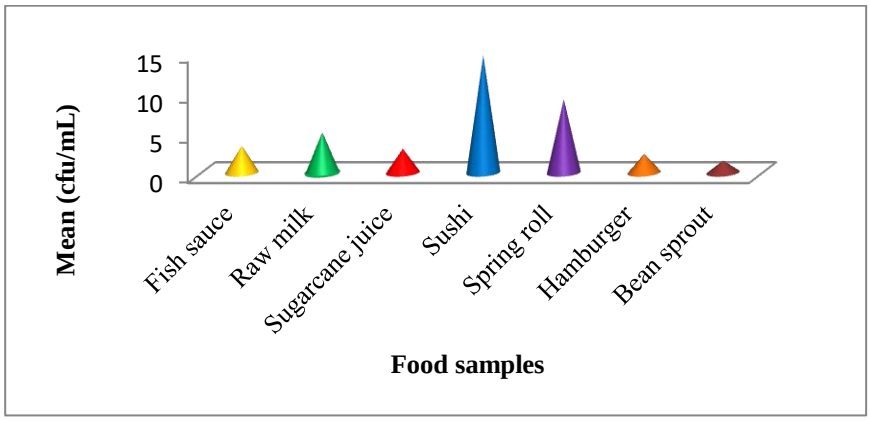
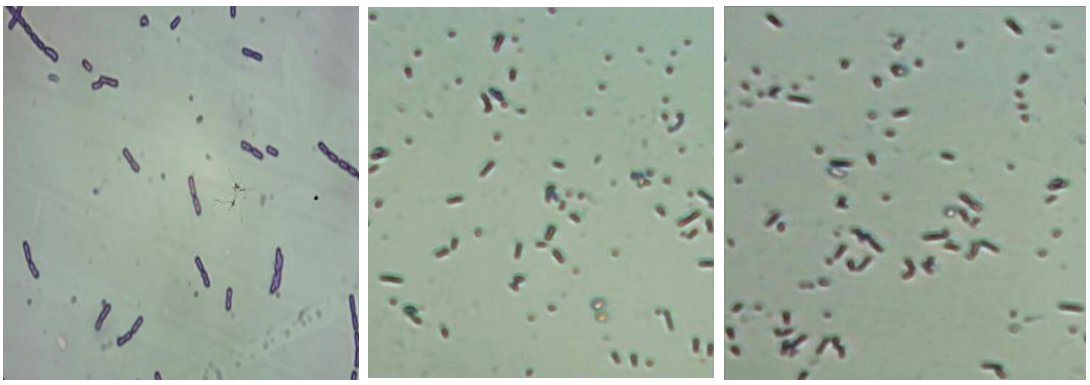



Fig. 3. Total cell count of mixed culture of different food samples



(a)Raw milk (b) Sushi (c) Spring roll

Plate 3. Cell morphology of isolated *E. coli* in Gram staining from different foods

Table 2. Morphological characteristics of isolated *E. coli* from raw milk

| Isolate code | Colony morphology | Cell shape | Gram stain | Growth on different media | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | MacConkey agar | EMB agar | TSI agar | | | |
| | | | | | | Butt | Slant | Gas | $H_2S$ |
| M 1 | Circular, 0.5-3.0 mm in diameter, colony surface with convex and smooth, shining creamy white | Short rod | **N** | **P** | **P** | A | A | **P** | **N** |
| M 2 | Circular, 0.7-3.2 mm in diameter, colony surface with convex, smooth and elevation, grayish creamy | Short rod | **N** | **P** | **P** | A | A | **P** | **N** |

**P** = positive, N = negative, A = acid

Table 3. Morphological characteristics of isolated *E. coli* from sushi

| Isolate code | Colony morphology | Cell shape | Gram stain | Growth on different media | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | MacConkey agar | EMB agar | TSI agar | | | |
| | | | | | | Butt | Slant | Gas | $H_2S$ |
| Ss 1 | Circular, 2.0-4.0 mm in diameter, flat entire margin spread, surface with smooth and shining, creamy white | Short rod | **N** | **P** | **P** | A | A | **P** | **N** |
| Ss 2 | Circular, 2.0-3.0 mm in diameter, colony with umbonate elevation, and undulated margin, grayish creamy | Short rod | **N** | **P** | **P** | A | A | **P** | **N** |

**P** = positive, N = negative, A = acid

Table 4. Morphological characteristics of isolated *E. coli* from spring roll

| Isolate code | Colony morphology | Cell shape | Gram stain | Growth on different media | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | MacConkey agar | EMB agar | TSI agar | | | |
| | | | | | | Butt | Slant | Gas | $H_2S$ |
| Sr 1 | Circular, 1.0-3.0 mm in diameter, colony convex, and smooth surface, shining grayish creamy colour | Short rod | **N** | **P** | **P** | A | A | **P** | **N** |
| Sr 2 | Circular, 1.0-4.0 mm in diameter, colony with smooth surface, entire margin, grayish creamy colour | Short rod | **N** | **P** | **P** | A | A | **P** | **N** |

**P** = positive, N = negative, A = acid

Table 5. Biochemical reactions of isolated *E. coli*

| Isolate code | Indole | MR | VP | Citrate | Nitrate reduction | Urease | Catalase | Gelatin liquefaction | Motility |
|---|---|---|---|---|---|---|---|---|---|
| M 1 | + | + | _ | _ | _ | _ | + | _ | + |
| M 2 | + | + | _ | _ | + | _ | + | _ | + |
| Ss 1 | + | + | _ | _ | + | _ | + | _ | + |
| Ss 2 | + | + | _ | _ | + | _ | + | _ | + |
| Sr 1 | + | + | _ | _ | + | _ | + | _ | + |
| Sr 2 | + | + | _ | _ | + | + | + | _ | + |

Table 6. Oxidation-fermentation reactions of isolated *E. coli*

| Isolate code | Glucose | Sucrose | Fructose | Mannitol | Mannose | Maltose |
|---|---|---|---|---|---|---|
| M 1 | +++(gas) | _ | ++(gas) | +++(gas) | +++(gas) | +++(gas) |
| M 2 | + | _ | + | +++(gas) | +++(gas) | +++(gas) |
| Ss 1 | +(gas) | ++(gas) | ++(gas) | +++(gas) | ++(gas) | +++(gas) |
| Ss 2 | ++(gas) | ++(gas) | +(gas) | ++(gas) | ++(gas) | ++(gas) |
| Sr 1 | ++(gas) | ++(gas) | ++(gas) | ++(gas) | ++(gas) | ++(gas) |
| Sr 2 | ++(gas) | ++(gas) | ++(gas) | ++(gas) | ++(gas) | ++(gas) |

+ = Fermentative, + gas = gas production

## Discussion

Many bacteria are found in different types of food such as milk, meats, eggs, fruits, fruit juice, vegetables, and sprouts. They act as primary devices for human foodborne diseases which are a major threat to control efforts in the food-producing industry (Molla *et al*., 2003).

Among bacteria, coliforms have occurred in various foods. The members of the coliform group are *Escherichia coli, Yersinia enterocolitica, Citrobacter freundii, Klebsiella pneumoniae, Enterobacter aerogenes, Salmonella* spp, *Shigella* spp, *Serratia* spp, *and Hafnia* spp. Among these coliforms, some strains are pathogenic to animals and man that causing severe intestinal and extra intestinal diseases in man (Kaper *et al*., 2004).

The coliform bacteria reside in the digestive tracts of vertebrates especially in the colon which is necessary for proper digestion of food in birds and mammals. So, these

bacteria (including *E. coli*) are the common indicators of feces and fecal contamination of food (Jay, 1996).

In the present study, only six *E. coli* isolates (4.28% of total 140 isolates) were obtained from foods of raw milk, sushi, and spring roll, but the fish sauce, sugar cane juice, hamburger and bean sprout have detached the presence of a coliform group of *Shigella* sp, *Salmonella* sp, and *Proteus* sp.

Yin Tun *et al*., (2013) stated that the occurrence of some pathogenic bacteria including *E. coli* was recorded in the fermented vegetables from street vendors in Pazundaung, Tarmwe, and Thuwana markets of Yangon environs.

Similarly, *E. coli* isolates were reported to occur in the raw cow milk and fresh fruit juice in Mekelle, Tigray Ethiopia (HaftyAbraha *et al*.,2017).

These results indicated that the tested raw milk, sushi, and spring roll as well as fish sauce, sugar cane juice, hamburger and bean sprout from Myagandamar market were probably contaminated by fecal matter.

The present data revealed that the sushi had the highest mean total viable cell count with ($1.46\times10^8$ cfu/mL), followed by the spring roll, ($8.8\times10^7$ cfu/mL): and the bean sprout had the lowest count, ($1.5\times10^7$ cfu/mL). According to the microbiological Guideline for food, the bacterial cell counts in the tested food samples were found as unsatisfactory condition (FSAI, 2016). Hence, we should be cautious in the consumption of foods to be clean and freshly prepared.

## Conclusion

Out of 140 isolates, only 6 *E. coli* isolates (4.28%) were found in these different foods. Many bacteria were found in all studied food samples. The total bacterial cell counts of studied samples were stated that within $10^7$ to $10^8$ cfu/mL. Among seven food types, three types of food samples were collected *E. coli* isolates but the other food samples were found the presence of coliform bacteria. Therefore, the resulted data indicated that the fecal contamination occurred in tested foods samples. So, fresh and healthy foods must be carefully chosen in food consumption.

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# Morphological Characters of some reptiles in Nay Pyi Taw Zoological Garden

Thandar Aye[1], Kyaw Swar Aung[2]

## Abstract

Some morphological characters of some reptiles in Nay Pyi Taw Zoological Garden, Nay Pyi Taw, Mandalay Region was investigated from June 2016 to December 2016. The body shapes, color, and distinctive features of reptiles were recorded. The study species were observed at the semi-wild condition.

**Keywords**: Reptiles, Morphological characters, Nay Pyi Taw Zoological Garden.

## Introduction

The Reptiles are the first vertebrates adapted for life in dry places on land. Some live near water or in water, but for the breeding purpose and egg-laying, they return to land. The Class Reptilia includes four orders, the first one is Testudinata (Tortoises and Turtles), the second one is Rhynchocephalia (tuataras) and the third one is Order Squamata. Order Squamata includes three sub-order namely, Amphisbaenia (worm lizards), Sauria (lizards), and Serpentes (snakes). The fourth Order is Order Crocodilia (alligators and crocodiles). (Bhamrah & Juneja, 2002)

The Nay Pyi Taw Zoological Garden is located in Nay Pyi Taw, the largest zoo in South East Asia. It is located at the side of Yangon-Mandalay highway road about 400 km away from Yangon. It is 2.48km2 wide and established in March 2007 and about 420 animals in Yangon Zoological Garden were shifted to this garden.

In December 2009, about 634 animals of 89 species; including 304 different mammal species; 265 individuals of 44 bird species, 65 individuals of 11 reptile species, and only one Amphibian species were kept for conservation and recreation to the public. Many visitors and researchers can be studied in a variety of animals in one place. The present study was conducted to study the distinctive morphological features of the observed reptile species and to understand how to maintain the animals in Nay Pyi Taw Zoological Garden.

## Materials and Methods

The study area was chosen as Nay Pyi Taw Zoological Garden, the largest zoo in South East Asia, Nay Pyi Taw, Mandalay Region. It is situated between latitude 19˚ 51" North and longitude 96˚ 15" East and located on the side of Yangon-Mandalay highway about 400km away from the north of Yangon (Fig 1). The study period lasted from June to August 2016.

The measurement of the studied species such as their body length and the tail length were carefully taken. The body shapes, color, and distinctive features of reptiles were recorded by using a digital camera. The animals were observed at semi-wild conditions during the study period. The distinctive characters of the studied species were recorded. Identification of the studied reptile species was followed after Boulenger, 1943 and Zug, et al., 2003.

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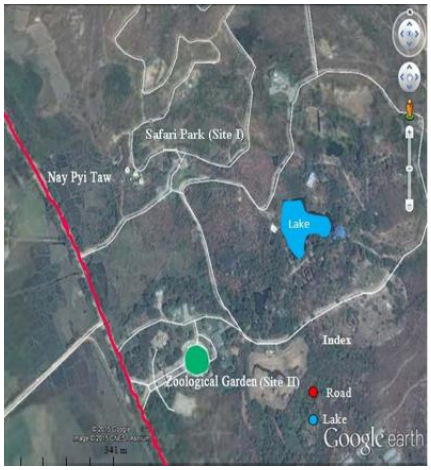


Fig. 1 Location Map of the study area (Source: Google earth, 2016)

## Results

A total of nine species belonging to eight families under three orders were recorded.

Table 1. Recorded reptile species in the study site

| No. | Order | Family | Species | Common name | Local name |
|---|---|---|---|---|---|
| 1. | Testudines | Testudinidae | *Manouria emys* | Asian Brown Tortoise | Leik maung, Chae chauk chaung leik |
| | | Trionychidae | *Nilssonia formosa* | Myanmar Peacock Soft Shell Turtle | Lay kwet leik, Wa lay lone leik |
| 2. | Crocodilia | Crocodylidae | *Crocodylus porosus* | Indo-Pacific Crocodile | Mee chaung |
| 3. | Squamata | Varanidae | *Varanus bengalensis* | Bengal Monitor | Phawt mawe` |
| | | Colubridae | *Ptyas korros* | Indo-Chinese Rat Snake | Linn mwae myat pyue |
| | | Elapidae | *Bungarus fasciatus* | Yellow Banded Krait | Ngan taw kyar |
| | | | *Naja kaouthia* | Monocellate Cobra | Mwae hauk |
| | | Viperidae | *Daboia russelii* | Siamese Russell's Viper | Mwae pwae |
| | | Pythonidae | *Python molurus* | Burmese Python | Sabal ohnn |

### Descriptive characters and general account on studied species

***Manouria emys*** **(**Schlegel and Muller, 1844)

Morphological characters: Carapace is oval, dome-shaped but somewhat flattened and the color is brown, well-defined growth annuli are on the carapace. The plastron is brown with black shading. Head, limbs, and tail are black. The tail ends in a horny scale. The large pointed spur occurs on each tight, giving rise to the name of six footed tortoises. Body size (Adult Carapace Length) is 60cm. (Plate 1 A, B) Conservation status: Endangered (IUCN Red List, 2000)

***Nilssonia formosa*** (Gray, 1869)

Morphological characters: Carapace is round and olive-gray to olive-brown with four dark central ocelli, eight pairs of coastal are well developed and meet at midline. The plastron is white and has four callosities. Head, neck, and limbs are olive with numerous yellow spots. The Head is yellow with black markings. Body size (ACL) is 49 cm. (Plate 1 C, D) Conservation status: Endangered ( IUCN Red List, 2000 )

***Crocodylus porosus*** **(**Schneider, 1801)

Morphological characters : The crocodile has a wide snout. Its length is twice its width at the base. It has fewer armor plates on its neck. The scales are oval. The small, triangular scutes are present between the posterior edges of the large, transversely arranged in the dorsal shield. The adult crocodile's broad body contrasts. The crocodile is the largest extant terrestrial and riparian predators in the world. The size of this species ranges 3.5 to 6 m (11 ft 6 in to 19 ft 8 in). (Plate 1 E) Conservation status: Least concern ( IUCN 2.3 )

***Varanus bengalensis*** (Daudin, 1802)

Morphological characters: Bengal monitors have external nostrils opening (nares) that are slit-like. It is oriented near horizontal and position between the eye and the tip of the snout. The scales of the skin are rougher in patches. Bengal monitors have a forked tongue. It has light brown or grey, and dark spots give them a speckled appearance. Snout to Vent Length is 75 cm and tail length is 100 cm. The total length is 175 cm in adults. (Plate1 F) Conservation status: Least concern ( IUCN 3.1 )

***Ptyas korros*** (Schlegel, 1837)

Morphological characters: Chinese rat snake's snout is obtuse and projecting. The eyes are very large. Rostral is visible from above. Intermasals are shorter than the prefrontals. Frontals as long as its distance from the tip of the snout. The color of the body is brown or olive above. The body length is 1.08 m and tail length is 0.7 m. ( Plate 2 A ) Conservation status : Unknown

***Bungarus fasciatus*** (Schneider, 1801)

Morphological characters: *B. fasciatus* is easily identified by its alternate black and yellow crossbands. Its triangular body cross-section and the marked vertebral ridge consisting of enlarged vertebral shields along its body. The head is broad and depressed. The eyes are black. The tail is small and ends like a fingertip, generally being one-tenth the length of the snake. The body length is 1.8 m and the tail length is 0.18 m. The venom of the banded krait mainly contains neurotoxins. This toxin may cause death. (Plate 2 B) Conservation status: Least concern( IUCN 3.1 )

***Naja kaouthia*** **(**Lesson, 1831)

Morphological characters: O-shaped mark on the hood. It has a black spot on the lower surface on the hood on either side, one or two black cross-bars on the belly behind it. The color of the adult is brownish or olivaceous. The elongated nuchal ribs enable a cobra to expand the anterior of the neck into a “ hood ”. A pair of fixed anterior fangs are present. The length of the body is 2.07 m, and the tail length is 0.23 m. The major toxic components in cobra venoms are neurotoxins. This toxin causes the highest fatality. (Plate 2 C) Conservation status: Least concern ( IUCN 3.1 )

***Daboia russelii*** (Shaw and Nodder, 1797)

Morphological characters: The head is flattened, triangular, and distinct from the neck. The snout is blunt, rounded, and raised. The nostrils are large. The eyes are large, flecked with yellow or gold. Five or six pairs of maxillary teeth especially as tubular fangs are contained. The body is stout, the cross-section of which is rounded to circular. The dorsal scales are strongly keeled, the lowest row is smooth. The tail is short. The color pattern consists of a deep yellow, tan, or brown ground color, with three series of dark brown spots that have a black ring around it. The body length is 1.06 m and the tail length is 0.18 m. The venom of viper mainly contains haemotoxins. This toxin causes death to a human. (Plate 2 D) Conservation status: Unknown

***Python molurus*** (Linnaeus, 1758)

Morphological characters: Burmese python is the largest nonvenomous snake in the world. This species is marked with a rectangular mosaic type pattern that runs the full length of the animal. An arrow-shaped marking present on the top of the head with light brown and tan rectangles. The color pattern is whitish or yellowish. It can grow to a length of about 7.6 m. (Plate 2 E) Conservation status: Nearly threatened ( IUCN 3. 1)

(A)*Manouria emys* (Carapace) (B) *Manouria emys* (Plastron)

(C) *Nilssonia formosa* (Carapace) (D) *Nilssonia formosa*(Plastron)

(E) *Crocodylus porosus* (F) *Varanus bengalensis*

Plate 1. Recorded reptile species under Order Testudines, Squamata and Crocodilia

(A) *Ptyas korros*

(B) *Bungarus fasciatus*

(C) *Naja kaouthia*

(D) *Daboia russelii*

(E) *Python molurus*

Plate 2 Recorded reptile species under Sub order Serpentes

Table 2. Different microhabitats of the observed reptile species

| No. | Species | Microhabitat of the observed reptiles | | | |
|---|---|---|---|---|---|
| | | Tree | Ground | Water | Hole |
| 1. | *Manouria emys* | | √ | | |
| 2. | *Nilssonia formosa* | | √ | √ | |
| 3. | *Crocodylus porosus* | | √ | √ | |
| 4. | *Varanus bengalensis* | √ | √ | | |
| 5. | *Ptyas korros* | √ | √ | | |
| 6. | *Bungarus fasciatus* | √ | √ | √ | √ |
| 7. | *Naja kaouthia* | √ | √ | | √ |
| 8. | *Daboia russelii* | | √ | | √ |
| 9. | *Python molurus* | √ | √ | | √ |
| Total | | 5 | 9 | 3 | 4 |

Table 3. Different kinds of snakes in relation with the status of envenomation

| No. | Scientific Name | Common Name | Kinds of snake | Status of envenomation |
|---|---|---|---|---|
| 1. | *Ptyas korros* | Indo-Chinese Rat Snake | Non-venomous snake | - |
| 2. | *Bungarus fasciatus* | Yellow Banded Krait | Venomous snake | Neurotoxic |
| 3. | *Naja kaouthia* | Monocellate Cobra | Venomous snake | Neurotoxic |
| 4. | *Daboia russelii* | Siamese Russell's Viper | Venomous snake | Haemotoxic |
| 5. | *Python molurus* | Burmese Python | Non-venomous snake | - |

## Discussion

The present study was carried out in Nay Pyi Taw Zoological Garden, Mandalay Region. A total of nine species belonging to eight families under three orders were recorded during the study period (Table 1). The recorded species were under Order Testudines, Squamata and Crocodilia. The two species of *Manouria emys*, the tortoise, belonging to family Testudinidae and *Nilssonia formosa*, the turtle, belonging to family Trionychidae of Order Testudines. Among them, *Manouria emys* and *Nilssonia formosa* are recorded as endangered species.

Under the Order Squamata, six species namely, *Varanus bengalensis*, *Ptyas korros*, *Bungarus fasciatus*, *Naja kaouthia*, *Daboia russelii*, *Python molurus* and *Crocodylus porosus* were recorded. Among them, the only one species, *Varanus bengalensis* is under the suborder Lacertilia. It was recorded that Bengal Monitor is the least concern species in the IUCN red data list. The snake species *Ptyas korros*, *Bungarus fasciatus*, *Naja kaouthia*, *Daboia russelii*, and *Python molurus* were recorded under the suborder Serpentes. Among the observed species, *Bungarus fasciatus* and *Naja kaouthia* were included in the family Elapidae.

It was recorded that some studied reptile species like Serpentes and tortoise dwells mostly on the ground. While the other species of crocodile and turtle-like to live in water but the Bengal monitors occasionally found on the ground their habitat is a burrow in the soil (Table 2).

In the present study, *Ptyas korros* and *Python molurus* are non-venomous snakes. *Bungarus fasciatus*, *Naja kaouthia*, and *Daboia russelii* are dangerously venomous snakes of Myanmar (Table 3). *Python molurus* is a nearly threatened species in the IUCN red data list.

The observed specimens were noted that they have distinctive colors and morphological characters of carapace, plastron, head, scales, body shape, and color. So, we should be carefully conserved this reptilian species. According to the survey of California Academy of Science, Myanmar is rich in reptilian fauna with those of South East Asia.

But nowadays, some reptile species face to habitat degradation, climatic change, exploitation to be used in many ways by the people. Therefore, we should try to find out the best ways to protect our reptilian fauna as much as possible.

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# Foraminifera Biostratigraphy of the Tabyin Formation in Sidoktaya Township, Magway Region

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## Abstract

A research study on the foraminiferal biostratigraphy of the Eocene formations in the Sidoktaya area was carried out based on a total of 27 shale samples collected from northern part of Salin Basin which is situated in the eastern part of the Sidoktaya area, Magway Region. The aim of the present work was to record, describe and define the foraminiferal biostratigraphy of Tabyin Formation and determine the geological age of each formation based on the planktonic and localized benthonic zone fossils. There are a total of 46 foraminiferal species, including 28 benthonic species together with 18 planktonic species which have been identified from the Tabyin Formation in the research area. The foraminifera species in the study area is adapted to normal salinity, low nutrient environments at 13.2º to 21.4º C.One biostratigraphic Zone, *Globigerina higginsi - Acarinina soldadoensis angulosa*Zone can be established by using the some selected Paleogene planktonic foraminifera. The *Globigerina higginsi-Acarinina soldadoensis angulosa* concurrent range Zone is falling in the Lutetian age. Associated with this zone species, there is another distinct species *Globigerina higginsi* which is found from the Lutetian age. Therefore, the research area of the Tabyin Formation is assigned to the early Eocene(Lutetian) in age.

## Introduction

A research study on the foraminiferal biostratigraphy and paleoenvironment of the Tabyin Formation in the Centre basin was carried out based on shale samples. The study area is situated in Central Lowland of Myanmar which lies between Rakhine Yoma in the west and the Shan Plateau in the east. The research area is situated between latitudes 20° 25' 27" and 20° 31' 12" N and longitudes 94° 14' 24"and 94° 26' 07" E. It is used in UTM map Sheet No. 2094 06 and 2094 07. It occupies the eastern part of the Sidoktaya area, Magway Region. The location map of this area is shown in figure (1).

The Central Lowland are mainly recovered Tertiary sediments and it is generally North-South trending. The Tabyin Formation (Lutetian) is well exposed in the Central Lowland, mainly Central subbasin and it is an argillaceous formation which mainly composed of bluish grey shale and mud with distinct foraminifera species. Based on benthic foraminiferal distribution of each subbasin, the main purpose of the study are to describe the foraminiferal biostratigraphy of the Tabyin Formation, and to find out paleoenviroment of early Eocene(Lutetian) time with content of benthic foraminifera

## Geological Background

The Central Myanmar Basin (CMB) is situated between Shan Plateau to the east and the Indo-Burman Ranges to west and it is composed of sedimentary, metasediments, intensive and volcanic rocks. The Central Cenozoic Belt or Central Myanmar Basin is divided into several Tertiary Sub-Basins along its nearly 1100 km. length. The subbasins have been almost filled the sediments since the Indo-Asian collision **(**Bender, 1983, Bertrand & Rangin, 2003, Searl *et al*., 2007, Allen *et al*., 2008, Licht *et al*., 2014). These sub-basins may have formed as a series of en echelon pull-apart basins trending approximately NW-SE

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with about 50 km wide in the Early Eocene as the Burma Plate moved northward relati ve to the Asia Plate (Pivink et *al*., 1998 , Rangin *et al*., 1999). A 15 km. thick succession of Cenozoic deposits was found in Central Myanmar Belt (Pivink *et al*., 1998).

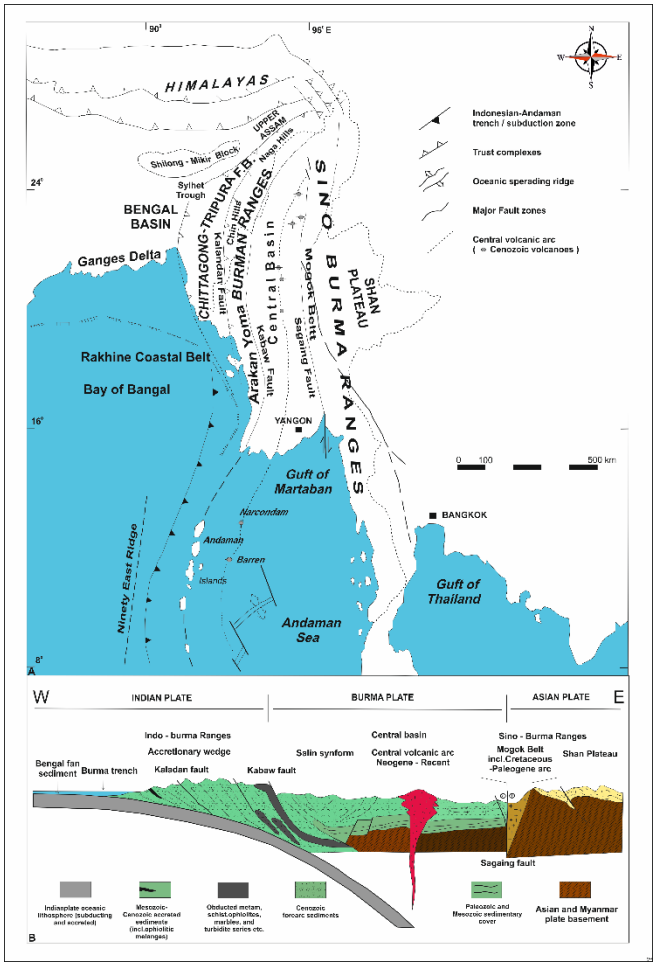



Figure 1. Location map of the study area

Myanmar Tertiary sediment cover approximately 160000 square miles, i.e. two third of the Myanmar National Boundary of 261228 square miles. Neogene sequence constitutes only about 80% of the whole Tertiary coverage, with a range of thickness of 7100 to 7300ft. The Central Lowlands can be divided into six sedimentary basins from north to south (Chit Saing, 2003). They are (1) Hukaung subbasin n (2) Chindwin subbasin (3) Central subbasin (4)Pegu Yoma subbasin (5) Pyay subbasin and (6) Irrawaddy Delta subbasin and Offshore Region. Each of which bears their own distinctive depositional environment and age, as shown by the fossil fauna and flora persent in their respective basin areas (Figure 2).

The Central Lowlands is characterized by development of a number of sedimentary basins in the following from north to south; Hukaung Basin located between Latitudes 25˚to 27˚N and Longitudes 96˚to 97˚E, Chindwin Basin located southeast of the Hukaung Basin Lying between Latitudes 22˚to 25˚N and Longitudes 96˚to 96˚E, the Central Basin between Latitudes 20˚to 18˚30", the Ayeyarwaddy Delta basin between Latitudes 18˚to 30˚14"N and Offshore Region. Among these four belts, the research area is located in the Central basin (Salin basin) Fig 2.1.

The research area is regionally lies on the central Cenozoic belt of Central lowland of Myanmar. The central Cenozoic belt processes several depositional basins and uplifts in which the Pyay embayment. The research area is situated on the southern part of Salin sub-

basin in the central lowland of Myanmar in which Paunggyi Formation, Laungshe Formation, Tilin Formation, Tabyin Formation, Pondaung Formation, Yaw Formation, Shwezataw Formation, Padaung Formation, Okhmintaung Formation, Pyawbwe Formation and Kyaukkok Formation are also well exposed. Lithologically these formations are made up of conglomerate, sandstone, muddy sandstone, shale, claystone of clastic rocks.In the research area the Tabyin Formation is well exposed. The Tabyin Formation is mainly composed of dark grey shale.

**General Stratigraphiy**

The present research area is situated in the western marginal portion of the Central Myanmar Basin. This basin is mainly composed of sedimentary rock formations namely Paunggyi Formation(Paleocene), Laungshe Formation(Lower Eocene), Tilin Formation(Lower Eocene), Tabyin Formation (Middle Eocene), Pondaung Formation (Upper Eocene), Yaw Formation (Upper Eocene), Shwezataw Formation (Lower Oligocene), Padaung Formation (Middle Oligocene), Okhmintaung Formation (Upper Oligocene), Pyawbwe Formation (Lower Miocene), Kyaukkok Formation (Lower Miocene), ObogonFormation (Middle Miocene) and Irrawaddy Formation (Pliocene) are also composed.

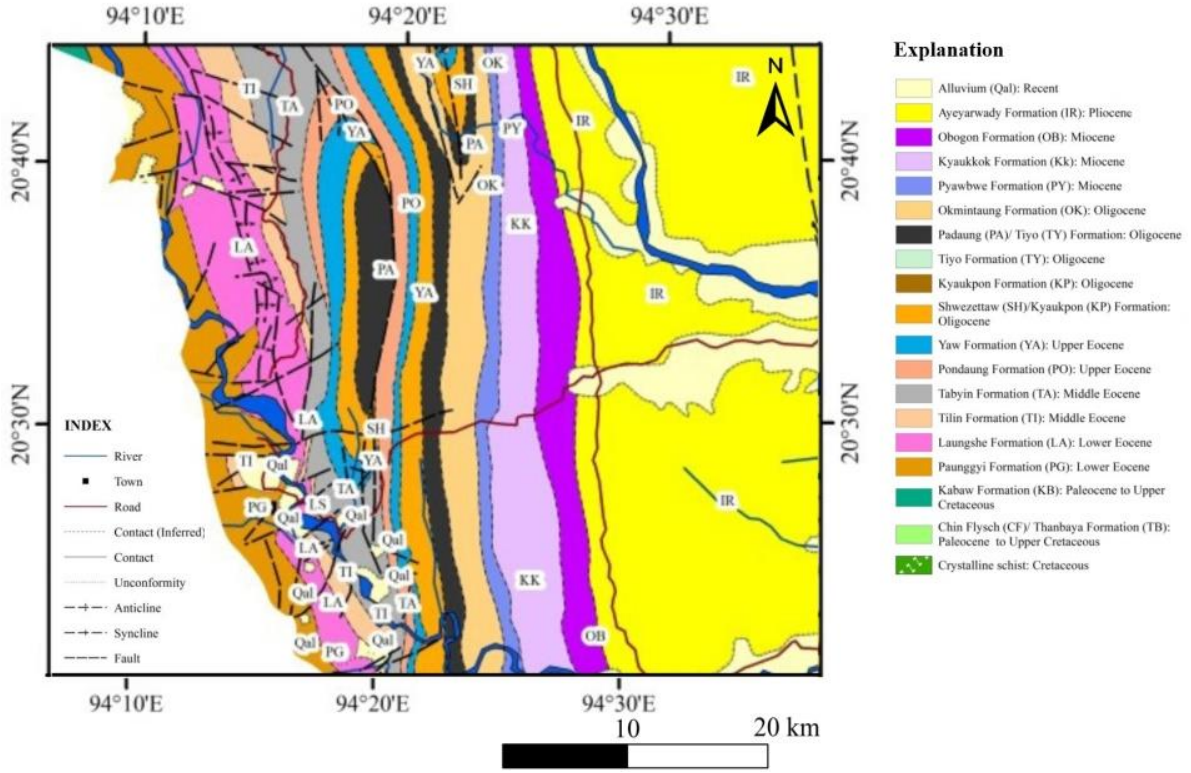



Figure 4 Geological Map of the Research Area (Modified after, MOGE)

In the research area, the Tabyin Formation is 318ft thickness exposed. The name Tabyin Clays was first given by Cotter (1914). The name was taken from the village of Tabyin about 13 miles due west of Pauk. This formation has been finalized as the Tilin Formation by AungKhin and Kyaw Win (1969) as a formation rank. The Tabyin Formation is well distributed at Sidoktaya - Salin car road in the research area.

The stratigraphic contacts between the Tabyin Formation and underlying Tilin Formation and the overlingPondaung Formation are well exposed and the nature is gradational contact in the research area. This Formation is mainly composed of shales / clay

and concretionary mudstone with minor amount of sandstone. Shales and mudstones are dark grey to bluish grey and, fairly carbonaceous. Clay has dark grey to bluish grey in colored and occurs as large amount. In the lower part of Tabyin Formation, it is mainly characterized by thick sequence of bluish-grey clay and shale intercalated with thin-medium bedded, fine-to medium grained sandstone (Fig 3). In some places, the sandstones with horizontal parallel laminations and wave ripple marks are also observed in the lower part of this formation. In the upper part of this formation, shale or clay and mudstone) are interbedded with blish grey to yellowish brown colored mediun-to thick-bedded sandstone . The sandstones are yellowish colored, medium-to thick bedded, fine-to coarse grained, micaceous, carbonaceous (Fig 4).

Figure 3. Bluish grey clay intercalated with thin-bedded, find-grained sandstone in the lower part of Tabyin Formation (Loc: 19˚ 15' 26.8" N and 94˚42' 37.4" E)

Figure 4 Sandstone with parallel laminations in the lower part of Tabyin Formation (Loc: 19˚ 15' 01.3"N and 94˚ 45' 20.4" E)

*Acarinina soldadoensis angulosa* and *Globigerina higginsi* are found in the research area of the Tabyin Formation. The age of the Tabyin Formation is Lutetian stage of Middle Eocene. The Tabyin Formation can be correlated with Ketpanda Formation of Mansigale Group. The Tabyin Formation of the research area is deposited under the shallow marine condition.

**Distribution of Foraminiferal Species**

There are a total of (46) foraminiferal species, including (28) benthonic species together with (18) planktonic species which have been identified from the Tabyin Formation in the research area(Table 1). All of these species are mostly distributed in the upper part. The Tabyin Formation is divided into two parts based on the distribution of the foraminiferal species. They are as follow:

(i) The upper part of the Tabyin Formation and

The lower part of the Tabyin Formation

**The Lower Part of the Tabyin Formation**

The mainly common foraminifera in the lower part of the Tabyin Formation are; *Robulus carital, Eponides elevates, Subreophax* sp., *Nonion elongatum, Entosolenia laevigata, Triloculina* sp. and *Globigerina hangi.* The lower part of the Tabyin Formation contains samples SH-1 to SH-6. The sample no. S5 is the distinctive part of the lower part and it contains 13 species of benthonic and 10 species of planktonic.

The lower part of the Tabyin Formation is characterized by the highly abundance of the benthonic species, *Siphotextularia* sp., *Ellipsonodosari averneuili, Nodosaria anomala, Nodogenerina comsobrina, Robulus carital, Eponides elevates, Subreophax* sp., *Nonion elongatum, Entosolenialaevigata and Triloculina* sp.

| TABYIN FORMATION | | | | | | | | | | | | | | | GEOLOGICAL FORMATIONS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | SAMPLE NUMBERS / FORAMINIFERAL SPECIES | | |
| | | | | | | BARREN ZONE | BARREN ZONE | | BARREN ZONE | | | BARREN ZONE | BARREN ZONE | | 1 | *Bathysiphon* sp. | BENTHONIC SPECIES |
| | | | | | | | | | | | | | | | 2 | *Rhizammina* sp. | |
| | | | | 2 | | | | | | | | | | | 3 | *Siphotextularia* | |
| | | | | | | | | | | | | | | | 4 | *Hyperammina elongata* | |
| | | | | | | | | | | | | | | | 5 | *Dentalina havanensis* | |
| | | | | | | | | | | | | | | | 6 | *Bolivina mexicana* | |
| | | | | | | | | | | | | | | | 7 | *Bolivina* sp. | |
| | | | | | | | | | | | | | | | 8 | *Bolivina goesii* | |
| | | | 3 | | | | | | | | | | | | 9 | *Ellipsonodosaria verneuili* | |
| | | | | | | | | | | | | | | | 10 | *Nodosaria* sp. | |
| | | | 1 | | | | | | | | | | | | 11 | Nodosaria anomala | |
| | | | | | | | | | | | | | | | 12 | *Pleurostomella gerontica* | |
| | | | | | | | | | | | | | | | 13 | *Cibicides tapanoeliensis* | |
| | | | 1 | | | | | | | | | | | | 14 | *Nodogenerina comsobrina* | |
| | | | | | | | | | | | | | | | 15 | *Robulus lucidus* | |
| | | | | 11 | | | | | | | | | | | 16 | *Robulus carital* | |
| | | | | | | | | | | | | | | 2 | 17 | *Robulus* sp F. Le Roy | |
| | | | | | | | | 3 | | 5 | | | | | 18 | *Cancris auriculus* | |
| | | | | | | | | | | | | | | | 19 | *Cancris sagra* | |
| 5 | 6 | 6 | | | | | | | | | | | | | 20 | *Eponides elevatus* | |
| | | | | 1 | | | | | | | | | | | 21 | *Subreophax* sp. | |
| | | | | 1 | | | | 1 | | | | | | | 22 | *Nonion elongatum* | |
| | | | | 1 | | | | | | | | | | | 23 | *Entosolenia laevigata* | |
| 1 | 1 | 3 | 1 | 2 | | | | | | 4 | 1 | | | | 24 | *Triloculina* sp. | |
| 2 | 2 | | | | 1 | | | 1 | | | | | | 1 | 1 | *Globigerina higginsi* | |
| | | | | 1 | | | | | | | | | | | 2 | *Globigerina* sp. | |
| | | | | | | | | | | | | | | | 3 | *Globigerina inaequispira* | |
| 2 | | | | | | | | | | 1 | | | | | 4 | *Globoquadrina altispira globosa* | |
| | | | | 1 | | | | | | 1 | | | | | 5 | *Globorotalia* sp. | |
| | | 1 | | | | | | | | | 1 | | | | 6 | *Globogerina* sp. | |
| | | | | | | | | | | | | | | | 7 | *Globogerina danvillensis* | |
| | | | | | | | | | | | | | | | 8 | *Acarinina soldadoensis soldadoensis* | |
| 1 | | | | | | | | | | | | | | | 9 | *Acarinina soldadoensis angulosa* | |
| | | | | | | | | | | | | | | | 10 | *Acarinina mckannai* | |
| | | | | | | | | | | | | | | | 11 | *Turborotalia centralis* | |
| | | | | | | | | | | | | | | | 12 | *Turborotalia cerroazulensis* | |
| | | | | 1 | | | | | | | | | | | 13 | *Orbulina bilobata* | |
| 6 | 7 | 9 | 6 | 18 | 0 | | | 4 | | 9 | 1 | | | 2 | Benthonic species population | | |
| 5 | 2 | 1 | 0 | 3 | 1 | | | 1 | | 2 | 1 | | | 1 | Planktonic species population | | |
| 11 | 9 | 10 | 6 | 21 | 1 | | | 5 | | 11 | 2 | | | 3 | Total numbers of species population | | |
| 2 | 2 | 2 | 4 | 6 | 0 | | | 2 | | 2 | 1 | | | 1 | Benthonic species diversity for each sample | | |
| 3 | 1 | 1 | 0 | 3 | 1 | | | 1 | | 2 | 1 | | | 1 | Planktonic species diversity for each sample | | |
| 5 | 3 | 3 | 4 | 9 | 1 | | | 3 | | 4 | 2 | | | 2 | Total numbers of species diversity for each sample | | |

**Table (1) The distribution of Benthonic and Planktonic species along the Sidoktaya-Dam section**

The planktonic species found in the lower part of the Tabyin Formation are: *Globigerina hagni*, *Globigerina higginsi*, *Globigerina* sp., *Globoquadrina altispiraglobosa*, *Globorotalia* sp., *Globogerina* sp., *Acarinina soldadoensis angulosa*, *Orbulina bilobata*, *Chilogumbelina wilcoxensis and Chiloguembelina* sp.

Table (4.1) Showing the species population and species diversity of the lower part of the Tabyin Formation

| Lower part of the Tabyin Formation | | | |
|---|---|---|---|
| Species | Benthonic | Planktonic | Total |
| Species Population | 46 | 40 | 86 |
| Species Population Ratio | 1.15 | 1 | 1.15:1 |
| Species Population % | 53% | 47% | 100% |
| Species Diversity | 16 | 14 | 30 |
| Species Diversity Ratio | 1.14 | 1 | 1.14:1 |
| Species Diversity % | 53% | 47% | 100% |

**The Upper Part of the Tabyin Formation**

The common foraminifera species in the upper part of the Tabyin Formation are; *Cancrisauriculus, Triloculina* sp., *Globigerina higginsi, Pleurostomella* sp., and *Robulus abullotensis*. The barren zones are occurs in the upper part of the Tabyin Formation. The upper part of the Tabyin Formation contains samples SH-7 to SH-21. The sample no. S16 is the distinctive part of the upper part and it contains 24 species of benthonic and 14 species of planktonic.

The benthonic species, *Bathysiphon* sp., *Rhizammina* sp., *Hyperammina elongate, Dentalina havanensis, Textularia lateralis, Bolivina mexicana, Bolivina* sp., *Pleurostomella gerontica, Ellipsonodosaria verneuili, Nodosaria* sp., *Cibicides tapanoeliensis, Robulus abullotensis, Nodosaria anomala, Bolivina goesii, Nodogenerina comsobrina, Pleurostomella* sp., *Robulus lucidus, Robulu scarital, Robulus* sp F. Le Roy, *Valvulineria* aff. *inaequalis, Cancris auriculus, Cancris sagra, Nonion elongatum and Triloculina* sp. are observed in the upper part of the Tabyin Formation.

Table (4.2) Showing the species population and species diversity of the upper part of the Tabyin Formation

| Upper part of the Tabyin Formation | | | |
|---|---|---|---|
| Species | Benthonic | Planktonic | Total |
| Species Population | 41 | 34 | 75 |
| Species Population Ratio | 1.21 | 1 | 1.21:1 |
| Species Population % | 55% | 45% | 100% |
| Species Diversity | 30 | 16 | 46 |
| Species Diversity Ratio | 1.88 | 1 | 1.88:1 |
| Species Diversity % | 65% | 35% | 100% |

The planktonic species found in the lower part of the Tabyin Formation are: *Globigerina higginsi, Globigerina inaequispira, Globoquadrina altispiraglobosa, Globorotalia* sp., *Globotaloides suteri, Globogerina* sp., *Globogerina danvillensis, Acarinina soldadoensis, Acarinina soldadoensis soldadoensis, Acarinina soldadoensis angulosa, Acarinina mckannai, Turborotalia centralis, Turborotalia cerroazulensis and Chilogumbellina wilcoxensis.*

**Biostratigraphy of the Area**

In the research area, the Tabyin Formation is mainly made up of shales minor amount of sandstones. The shales in the Tabyin Formation are fairly fossiliferous, containing a few number of foraminiferal specimens expect sample No.S5 and S12.

There are a total of (46) foraminiferal species (28) benthonic species and (18) planktonic species, which have been identified from the Tabyin Formation. The biostratigraphy of Sidoktaya area can be established by using the some selected Paleogene planktonic foraminifera, using the International Stratigraphic Guide prepared by Hedberg (1976)

Table (4.5) Biostratigraphic Zone in the research area**.**

| Formation | Biostratigraphic Zone | Geological Age | Age |
|---|---|---|---|
| Tabyin Formation | *Globigerina higginsi-Acarinina soldadoensis angulosa* Zone<br>(Concurrent range Zone) | Lutetian | Middle Eocene |

The *Globigerina higginsi-Acarinina soldadoensis angulosa* Zone is defined as concurrent range zone because the first occurrence of the *Acarinina soldadoensis angulosa* in the sample position S1,and the last appearance in sample position S16 and S21 is found in the of Tabyin Formation, association with the index species of *Globigerina higginsi* (Figure4.5). The *Globigerina higginsi-Acarinina soldadoensis angulosa* concurrent range zone is correlated with the Paleogene 9 to 10 planktonic foraminiferal zone of Blow (1969).

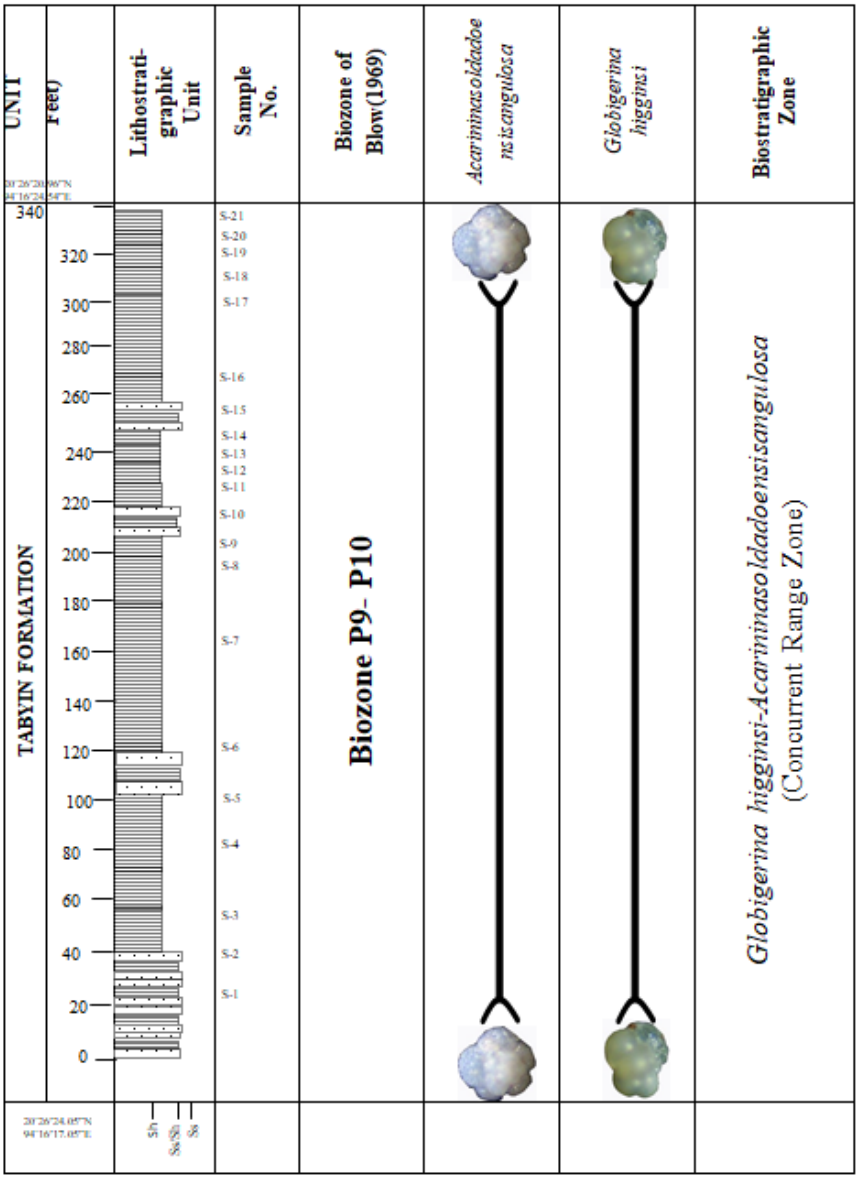


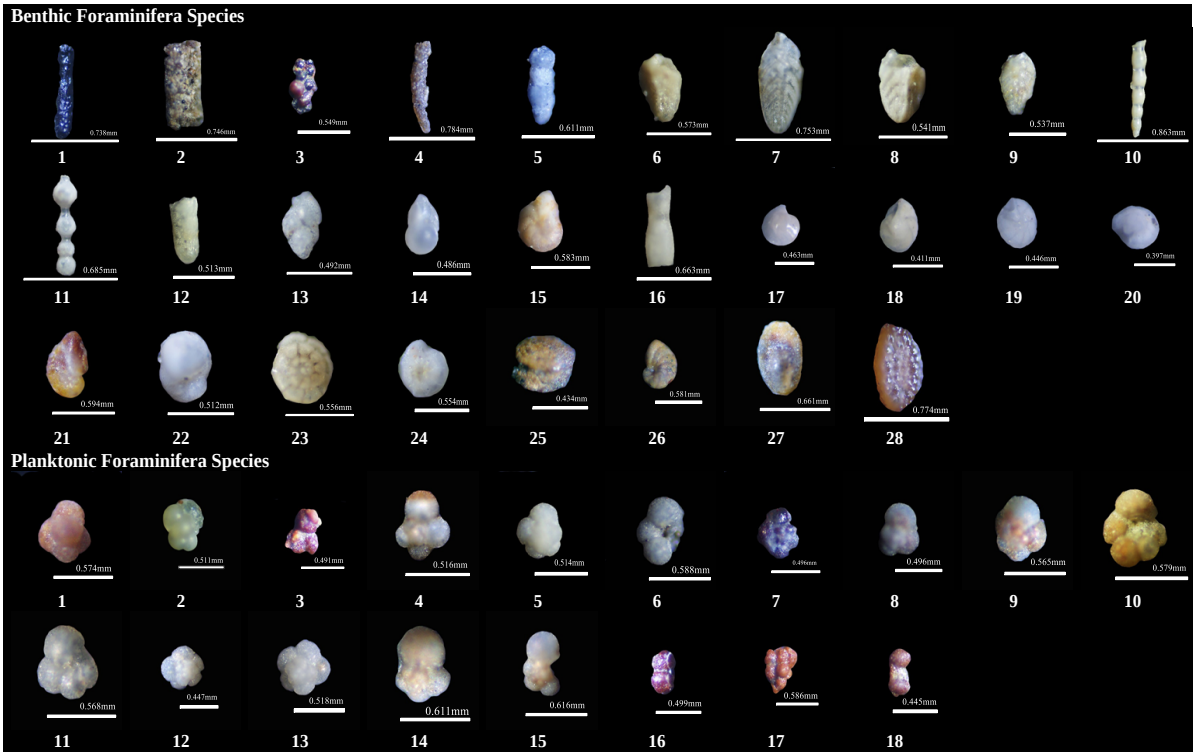

Figure 4.5 Some selected species and their range for the biostratigraphic zone of the Tabyin Formation

**Age of the Tabyin Formation**

There are altogether (18) numbers of planktonic species occurring in the Tabyin Formation. The common occurrences of *Acarinina* sp., *Turborotalia* sp. and *Turncorotaloides*sp, indicate in the Middle Eocene age.

The *Globigerina higginsi-Acarinina soldadoensis angulosa* concurrent range Zone may be regarded as the Tabyin Formation, among these the *Acarinina soldadoensis angulosa* is distinctive zonal specie. The stratigraphic range of this zonal specie is limited within the Paleogene Biozone P9 – P10 (Petters, 1954). Associated with this zone species, there is another distinct species *Globigerina higginsi* which is found from the Lutetian age. Therefore, this zonal species indicates that the *Globigerina higginsi-Acarinina soldadoensis angulosa* concurrent range Zone is falling in the Lutetian.

Therefore, the research area of the Tabyin Formation is assigned to the Eocene in age (Lutetian)




**Benthic Foraminifera Species:**1. *Bathysiphon* sp. 2. *Rhizammina* sp. 3. *Siphotextularia* 4. *Hyperammina elongate* 5. *Dentalina havanensis* 6. *Textularia lateralis* 7. *Bolivina Mexicana* 8. *Bolivina* sp. 9. *Bolivina goesii* 10. *Ellipsonodosaria verneuili* 11. *Nodosaria* sp. 12. *Nodosaria anomala* 13. *Pleurostomella gerontica* 14. *Pleurostomella* sp. 15. *Cibicides tapanoeliensis* 16. *Nodogenerina comsobrina* 17. *Robulus abuillotensis* 18. *Robulus lucidus* 19. *Robulus carital* 20. *Robulus* sp F. Le Roy 21.*Valvulineria* aff. *Inaequalis* 22. *Cancris auriculus* 23. *Cancris sagra* 24. *Eponides elevatus* 25. *Subreophax* sp. 26. *Nonion elongatum* 27. *Entosolenia laevigata* 28. *Triloculina* sp.

**Planktonic Foraminiera Species:**1. *Globigerina hagni* 2. *Globigerina higginsi* 3. *Globigerina* sp. 4. *Globigerina inaequispira* 5. *Globoquadrina altispira globose* 6. *Globorotalia* sp. 7. *Globotaloides suteri* 8. *Globogerina* sp. 9. *Globogerina danvillensis* 10. *Acarinina soldadoensis* 11. *Acarinina soldadoensis soldadoensis* 12. *Acarinina soldadoensis angulosa* 13. *Acarinina mckannai* 14. *Turborotalia centralis* 15. *Turborotalia cerroazulensis* 16. *Orbulina bilobate* 17. *Chilogumbellina wilcoxensis* 18. *Chiloguembelina* sp.

## Summary and Conclusions

The research area is situated between latitudes 20° 25' 27” and 20° 31’ 12” N and longitudes 94° 14' 24”and 94° 26’ 07” E. It is used in UTM map Sheet No. 2094 06 and 2094 07. It is occupied the eastern part of the Sidoktaya area, Magway Region. A research research “Foraminifera Biostratigraphy of the Tabyin Formation” was carried out based on (21) shale samples from the Tabyin Formation respectively. The aim of the present work was to record, describe and define the foraminiferal biostratigraphy of Tabyin Formation and determine the geological age of each formation based on the planktonic and localized benthonic zone fossils. The geological field work was carried out from 3.11.2016 to 10.11.2016, during which a total of two geological traverses along the Sidoktaya – Salin car road section section and Sidoktaya dam section were made. The present research area is situated in the western marginal portion of the Central Myanmar Basin. This basin is mainly composed of sedimentary rock formations namely Paunggyi Formation (Paleocene), Laungshe Formation (Lower Eocene), Tilin Formation (Lower Eocene), Tabyin Formation (Middle Eocene), Pondaung Formation (Upper Eocene), Yaw Formation(Upper Eocene), Shwezataw Formation(Lower Oligocene), Padaung Formation(Middle Oligocene), Okhmintaung Formation(Upper Oligocene), Pyawbwe Formation(Lower Miocene), Kyaukkok Formation(Lower Miocene), Obogon Formation(Middle Miocene) and Irrawaddy Formation (Pliocene) are also composed. In the research area, the Tabyin Formation is well exposed. The Tabyin Formation is composed of shales interbedded with argillaceous sandstones. Sandstones are grey, moderately hard, thinly bedded, carbonaceous and argillaceous interbedded with fossiliferous lenses. The Tabyin Formation is divided into two parts based on the distribution of the foraminiferal species. The lower part of the Tabyin Formation contains samples S1 to S6. The sample no. S5 is the distinctive part of the lower part and it

contains 13 species of benthonic and 10 species of planktonic. The upper part of the Tabyin Formation contains samples S7 to S21. The sample no. S16 is the distinctive part of the upper part and it contains 24 species of benthonic and 14 species of planktonic. There are a total of (46) foraminiferal species (28) benthonic species and (18) planktonic species, which have been identified from the Tabyin Formation. The biostratigraphy of Sidoktaya area can be established as *Globigerina higginsi-Acarinina soldadoensis angulosa* Zone by using the some selected Paleogene planktonic foraminifera. The research area in the lower part of the Tabyin Formation is deposited under relatively shallow marine of deeper condition and the upper part of the Tabyin Formation is deposited relatively shallow marine with high energy has been reconstructed based on the species diversity and the ratio of benthonic and planktonic species.

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# Lithofacies Analysis and Depositional Environment of the Kyaukkok Formation in Saw Gwe Taung Anticline, Aunglan Township, Magway Region

Win Min Oo[1], Myo Thiri Sandar Aung[2], Aye Aye Min[3]

## Abstract

The research area is located around the Saw Gwe Taung Anticline in Aunglan Township, Magway Region. The research area is composed of Kyaukkok Formation of the Upper Pegu Group and the Irrawaddy Formation. The Kyaukkok Formation is mainly consisted of yellowish brown to grayish brown, fine- to medium-grained, sometimes coarse-grained and medium-bedded to massive, micaceous sandstones with bluish gray to light gray colored thin shale partings. Some macrofaunas and microfaunas are found in Kyaukkok Formation such as gastropods, pelecypods and some foraminifera. The age of the Kyaukkok Formation is regarded as Early Miocene. The Irrawaddy Formation rests unconformably on the Kyaukkok Formation. In the Kyaukkok Formation, six lithofacies were observed. These are Parallel to low angle cross-bedded sandstone facies, Fossiliferous sandstone facies, Cross-bedded sandstone facies, Thin- to medium-bedded sandstone interbedded with shale facies, Wavy bedded sandstone facies and Sand-mud interlayer facies. Based on these six facies, two facies associations can be divided in the Kyaukkok Formation. These are Shoreface facies association and Intertidal facies association. Based on the lithology, faunal evidences and lithofacies, the depositional environment of the Kyaukkok Formation in the research area is regarded as shoreface environments and along the tidal shoreline or tide-dominated deltaic environments (shoreface sand bars, intertidal channel, intertidal sand flats and intertidal mixed flats).

## Introduction

The research area is located around the Saw Gwe Taung in Aunglan Township in Magway Region. The study area is located about 20 kilometers at the southeast of Aunglan. The location map of the study area is shown in Figure (1). The Saw Gwe Taung Anticline and other mountains and hills in the research area are usually trending in NNW – SSE direction. The average elevation of the study area is higher than 50 meters. The study area is situated on the east bank of the Ayeyarwady River. The area has two main streams, namely, Bwetgyi Chaung and Yenangyi Chaung. The streams and their tributaries in the study area have coarse dendritic pattern. Some small streams are formed as sub-parallel to parallel due to the lithological control. The drainage map of the study area is shown in Figure (2).

The objectives of the research are the to study the stratigraphy of the study area, to compile the pre-existing geological maps and previous studies of the study area, to establish the facies and facies association of the study area and to interpret the possible depositional environments of the Kyaukkok Formation based on lithofacies evidences.

## Methods of Study and Materials

Before going to the field, collections of the literature and data of the southwest flank of Central Basin or Salin Sub-asin or sometimes Minbu Basin were done. Before doing field work, UTM maps were used as a base map. A geological map is prepared with lithology, contact, location, etc. on a base map. Tape and compass traverse method (Compton, R. R, 1962) is quite useful in geological mapping.

[1] Dr., Professor, Department of Geology, Myeik University
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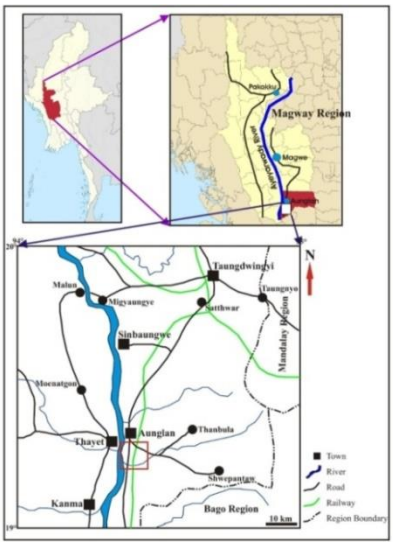


Figure (1) – Location map of the study area.

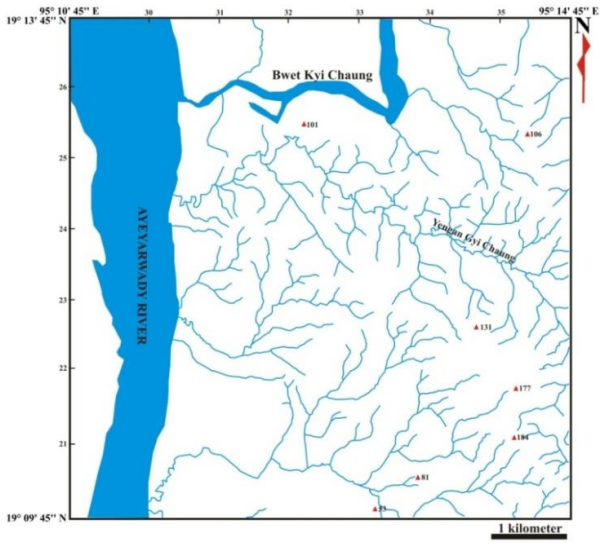


Figure (2) – Drainage map of the study area.

Collection of representative sandstone and shale samples were made mostly with nearly equal interval of space along the sections. A total of (30) samples (18 of sandstones and 12 of shales) have collected during the field from the rock units of Kyaukkok Formation. All samples are labels with locations, numbers, stratigraphic position and other related information. The sedimentary structures and stratigraphic natures were carefully observed, measured and recorded for the purpose of facies analysis. The sandstone samples have been prepared as thin-sections for microscopic study

## Stratigraphy of the Area

The research area occupies the southeastern continuation of the Padaukpin Anticline in the north and the Thayetkon Anticline which are located at the western bank of the Ayeyarwady River in Thayet Township. The Saw Gwe Taung Anticline is located just eastern bank of the Ayeyarwady River and which is NW – SE trending with Miocene and Pliocene rocks.

Table – (1) Stratigraphic Succession of the Study Area

| Age | Formation | Thickness (meters) |
|---|---|---|
| Late Miocene – Pliocene | Irrawaddy Formation | Unmeasured |
| Early Miocene | Kyaukkok Formation | 590 m |

### Stratigraphy of Kyaukkok Formation

The Kyaukkok Formation is well exposed along the Saw Gwe Taung. It is an anticline and trend is NW – SE direction. The good exposures are occurred along the Pyay – Aunglan railway section. The thick-bedded to massive, yellowish brown, micaceous sandstones are also exposed in the streams and on the hills.

The Kyaukkok Formation is mainly composed of yellowish brown to grayish brown, fine- to medium-grained, sometimes coarse-grained and medium-bedded to massive, micaceous sandstones (see in Figure – 3 and 4) with bluish gray to light gray colored thin shale partings (Figure – 5 and 6). The calcareous sandstone concretions with fossils are also

observed (Figure – 7). The lower part of this formation consists of grayish brown, fine- to medium-grained, medium- to thick-bedded, hard and compact sandstones interbedded with bluish gray shales with minor amount of siltstones and calcareous sandstone concretions (Figure – 8). The alternations of yellowish to gray, nodular shales and calcareous sandstones with fossils are occasionally occurred (Figure – 9). The upper part of this formation is composed of yellowish brown, medium- to coarse-grained, thin- to medium-bedded, soft sandstones containing numerous shell fragments of gastropods and pelecypods (Figure – 10).

Figure (3) – Yellowish to grayish brown, fine-grained, thick-bedded, micaceous sandstones of the Kyaukkok Formation. (Loc. N 19° 11' 16" E 95° 12' 41")

Facing – 295°

Figure (4) – Grayish brown, medium-grained, thick-bedded, laminated sandstones of the Kyaukkok Formation. (Loc. N 19° 11' 10" E 95° 12' 39")

Facing – 230°

Figure (5) – Bluish to yellowish gray, medium-bedded, sandy shales of the Kyaukkok Formation. (Loc. N 19° 11' 34" E 95° 12' 48") Facing – 120°

Figure (6) – Brown, medium-bedded, concretionary sandstones and sandy shales of the Kyaukkok Formation. (Loc. N 19° 10' 53" E 95° 12' 33") Facing – 120°

The rock units of Kyaukkok Formation comprises Gastropods, Pelecypods (Figure – 11 and 12) and some Foraminifera. The age of the Kyaukkok Formation is regarded as Early Miocene. The stratigraphic measurement of the Kyaukkok Formation was carried out along the railway section which across the Saw Gwe Taung Anticline. The measured thickness of Kyaukkok Formation in the study area is 590 meters (Figure – 13).

Figure (7) – Bluish to yellowish gray, medium-bedded, sandstones and sandy shales of the Kyaukkok Formation. (Loc. N 19° 11' 31" E 95° 12' 46") Facing – 240°

Figure (8) – Yellow to buff-colored and bluish gray, thin-bedded, sandy shales of the Kyaukkok Formation. (Loc. N 19° 11' 36" E 95° 12' 50") Facing – 150°

Figure (9) – Yellowish brown, fine-grained, thin-bedded, sandstone interbedded with sandy shales of the Kyaukkok Formation. (Loc. N 19° 11' 38" E 95° 12' 53") Facing – 110°

Figure (10) – Yellowish brown, fine-grained, medium-bedded, fossiliferous sandstone of the Kyaukkok Formation. (Loc. N 19° 11' 16" E 95° 12' 41") Facing – 295°

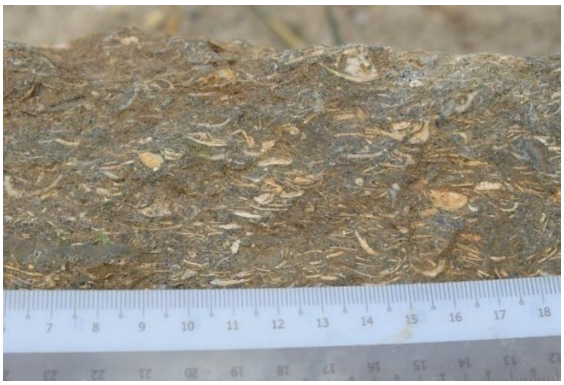

Figure (11) – Brown, fine-grained, medium-bedded, fossiliferous sandstone of the Kyaukkok Formation. (Loc. N 19° 11' 26" E 95° 12' 45")

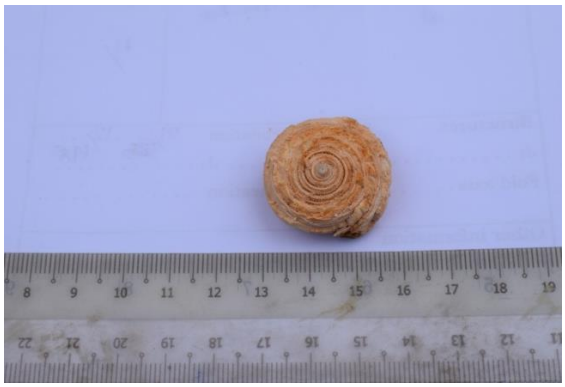

Figure (12) – Gastropod extracted from brown, fine-grained, medium-bedded, fossiliferous sandstone of the Kyaukkok Formation. (Loc. N 19° 10' 58" E 95° 12' 35")

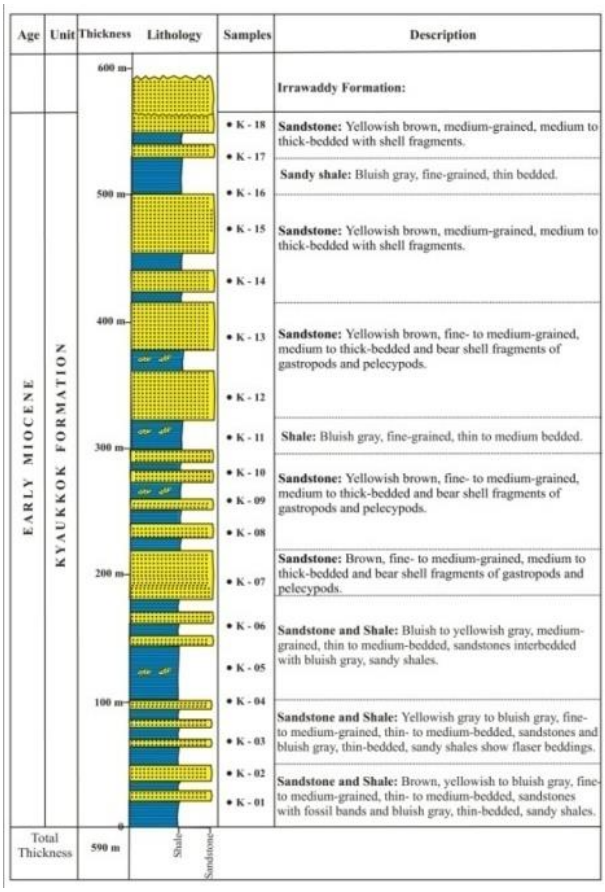


Figure – (13) Stratigraphic columnar section of the Kyaukkok Formation measured along the southern limb of the Saw Gwe Taung Anticline.

(Measured from N 19° 11' 27" E 95° 12' 45" to N 19° 10' 38" E 95° 12' 27")

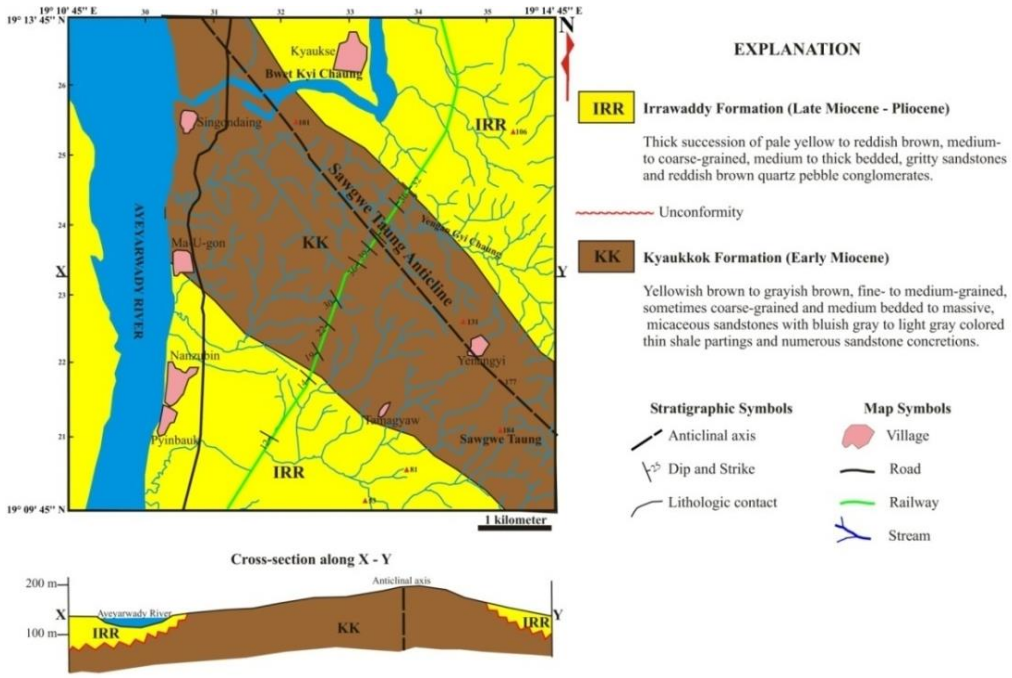


Figure – (14) Geological map of the Saw Gwe Taung area, (modified after L. Zau Naw, (1972)

## Facies Analysis

The rock units of the Kyaukkok Formation are divided into facies division using the criteria of lithology, stratification, contact relationship, faunal contents and sedimentary structures. The process of deposition of each individual facies has been interpreted as closely as possible and the vertical succession and relationship to facies to another has been analyzed. For the determination of the sedimentary environments of different stratigraphic unit of the study area, lithofacies studies were carried out. In order to interpret the lithofacies, some observations were carried out such as rock type, grain-size, contact relationships, sedimentary structures and faunal contents. The observed six lithofacies that constitute and characterize the Kyaukkok Formation are:

1. Parallel to low angle cross-bedded Sandstone Facies (Slx)
2. Fossiliferous sandstone Facies (Sf)
3. Cross-bedded sandstone Facies (Sxb)
4. Thin- to medium-bedded sandstone interbedded with shale Facies (Sim)
5. Wavy bedded sandstone Facies (Sw)
6. Sand-mud interlayer Facies (Smi)

### (1) Parallel to low angle cross-bedded Sandstone Facies (Slx)

**Description:** This facies is mainly composed of yellow to buff-colored, medium-grained, thick-bedded, micaceous sandstone with planar cross-beddings and horizontal to low angle cross-stratifications (Figure – 15). The cross-beddings occurred in this facies are generally very low angle and the maximum angle is mostly less than 15°. The opposite directed cross-bedding is gentler. In the lower part, large scale trough cross stratifications, horizontal to low angle cross stratifications with mud drapes are observed (Figure – 16). The sand – shale ratio of this facies is about 10:1.

Figure (15) – Thin-bedded, cross-stratified sandstones of the Kyaukkok Formation showing planar cross-bedded and horizontal to low angle cross-stratified sandstones, a characteristic of shore face sand bars. (Loc. N 19° 11' 36" E 95° 12' 50") Facing – 150°

Figure (16) – Medium-bedded, cross-stratified sandstone of the Kyaukkok Formation showing horizontal to low angle cross stratifications are observed as a characteristic of intertidal shore face sand bar. (Loc. N 19° 11' 38" E 95° 12' 53") Facing – 110°

**Interpretation:** This type of cross-bedding is produced due to migration of sand bars in near shore area where the deposition takes place mainly by low-velocity currents under a shallow cover of water (Reineck and Singh, 1980). The very low angle cross-beds are the major sedimentary features of the sand bar in which more gentle cross-beds resemble the land ward current. Therefore, it may be deposited in bar area (beach bar and sand bar) or a characteristic of intertidal shore face sand bar (Nichols, 2009).

**(2) Fossiliferous sandstone Facies (Sf)**

**Description:** This facies is mainly composed of brown, medium- to coarse-grained, medium- to thick-bedded fossiliferous sandstone with reworked pebbles which is intercalated in thick sequence gray shale (Figure – 17, 18 and 19). The contained fossils are Pelecypods and Gastropods in the brown, thin-to medium-bedded, fossiliferous sandstone and also consist of pebbles (Figure – 20). The sand – shale ratio of this facies is about 5:1.

Figure (17) – Fossiliferous sandstone with well cemented portion in the upper part and a large trace fossil burrow, a characteristic marine cementation (hard ground) in near shoreface environment. (Loc. N 19° 11' 18" E 95° 12' 41") Facing – 290°

Figure (18) – Medium- to coarse-grained, thick-bedded, fossiliferous sandstone of the Kyaukkok Formation showing high energy wave reworking environment, a characteristic of shore face sand bars. (Loc. N 19° 11' 16" E 95° 12' 41") Facing – 295°

**Interpretation:** The fossiliferous sandstones in thick shales facies point out storm surged deposits which are weather system that have associated strong surface winds. In continental settings, they are important in Aeolian transport of materials which include the transport of airborne sediment out into the oceans. Large storm have a very large impact shallow marine environments and storm-related processes of the sedimentation are dominant in most shelf and epicontinental seas. The storm winds drive currents in the oceans that move water and sediments across and along continental shelves. Large waves affect much deeper parts of the shelf than normal, fair weather waves. This facies indicate the offshore transition environment with occasional storm surged condition (Reineck and Singh, 1980).

Figure (19) – Reddish brown fossiliferous sandstone horizon overlying on horizontally stratified sandstone, a characteristic of upper shore face sand bars which had undergone sub aerial exposure in oxidizing condition. (Loc. N 19° 10' 58" E 95° 12' 35") Facing – 290°

Figure (20) – Fossiliferous sandstone of Kyaukkok Formation showing reworked pebbles together with coral fragments and shell fragments, a characteristic of high energy wave/current commonly found in shore face channel or sand bars. (Loc. N 19° 10' 53" E 95° 12' 33") Facing – 120°

**(3) Cross-bedded sandstone Facies (Sxb)**

**Description:** It is mainly composed of brown, medium-grained, thin- to medium-bedded sandstone with cross-beddings. The grain size variation from the lower to upper part of a bed is differed from one place to another. Locally, channel lag deposits and shales are formed as characterized facies (Figure – 21). Fossils are found in the base of a bed. The erosive base of the lower and sharp upper contact of a single bed is quite remarkable. Small and large scour and fill are observed. The sand – shale ratio of this facies is about 8:1.

Figure (21) – Brown, medium-grained, thin- to medium-bedded sandstone with cross-bedded sandstone of the Kyaukkok Formation. (Loc. N 19° 11' 27" E 95° 12' 45") Facing – 290°

**Interpretation:** This facies can be interpreted as a channel deposit of an area. It may be taken place under high energy condition by the rapid currents on the slope or in the under flow regime. The active channels commonly with cut and filled structure formed during the erosion incision of base upon which the coarse clastic occur as log materials. It may be regarded as active channel deposits on an intertidal flat or a distributary channel of the delta plain area (Reineck and Singh, 1980).

**(4) Thin- to medium-bedded sandstone interbedded with shale Facies (Sim)**

**Description:** It is mainly composed of yellowish brown, fine-grained, thin- to medium-bedded sandstone interbedded with brownish gray thin shale interlayer (Figure – 22 and 23).

Locally, channel lag deposits of shale are formed as characterized facies. Fossils are found in the base of a bed. The sand – shale ratio of this facies is about 4:1.

Figure (22) – Yellowish gray, fine-grained, thin-bedded sandstone with shale interlayers of the Kyaukkok Formation (Loc. N 19° 11' 27" E 95° 12' 45") Facing – 290°

Figure (23) – Yellowish brown, fine-grained, thin- to medium-bedded sandstone and shale interlayers of the Kyaukkok Formation. (Loc. N 19° 11' 27" E 95° 12' 45") Facing – 290°

**Interpretation:** This facies can be interpreted as a channel deposit of an area. It may be taken place under high energy condition by the rapid currents on the slope or in the upper flow regime. The active channels commonly with cut and filled structure formed during the erosive incision of base upon which the coarse clastic occurs as lag materials. It may be regarded as active channel deposits on a tidal flat or a distributary channel of the delta plain area (Reineck and Singh, 1980).

**(5) Wavy bedded sandstone Facies (Sw)**

**Description:** This facies consist of interbedded sandstone and mudstone with layers in sharp contacts. The sandstones are yellowish brown, fine- to medium-grained and thin- to medium-bedded (Figure – 24). Thin sandstone and interlayered bedding unit showing wavy bedding found in thin sandstone (Figure – 25). The sand – shale ratio of this facies is about 4:1.

Figure (24) – Thin sandstone and mudstone interbedded unit showing wavy bedding found in thin Sandstones, characteristic of Intertidal Mixed Sand and Mud flats, Kyaukkok Formation. (Loc. N 19° 11' 24" E 95° 12' 44") Facing – 120°

Figure (25) – Sand/Mud interlayered bedding found in Kyaukkok Formation showing wavy bedding of thin sandstones and silty and sandy Mudstone, normally found in intertidal sand and mud flats environments in a delta front. (Loc. N 19° 11' 24" E 95° 12' 44") Facing – 120°

**Interpretation:** The lithologic character and wavy bedded sandstone are thought to be product of deposition in a wave-agitated coastal environment. The presence of sand beds alternate with shale intercalation point out the area of the energy condition and slack water period. The repeated occurrence can be interpreted as the area under the influence of the oscillation of sea level. The associated shale unit and this sand bed are thought to be of the deposition beyond the sand dominated delta plain. This facies can be interpreted as shoreface deposit on intertidal mixed flats (Reineck and Singh, 1980).

**(6) Sand-mud interlayer Facies (Smi)**

**Description:** Lithologically, this facies is characterized by yellowish brown, fine-grained, thin- to medium-bedded and shale interlayer (Figure – 26). Parallel laminations are common in the sandstones. These sandstones are hard and compact. The contact can be distinguished from other facies by the presence of mud layers. The mud flasers of this bedding are wavy in form they show concaving upward when occupying ripple troughs and concavity downward when they overlies ripple crests (Figure – 27).The sand–shale ratio of this facies is about 3:1.

**Interpretation:** The alternate nature of sand-mud bedding resembles the depositional condition current action and slack water condition. The deposition of sand derive from the land area the current or storm conditions whereas finger particle settle out the suspension within the sequences of upward fining position, overlain by thick clay sequences exhibit the deepening periods of the basin. The sand-mud interlayer can also be occurred in the area of overbank where the floods occurred. The upward fining nature merged into shale sequences resembles the offshore transition zone deposition under initial stage of transgression. This formation requires the conditions in which new sand depositing currents only partial erode the crests of earlier formed ripples and the mud layer draping over it. The wavy flaser bedded mud layer drapes can be regarded as intertidal zones (Reineck and Singh, 1980).

Figure (26) – Yellowish brown, fine-grained, thin- to medium-bedded sandstone and shale interlayers of the Kyaukkok Formation (Loc. N 19° 11' 23" E 95° 12' 43") Facing – 295°

Figure (27) – Yellowish brown, fine-grained, thin- to medium-bedded sandstone and shale interlayers of the Kyaukkok Formation (Loc. N 19° 11' 23" E 95° 12' 43") Facing – 295°

## Facies Associations

In the Kyaukkok Formation of the study area, two facies associations can be divided based on the six lithofacies. These are shoreface facies association and intertidal facies association.

**(a) Shoreface Facies Association:** This facies association is characterized by parallel to low angle cross-bedded sandstone facies and fossiliferous sandstone facies. The parallel to low angle cross-bedded sandstone facies is mainly composed of yellow to buff-colored, medium-grained, thick-bedded, micaceous sandstone with planar cross-beddings with horizontal to low angle cross-stratifications. This type of cross-bedding is formed due to migration of sand bars in near shore area where the deposition takes place mainly by low-velocity currents under a shallow cover of water. The fossiliferous sandstone facies is composed of brown, medium- to coarse-grained, medium- to thick-bedded fossiliferous sandstone with reworked pebbles which is intercalated in thick sequence gray shale. The depositional environment of this facies association can be regarded as shoreface environment (Figure – 28).

**(b) Intertidal Facies Association:** This facies association is characterized by cross-bedded sandstone facies, thin- to medium-bedded sandstone interbedded with shale facies, wavy bedded sandstone facies and sand-mud interlayer facies. According to the lithology, sedimentary structures and faunal evidences, this facies association was deposited along the tidal shoreline or tide-dominated deltaic environment because of tidal sedimentary processes and structures were most commonly found in this facies association (Figure – 29).

**Possible Depositional Environment**

The shoreface facies association of the Kyaukkok Formation is characterized by the prograding shoreline depositional environments. The idealized depositional environment of shoreface facies association of the Kyaukkok Formation was showing a characteristic of a shoreface environment (Figure – 28).

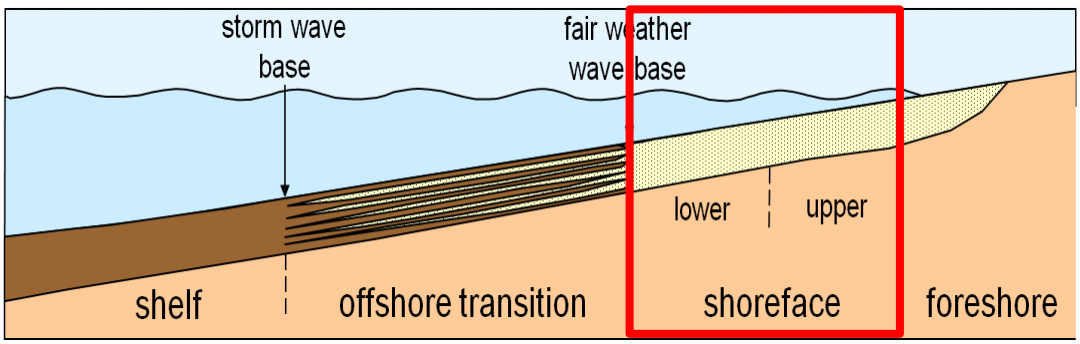


Figure (28) – Showing a generalized cross section of a prograding shoreline depositional environments. Idealized depositional environments of the Kyaukkok Formation showing a characteristic to shoreface environments (Nichols, 2009).

The intertidal facies association of the Kyaukkok Formation is consisted of six lithofacies such as parallel to low angle cross-bedded sandstone facies, trough cross-bedded sandstone facies, current ripple sandstone facies, cross-bedded sandstone with shale pebble facies, thin- to medium-bedded sandstone interbedded with shale facies, wavy bedded sandstone facies and sand-mud interlayer facies. This facies association was regarded as along the tidal shoreline or tide-dominated deltaic environments (shoreface sand bars, intertidal channel, intertidal sand flats and intertidal mixed flats) (Figure – 29).

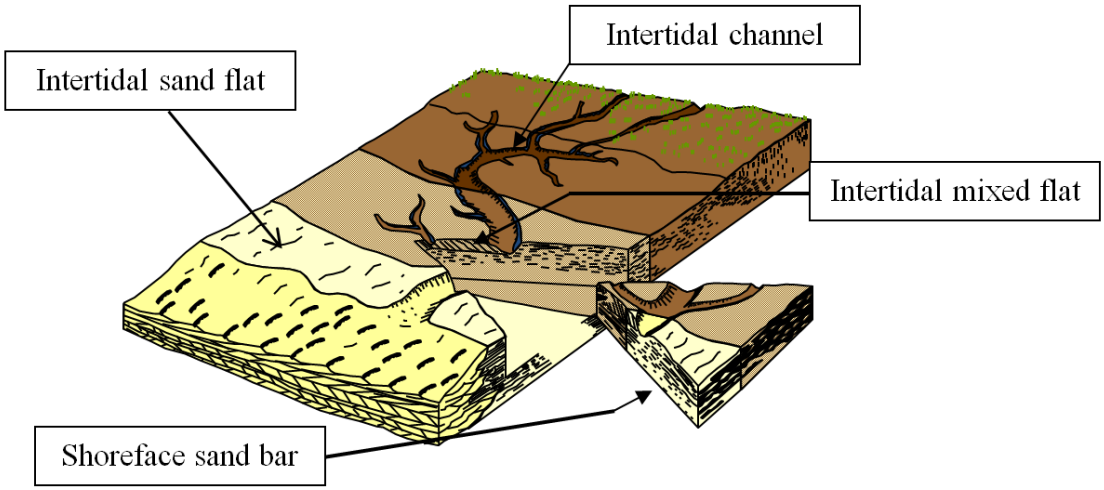


Figure (29) – Showing a tidal shoreline or tide-dominated deltaic environment with characteristic lithofacies, tidal sedimentary processes and structures most commonly found in some sections of Kyaukkok Formation, (Walker, 1984).

## Summary and Conclusion

1. The research area is located around the Saw Gwe Taung Anticline in Aunglan Township, Magway Region. The Saw Gwe Taung Anticline and other mountains and hills in the researched area are usually trending in NNW – SSE direction.
2. The area is located in the southern flank of Central Basin or Salin Sub-basin or sometimes Minbu Basin. The Minbu Basin has two flanks, namely, the western flank and the eastern flank. The Saw Gwe Taung Anticline is located just eastern bank of the Ayeyarwady River and which is NW – SE trending with Miocene and Pliocene rocks.
3. The area is composed of only two lithostratigraphic units. These are Kyaukkok Formation of the Upper Pegu Group and Irrawaddy Formation.
4. The Kyaukkok Formation is mainly composed of yellowish brown to grayish brown, fine- to medium-grained, sometimes coarse-grained and medium-bedded to massive, micaceous sandstones with bluish gray to light gray colored thin shale partings. The calcareous sandstone concretions with fossils are also observed.
5. In the Kyaukkok Formation, six lithofacies were observed. These are Parallel to low angle cross-bedded sandstone facies, Fossiliferous sandstone facies, Cross-bedded sandstone facies, Thin- to medium-bedded sandstone interbedded with shale facies, Wavy bedded sandstone facies and Sand-mud interlayer facies.
6. Based on these six facies, two facies associations can be divided in the Kyaukkok Formation. These are Shoreface facies association and Intertidal facies association.
7. Based on the lithology, faunal evidences and lithofacies, the depositional environment of the Kyaukkok Formation in the study area is regarded as shoreface environments and along the tidal shoreline or tide-dominated deltaic environments (shoreface sand bars, intertidal channel, intertidal sand flats and intertidal mixed flats).

## Acknowledgements

Firstly, we would like to thankful to Dr Ni Ni Oo (Rector) and Dr Win Win Than (Pro-Rector), Myeik University for their allowing us to do this research project. We wish to express our special gratitude to Dr Cho Cho Aye (Professor and Head, Department of Geology, East Yangon University) and Dr Soe Moe Lwin (Professor and Head, Department of Geology, Myeik University) for their encouragements and advice. We also grateful thank to Mg Thurain Toe, Mg Min Wai and Mg Way Yan Myo (M Sc Students, Geology Department, East Yangon University) for their helps during the field and laboratory work.

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# Petrographical and Petrochemical Studies of Igneous and Meta-igneous Rocks in Taungphilar Area, East of Thar Wut Hti- Lewe Townships, Mandalay Region

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## Abstract

The study area is located in the Taungphilar area, eastern part of the Thar Wut Hti and Yae Ni Townships, in the Mandalay Region. The study area is mainly composed of igneous and metasedimentary rock. Granitic rock comprises porphyritic biotite granite and metaigneous rocks are porphyritic biotite gneissose granite, biotite gneissose granite and migmatite. These rocks are mainly composed of essential minerals quartz, alkalifeldspar, plagioclase, biotite and accessory minerals like sphene, and some opaque minerals. Porphyritic biotite granite shows very coarse-grained hypidiomorphic granular and porphyritic textures. The phenocrysts are usually microcline and microperthites and perthites. Generally, major oxides content of igneous rocks in the study area ranges from $SiO_2$ (69.67- 73.78%), $AL_20_3$ (19.92-15.55%), $TiO_2$ (0.66-0.29%), $Fe_2O_3$ (3.18-1.163%), MnO (0.08-0.05%), CaO (2.95-1.74%), $K_2O$ (4.89-4.73%) and $P_2O_5$ (0.21-0.017). In Harker's major oxide variation diagram, major element oxides ($AL_20_3$, $TiO_2$, $Fe_2O_3$, MnO, CaO, $P_2O_5$) have negative correlation with $SiO_2$ but $K_2O$ have slightly positive correlation. One of the granitic sample fall in granite field and the other two samples fall in the granodiorite field.


**Keywords**: Granitic rocks, Porphyritic texture, Phenocryst, Microcline, Perthite

## Introduction

The study area is located in the Taungphilar area, eastern part of the Thar Wut Hti and Yae Ni Townships, in the Mandalay Region. It is situated between latitude 19°33'39.60"N and 19°28'40.80"N and Longitudes 96°23'16.80"E and 96°28'30.00"E with references to topographic map index no.94A/6 and 94A/7. The study area is far 8 miles from Yae Ni and can be reached directly by car and motor cycle. The communication is better in western part than in the eastern part. (Fig. 1)

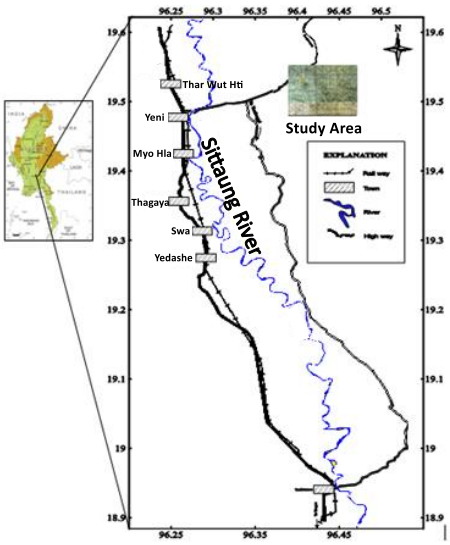


Figure. (1) Location map of the Taungphilar Area, east of Thar Wut Hti- Lewe Townships

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## Petrography

The study area is mainly composed of igneous and metasedimentary rock. In the eastern and western parts of the study area is mainly composed of metasedimentary rock (banded marble, banded quartzite and calc-silicate rock). Middle part of the study area is mainly composed of igneous and metaigneous rocks such as porphyritic biotite granite, porphyritic biotite gneissose granite, biotite gneissose granite and migmatite. The mataigneous rocks show randomly oriented feldspar phenocrysts gradually change to preferred orientation as a result of later regional metamorphism.

### Igneous rock (Mainly granitic rocks)

### Porphyritic biotite granite

This is the most common and the oldest igneous rock in this area. This unit is well exposed in the middle part of the area, especially at the northeast of Nampon village and Aung Nan Shwe village. The rock shows big boulder and well jointed nature (Fig. 2). The grain size of the rock is coarse- to very-coarse-grained texture. The sizes of the phenocrysts are ranges from 5 cm to 10cm. The phenocrysts are alkali feldspar and quartz which are randomly oriented in figure (4-b). Mineral segregation is found in this rock at the some places at shown in figure (3-a). It commonly suffers spheroidal weathering (Fig.4-a). It is also noted that the microgranite and quartzofeldspathic veins are intruded in into this unit (Fig.3-b).

### Microscopic Identification

In thin section studies, the rock shows typically porphyritic and generally hypidiomorphic texture. Essential minerals are quartz, alkalifeldspar and plagioclase and accessory minerals like biotite, sphene, zircon and apatite and some opaque minerals. Both quartz and alkalifeldspar crystals for the most parts occur as phenocrysts. Quartz is the essential mineral and it make up (62%) of the rock. It occurs as inclusions in the orthoclase and twinned plagioclase feldspar. Quartz shows anhedral grain and wavy extinction. Alkalifeldspars represented by orthoclase, microcline, perthite and microcline microperthite. It comprises more than two third of the total feldspar. Alkalifeldspars tend to occur as phenocrysts and also occur as groundmass (Fig.5-a). Untwinned orthoclases are common and mostly exhibit perthitic nature (Fig.8-a). The most common twinning is simple twinning (Fig.5-b). Microcline showing cross-hatched twinned and is observed as filling interstices between other minerals (Fig.8-b). Subhedral crystal of plagioclase is present and distinctly occurs as phenocryst. It ranges from $An_{15}$ to $An_{19}$ in composition (oligoclase). Plagioclase enclosed in alkalifeldspar phenocryst is also observed in some sections (Fig.6-b). It indicates that plagioclase crystallized earlier than orthoclase. Polysynthetic twins are common. The progressive zoning shows gradation from core to margin (Fig.6-a). Saussurization effect occurs along the twin planes. Bulbous and rim shaped myrmekitic texture is occasionally developed along the margin of alkalifeldspar especially in contact with plagioclase (Fig.7-a). Biotite is common mafic mineral. It is less than amount of quartz and feldsparnd show subhedral form and one-set of cleavage. Some biotites are bent due to deformation (Fig.7-b).

### Metaigneous Rocks

### Porphyritic gneissose granite

### Megascopic study

This unit is well exposed in rock quarries at the east of Taungphilar monastery. This rock shows randomly oriented feldspar phenocryst gradually change to preferred orientation as a result of gradational transformation of porphyritic biotite granite into porphyritic gneissose granite. The porphyritic gneissose granite is found close to the portphyritic biotie

granite body. Quartzofeldspathic veins are intruding into porphyritic gneissose granite (Fig.9-b). On the exposures, it shows well jointed nature (Fig.9-a). Locally augen structures are formed by large feldspar porphyroblasts (Fig.9-c). Generally trend of the foliation is the NNW – SSE direction.

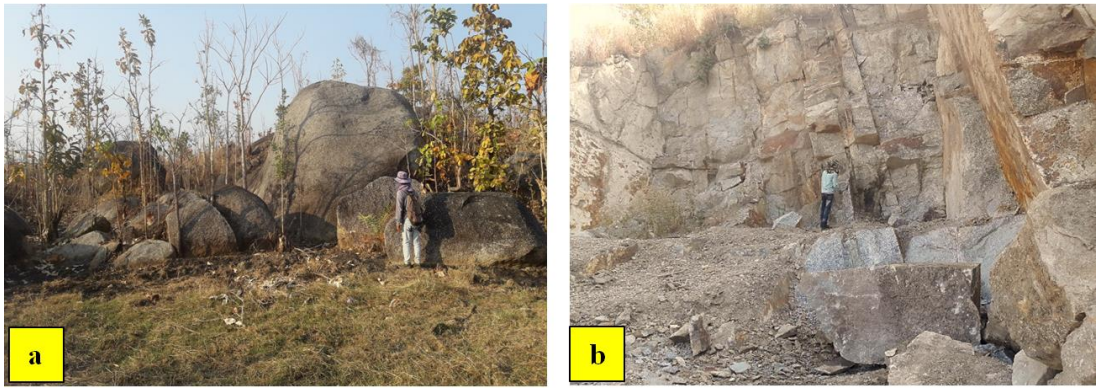


Figure. (2) (a) Large boulder of porphyritic biotite granite Facing 10°, Loc. 19°29'44.28"N 96°23'59.65"E (b) Well exposed and vertical jointed nature of porphyritic biotite granite Facing 102°, Loc. 19°30'2.02"N 96°25'13.96"E

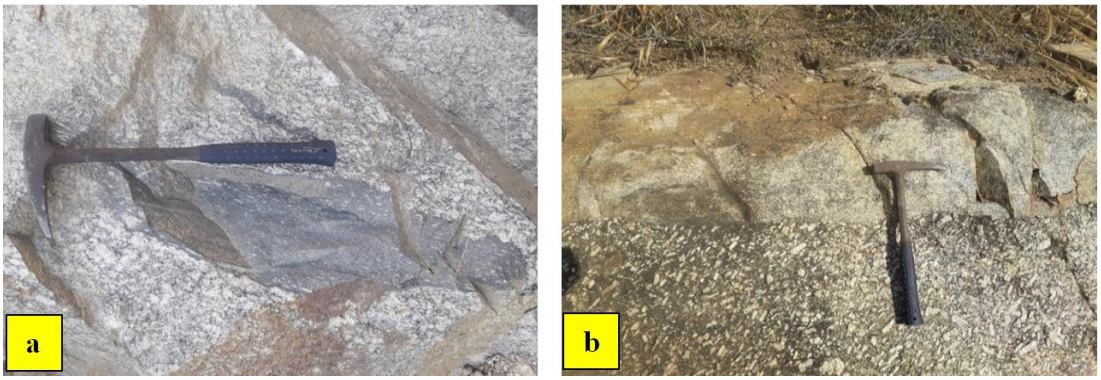


Figure (3) (a) Mafic mineral segregation in porphyritic biotite granite Facing 345°, Loc. 19°31'25.09"N96°25'22.83"E (b) Biotite granite intruded into porphyritic biotite granite Facing 70°, Loc.19°30'0.24"N, 96°25'41.80"E

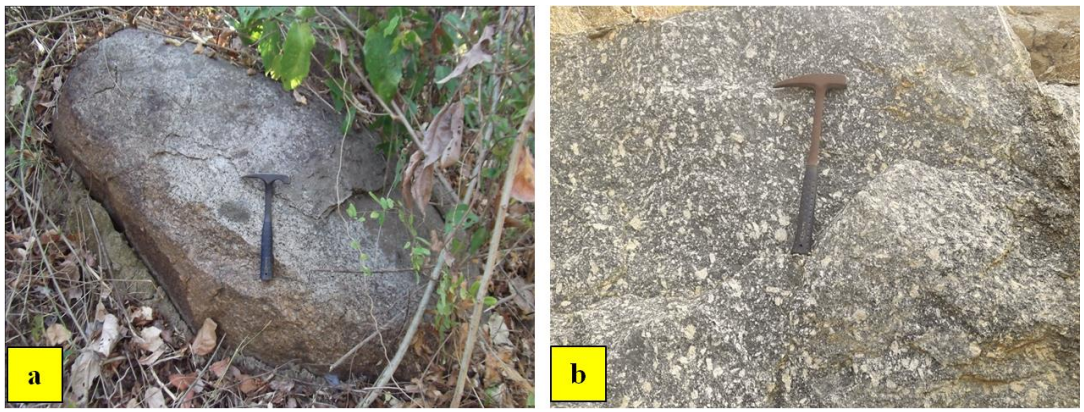


Figure (4) (a) Exfoliation nature on porphyritic biotite granite Facing 82°, Loc. 19°30'1.19"N 96°25'42.51"E (b) Randomly oriented nature of quartz and feldspar phenocrysts on porphyritic biotite granite exposure Facing 342°, Loc. 19°31'56.28"N 96°24'40.97E

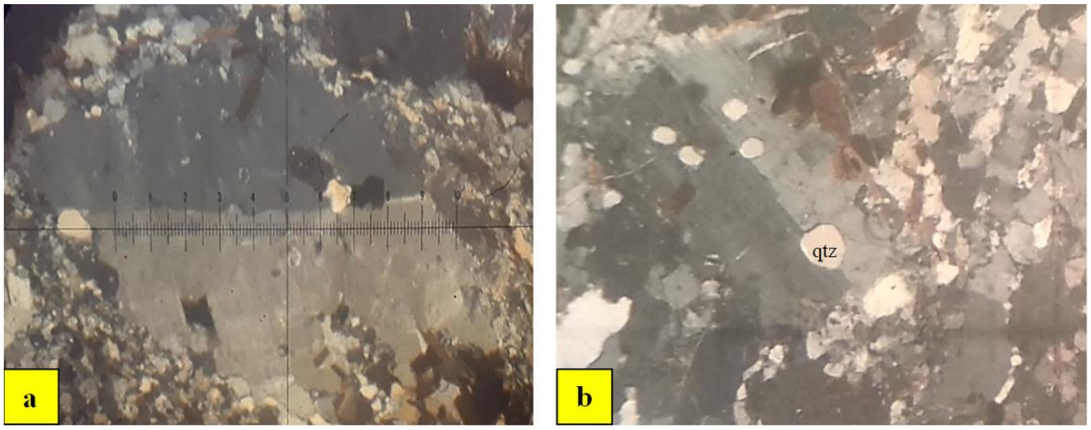


Figure (5) (a) Migrated margin and simple twinned of orthoclase feldspar in porphyritic biotite granite between XN, 4X (b) Inclusion quartz (qtz) in twinned orthoclase feldspar in porphyritic biotite granite between XN, 4X

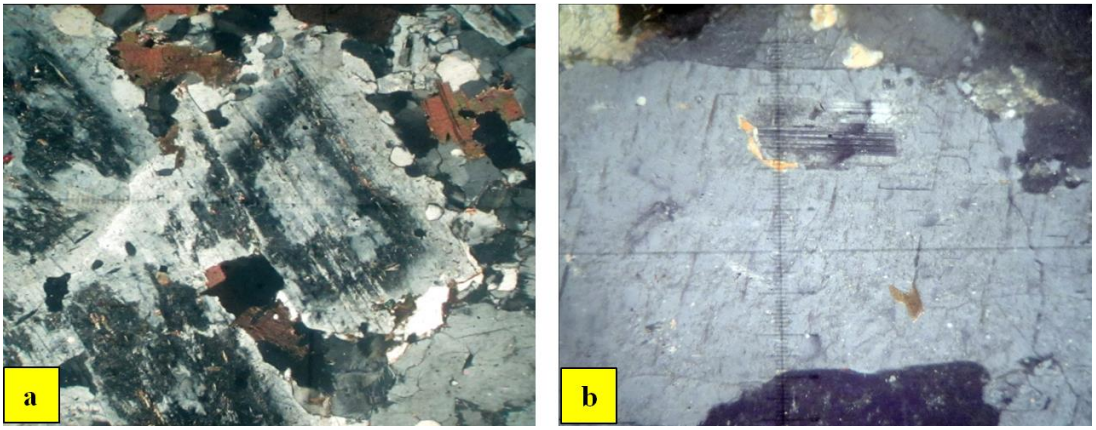


Figure (6) (a)Zoning of plagioclase in porphyritic biotite granite between XN, 4X (b) Plagioclase inclusion in alkalifeldspar in porphyritic biotite granite between XN, 4X

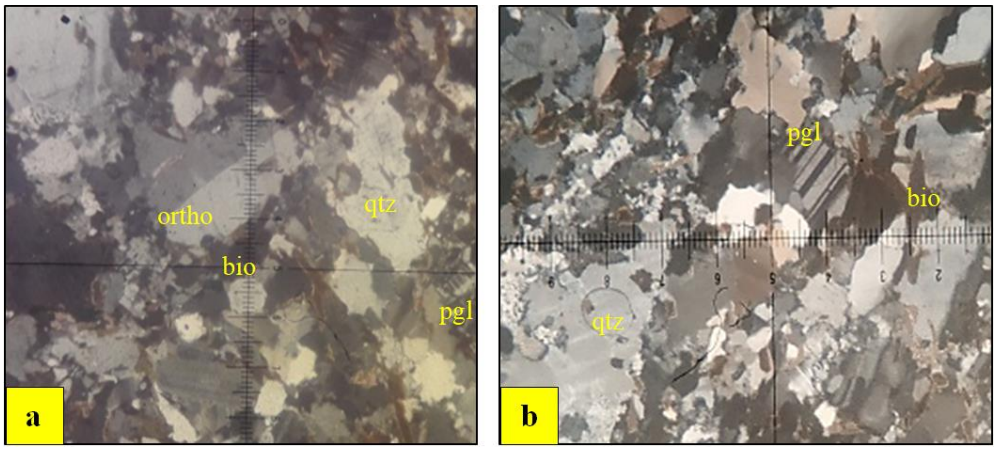


Figure (7) (a) Quartz (qtz), biotite (bio), alkalifeldspar (ortho) and plagioclase (pgl) minerals in porphritic biotite granite between XN, 4X (b) Quartz (qtz), biotite (bio) and plagioclase (pgl) feldspar in porphritic biotite granite between XN, 4X

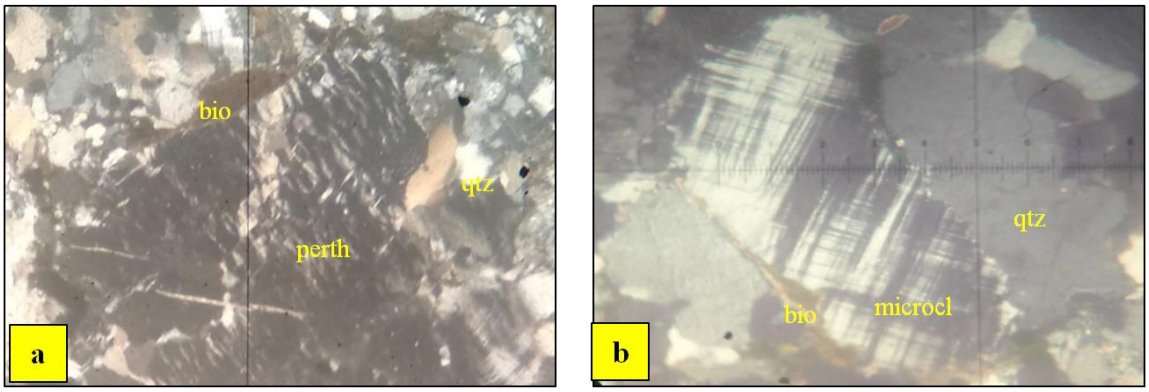


Figure (8) (a) String perthite, biotite and quartz in porphyritic biotite granite between XN,4X (b) Micorcline, biotite flake and quartz in porphyritic biotite granite between XN,4X

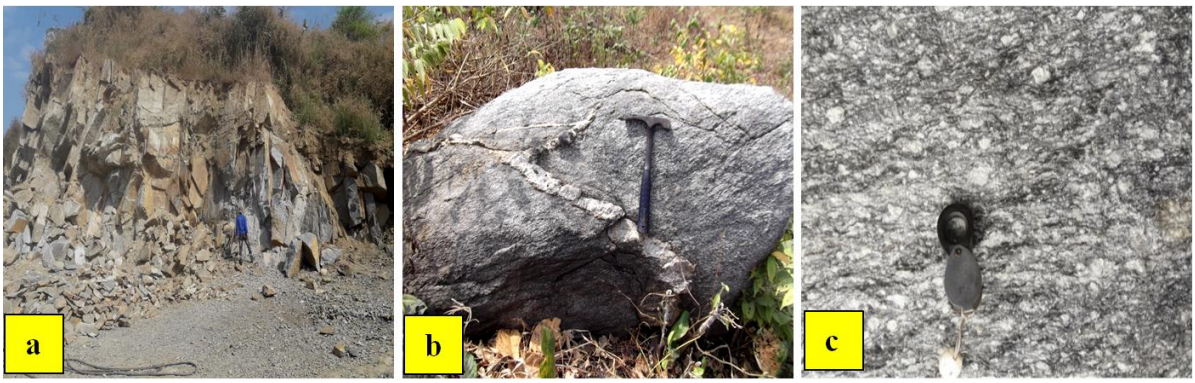


Figure (9) (a) Highly jointed nature of porphyritic gneissose granite (b) Quartzofeldspathic vein intruded into porphyritic biotite gneissose granite Facing.195°, Loc. 19°31'56.58"N 96°24'35.81"E (c) Augen structure in porphyritic gneissose granite Facing,42, loc. 19° 31.836'N, 96° 24.661'E

## Microscopic identification

In thin section study, it shows hypidiomorphic granular texture, porphyroblastic gneissose texture and augen structure. The mineral constituents for the most parts are similar to those of the porphyritic biotite granite, especially alkalifeldspar, quartz and plagioclase. Epidote, zircon and sphene are found as accessory minerals. Phenocrysts are bordered by alignment of finely biotite mica. The rock shows preferred orientation of the elongated quartz, feldspar and biotite minerals. Quartz shows anhedral coarse-grained and interlocking with each other. It occurs as both large and small interstices between larger grains (Fig.10-a). In addition, owing to stress, quartz occurs in two generations, mineral tends to show elongated character and marginal granulations are common. Most of them display undulosed extinction. Biotite flakes are curved and kink folding due to deformation. Orthoclase also occurred as simple twin (Fig.10-b). Plagioclases show subhedral grains and polysynthetic twining with narrow bands. Myrmekitization occurs between quartz and plagioclase (Fig.11-a). Perthites are found in this rock such as string perthite and microperthite. Minute groundmass grains are swirled around the larger phenocrysts (Fig.11-b).

**Gneissose granite**

**Megascopic study**

This unit is well exposed at the southern part of the study area and especially at the Thitkyein Mountain and 19° 29.905'N and 96° 24.869'E. It is the medium- to coarse- grained texture. The foliation shows the NNE-SSW direction (Fig. 12-b). Small quartz veins intruded into this unit (Fig. 12-a)

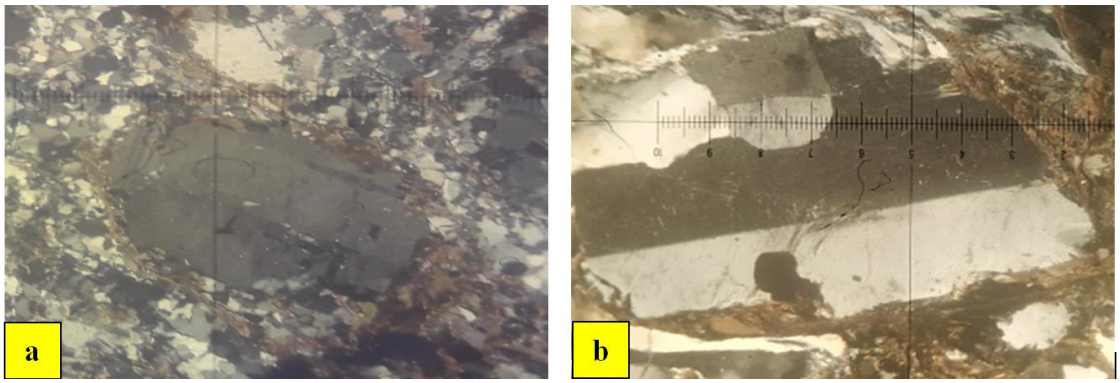


Fig (10) (a) Quartz phenocryst is surrounded by minute quartz and biotite grains in porphyritic gneissose granite between XN, 4X (b) Simple twinned orthoclase in porphyritic gneissose granite between XN, 4X

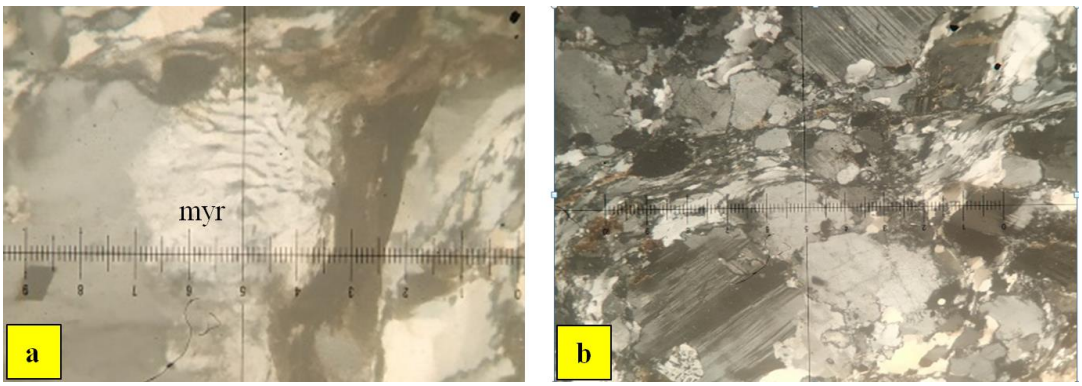


Fig (11) (a) Myrmekitic textures (myr) in porphyritic gneissose granite between XN, 4X (b) Marginal granulation of constituent grains in porphyritic gneissose granite between XN, 4X

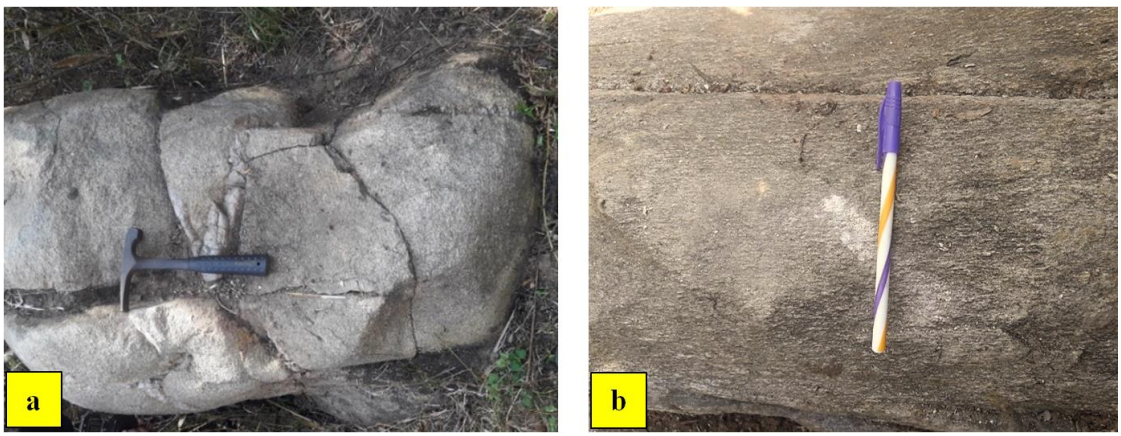


Fig (12) (a) Quartz vein intruded in gneissose granite Facing 93, loc. 19° 28.733'N, 96° 25.957'E (b) Parallel alignment of quartz and feldspar with biotite in gneissose granite Facing 101°, Loc. 19° 28.785'N, 96° 25.772'E

**Microscopic Identification**

In thin section, the rock shows coarse-grained holocrystalline texture. It is principally composed of quartz, alkalifeldspar, plagioclase with minor biotite and other accessory minerals are zircon, apatite, sphene and opaque minerals. Quartz is the most common constituent mineral and occurs both as anhedral and elongated grains. The finer grains occur as the interstices between earlier formed larger grains. It also occurs as inclusion in akalifeldspar and plagioclase. Irregular cracks frequently occur in quartz grains. The most common feldspars in this rock are orthoclase, perthite and microcline. String perthite is dominant in this unit (Fig.14-b). These feldspars show crushing and granulated margin. Orthoclase shows simple twin. Microcline appears as large subhedral grains as interstitials forms (Fig. 13-b). Plagioclase shows narrow twin band features (Fig.14-a). Biotite found as prismatic habit and also altered to chlorite along the cleavage planes. Cleavage planes are bent and foliation wrapped around quartz grain in this unit (Fig. 13-a).

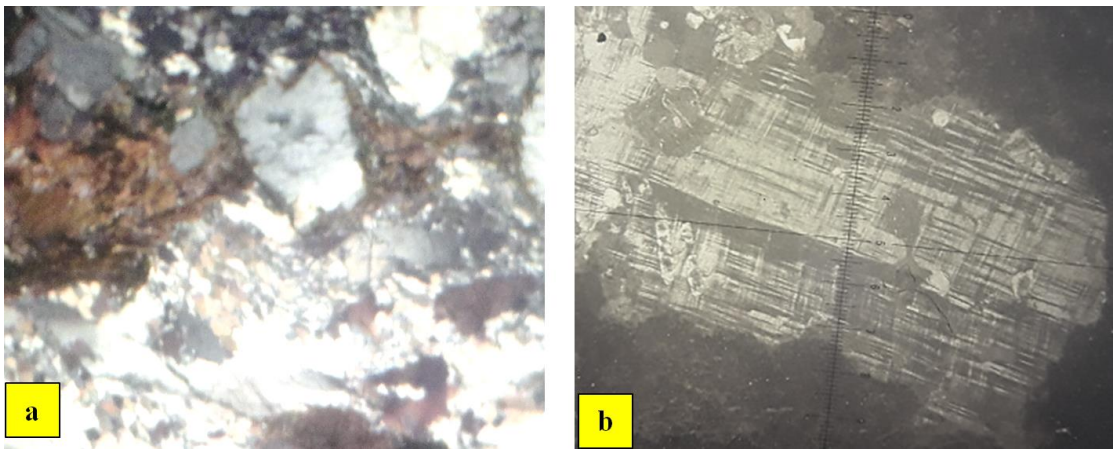


Fig (13) (a) Elongated and parallel alignment of bioitie (bio) flakes and anherdarl outline of quartz (qtz) in gneissose granite between XN, 4X (b) Microcline in gneissose granite between XN, 4X

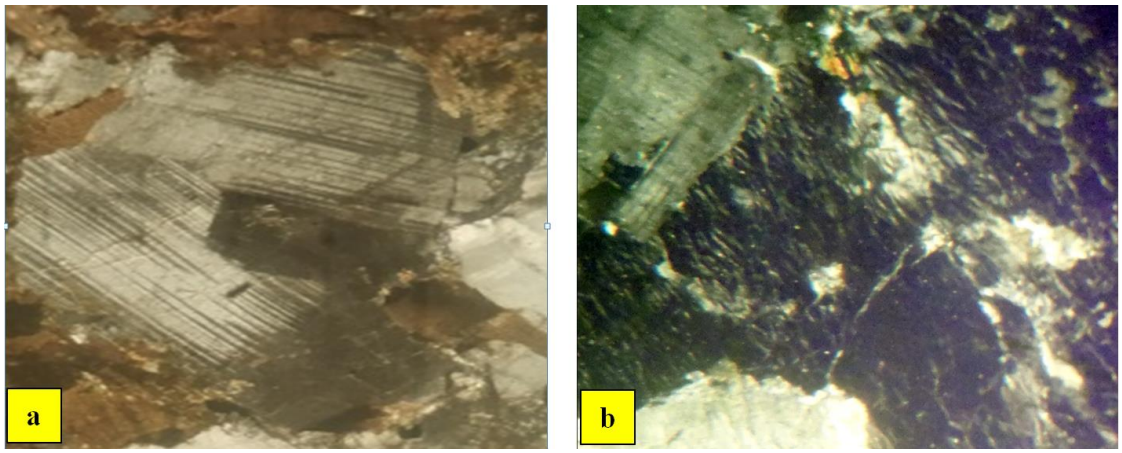


Fig (14) (a) Narrow twinned band of plagioclase (plag) in gneissose granite between XN, 4X (b) String perthite in gneissose granite between XN, 4X

## Banded Migmatite

### Megascopic study

This unit is contact with porphyritic biotite grantie and calc-silicate rock. The migmatite are found highly jointed natured and yellowish brown to buff color on weathered surface. The rock is hard and tends to split along the foliation plane. In this unit, the leucosome is composed of abundant quartzofeldspathic minerals and whereas the melasome is mainly biotite rich bands. Intruded by many parallel streaks of quartzofeldspathic minerals resulted a peculiar lit- par- lit structures and resulting layered or banded structures (Fig.15, 16, 17). The large exposures are found at the loc. 19° 31.606'N and 96° 25.723'E and 19° 30.905'N and 96° 26.133'E.

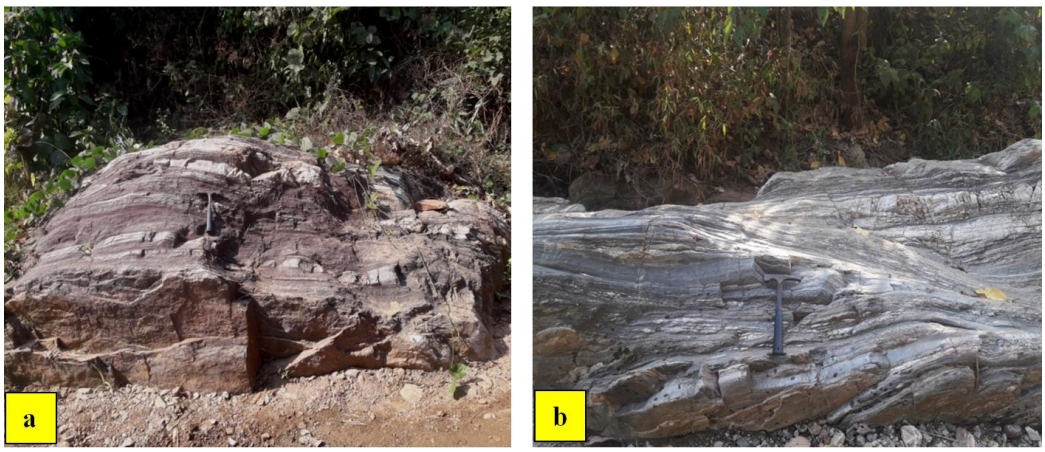


Fig (15) Stromatic (layered) structures of migmatite at Kyaukpya chaung (a) Facing. 57° 19° 30.881'N, 96° 26.406'E and (b) Facing. 36°. 19° 30.876'N, 96° 26.410'E

### Microscopic Identification

Under the microscope, it is composed orthoclase, plagioclase, quartz and biotite. Most of the minerals are altered to sericites. Biotite flakes are brown and elongated form and augen of recrystallized feldspar and quartz can be observed between the dark bands of biotite mica (Fig.18). Orthoclase occurs as porphyroblasts and surrounded by the granulation of quartz and biotite. Plagioclases are rare and show the polysynthetic twin. Quartz forms as elongated grains.

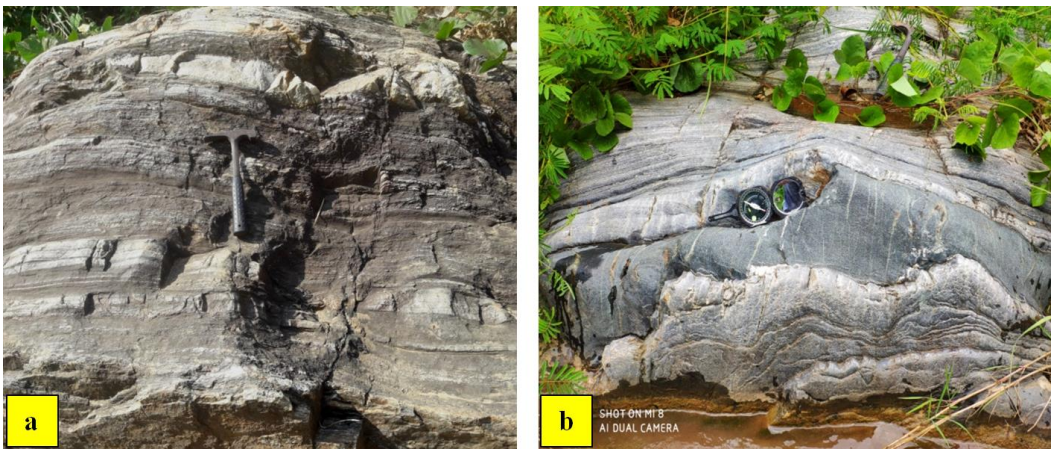


Fig (16) Discrete layer parallel quartzofeldspathic (leucocratic) regions are bordered by biotite rich melanosome. (a) Facing. 65°, 19° 30.881'N, 96° 26.400'E and (b) Facing.72°, 19° 30.881'N, 96° 26.406'E

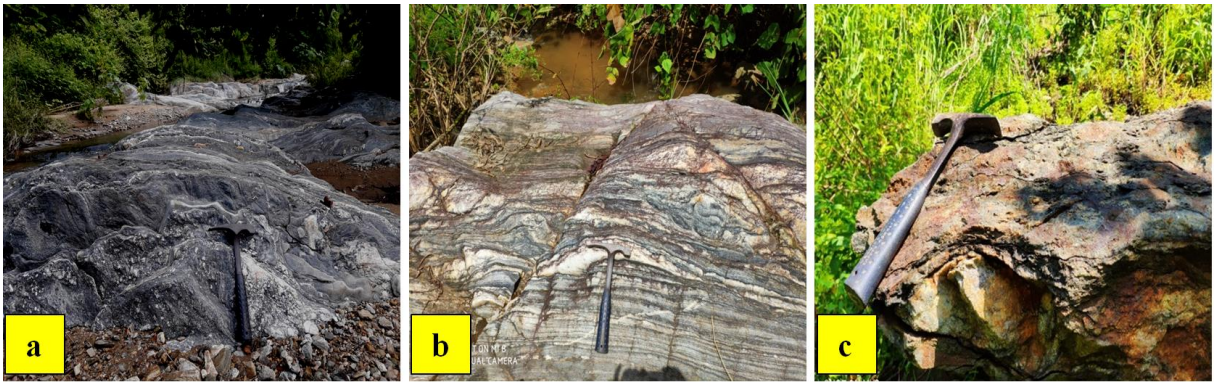


Fig (17) (a) Pegmatitic materials are disseminated in layered structures of migmatite, Facing 78°, Loc. 19° 30.910'N, 96° 26.466'E and (b) Banded leucosome with pinch and swell structures in magmatite, Facing. 96°, Loc. 19° 30.880'N, 96° 26.346'E (c) Ophthalmitic (augen) sturcutrue in migmatite Facing,56, Loc. 19° 31.554'N, 96° 25.633'E

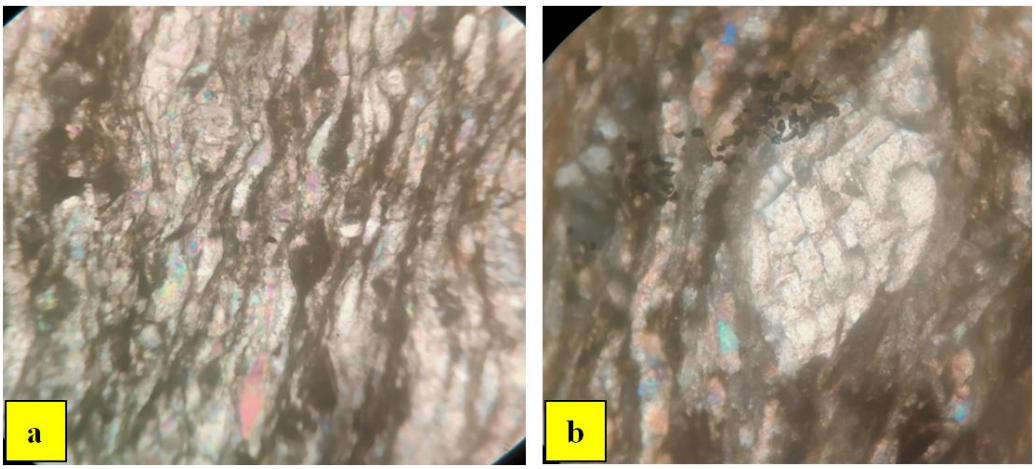


Fig (18) Photomicrograph showing (a) Alternating layer of quartzofeldspathic minerals and biotite rich band (b) Feldspar porphyroblast in biotite rich band in magmatite

## Petrochemistry

### Analytical Mehtods

Anaylsed samples and location of igneous of the study area are as shown in table (1). The major elements composition of the representative samples of igneous rocks from the study area are shown in table (2). These major oxide were used in the construction of bivariate and triangular series which were drawn by using GCD kit 3.1 software.

Table (1) Anaylsed samples and location of igneous rocks of the study area

| Sample No. | Symbols | Rock Name | Location |
|---|---|---|---|
| S-1 | ■ | Pophyritic biotite granite | 19° 32.430'N 96° 24.600'E |
| S-2 | ● | Pophyritic biotite granite | 19° 31.423'N 96° 25.051'E |
| S-3 | ▲ | Pophyritic biotite granite | 19° 30.444'N 96° 25.163'E |

Table (2) Major oxide (wt%) of the igneous rocks from the study area

| Sample No. | S-1 | S-2 | S-3 |
|---|---|---|---|
| $SiO_2$ | 69.67 | 71.04 | 73.78 |
| $TiO_2$ | 0.66 | 0.29 | 0.39 |
| $Fe_2O_3$ | 3.18 | 1.63 | 2.23 |
| $Al_2O_3$ | 17.56 | 19.92 | 15.55 |
| MnO | 0.08 | 0.05 | 0.06 |
| CaO | 2.95 | 1.74 | 2.07 |
| MgO | 0.00 | 0.00 | 0.00 |
| $Na_2O$ | 0.00 | 0.00 | 0.00 |
| $K_2O$ | 4.89 | 4.73 | 4.86 |
| Total | 98.99 | 99.40 | 98.94 |

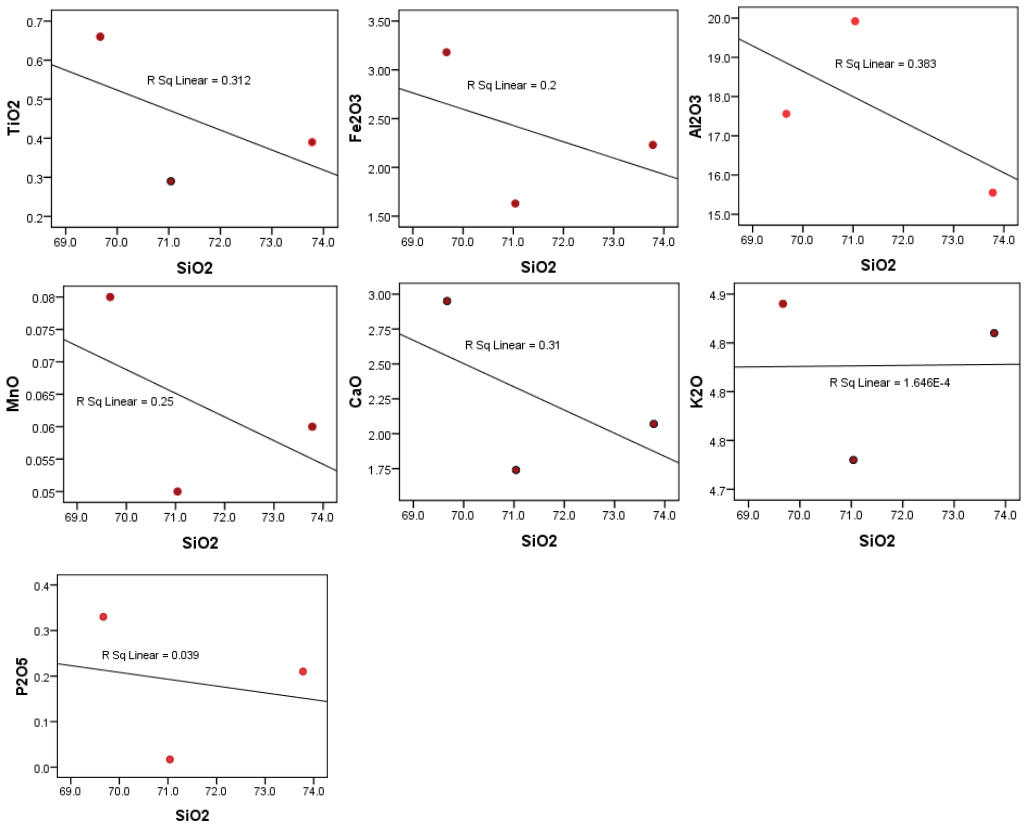


Fig (19) Harker's variation diagrams illustrating the correlation between $SiO_2$ and major oxides of the igneous rocks from the study area .Symblols as Table (2)

**Geochemical features of the granitic rocks of the study area**

The measured chemical data of the granitic rocks are fairly acceptable for petrochemical studies. Therefore detailed petrochemical studies of granitic rocks were made on the basis of their chemical characteristic distinctions by major element values. The igneous rocks in the study area are porphritic bioitie granite. Generally, major oxides content

of igneous rocks in the study area ranges from $SiO_2$ (69.67- 73.78%), $AL_20_3$ (19.92-15.55%), $TiO_2$ (0.66-0.29%), $Fe_2O_3$ (3.18-1.163%), MnO (0.08-0.05%), CaO (2.95-1.74%), $K_2O$ (4.89-4.73%) and $P_2O_5$ (0.21-0.017%).

In Harker's Major oxide variation diagram, major element oxides ($AL_20_3$, $TiO_2$, $Fe_2O_3$, MnO, CaO and $P_2O_5$) have negative correlation with $SiO_2$ but $K_2O$ have slightly positive (Fig. 19). TAS diagram of the granitic rocks of the study area fall in granite and granodiorite field (Middlemost, 1985) (Fig20-a). According to $K_2O$ vs $SiO_2$ diagram (Fig20-b), after Peccerillo and Taylor (1976), the two granitic rock samples fall within the high-K calcl-alkaline series whereas the other one sample straddle the boundary between high-K calc-alkaline series and shoshonite series.

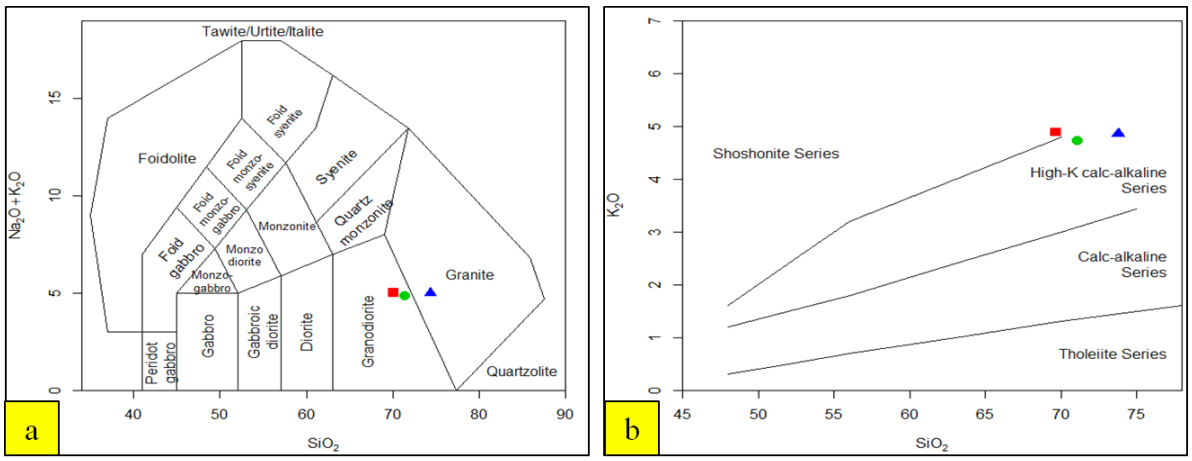


Fig (20) (a) TAS diagram of the granitic rock of the study area fall in granite and granodiorite field (Middlemost, 1985) (b) $K_2O$ and $SiO_2$, the dividing line chosen by Peccerillo and Taylor (1976). Symbol as in table (2)

## Summary and Conclusion

The granitic rocks are widely distributed and covering about two-third of the area. These rocks are mostly biotite bearing acid intrusive rock. They are mostly of coarse-grained with porphyritic texture. Microscopically, these rocks show typically porphyritic and generally hypidiomorphic texture. Essential minerals are quartz, alkalifeldspar and plagioclase and accessory minerals like biotite, sphene, zircon and apatite and some opaque minerals. Quartz, alkalifeldspar and plagioclase feldspar crystals for the most parts are occured as phenocrysts. Porphyritic gneissose granite shows peculiar porphyroblastic gneissose texture and augen structure. Phenocrysts are bordered by alignment of finely biotite mica. According to Harker′s variation diagrams, $K_2O$ shows a slight increase with increasing $SiO_2$. According to TAS diagrams, the granitic samples fall in granite field and granodiorite field. The granitic rocks from the study area are likely the result of fractional crystallization during magmatic evolution.

## Acknowledgements

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# A Study on Sandstone Diagenesis of Laungshe Formation near Thar Kaung Village, Gangaw Township, Magwe Region

Phyo Wai Lin[1] and Ni Ni Lwin[2]


## Abstract

The research area is located in the southwestern part of the Chindwin Basin. It lies between north lattitude 22° 15′ and 22° 30′ ; east longitude 94° 05′ and 94° 15′ , also fall in the topographic map no.84 J/3. The study formation, Laungshe Formation (early Eocene) is conformably underlain by Paunggyi Formation and overlain by Tilin Formation. The Laungshe Formation is mainly composed of thin bedded clay stones, siltstone and fine to medium grained compact sandstones underlying Tilin sandstone. Aung Khin and Kyaw Win (1964) used the named. Laungshe Formation as a formal lithostratigraphic unit. This formation is generally dipping eastward and good exposures are found along Mauk Chaung, Myittha Chaung, Kyauk Sin Chaung, Waba Chaung and Kawa Chaung. Normenclature of sandstones in Laungshe formation is made according to the classification of Pettijohn et.al. (Modified from Dott, 1964). The sandstone of the Laungshe Formation is composed of about 65% to 95% detrital grains and 5% to 35% chemical cements. Detrital components are generally moderately to well sorted, and subangular to subrounded. Sandstone of the Laungshe Formation are classified as feldspathic and lithic arenites. Diagenetic features observed in these sandstones are authigenesis, replacement and decementation. The progressive stages of diagenesis Laungshe sandstones are (i) early burial and compaction, (ii) precipitation of clay rims, (iii) precipitation of early calcite cement, (iv) precipitation of clay cements, (v) precipitation of zeolites cement, (vi) late calcite replacement of diagenetic phases and (vii) secondary porosity developments.


**Keywords:** Laungshe Formation, diagenesis, authigenesis, decementation, feldspathic and lithic arenites

## Introduction

The emphasized study of present area is located between north latitude 22° 15′ N to 22° 30′ N and east longitude 94° 05′ E to 94° 15′ E at about 11miles north of Gangaw,and is represented by 84-J/3 one inch topographic map. The location map of the Thar Kaung area is shown in figure (1). The study area can be accessible by car from Mandalay to Pakokku via Gangaw, and by train from Pakokku since Pakokku-Gangaw-Kalaymyo rail road was established. There is one mortorable road running north-south which connects Gangaw and Kalaymyo through some villages along Myittha river. Geologically, the study area is situated in South Western site of Chindwin Basin.

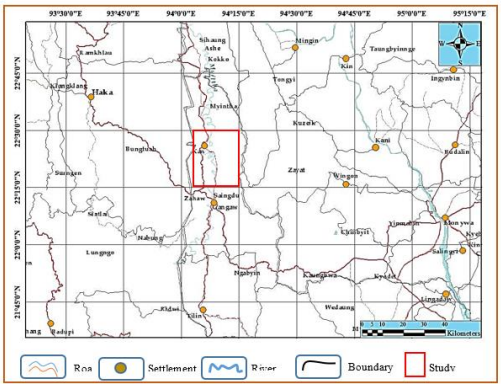


Figure (1) Location Map of the Thar Kaung Village, Gangaw Township

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## Regional Geologic Setting

The Wastern Ranges of the Gangaw-Kalay area comprise the Naga Hills in the North, the Chin Hills in the middle, and the Arakan Yoma in the South. They are underlain mostly by a thick sequence of flysch deposits which are locally deformed into chaotic tectonic style (Win Swe, 1972).

The present study area encompasses a small segment of the western marginal portion of the Central Belt, where Mesozoic and Tertiary rocks are exposed. The regional trend of the mountain run generally north-south, parallel to the strikes of the rock units, with slight variations in some places. The western part of this area is wholly made up of the Upper Triassic flysch which are faulted against and overlapped by the Mio-Pliocene strata of the Shwekondaing formation which crops out in a N. S belt.

The age of the flysch of the western ranges cannot be ascertained with certainly as the flysch is scarcely fossiliferous. Some workers, however, believe that the flysch is restricted only to Cretaceous and Eocene age (e.g Nyi Nyi 1964; Tanish, 1950). Brunnchweiller (1966), on the other hand, regarded the older fossils as reworked from the older formations and concluded that the bulk of the flysch is not older than Eocene, the age of the youngest fossils it contains.

Brunnchweiller (1966) believe the boundary to be a regional over thrust fault which carried rocks from the central belt over those of the western ranges. Kyaw Win (1969), Win Shwe and others accepted the over thrust hypothesis for the southern and northern Chin Hills respectively. So, there is a stand still controversy of major structural features between the two different assumption.

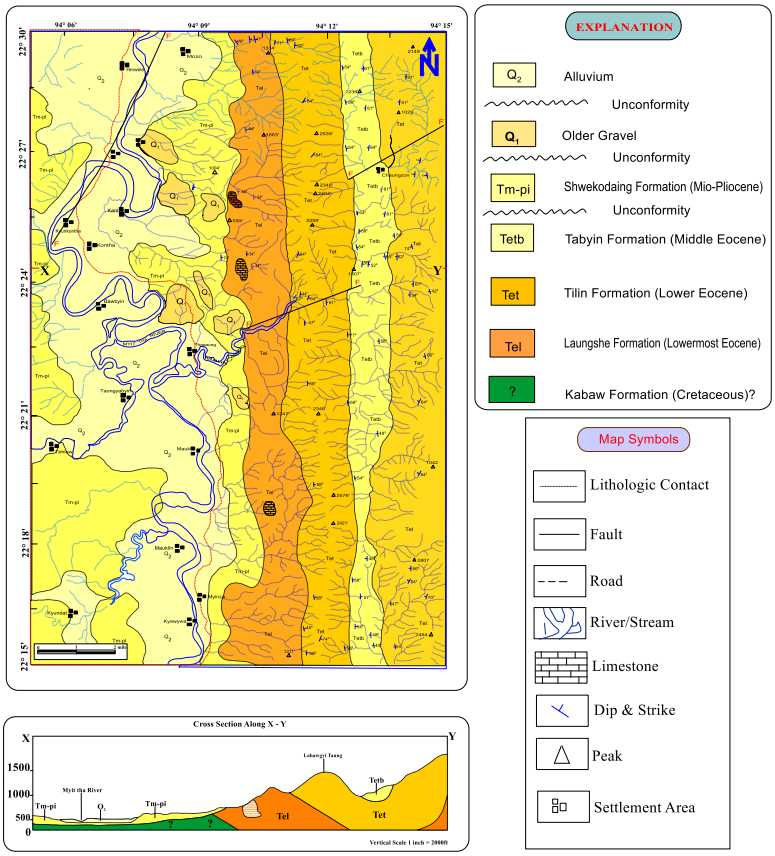


Figure (2) Geological map of the Myinza-Hmwele Area, Gangaw Township, Magwe Region (modified from Tun Aung, 1974)

## Petrography

### Introduction

Petrographic study of sandstone is widely used to determine the detail framework composition of the sandstone and the physical, chemical and biological changes of the sandstones during diagenesis. In present work sandstone samples are systematically collected from Laungshe Formation for petrographic studies. The Laungshe Formation is mainly composed of shale with sandstone intercalation. Sandstone composition of Laungshe Formation is influenced by tectonic setting, lithology of the source rock, intensity of weathering and erosion of the source rock, transportation processes, and depositional environment within the sedimentary basin. This petrographic study will give more precise information on the occurrence and amount of authigenic mineral assemblages in sandstones of a given burial history.

### Method of Study

Suitable sandstone samples collected during field works are cut into thin sections and studied under a polarizing microscope. The visual estimation of component grains made to obtain model composition and the petrographic classification. The widely used samples classification of sandstone, after Pettijohn et.al, (1987); (modified from Dotts, 1964) is used.

Categories used in classification for modal analyses are as follows;

A. Quartz (Qt = Qm + Qp)

Qt = total quartz grains

Qm = monocrystalline quartz (wavy and non-wavy extinction)

Qp = polycrystalline quartz (crenulated and sutured intercrystalline boundaries)

B. Feldspar (F = P+K)

F = total feldspar

P = plagioclase feldspar

K = Potassium feldspar (orthoclase, microcline and perthite)

C. Lithic fragments (Lt = Qp+Lvm+Lsm)

Lt = total lithic fragments (L+Qp)

L = total unstable lithic fragments (Lvm+Lsm)

Lv/Lvm = volcanic/metavolcanic lithic fragments

Ls/Lsm = sedimentary/metasedimentary lithic fragments

### Laungshe Formation

The sandstones of Laungshe Formation are composed of about 65 to 95% detrital grains and 5 to 35% chemical cements. Detrital grains in these sandstones are generally moderately to well sorted and angular, subangular to subrounded. The diameter of detrital grains ranges from 0.5mm to 0.25mm.

### Quartz

Detrital quartz grains comprise about 45% of total volume of the rocks. Most are monocrystalline quartz grains which form subangular to subrounded. Most of the monocrystalline quartz grain possess unit extinction where the whole crystal is extinguished

uniformly under crossed polars. Some of the grains show undulose extinction, where extinction is not uniform but sweets across the crystal as it is rotated from 5 to 15. Undulose extinction usually is a reflection of strain in crystal lattice (Fig-4A). Some crystals incorporate mineral inclusions (Fig-4C). Composite or polycrystalline quartz grains are also found in these sandstones.

The composite nature of the grains are clear only in the view taken with polar crossed (Fig-4B). Semicomposite quartz grains with slightly undulose extinction are frequently observed. Each grain consists of a number of separate quartz crystals. Such grains are common in hydrothermal veins but also occur in many other metamorphic and plutonic rocks (Scholle, 1979). When the crystals boundaries are sutured, this is a characteristic of quartz from a metamorphic source (Scholle, 1979). Composite quartz from igneous sources has straighter crystal boundaries. Some quartz grains are irregularly fractured (Scholle, 1979).

**Feldspar**

Feldspar occupy about 20% of total detrital population. They are generally fresh and some are moderately weathered. Most of them show angular, subangular to subrounded, and subequant to elongated shape. Alkali feldspar are more common than calcic plagioclase, due to the partly more resistant to chemical weathering, and partly because the ultimate source of many terrigenous rocks is granite or gneiss, in which the feldspars are mainly the alkali variety. Of alkali feldspar, Microclines (Fig-4D) show the cross-hatched twinning which it, invariably displays. Orthoclase crystals usually break along the twin planes so that the sample Carlsbad twinning is rarely seen. Orthoclase often look like quartz and can be recognized by its dusty and partly altered appearance, especially relative to very clear and clean looking quartz grains. Plagioclase can be identified by its polysynthetic, multiple twinning. Feldspars with overgrowth are found (Fig-4D).

**Rock fragment**

There are varieties of lithic fragments such as chert, volcanic rock fragments, and metamorphic rock fragments, which occupy about 23% of total detrital framework. Some metamorphic fragment formed elongated grains (Fig-4E) which are classified as slate fragment or very low grade MRF. Some fragments contain small laths of plagioclase feldspar and a very fine crystalline matrix, most of which are derived from basic, island are volcanic source areas (Scholle, 1979). The small feldspar crystals are the main features used to distinguish these grains from chert or clay fragments. Composite or polycrystalline quartz of high grade metamorphic sources is common (Fig-4B).

Other than chert, the lithic fragments are relatively uncommon because they usually break down fairly easily into their component grains. Some large sandstone samples in which the component particles are all quartz, are clearly distinguishable even with PPL. This contains with the composite quartz grains of igneous and metamorphic source, where individual crystals are not visible in PPL. Cherts are relatively abundant types of rock fragments since chert is stable and resistant to weathering. They are angular, subangular to subrounded and range in grain size from 0.20mm to 0.50mm and coated by ion cements.

**Mica**

Very little mica cintent is observed. Muscovite is less common than biotite. Biotite flakes are bent and contorted due to effect of compaction (Fig-4F).

### Accessory minerals

Identifiable accessory minerals such as hematite, chlorite, serpentinite, glauconite, and hornblende are present, ranging from 0.2 to 0.3mm in size. Most of them are generally subangular to subrounded, subhedral to anhedral grains.

### Cement

The detrital grains are generally cemented by calcite. Cementation is the principle process leading to porosity reduction in sandstone. The most common in the Laungshe sandstone are calcite, iron oxide and silica cements. Calcite cement shows high order interference colour in the cross-nicol. Sometime, the introduction of calcite cement, following partial replacement of quartz grains or additions of quartz overgrowth is found. Boundaries between overgrowth and carbonate indicate that the carbonate was deposited later than overgrowth. Iron oxide cement, mainly hematite is present as thin coating on detrital grains. Silica cements are generally replaced by calcite cement after deposition. In some cases, this cement surrounds the silicate minerals such as quartz and feldspar.

### Nomenclature

According to the sandstone classification of Pettijohn et.al, (modified from Dott, 1964), Laungshe sandstones are dominantly feldspathic and lithic arenites.

## Diagenesis of Laungshe Sandstone

### Introduction

Diagenesis is used to include all those processes which turn a fresh sediment into stable rock of some hardness, under conditions of pressure and temperature (Sujkowski, 1958). The time limits are the movement of deposition of a new sedimentary layer at the one end and the one set of metamorphism at the other. The later limit, of course cannot be determined in precise terms of pressure or temperature involved, and only to some degrees by characteristic changes in mineral composition. Diagenesis, after all, is but the introduction to metamorphism. On the other hand, there is no sharp boundary between diagenesis and weathering (Sujkowski, 1958).

Sandstone diagenesis in the Eocene unit is important for several reasons;

1. The early Eocene sandstones of the Laungshe Formations comprise one detrital mineral essembledge but still cover a wide range of depositional facies. Thus diagenetic features can be evaluated as a function of established depositional facies.
2. Diagenesis can be related to the sedimentologic and tectonic basinal setting.
3. The resulting diagenetic phases are partly controlled by the original sandstone mineralogies (Hayes, 1979).
4. Secondary porosity (Hayes 1979; Schmidt and Mc Donald, 1979) is present in the Eocene rocks. These features can be related to some events in the basin history.

Shortly, we want to be able to do two things related to the historical geology of sandstones with an understanding of diagenesis; (1) to "Look through" obscuring diagenetic features to better judge the provenance and environment of deposition of the original sand; (2) to use the evidences of diagenesis to reconstruct a coherent post depositional geologic history (Pettijohn et. al, 1972).

**Diagenetic features, Laungshe Sandstone, Authigenic Cements**

**(a) Quartz**

Authigenic quartz occurs in minor amounts. In rare case, they are found as syntaxial overgrowth.

**(b) Calcite**

Calcite cement is the most volumetrically significant authigenic constituent in these sandstones. The occurrence of cement varies from an even to patchy distribution to local segregation. Poikilotopic crystals, replacement of quartz and feldspar grains by calcite is common. Some replacement can be traced by outline of original quartz and feldspar grains, prior to replacement. Dissolution of calcite cement at large stage of diagenesis is also observed (Fig-5A). In some section of high percentage of calcite cement and apparent loose packing of the framework grains suggests calcite cementation occurred very easily in the burial history.

**(c) Phyllosilicates**

Clays play a significant role in cementation and porosity-permeability modification. Clays occur in several different modes in these sandstones. Detrital clay occurs as dispersed among the framework grains. Authigenic phyllosilicates occur as clay coats surrounding the framework quartz grains. Distinction of clay coats and clay rims can be made on the basis of the clay crystal's orientation to its substrate (Wescott, 1983). It is difficult to make optically and the general term "clay coats" is used here. The precipitation of clay coats usually is an early or the first diagenetic event, often predating quartz overgrowth or calcite cement. Clay coat may inhibit the formation of quartz overgrowths (Pittman, 1972). When clay coat completely cover detrital grains. There are no nucleation sites for quartz overgrowth and some porosity is maintained. Chlorite occurs as microscopic crystals radiating into pore spaces (Fig-5B). It may occur as detrital flakes, usually derived from low grade metamorphic rocks, as an alteration product or as an authigenic mineral. Kaolinite occurs in some pores possibly as a result of alteration of feldspar.

A very small amount of glauconite is present. As they show no evidence of being worn in transport, it is considered to be authigenic. Some glauconite grains are coated by thin iron oxide or clay layer. It occurs in samples with a greater amount of biotite. They may be the product from alteration of the biotite as suggested by Galliher (1935, Fig-5E).

**(d) Feldspar**

Feldspar cement is rare in these sandstones.

**(e) Iron Oxide**

Iron oxide form volumetrically minor amounts of cement in these sandstones. They are associated with clayey or matrix rich zones. The smectite-illite transformation would yield Fe+2 that could be used for sandstone cementation. The cement may also be related to the oxidation of pyrite formed during the decay of organic materials in the clay laminae or bioturbated zones (Westcott, 1983). Intrastratal dissolution of unstable detrital ferromagnesium minerals is an important source of diagenetic iron oxides (Scholle, 1979).

**(f) Zeolite**

Zeolite species, especially laumonites are common in these sandstones (Fig-5C). They are derived from alteration of volcanic clasts.

**Replacement**

Replacement is one-for-one solution of one mineral and precipitation of another in its place. These reactions occur when pore fluid are not in equilibrium with the rock forming minerals, and they can occur at various times during the diagenetic history of sandstone. The most common reactions involve the replacement of silicate minerals by carbonate.

**(a) Calcite Replacement of Clay**

In some thin section, the calcite has replaced the clay fraction in the sense that the clay is no longer present as in insoluble residue in the carbonate. In other examples, some of the clay remains as a residue within the calcite (Fig-5D). Replacement of clay minerals by calcite is favoured by a pH = 8 and a high concentration of Ca-ion under which conditions certain clay minerals become unstable (Dapples, 1967).

**(b) Calcite Replacement of Quartz**

Dissolution process plays a major role in replacement of one mineral by another. In this process, the grains (and cements) have to be in contact with each other to continue to support the rock without collapse. At this interval, all dissolution of the replacement and precipitation of the replacing mineral take place in an exceedingly thin film between the bounding surfaces of the two phases (Fig-3).

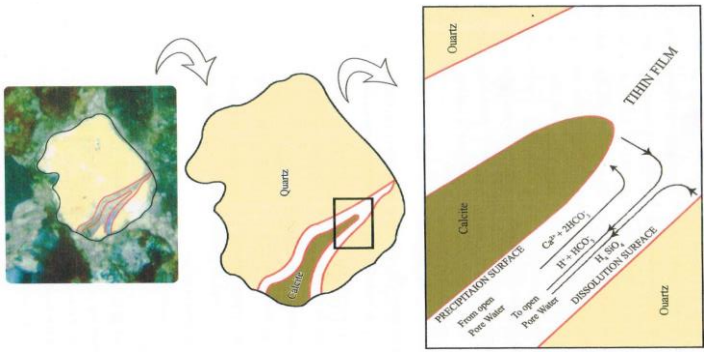


Figure (3) Chemical transport in thin film at a front of replacement of quartz by calcite. In set shows details of process (modified from Pettijohn, et.al. 1972).

Such a film is at least, as thin as 0.1mm and probably of the order of microns so that surface tension gives it enough strength to be mechanically supported according to Pettijohn, et.al 1972. The transport processes within this film must be adequate to move the dissolved material out and the precipitating material from the open pore water reservoir (Pettijohn, et.al 1972). A typical case of calcite replacing detrital quartz take place in following sequence of reactions.

1. $SiO_4$ tetrahedra dissolve from a quartz surface and hydrate to become H4SiO4 molecules in solution.
2. The concentration of H4SiO4 being higher in the thin film than in pore fluid (necessary for dissolution to proceed), the H4SiO4 diffuse out into pores.
3. The concentration of Ca2+ and HCO3 being higher in pore fluid than in thin film, the two kinds of ions diffuse into the water.
4. The ion activity product of Ca2+ and HCO3 exceeding the solubility product of calcite at the calcite surface, CaCO3 precipitates according to the equation.

$Ca_2$+ +2$HCO_3$ = $CaCO_3$+H+$HCO_3$ and to maintain the concentration gradient that power the diffusion, H+ must diffuse out of the film into the pore spaces.

**Decementation**

Another feature of diagenesis, decementation are observed in these sandstones. According to Chepikov et.al, 1961, just as the name implies, this process is one by which a former precipitate, such as a pore filling calcite cement that had partially replaced detrital grains, dissolves leaving behind its diagnostic relict texture of corroded grains and remnant of the pore space filling (Fig-5A). The observation of this evidence lead directly to the interpretation of a reversal from precipitation to dissolution that required some geological change which made the composition of the pore fluid change from supersaturated to undersaturated condition. Such change may come about by uplift of sandstone from a deeply buried position in which the pore water was slightly supersaturated or saturated brine to a new position close to the surface where it may be invaded by undersaturated surface water of meteoric derivation Chepikov *et.al* (1961).

**Secondary Porosity**

Since secondary porosity was first recognized by Nutting (1934, Ref. cited in Shamugam, 1983), numerous studies have dealt with the concept of porosity enhancement in sandstones by fracturing and dissolution. Chepikov et.al, (1961) stated the criteria for recongnizing secondary porosity in sandstones which include (1) corroded grains, (2) adjacent porous and less porous zones, (3) sinuous pores, (4) remnant cement, and (5) inhomogeneity of packing. The identifiable types of secondary porosity in the Laungshe sandstones are (1) corroded grains (Fig-6A), (4) remnant cement.

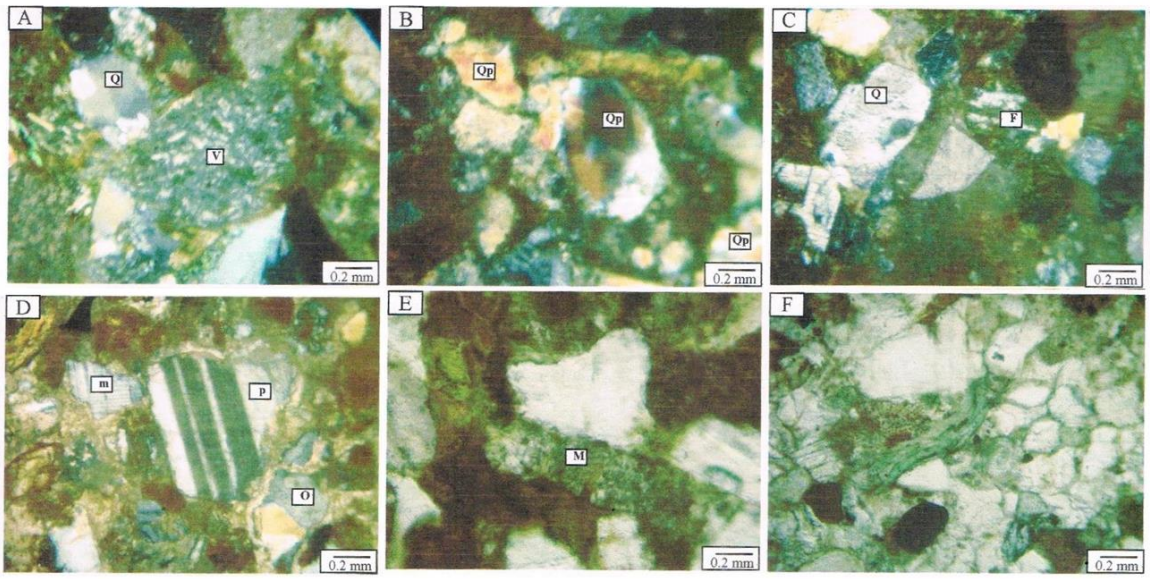


**Figure (4)** Thin section photomicrographs of sandstones from Laungshe formation. **A)** a single crystal quartz grain (Q) with strongly undulose extinction. Grain extinguishes completely with more than 5 degrees of stage rotation (XN); volcanic rock fragments (v) with small laths of plagioclase feldspar and a very finely crystalline matrix. **B)** Polycrystalline and semi composite quartz grains (QP). The grain in the center of the view shows slightly undulose extinction (XN). **C)** Mineral inclusion in a quartz grain (Q). Plagioclase feldspar with polysynthetic twining (F) (XN). **D)** Microcline (m) with faint cross-hatched twining, plagioclase (P) and orthoclase feldspar (O) with cloudy appearance in PPL, simple Carlsbad twin in XN. Some of the feldspar grains have authigenic overgrowths. **E)** Elongate slate or very low grade metamorphic fragment (M), PPL. **F)** Bent and contorted biotite flake due to effect of compaction (PPL).

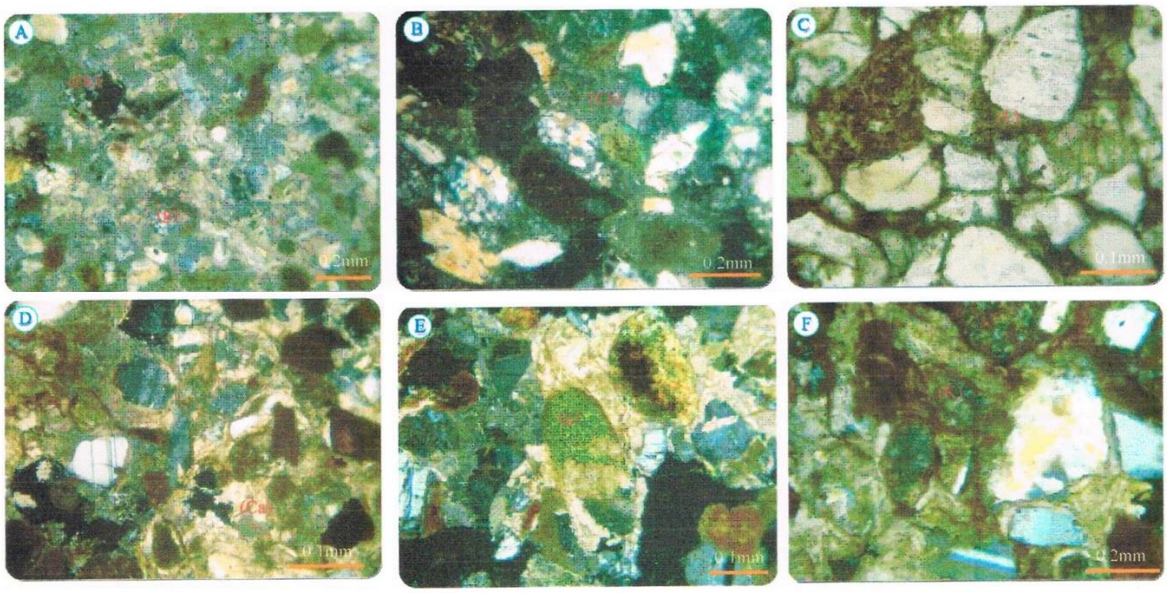


**Figure (5)** Photomicrograph showing diagenetic features in Laungshe Formation. A) Calcite replacement grain can be traced by original grain boundary. Replaced calcite is later dissolved and decemented forming secondary porosity (Dc)- dissolution of other labile grains (g) is also noted. B) Chlorite (Ch) in the pore space. It may occur as detrital flakes and alteration product of volcanic rock fragment. It shows anomalous bluish grey colour and green colour in XN. C) Laumontite (L), a zeolite species, alteration product of volcanic rock fragment. D) Calcite cement partially replace the clay matrix (Ca) dissolution of calcite are observed at the later stages. E) Authigenic glauconitic aggregate (g). F) Kaolinite (K) as an authigenic pore filling cement worm-like structure suggests in situ formation. Complete late stage calcite cement (C) and replacement, with preservation of rim-like textures.

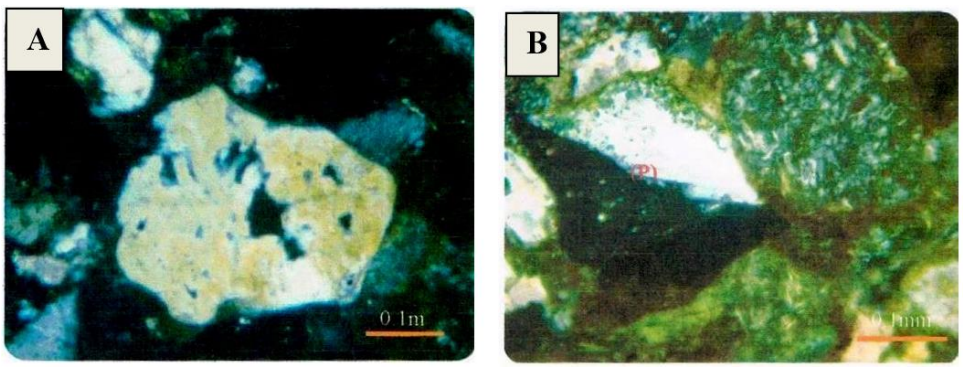


**Figure (6)** Photomicrograph showing secondary porosity of Laungshe Formation. A) Corroded grains forming secondary porosity. B) Moldic porosity (P) sheltered by quartz grain.

## Diagenetic Sequence of Laungshe Sandstones

The Laungshe sandstones experienced porosity reduction by mechanical compaction and cementation. Some detrital grains have clay coats or clay rim. The precipitation of clay rims usually is an early or the first diagenetic event, often predating quartz overgrowths or calcite cementation. Some calcite cement preserved opened framework textures prior to extensive burial and subsequent compaction. Mechanical compaction features are evidenced by abundance of squashed rock fragments or pseudomatrix (Dickinson, 1970) and by plastic

deformation of altered and unaltered labile detrital grains (e.g. Micas, sedimentary rock fragment, volcanic rock fragment).

For clay mineral authigenesis, acidic pore fluid is required for kaolinite, together with low $K^+$. This condition can be produced by flushing of sandstone by fresh water during uplift after burial phase, or during an early burial stage.

Chlorite precipitates from more alkaline pore fluids containing little $K^+$ but sufficient $Mg^{2+}$. Chlorite generally is precipitated at higher temperature (Tucker, 2001).

Zeolite cement and/or replacements are common in many samples. These rocks Ca- and Na-rich mineralogy and presumably have been buried at slightly greater depths (1-2km or more) to produce condition suitable for zeolite formation.

Secondary or enhanced porosity is commonly recognized by dissolution and other features. These features are described by Chepikov *et.al* (1961).

The progressive stages of diagenesis in the Laungshe sandstone can be summarized as the following sequence of events based largely on microscopic observations.

1. Early burial and compaction causing destruction of primary porosity and formation of pseudomatrix;
2. Precipitation of clay rim;
3. Precipitation early calcite cement;
4. Precipitation of clay cement (Chlorite);
5. Precipitation of zeolite cements;
6. Late calcite replacement of the diagenetic phases;
7. Secondary porosity developments.

## Summary and Conclusions

The study area is situated in a small segment of the southwestern marginal portion of the Chindwin Basin, Central Cenozoic Belt. In this region, the western ranges comprise the Naga Hills in the north, the Chin Hill in the middle, and the Arakan Yoma in the south. The present study emphasizes mainly on the diagenesis of Laungshe sandstone (late Eocene).

Laungshe Formation is mainly composed of thin bedded clay stones, siltstone and fine to medium grained compact sandstones underlying Tilin sandstone. Aung Khin and Kyaw Win (1964) used the named. Laungshe Formation as a formal lithostratigraphic unit. This formation is generally dipping eastward and good exposures are found along Mauk Chaung, Myittha Chaung, Kyauk Sin Chaung, Waba Chaung and Kawa Chaung.

Nomenclature of sandstones in Laungshe Formation is made according to the classification of Pettijohn *et.al.* (Modified from Dott, 1964). The sandstone of the Laungshe Formation is composed of about 65% to 95% detrital grains and 5% to 35% chemical cements. Detrital components are generally moderately to well sorted, and subangular to subrounded. Sandstone of the Laungshe Formation are classified as feldspathic and lithic arenites.

Diagenetic features observed in these sandstones are authigenesis, replacement and decementation. The progressive stages of diagenesis Laungshe sandstones are (i) early burial and compaction, (ii) precipitation of clay rims, (iii) precipitation of early calcite cement, (iv) precipitation of clay cements, (v) precipitation of zeolites cement, (vi) late calcite replacement of diagenetic phases and (vii) secondary porosity developments.

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Firstly, we would like to thankful to Dr Ni Ni Oo (Rector) and Dr Win Win Than (Pro-Rector), Myeik University for allowing to do this research. Secondly, we wish to my sincere gratitude to Dr Soe Moe Lwin, Professor and Head of Geology Department, Myeik University, and Dr Win Min Oo, Professor of Geology Department, Myeik University, for their advice, discussion and giving opportunity to do this research work.

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# Socio-economic Determinants on Marine Resources Exploitation of Coastal Fishing Communities in Bok Pyin, Tanintharyi Region

Zin Lin Khine[1], Si Thu Hein[2], Pann Mo Mo[3], and Nyo Nyo Tun[4]

## Abstract

A socio-economic assessment was conducted Sa Tein Fishing Village, Bok Pyin from October 2018 to March 2019. The primary occupations of the household heads included fishing, shrimp fishing, crab fishing, crab buying center, bag net fishery, dried fish processing, shrimps and squids processing, and fish paste processing. Most of the household heads were fishermen and others as livestock farmers, agriculture (betel nut), shopkeepers, and so on. Fishermen caught fish by drift nets, hook lines, and bag nets in pelagic and inshore fishery, shrimps by trammel nets, crabs by traps, and bivalves by gleaning. As the awareness of fishermen in fishery law was high, they did not use illegal fishing techniques in their fishing activities. Fishermen faced social and economic challenges due to declining marine resources and increasing fishing pressures (overfishing) in the fishing communities of Bok Pyin and Sa Tein Village. As most fishermen were willing to maintain and preserve marine resources in these fishing communities, Community-based Fishery Management (CBFM) would be able to establish in this area.

**Key words:** Bok Pyin, fishermen, households, Sa Tein Fishing Village, socio-economic.

## Introduction

Bok Pyin is positioned between Myeik and Kawthaung throughout the lower part of the Tanintharyi region and expresses a land frontier with Thailand. These features are remote and rural, and fishing, agriculture, farming, and lead mining are the main economic activities. Most people are fishermen in Sa Tein Fishing Village inside the border of Bok Pyin. As fishing is a major career that generates earnings, most people are depending on marine resources for their livelihoods in fishing communities of Bok Pyin.

Socioeconomic status refers to information on a variety of fishing community factors such as demographics, jobs, fishing boats, fishing equipment, and lifestyle products, etc. Socioeconomic assessment report provides information for the social, cultural, economic status, and conservation stages in fishing communities. Managers of coastal fisheries required socio-economic data to identify potential problems and focus priorities in fishing villages (Kronen, *et al.* 2007). The objectives of the present study in Bok Pyin were to investigate the socio-economic framework, to determine the households' livelihood strategies and marine resource use, and to evaluate the awareness of household heads on rules and regulations of marine resources.

## Materials and Methods

The socio-economic survey was conducted in the fishing communities of Bok Pyin and Sa Tein Village from October 2018 to May 2019 (Figure 1). In this survey, the detailed socioeconomic survey questionnaire was used to obtain the data. In Sa Tein Village, samples as 50% of total households were collected. According to random sampling, 51 households from 102 households were selected to participate in the survey as respondents. In Bok Pyin, fish market surveys and fish buying centers (fish, bivalves, squids, and crabs) were also carried out to get an overview of some particular issues such as fish catching, crafts, and

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gears used for fishing, marketing, employment, and income, etc. In the fishing communities of Bok Pyin and Sa Tein Village, interviews were conducted with heads of households HH, informed household members, fishermen, key informant interviews KIIs (village leaders or seniors and informed members of the community) and groups of community members (men, women, youth, etc.). A data code sheet was developed by the team and used to code the data uniformly for data entry purposes. Data were gathered to assess the basic demographics (population size, ethnic composition, language, religion, education level, and adult literacy rates), primary and secondary occupations, basic services, and infrastructure. In the fishing communities of Bok Pyin and Sa Tein Village, fishermen who relied primarily on marine resources were discussed based on the FGD principles (Focus Group Discussions). All empirical data were analyzed by R programming.

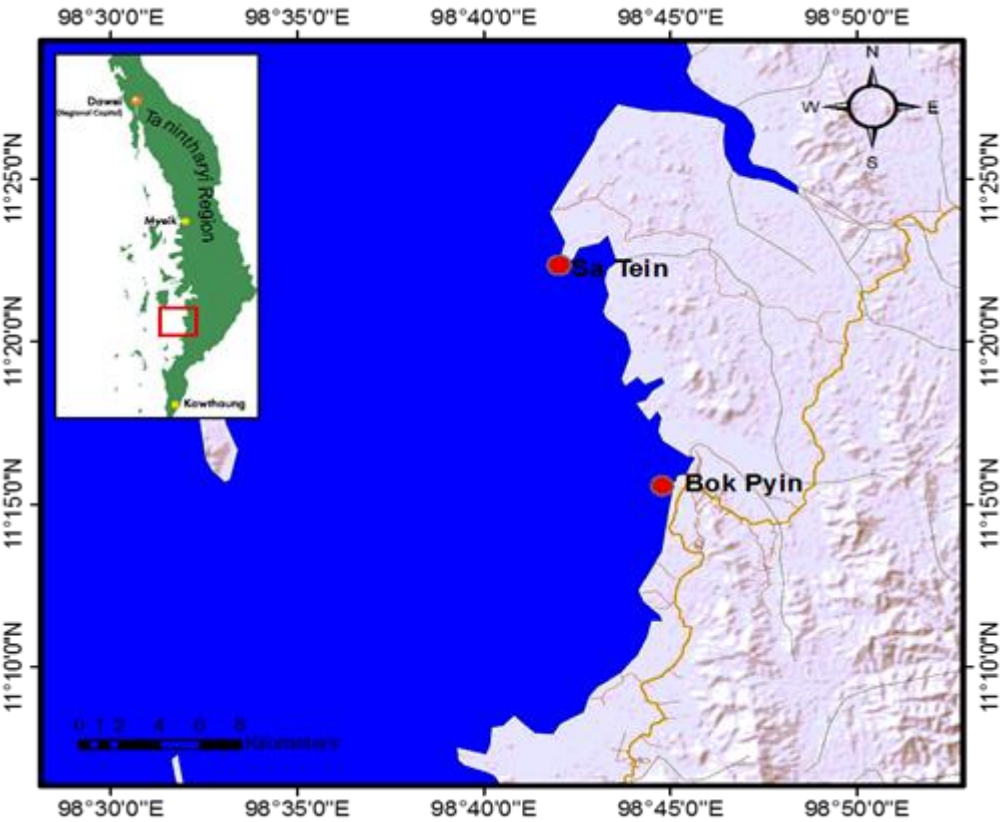


Figure 1. Map of the study area

## Results

### Fishing-specific economic status

According to household occupations and livelihood data, fishing was the main occupation for their livelihoods. The primary occupations of household heads included 29.26% with fishing, 19.51% with shrimp fishing, 9.75% with crab fishing, 2.43% with crab buying center, 19.5% with bag net fishery, 7.31% with dried fish, shrimps and squids processing, and 4.87% with fish paste processing (Figure 2). Thirty-five percentage of household heads did not have secondary occupations. However, some household heads did fishing, gleaning, buying and selling of marine fish or other resources, dried fish processing, gardening, buying and selling betel nut, shopkeepers, and casual labors for their secondary occupations (Figure 3).

**The role of women in fishing activity**

According to socio-economic data, gender composition was 130 males and 128 females. The percentages were registered for males and females based on sex composition, 50.39 %, and 49.61 %. The household survey data indicated the importance of women activities in these fishing communities. Women were the main caregivers and provided for food security in the family. The 12% of women were fishing helpers who assist in the fishing of their husbands at sea, 31% dried fish, squids and shrimps processing and17% dried skin processing of pufferfish (Figure 4).

**Marine resources dependency**

The coastal and marine resources data (coastal habitats and fisheries support systems), fishery resources data (fishing activities, fishing gears, fishing grounds, and the catches) and marketing orientation were recorded from household heads interview, key informant interviews (KIIs) and focus group discussion (FGD) in the fishing communities of Bok Pyin and Sa Tein Village. *Plotosus lineatus, Lates calcarifer, Chirocentrus dorab, Parastromateus niger, Sillago sihama, Cynoglossus lingua, C. bilineatus, Arius maculatus, A. caelatus, Otolithoides pama, Gymnra poecilura, Pampus argenteus, and Lobotes surinamensis* were caught by drift nets with the mesh size of 2.5 - 4.5 inches every month. Their fishing grounds were the waters off Aleman, Pawe, Kho, Kyauk Ni Maw, Ohn Taw Kan, Taung Kaing, and Wutt Islands (Figure 5). Bivalves including *Anadra granosa* and *Tegilarca rhombea* were collected by hand between March and May in the areas of Yar Thet and Maw Su. Crabs were caught by traps in Thae Phyu and Chaung Ka Set areas and they were sold in crab buying centers of the village. *Penaeus monodon, Penaeus indicus,* and *Macrobrachium* sp. were caught by trammel net with a mesh size of 2 or 2.5 inches between October and May. Moreover, fish and other marine fauna were sold in fish buying centers of Kawthaung and Myeik.

**Catch trends of marine resources**

Many fishermen who have had fishing experience in the last five years considered many marine resources to be in a declining condition. Fishermen perceived that there was a drop in catches and income despite fish prices being high. Almost all fishermen caught mainly fish, prawns, and crabs. About 73% of fishermen who caught inshore fish estimated that their catches had dropped by half in the last 5 years. Approximately 50% of fishermen believed that their catches were decreased in pelagic fishing, 27% in sand crabs fishing, 36% in lobsters, 47% in squid fishing, 43% in prawn fishing, and 50% in rays and sharks fishing at present. Therefore, most households did not consider that future generations can depend on coastal and marine resources as a livelihood activity in the fishing communities of Bok Pyin and Sa Tein Village (Figure 6).

**Awareness of the laws governing marine resources**

The respondents answered about the fishing, mangrove, and aquaculture laws. In the fishing communities of Bok Pyin and Sa Tein Village, the survey team recorded three main points with respondents' answers or replies; Yes (if a respondent answered and knew about it), No (if a respondent didn't give any answer maybe they knew or not about it) and Don't Know (if a respondent answered that they didn't know about it). Respondents (52%) were aware of fishery laws and 30% of forestry law (Figure 7). As the levels of the awareness of fishery rules and regulations were high, most local fishermen did not catch sharks, seahorses, and dolphins. They did not use illegal fishing techniques including dynamite fishing, poisons, and chemicals, etc. Moreover, the awareness of mangrove conservation was moderate among

respondents. They caught shrimps and crabs around mangrove forests but they did not exploit timbers and charcoals from mangrove.

**Perceived conditions of marine resources**

From the data based on the perceived circumstances of marine resources, 60% of respondents considered the beach conditions were in bad condition. The threats of the beach were strong erosion and sea-level rise. More than 20% of respondents answered mangrove and corals were in bad conditions and 77% of respondents believed seagrass were also in bad conditions. The current marine resource status in these communities was assessed from respondents' data including village leaders, administrators, household heads, and fishermen. The first quartiles of the beach were very bad and other resources on bad levels. The empirical data were shown in Figure 8, based on the present situation of these resources.

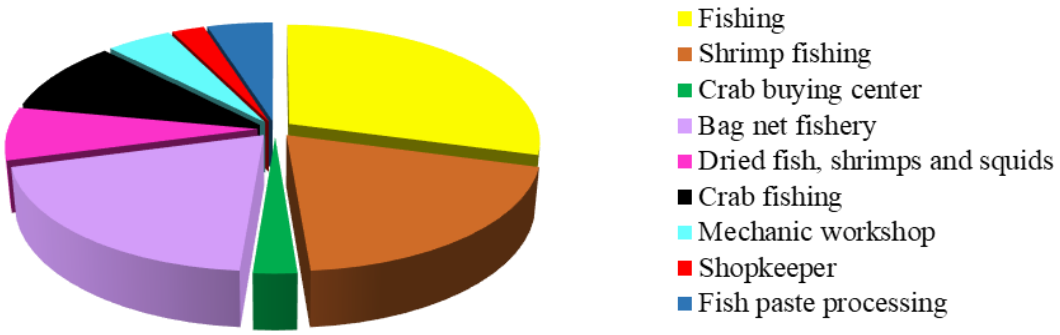


Figure 2. Household heads' primary occupation

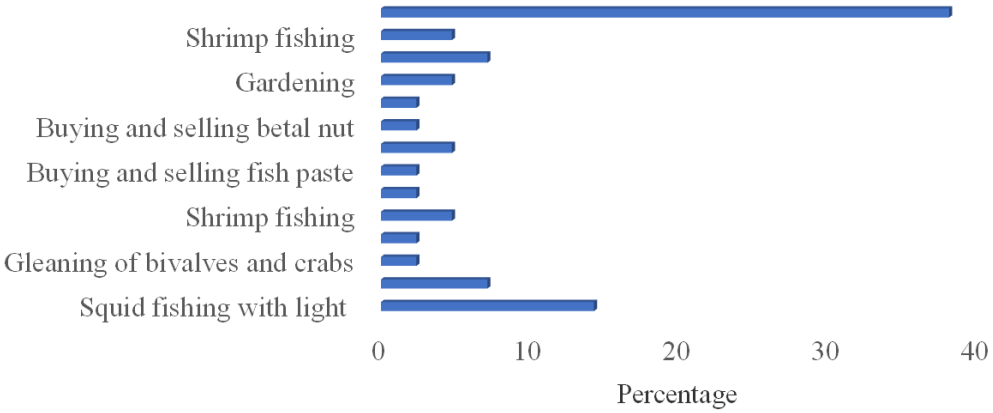


Figure 3. Household heads' secondary occupation

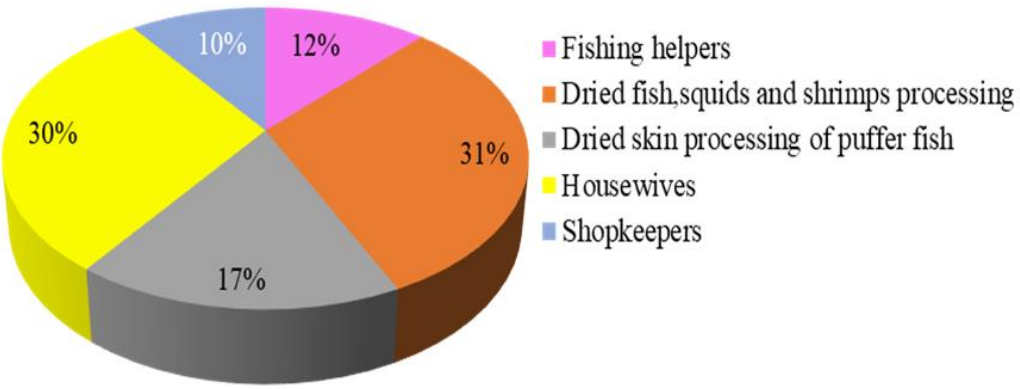


Figure 4. The livelihoods activity of women in Sa Tein Fishing Village

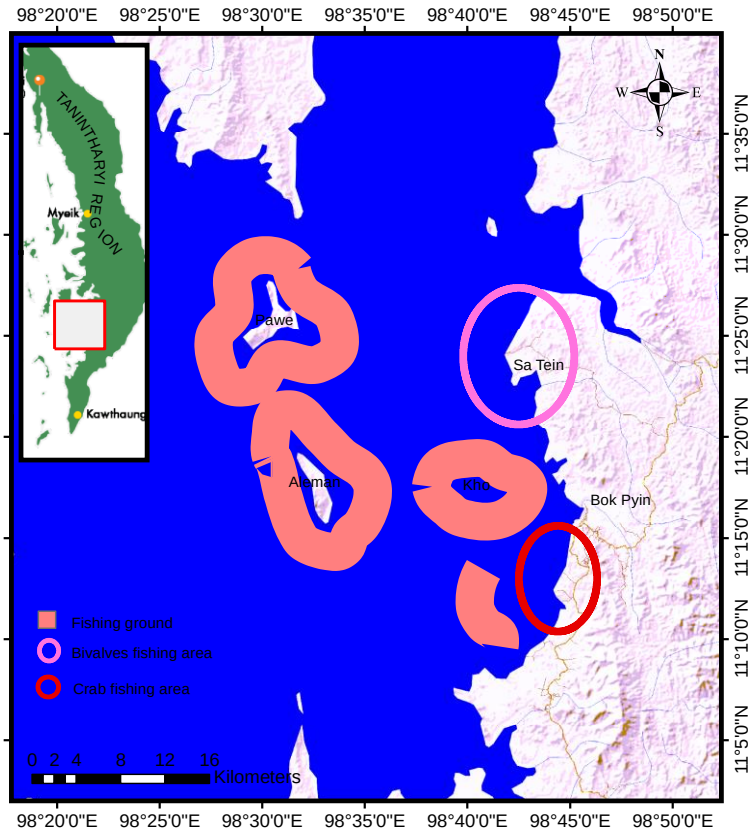


Figure 5. Map showing identified fishing grounds in Bok Pyin Waters

**The status of household demography and livelihoods**

In Sa Tein Fishing Village, 20% of household heads between the ages of 41-50 did not have the formal educational level, 2% between the age composition of 71-80 years had attained college degrees, and 17% between the ages of 31-40 passed grades 1-4. According to the overall percentages of school attendees, the different age groups of most household members had attained grades 5-6 (Figure 9). The mean value of age was 49.66 years (SD= 20.49) and education level was Mean = 6.2 (SD = 4.49) (Figure 10).

In Sa Tein Fishing Village, the survey data indicated that the percentage of migrants was higher than non-migrants; the migrant people (76%) and non-migrants (24%) in these communities. Most people migrated from other islands of Myeik Archipelago to Sa Tein Village for their livelihoods during 1995 - 2013. In the present period (2018-19), as the beach of this village has been eroding year after year, the border of the village area became smaller and narrower. Therefore, many households moved again from this village to other villages and some also moved their houses from the front of the beach to the inside of the village.

According to the data of fishermen's income, some fishermen who owned small boats were not able to catch fish due to rough weather in the rainy season. Therefore, there was a seasonal variation in income with low earnings during the rainy season (June - September). Among fishing households, 28.5% of household-owned motorized boats (10 HP engine), 26.1% motorized boats (5 HP engine), 9% non-motorized boats, and 35.7% did not have boats for fishing. Moreover, the numbers of fishing boat status were presented bar charts with standard error bars (Figure 11). The fishing boat status among households were analyzed Mean=10.5, SD=4.65, and SE = 2.32.

The wealth of individual households was determined according to three broad wealth classes – well off, moderate and poor depending on the material styles of life (the kinds of houses, boats, motorbikes, TV, and telephone). According to the criteria set in this study for wealth indication, the majority of the surveyed households in these communities were classified as poor (40%), moderately well off (45%), and very few households (15%) qualified as well off. The wealth status of the household was Mean= 0.33 (SE =0.04), maximum, minimum, the first and third quartiles were shown in Figure 10.

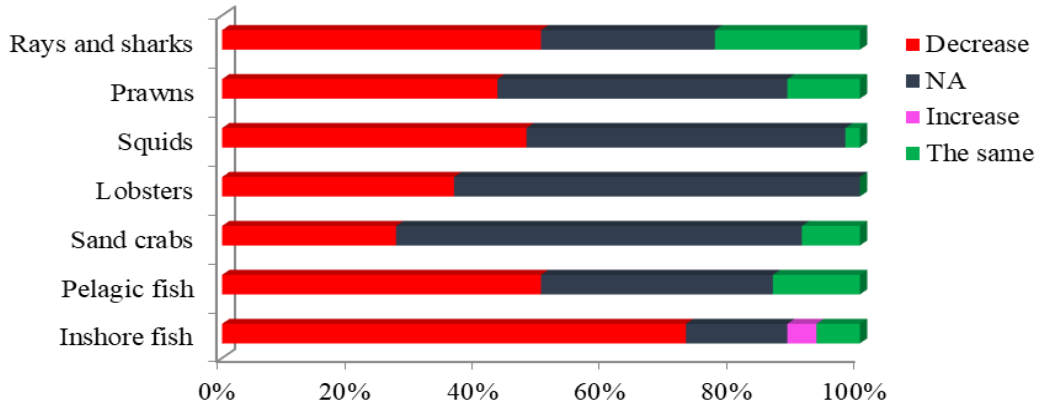


Figure 6. Catch trends of marine resources

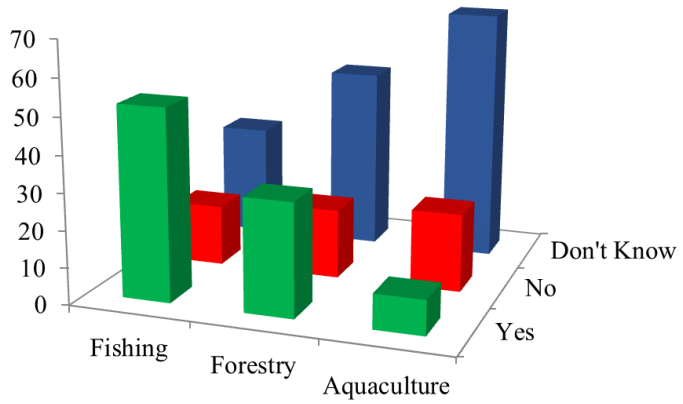


Figure 7. The awareness of the household heads in marine resources rules and regulations in fishing communities

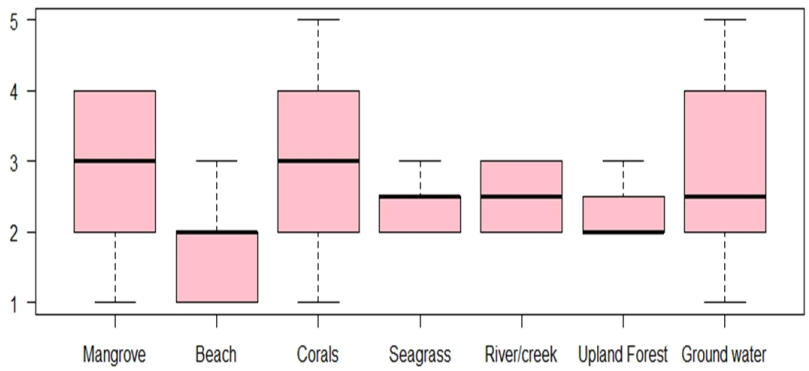


Figure 8. The perceived conditions of the household heads on the status of marine resources (1= very bad, 2= bad, 3= normal, 4= good and 5= very good)

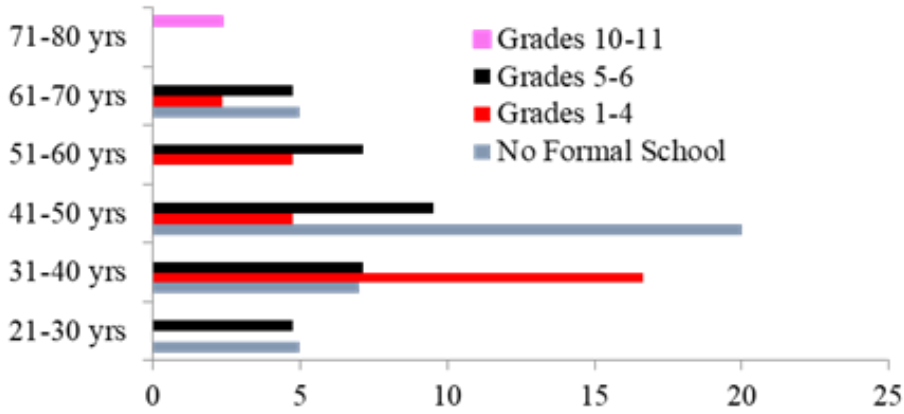


Figure 9. Household heads' age and education levels

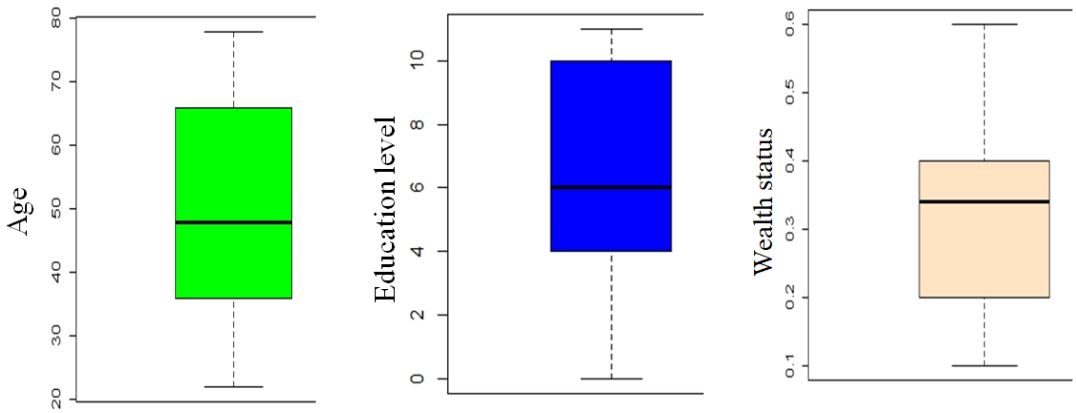


Figure 10. Boxplot showing age, education and wealth status of household heads for the median, first quartile, third quartile, maximum and minimum values

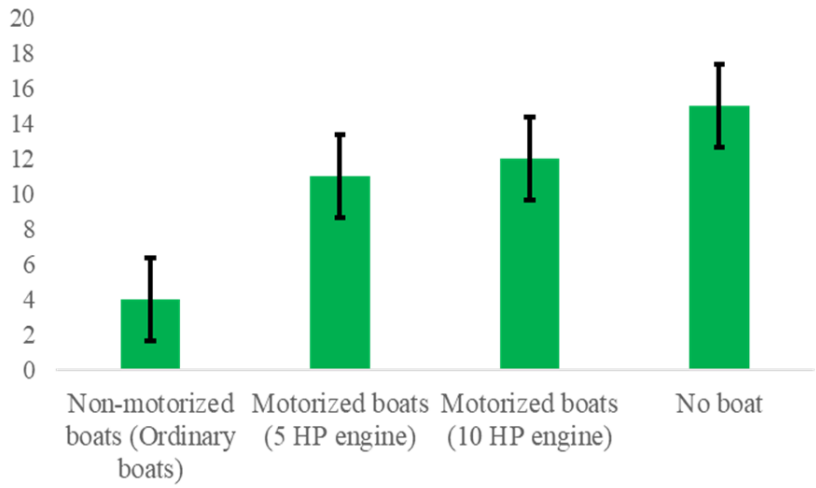


Figure 11. The status of fishing boats (numbers) among households

## Discussion

The present study reported the major finding of socioeconomic conditions of fishing communities in Bok Pyin. In Sa Tein Fishing Village, most people depended solely on marine resources for the main sources of income. The percentage of 92.63 of households got their income depending on fishery-related activities. Inappropriately, their incomes were not adequate for their expenses, and these sources impact the lifestyles of fishing communities. Since 35 % of households did not have secondary employment, they needed alternative jobs to afford earnings for their lives.

In Bok Pyin, other income-generating activities including in the form of agricultural activities, livestock keeping, shopkeepers, and casual labors, etc. were required to sustain the life of fishermen families in closed fishing season and the rainy season (June-August). According to the previous study (Schneider *et al.* 2014, Zin Lin Khine and Hnin Hnin Maw, 2017 and Zin Lin Khine, *et al.* 2018), over fifty percent of households in Myeik Archipelago faced difficulties in their livelihoods during the rainy season. Likewise, in the present study area, about 80% of households found it very difficult to make their livelihoods in the rainy season.

Malleret (2004) reported that the material style of life (house, boat, livestock, and land ownership) as indicators to assess the wealth and poverty levels of households in fishing communities. Similarly, the present survey team determined the wealth status of households (the kinds of houses, boats, motorbikes, TV, and telephone, etc.) for each household. It pointed out most households (85%) at moderate and poor levels. The vulnerability of fishermen included not only low wages and poor economic status but also a lack of alternative job opportunities, the facilities of health, education, and electricity in the present fishing communities.

According to the present empirical data, the owners of fish buying centers, key informant interviews (KIIs) and focus group discussion (FGD) reported that catfish, seabass, herring, pomfrets, sillago, tongue sole, croaker, rays, and tripletail were caught by drift nets, bag nets, and hook-lines. Fortunately, fishermen who fished by spearfishing, trawlers, and illegal fishing equipment were not found in the present study area. Moreover, they did not catch sea cucumbers, chitons, coral fish, seahorses, sharks, and manta rays. Saw Han Shein (2013), Schneider *et al*. (2014) and BOBLME (2015) reported that artisanal fishermen used stationary bag nets, drift nets, cage, trap, and spearfishing with compressors to catch mullet, sand crab, mackerel, groupers, snapper, parrotfish, tunas and threadfin in Tanintharyi Region. The results of previous and present observations mentioned that the artisanal fishermen did not practice destructive fishing techniques including trawlers, poisons and dynamite fishing, etc.

Most fishermen from the present study area believed a deterioration in marine resources based on more than five years of fishing experience. More than 50% of fishermen considered that the catches of fish, shrimps, lobsters, bivalves, and crabs had a decrease in the present period (2018-19) than the last five years. According to previous observation (BOBLME, 2015 and Howard, 2018), most coastal people have found that over the past 30 years marine resources have undergone a dramatic decline. Consequently, the results of the preceding and present study revealed that marine resources have been exhausted in fishing communities of Tanintharyi Region.

Myanmar Marine Fishery Law (1990) was enacted to prohibit illegal fishing practices (trawls, poison, dynamite fishing, etc.) and to protect coastal and marine resources. Myanmar Forestry Law (1992) was extended to reserve forests, municipal forests, and forest land

(Trachtman, 1997). The present survey team directed respondents to record the awareness of fishery and forestry laws. In the present fishing communities, the respondents' awareness had a high level in fishery laws and a moderate level in forestry laws. Parashar (2016) reported that fishery management can conserve natural biodiversity while improving fishermen's livelihoods by simultaneously increasing the catch rate. Therefore, it was an important point that the implementation of fishery law played a vital role in healthy natural resources and in supporting the lifestyle of fishermen in the present fishing communities. No-take Zone (NTZ) of Marine Protected Areas (MPA) could be exhibited for small-scale fishermen to manage marine resources in Myeik Archipelago (Mizzrahi, *et al.*, 2020). According to present observation, the local fishermen are interested in developing Community-based Fishery Management to improve their resources in the fishing communities of Bok Pyin and Sa Tein Village.

## Conclusion

The present socio-economic assessment supported to obtain the data of socioeconomic condition, marine resource use, the catch trends of marine resources, respondents' awareness of rules and regulations, and the material style of life in the present fishing communities. Most local people relied almost entirely on marine living resources for the essentials of life. Inappropriately, as marine resources were decreasing year after year, some fishermen were willing to change their occupations and to get new employment and other income-generating activities (agriculture, livestock keeping, and labors, etc.). More than 50 percent of fishermen desired Community-based Fishery Management (CBFM) is designed to preserve and maintain marine resources within these communities. They believed if these resources are well managed and conserved, it will sustain the fishery resources for years.

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# Study on the Length-Weight Relationship and Stomach Content Analysis of *Liza argentea* (Family-Mugilidae) in Myeik

Hnin Hnin Maw[1], Khin May Chit Maung[1], Khin Yu Nwe[1] and Chaw Su Lwin[1]

## Abstract

The length-weight relationship and stomach content of *Liza argentea* were studied in Myeik from June 2015 to June 2016. The resultant equation of the length-weight relationship was $W= 0.72\ L^{1.50}$. The calculated coefficient correlation 'r' value showed that it was negatively correlated. Food items observed in the stomach of *L.argentea* were algae, phytoplankton, zooplankton, plant materials, worms, crustaceans, bivalves, fishes, detritus and fine sand grain. Phytoplankton group comprising diatoms and dinoflagellates was the dominant food item of *L.argentea*.

**Key words:** Length-weight relationship,*Liza argentea*, phytoplankton, zooplankton

## Introduction

*Liza argentea* (Family- Mugilidae) is a medium to large sized fish with an elongated body. It is locally known as Gawyat. Species of *L. argentea* is caught by gillnets, cast nets, stakenets, lift nets and beach seines. They are found throughout the year and abundant in the rainy season (Carpenter and Niem, 1999).

The length-weight relationship is of great importance in fishery assessments. Length-weight relationship data can estimate the stock composition, age of maturity, lifespan, mortality, growth and production. The variety of the diet of fish can be expressed by analyzing the gut content under the microscope. The results of this study can help to understand the feeding habits of these species.

The present study aims to find out the relationship between length and weight and to analyze the stomach contents of *Liza argentea* common in Myeik areas.

## Materials and Methods

Fish samples were collected from Myeik market from June 2015 to June 2016 (Fig. 1). Identification was based on the distinctive external characters as follows by Carpenter and Niem (1999). Fish length (from the tip of the mouth to caudal fin) was measured to the nearest centimeter and weight was measured in grams. The equation used for length-weight relationship was as follow:

$$W= a\ L^{b} \text{ (Pauly, 1987)}$$

where,

W = Weight of fish in (g)

L = Total length (TL) of fish in (cm)

a = Coefficient

b = Exponent

The degree of association between length and weight variables was calculated by the determination of the correlation coefficient 'r'.

From the stomach content analysis, the belly of the fish was cut open and removed the

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stomach. And then, all food contents containing in the stomach were well mixed with water and examined under the microscope. The number of each food item was counted and expressed as the percentage of the total number of food items found in the stomach. The identification of phytoplankton was followed by Halse and Evensen (1997) and Steidinger and Tangen (1997).

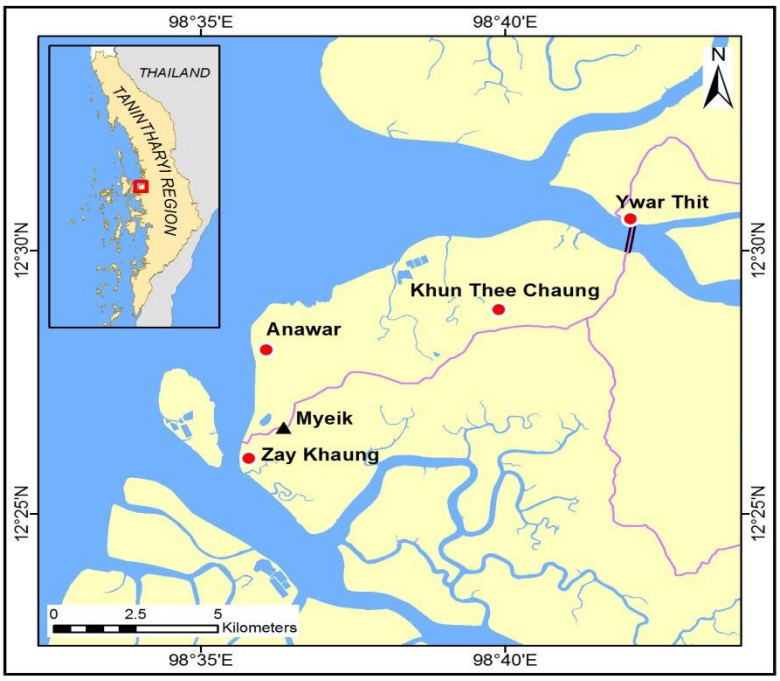


Figure1. Location of the fish sampling area

## Results

A total of one hundred and fifty *L. argentea* samples (Fig. 2) ranging from 6.0 - 7.5 cm length and 17.0 - 45.7 g weight was used to determine the length-weight relationship and stomach content.

Figure 2. *Liza argentea*

**Length-weight relationship**

The curve of the length-weight relationship of *Liza argentea* was shown in figure 3. The calculated equation is;

$$W = 0.72\ L^{1.50}$$

According to the value of 'b', it was shown the negative growth pattern between the length and weight relationship. The observed coefficient correlation 'r' was 0.33. It was indicated that the length and weight of *Liza argentea* were negatively correlated.

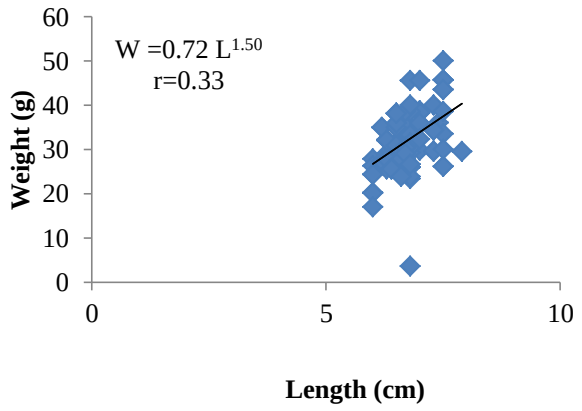


Figure 3. Length-weight relationship of *Liza argentea*

**Stomach content analysis**

Food items found in the stomach of *L. argentea* were algae, phytoplankton, zooplankton, plant materials, worms, crustaceans, bivalves, fishes, detritus and fine sand grain. Phytoplankton group comprising diatoms and dinoflagellates was the dominant food item. The contents of phytoplankton were studied by using the numerical method and shown in Table 1. Phytoplankton food items were composed of 25 species, including 23 diatoms and 2dinoflagellates (Figures 4 and 5). The highest composition was found in *Coscinodiscus sp.* (17.23%), followed by *Planktonella sp.* (14.76%) and *Nitzschia sp.* (14.46%).

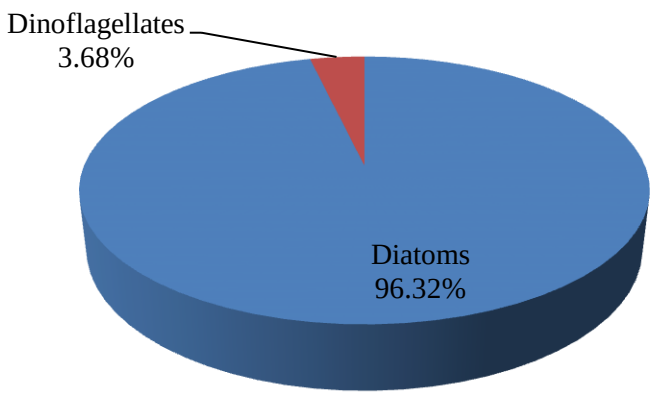


Figure4. Composition of diatoms and dinoflagellates found in the stomachs of *Liza argentea*

Table1. Common food items of phytoplankton found in the stomachs of *Liza argentea*

| No. | Species name | Percentage in number |
|---|---|---|
| | Diatoms | |
| 1. | *Coscinodiscus sp.* | 17.23 |
| 2. | *Pleurosigma sp.* | 11.38 |
| 3. | *Amphiprora sp.* | 3.69 |
| 4. | *Pseudo-nitzschiaseriata* | 2.46 |
| 5. | *Nitzschia sp.* | 14.46 |
| 6. | *Skeletonema sp.* | 5.53 |
| 7. | *Planktonella sp.* | 14.76 |
| 8. | *Navicula sp.* | 0.61 |
| 9. | *Odontella sp.* | 2.15 |
| 10. | *Triceratum sp.* | 1.53 |
| 11. | *Rhizosolenia sp.* | 8.30 |
| 12. | *Leptocylindrus sp.* | 7.15 |
| 13. | *Gyrosigma sp.* | 0.61 |
| 14. | *Cyclotella sp.* | 1.23 |
| 15. | *Tabellaria sp.* | 1.23 |
| 16. | *Surirella sp.* | 0.61 |
| 17. | *Lauderia sp.* | 0.92 |
| 18. | *Bacillaria sp.* | 1.23 |
| 19. | *Chaetoceros sp.* | 2.15 |
| 20. | *Thalassionema sp.* | 1.23 |
| 21. | *Sringodium amenicanum* | 1.53 |
| 22. | *Eucampia sp.* | 0.61 |
| 23. | *Helicotheca sp.* | 0.61 |
| | Dinoflagellates | |
| 24. | *Ceratium sp.* | 1.53 |
| 25. | *Prorocentrium sp.* | 2.15 |

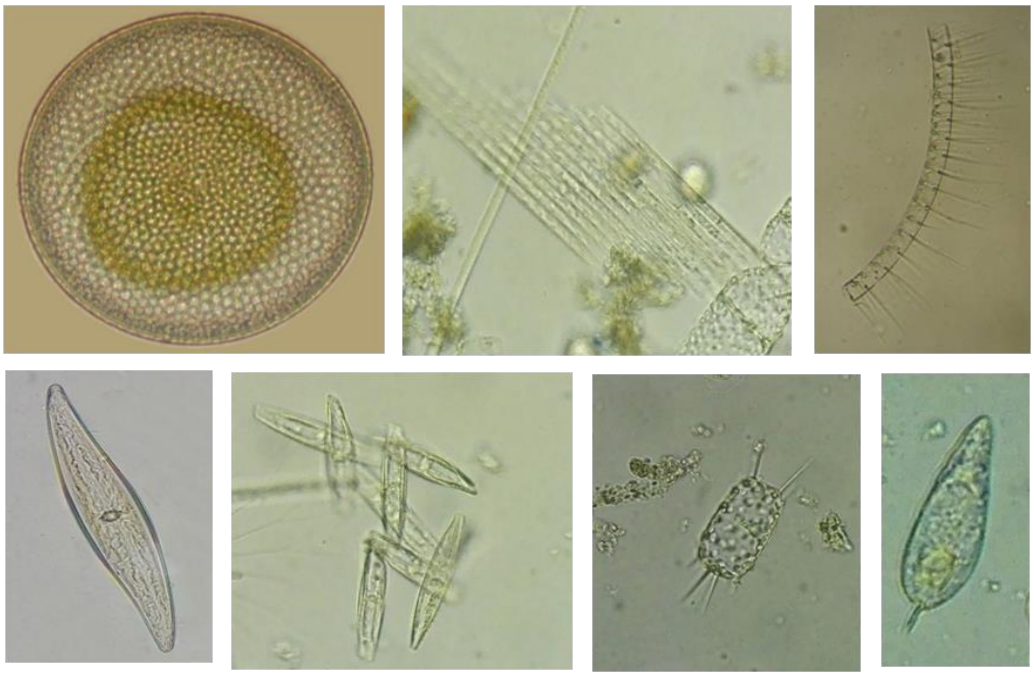

Figure5. Some food items found in the stomachs of *Liza argentea*

## Discussion

The growth of fish was determined from the resultant value of the ‘b’. It is called isometric growth pattern when 'b' value equals 3 and called allometric growth patterns when 'b' value is larger or smaller than 3. The calculated ‘b’ value of the length-weight relationship of *Liza argentea* in the present study was 1.50. It was showing the negative growth pattern between the length and weight relationship of *Liza argentea*. Nan Mya Han2014 also reported a negative growth pattern of *Liza sp.* with the exponent ‘b’ value of2.839458.The slope (b) value less than 3 indicates that a fish becomes more slender as it increases in length (Thomas *et al.*, 2003).

In the present study, the coefficient correlation 'r' value of 0.33 was indicated that the length and weight of *Liza argentea* were negatively correlated. The coefficient correlation 'r’ value of 0.88 was indicated that the length and weight of *Liza dussumieri* was positive correlation Nang Mya Han (2014).

The food items that occurred in the stomach of *Liza argentea* in the present study were algae, phytoplankton, zooplankton, plant materials, worms, crustaceans, bivalves, fishes, detritus and fine sand grain. Among the recorded food items, diatoms and dinoflagellates were the major food items comprising 96.32% and 3.68% of phytoplankton food items respectively. The most dominant diatoms were *Coscinodiscus sp.*, *Nitzschia sp.*, *Planktonella sp.* and *Pleurosigma sp.* Nang Mya Han (2014) observed the major food items in the stomach of *Liza sp*. as algae, diatoms/phytoplankton, zooplankton, plant materials, worms, crustaceans, bivalves, fishes, detritus and fine sand grain. Nang Mya Han (2014) also reported the dominant food items of diatoms: *Coscinodiscus asteromphalus*, *Nitzschialanceolata*, *Planktonellasol* and *Pleurosigmaangulatum* in the stomach of *Liza dussumieri*. Mondal *et al.* (2016) stated that *Liza tade* actively selected Chlorophyceae followed by Myxophyceae and Bacillariophyceae.

## Conclusions

The resulted 'b' value was shown the negative growth pattern between the length and weight relationship of *Liza argentea* common in Myeik areas. The coefficient correlation 'r' value was indicated that the length and weight of *Liza argentea* were negatively correlated. According to the stomach content analysis, diatoms (96.32%) constituted the dominant food item in the stomach contents of *L. argentea.*

## Acknowledgements

The authors would like to thank Dr. Ni Ni Oo, Rector and Dr. Win Win Than, Pro-Rector of Myeik University for their permission to carry out this research. Special thanks to Dr. Nyo NyoTun, Professor and Head of Marine Science Department, Myeik University for her critical suggestions and permission to use the laboratory facilities. We also thank to fishermen undertaking stake-nets fishery for their help in sampling the fish samples.

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# Study on the Fishes and Fishery of Tizit Village, Longlone Township, Tanintharyi Region

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## Abstract

The current research was conducted in Tizit Village, Longlone Township, Dawei District, and Tanintharyi Region from June 2018 to June 2019. Thirty-six species belonging to twenty-eight genera and twenty-one families were recorded. Among the families, eight families were monthly found and thirteen families were found only in a few months. The maximum species composition of fish was recorded in January (2019), June and November (2018) and also the minimum species composition of fish was recorded in August (2018). Gill nets were used as the main fishing gear by the local people. The species belonging to the families of Scombridae, Sillaginadae, Carrangidae and Stromateidae were recorded as the commercially important fishes in the study area.

**Key words:** Fishes and Fishery, Species composition, Tizit Village

## Introduction

Fish are the most numerous of the vertebrates, with at least 20000 known species and more than half (58%) are found in the marine environment. Over one billion peoples worldwide rely on fish as a major source of animal proteins. According to FAO report population growth, urbanization and rising per capita incomes have led the world fish consumption to more than triple over the period 1916-2001, increasing from 28 to 96.3 million tones. Global fisheries production reached 130.2 million tons in 2001, having doubled over the last thirty years. This rate is also higher than for other animal food producing systems such as terrestrial famed meat (Alam, *et al*. 2013).

Marine fisheries in Myanmar waters have diverse aquatic resources. Tanintharyi Coastal Zone is famous in Myanmar because it possesses many marine resources. It lies in southern Myanmar. These resources provide the local people not only nutritious food but also income and employment opportunities. A great diversity of marine fish inhabits in this area (Saetersdal *et al.*1999).

The study area, Tizit Village is located in Longlone Township, Dawei District, Tanintharyi Region. It is situated about 5 miles from south of Longlone Township. It is a small fishing village and most of the villagers' careers as fishermen. The aims of this study are: to investigate the diversity of fish, to study the monthly composition of species and to know the fishery of Tizit Village.

## Materials and Methods

The fish samples were collected monthly from Tizit Village (Lat. 13° 31' N and Long. 98° 43'E) from June 2018 to June 2019. The information concerning fishery was taken from the local fishermen. The samples were taken photographs by a digital camera and all measurements, morphological characters and coloration of fish were also recorded. Colour was noted in fresh condition Identification was mainly based on their distinctive external morphology. Then, the fish samples were preserved in 5% ethanol. This study has followed the classification system used by Fisher and Whitehead (1974), Carpenter and Niem (2001), Fisher and Bianch (1984) and Mya Than Tun (2001).

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Figure 1. Map showing the study area

## Results

In the present study, 36 species belonging to 28 genera and 21 families of fishes were recorded from Tizit Village during the study period. The classification list of fish found in the study area was described in Table1. They were 6 species of Family Carangidae, (*Alepes djedaba, A. melanoptera, Carangoides uii, Megalaspis cordyla, Scomberoides commersonnianus, Uraspis helvola*), 2 species of Cynoglossidae (*Cynoglossus arel, C. lingua*), 3 species of Gerreidae (*Gerres decacanthus, G. macracanths, G. filamentosus*), 4 species of Leiognathidae (*Leiognathus stercorarius, L .bindus, L. dura, Graza minuta*), 2 species of Nemipteridae (*Nemipterus bathybius, N. peronei*), 1 species of Synodontidae (*Saurida tumbil*), 2 species of Scombridae (*Rastrelliger brachysoma, R. kanagurta*), 1 species of Platychephalidae (*Suggrundus rodricensis*), 1 species of polynemidae (*Polydactylus indicus*), 1 species of Priacanthidae (*Priacanthus blochii*), 1 species of Mullidae, (*Upeneus sluphureus*), 1 species of Drepanidae (*Drepane punctata*), 2 species of Mugilidae (*Inegocia japonica, Liza abu*), 1 species of Sphyraeanidae (*Sphyaena barracuda*), 1 species of Stromateidae (*Pampus argenteus*), 2 species of Sciaenidae (*Dendrophysa russelli, Otolithoides biauritus*), 1 species of Terapontidae (*Terapon puta*), 1 species of Trichiuridae (*Trichrius lepturus*), 1 species Sillaginadae (*Sillago sihama*), 1 species of Engraulidae (*Setipinna taty*) and 1 species of Serranidae (*Epinephelus sexfasciatus*).

Table 1.Classification of fish collected from the study area from June 2018 to June 2019

| Class | Order | Family | Genus | Sr. No | Speices |
|---|---|---|---|---|---|
| Teleostomi (Bony fish) | Perciformes | Engraulidae | *Setipinna* | 1 | *Setipinna taty* |
| | Aulopiformes | Synodontidae | *Saurida* | 2 | *Saurida tumbil* |
| | Perciformes | Sphyraenidae | *Sphyraena* | 3 | *Sphyraena barracuda* |
| | | Trichiuridae | *Trichrius* | 4 | *Trichrius lepturus* |
| | | Scombridae | *Rastrelliger* | 5 | *Rastrelliger brachysoma* |
| | | | | 6 | *R. kanagurta* |
| | | Carangidae | *Alepes* | 7 | *Alepes djedaba* |
| | | | | 8 | *A. melanoptera* |
| | | | *Carangoides* | 9 | *Carangoides uii* |
| | | | *Megalaspis* | 10 | *Megalaspis cordyla* |
| | | | *Scomberoides* | 11 | *Scomberoides commmersonnianus* |
| | | | *Uraspis* | 12 | *Uraspis helvola* |
| | | Leiognathidae | *Leiognathus* | 13 | *Leiognathus stercorarius* |
| | | | | 14 | *L. bindus* |
| | | | | 15 | *L. daura* |
| | | | *Gazza* | 16 | *Gazza minuta* |
| | | Sciaenidae | *Dendrophysa* | 17 | *Dendrophysa russelli* |
| | | | *Otolithoides* | 18 | *Otolithoides biauritus* |
| | | Mullidae | *Upeneus* | 19 | *Upeneus sluphureus* |
| | | Nemipteridae | *Nemipterus* | 20 | *Nemipterus bathybius* |
| | | | | 21 | *N. peronii* |
| | | Stromateidae | *Pampus* | 22 | *Pampus argenteus* |
| | | Drepanidae | *Drepane* | 23 | *Drepane punctata* |
| | Mugiliformes | Mugilidae | *Liza* | 24 | *Liza abu* |
| | Perciformes | Polynemidae | *Polydactylus* | 25 | *Polydactylus indicus* |
| | | Gerreidae | *Gerrres* | 26 | *Gerres decacanthus* |
| | | | | 27 | *G. macracanthus* |
| | | | | 28 | *G. filamentosus* |
| | | Terapontidae | *Terapon* | 29 | *Terapon puta* |
| | | Silliginidae | *sillago* | 30 | *Sillago sihama* |
| | | Serranidae | *Epinephelus* | 31 | *Epinephelus sexfasciatus* |
| | Pleuronecticforms | Cynoglossidae | *Cynoglossus* | 32 | *Cynoglossus arel* |
| | | | | 33 | *C. lingua* |
| | Scorpaniformes | Platycephalidae | *Suggrundus* | 34 | *Suggrundus rodricensis* |
| | | | *Inegocia* | 35 | *Inegocia japonica* |
| | Perciformes | Priacanthidae | *Priacanthus* | 36 | *Priacanthus blochii* |

Figure 2. Types of fish: A) *Carangoides uii*; B) *Scomberoides commersounianus*; C) *Megalspis cordyla*; D) *Alepes djedaba*; E) *A. melanoptera*; F) *Uraspis helvola;* G*) Rastrelliger kanagurta;* H) *R. brachysoma;* I) *Sillago sihama;* J) *Gerres macrocanthus*; K) *G. decanthus*; L) *G. filamentous*; M) *Leiognathus daura*; N) *L. stercorarius*; O) *L. bindus*; P) *Grazza minuta*; Q) *Nemipterus bathybius* and R) *N. peronei*

Figure 3. Types of fish: A) *polydactylus indicus*; B*) Saurida tumbil*; C) *Sphyraena barracuda*; D) *Upeneus sulphureus;* E) *Dendrophysa russelli*; F) *Liza abu*; G) *Pricanthus blochii*; H) *Terapon puta*; I) *Epinephelus sexfasciatus*; J) *Inegocia japonica*; K) *Suggrundus rodricensis*; L) *Trichrius lepturus*; M) *Cynoglossus arel*; N) *C. lingua*; O) *Otolithoides biauritus*; P) *Drepane punctuate*; Q) *Pumpus argenteus* and R) *Setipinna taty*

## Monthly species composition of fish in Tizit Village

Monthly species compositions of fish were recorded from June 2018 to June 2019. During the study period, 19 species in June, 22 species in July, 18 species in August, 19 species in September, 21 species in October, 28 species in November, 20 species in December (2018), 31 species in January, 23 species in February, 22 species in March, 24 species in April, 25 species in May, 29 species in June (2019) were recorded respectively (Table 2).

Table2. Monthly species composition of fish in the study area

| No. | Species | Local name | Months | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2018 | | | | | | | 2019 | | | | | |
| | | | Jun | July | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1 | *Setipinna taty* | Nga Pone Nar | + | | | | | + | | + | | | | | |
| 2 | *Saurida tumbil* | Thel Doe | | + | | | + | + | + | + | + | + | + | + | + |
| 3 | *Sphyraena barracuda* | Kyain Mu Dunn | | + | | + | + | + | + | + | + | + | + | + | + |
| 4 | *Trichrius lepturus* | NgaTa Kun | + | | + | + | | | + | | + | | | + | + |
| 5 | *Rastrelliger brachysoma* | Ngar Yar | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 6 | *R. kanagurta* | Nga Lone | | + | | + | | | | + | | + | + | + | + |
| 7 | *Alepes djedaba* | Vee War Long | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 8 | *A. melanoptera* | Han Cho Gut | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 9 | *Carangoides uii* | Kalar Ngu Pyar | + | | + | | | + | | + | + | | + | | + |
| 10 | *Megalaspis cordyla* | Set Bar Yi | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 11 | *Scomberoides commersonnianus* | Sar Plunt | + | + | | + | + | + | | + | + | | + | + | + |
| 12 | *Uraspis helvola* | PalanTol | | | + | | + | + | | | | | | + | + |
| 13 | *Leiognathus stercorarius* | Ni Shaw | + | + | + | + | + | + | | + | + | + | | + | + |
| 14 | *L. bindus* | San Da Palar | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 15 | *L. daura* | Ni Shaw | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 16 | *Grazza minuta* | Ni Shaw | + | + | | | + | + | | + | | + | | + | |
| 17 | *Dendrophysa russelli* | Byin | | + | + | | + | + | | + | | + | + | + | + |
| 18 | *Otolithoides biauritus* | Byin | | + | + | + | + | + | + | + | + | + | + | + | + |
| 19 | *Upeneus sulphureus* | Nga Ni | | + | | + | | + | | + | | | + | | + |
| 20 | *Nemipterus bathybius* | Nga Ni | + | | | + | | + | | + | | + | | | |
| 21 | *N. peronii* | Jaw Ni | + | | | + | + | + | + | + | + | + | + | + | + |
| 22 | *Pampus argenteus* | Muu Kyal | | + | + | | + | | + | | + | | + | + | + |
| 23 | *Drepane punctata* | Sinn Ooe Phone | + | | + | | + | | | + | | | + | | + |

***Symbols:*** (+) = Present, (-) = Absent

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | *Liza abu* | Gull Yant | + | | + | | | + | | + | + | | + | | |
| 25 | *Polydactylus indicus* | Kwal Yin | | + | | + | | + | | + | | + | | | |
| 26 | *Gerres decacanthus* | Kan Guu | | + | | + | | + | | + | + | | | + | |
| 27 | *G. macracanthus* | Kan Guu | + | + | | + | + | + | + | + | + | + | + | + | + |
| 28 | *G. filamentosus* | Kan Guu | + | | + | + | + | + | + | + | + | + | + | + | + |
| 29 | *Terapon puta* | San Pyut | + | + | | | + | + | + | + | + | + | + | + | + |
| 30 | *Sillago sihama* | Nga Thae Toe | + | + | + | + | + | + | + | + | + | + | | + | + |
| 31 | *Epinephelus sexfasciatus* | Kyuk Dut | | | + | | | | + | | | | | | + |
| 32 | *Cynoglossus arel* | Khwee Shar | + | + | + | + | + | + | + | + | + | + | + | + | + |
| 33 | *C. lingua* | Khwee Shar | + | | + | | | | | + | | | | | |
| 34 | *Suggrundus rodricensis* | Nga Shin Nin | | | | | | | | + | | | + | | + |
| 35 | *Inegocia japonica* | Nga Shin Nin | | + | + | | | | + | | | | | | + |
| 36 | *Priacanthus blochii* | Tar Waunt | + | | | | + | + | + | + | + | + | + | + | + |

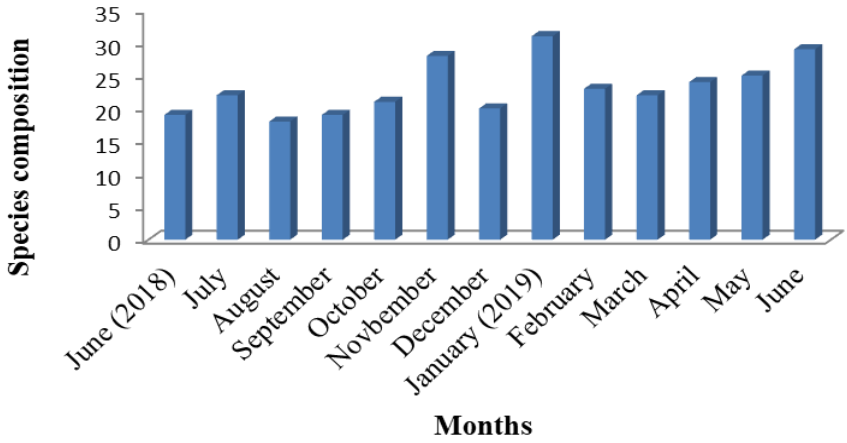


Figure 4. Monthly species composition of fish in the study area

**Fishery**

Local people caught fishes near Tizit Village during the rainy season. During the dry season, they caught fish in the water of Bote Aw, Pae Zin, Kyuk Twin, Shin Htauk, Kalar Mae and near Nyunngzin.

About 80 fishing boats were caught near in Tizit Village. Fishes were caught mainly by drift gillnet (local name-Myaw Pike) in Tizit village. The size of the boat was about 8.5 m- 9 m long, 2.7 m wide and 2m -3 m deep. The boat was fitted with 10 Horse Power (HP). The dimension of the net was 126 m -378 m in length and 6.75m -15.75 m in height). The mesh size was 2.54cm (Figure 6 A-E). The net was made of nylon filament provided with lead sinkers and floats to keep the net vertical. The diameter of the foot rope was 2.3-3.0 mm. The boat loaded about 1-2 metric tons.

When operating, the net was allowed to drift with plastic floats. The net was drifted in the direction of the current and tide. Shoals of fish were gilled in the net. After a few hours,

the fishermen hauled up the net and collected the fish. Fishing is mostly conducted at day time during the neap tide and catches are hauled up one to two times on a fishing day. Fishermen go out to the fishing grounds once a day and each trip could last 6-8 hours depending on the weather and the amount of fish they caught. They kept fish with ice and sold to the buyer or at the Longlone market. Some small fish were dried under the sun.

*Rastrelliger brachysoma*, *R. kanagurta*, *Pampus argenteus*, *Sillago sihama* were recorded as commercially important species in Tizit Village. The fish caught was placed in the basket and sold to the buyer. The price of a basket was 30,000-35, 000 kyats depending on the quality of the fish. *Alepes djedaba*, *A. melanoptera*, *Megalaspis cordyla*, *Scomberoides commmersonnianus*, *Epinephelus sexfasciatus*, *Uraspis helvola* and *Carangoides uii* were the second commercially important species and the price of a basket was 20,000–25,000 kyats.

*Gerres decacanthus*, *G. macracanthus*, *G. filamentosus*, *Leiognathu sstercorarius*, *L. bindus*, *L. daura*, *Gazza minuta*, *Nemipterus bathybius*, *N. peronei*, *Priacanthus blochii*, *Polydactylus indicus*, *Polydactylus indicus*, *Terapon puta*, *Upeneus sluphureus*, *Sphyraena barracuda*, *Drepane punctate* and *Liza abu* sold to the small buyer or local market. The price of a basket was 13,000-15,000 kyats.

*Trichrius Lepturus*, *Setipinna taty*, *Dendrophysa russelli*, *Otolithoides biauritus*, *Cynoglossus arel*, *C. lingua*, *Saurida tumbil*, *Inegocia japonica*, *Suggrundus rodricensis* were made as dried fish. For the local consumption, fish were scaled, headed, gutted and washed with fresh water. After washing the fish, small amount of salt was added and the fish were dried under the sun. This dried fish was sold in the market and the price was 4000-8000 kyats/kg.

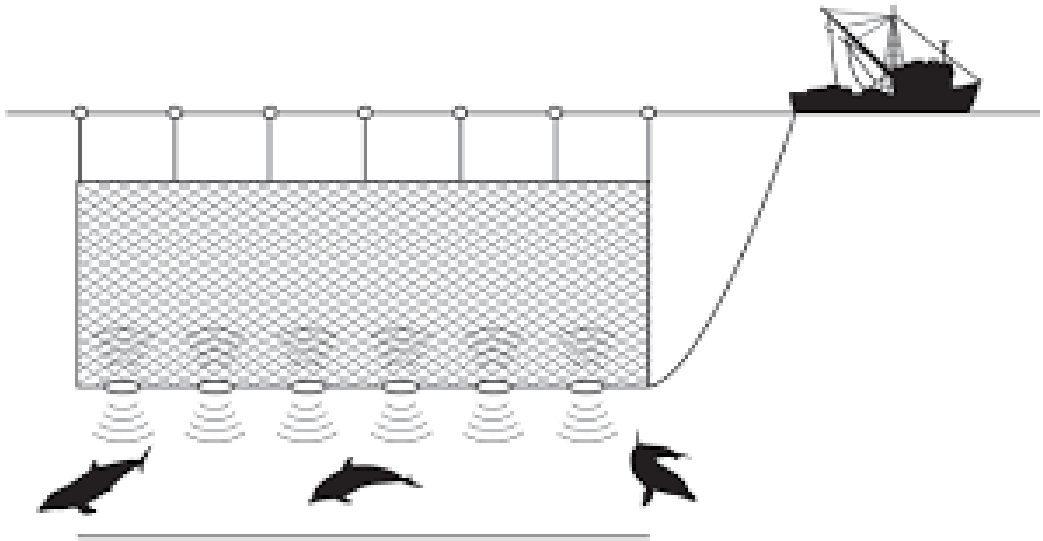

Figure 5. Sketch showing the drift gill net fishing with fishing boat

Figure 6. A-E. A) Fishing boat; B) fishing net; C) Mesh size; D) Lead sinkers and E) some floats used in the head rope

## Discussion

Thirty-six species of fish were observed in the present study. Among them, A*lepes djedaba*, *A. melanoptera*, *Megalaspis cordyla*, *Leiognathus. daura*, *L. bindus*, *Cynoglossus arel*, *Gerres macracanthus*, *Rastrelliger*, *Brachysoma* and *Sillago sihama* were common species and occurred abundantly in this area. These species were also recorded around the Myeik Coastal Waters and along the Coastal of Mon State, concurred by Tint Swe (2011) in Mon State, Kyaw Thura (2011) in the mangrove forest of Shwe Pay, Myeik, Thinzar Lwin Lwin (2014) in Myeik Coastal Area and Hnin Hin Maw *et al*. (2019) in Thet-Yar-Wa Water.

According to the monthly species composition of fish in the study area, A*lepes djedaba*, *A. melanoptera* and *Megalaspis cordyla* were found in all months. *Scomberoides commersonnianus* was found in June, July, September, October and November (2018), January, February, April, May and June (2019). *Uraspis helvola* was found only in August, October, November (2018) May and June (2019). *Carangoides uii* was not observed in September, October and December (2018). Therefore, three species of Family Carrangidae were abundant in the study area during the study period.

In Family Leiognathidae, *L. daura*, *L. bindus* were found in all months but other two species were not found. *L. stercorarius* was observed in all months expect in December and April. *Grazza minuta* was observed in June, July, October and November (2018), January, March and May (2019). Therefore *L. daura* and *L. bindus* were abundant in the study area.

For the Family Cynoglossidae, *Cynoglossus arel* was found in all months but *C. lingua* was found only in June, August (2018) and January (2019) during the study period. Therefore, *C. arel* was more abundant than *C. lingua* in the study area. In Family Gerreidae *Gerres macracanthus* was found almost in all months expect in August. Moreover, *G. filamentosus* was found in all months except July, September and November (2018), *G. decacanthus* was observed in July, September, and November (2018), January, February and May (2019). Therefore, *G. macracanthus* was recorded as one of the abundant species in the study area during the study period.

In Family Nemipteridae, *Nemipterus peronii* was abundantly found more than *N. bathybius*. Two species of Family Platychephalidae were recorded. They were different genus. One was genus *Inegocia* and the other was genus *Suggrundus*. *Inegocia japonica* was found only in June, July and December (2018). *Suggrundus rodricensis* was observed only in January, April and June (2019). Therefore, Family Platychephalidae was not abundant in the study area.

In Family Scombridae, *Rastrelliger. brachysoma* was found in all months but *R. kanagurta* was found only in July, September (2018), January, March, April, May and June (2019). Therefore, *R. brachysoma* was more abundant than *R. kanagurata*. Similarity, *Otolithoides biauritus* was more abundant than *Dendrophysa russelli* in Family Sciaenidae. Only one species was found in families Drepanidae, Mugilidae, Mullidae, Polynemidae, Priacanthidae, Sphyraeanidae, Stromateidae, Synodontidae, Terapontidae, Trichiuridae, Sillaginadae, Engraulidae and Serranidae.

Families Scombridae, Sillaginadae and Stromateidae were recorded as the first commercially important families and Family Carangidae was recorded as the second commercially important family. Besides, Families Trichiuridae, Cynoglossidae, Platycephalidae, and Engraulidae were found as the economically important families in the study area because local people made them as dried fish and sold at the local market.

Drift gill net (local name-Myaw Pike) is used in Tanintharyi Coastal Waters. In the present study, gill net was used the main fishing gear in Tizit Village. Based on the small mesh size of gill nets, they impact fish species if local people use them in mangrove forests which are the nursery grounds for fish larva, and spawning grounds for adult fish. Therefore, the strict regulations on fishing gears are needed for sustainable development in the future.

## Conclusions

The high diversity of fish almost in all months was recorded in Tizit Village during the study period. Therefore, the current research indicates that the water of Tizit Village may be a very productive water area. The development of the production of fish in the study area leads to an increase in the income of local people. Another major impact of gill net is the large incidental catches of non-targeted species and causes the degradation of marine resources in Tizit Village.

## Acknowledgements

We wish to express thanks to Rector, Dr. Ni Ni Oo, and Pro-Rector, Dr. Win Win Than of Myeik University, for kind permission to conduct this study. We are very grateful to Dr. Nyo Nyo Tun, Professor, and Head of Marine Science Department, for permitting us to do this research. Special thanks to U Hla Than, who helps to collect fish specimens and fishery information.

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# Study on the Marketable Finfishes in Myeik Coastal Water

Thinzar Lwin Lwin[1], Lett Wai Nwe[1], Pann Mo Mo[2] and Si Thu Hein[1]

## Abstract

A total of 31 species from 27 genera belonging to 22 families of finfish were recorded in the present study. Among them, Family Carangidae, *Carangoides chrysophrys, C. ferdau, Megalaspis cordyla, Selar boops* and *Parastromateus niger* were commonly recorded in the present study. *Pampus argenteus* gets the highest price (5.38 US $ per kg) and *Drepane punctata* was the lowest price (0.49 US $ per kg).

**Key words:** Marketable finfishes, Myeik Coastal Areas, *Pampus argenteus, Drepane punctata*

## Introduction

The Tanintharyi Coastal Area, the longest coastal area of Myanmar, is included in the Andaman Sea. Myeik Archipelago which extends from Mali Island to Similand Island and belongings about 800 islands covering an area of about 34,340 sq.km Marine fishes account for about 75% at the total fish production in Myanmar and the rest 25% coming from freshwater. Myeik is a coastal city. In this region, fishing is the main occupation for local people. The fishery is the critical point for these coastal people as it is the main income for them. Thailand is the largest importer of Myeik's fisheries products. Fish contain high protein levels and play an important role in the diet. Fish is a healthy source of protein, calcium and vitamin A and essential fatty acids as well as of other elements crucial to good nutrition.

The purpose of this present study is to record the commercial fishes and to identify the species.

## Materials and Methods

Fish samples were collected from fish landing sites from July 2016 to June 2017 from Myeik Coastal Water. The samples were recorded and photographed in a fresh condition. The collected samples were preserved in 10% formalin. The collected finfish samples were identified in detail by observing the morphological characters followed by Fischer and Whitehead (Eds) (1974), Carpenter and Niem (Eds) (1999) and Carpenter and Niem (Eds) (2001).

## Results

A total of 27 genera with 31 species belonging to the 22 families of marketable fishes were found in the present study. In family Carangidae, *Carangoides chrysophrys, C. ferdau, Megalaspis cordyla, Selar boops* and *Parastromateus niger* were recorded. In Sciaenidae, *Pennahia anea,* and *Johnius belangerii* were recorded. In family Scombridae, *Rastrelliger brachysoma, R. kanagurta and Scomberomorus commerson* were recorded. In Serranidae, *Cephalopholis argus* and *C. miniata* were recorded. In Pomadasyidae, *Pomadasys hasta* and *P. maculates* were recorded. In family Clupeidae, Cynoglossidae, Drepanidae, Gerreidae, Holocentridae, Latidae, Lutjanidae, Muraenesocidae, Nemipteridae, Platycephalidae, Polynemidae, Priacanthidae, Pristigasteridae, Sillaginidae, Sphyraenidae, Stromateidae and Trichiuridae, only one species for each family was recorded throughout the study period.

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Table 1. A list of marketable fishes recorded from Myeik Coastal Water

| Phylum | Class | Family | Genus | Sr.No. | Species | Common Name | Local Name |
|---|---|---|---|---|---|---|---|
| Chordata | Osteichthyes | Clupeidae | *Tenualosa* | 1 | *Tenualosa ilisha* Hamilton-Buchanan | Hilsa shad | Nga-tha-lauk |
| | | Sphyraenidae | *Sphyraena* | 2 | *Sphyraena barracuda* Walbaum | Great Barracuda | Kyi Pwayt Taunt |
| | | Pristigasteridae | *Ilisha* | 3 | *Ilisha elongata* Bennett | Elongate Ilisha | MyetLonnKyel |
| | | Trichiuridae | *Lepturacanthus* | 4 | *Lepturacanthus savala* Cuvier | SavalaniHairtail | Nga Ta Khun |
| | | Scombridae | *Rastrelliger* | 5 | *Rastrelliger brachysoma* Bleeker | Short Mackerel | Pa Lar Lan |
| | | | *Rastrelliger* | 6 | *R. kanagurta* Cuvier | Indian Mackerel | Pa Lar Tue |
| | | | *Scomberomorus* | 7 | *Scomberomorus commerson* Lacepede | Spanish Mackerel | Bee Zinn |
| | | Polynemidae | *Eleuthronema* | 8 | *Eleuthronema tetradactylum* Shaw | Four Finger Threadfin | Za Yaw |
| | | Carangidae | *Carangoides* | 9 | *Carangoides chrysophrys* Curvier | Longnose Trevally | ZarKyann |
| | | | *Carangoides* | 10 | *C. ferdau* Forsskal | Blue Trevally | Ka La Ngu |
| | | | *Megalaspis* | 11 | *Megalaspis cordyla* Linnaeus | Torpedo Scad | Pann Zinn |
| | | | *Parastromateus* | 12 | *Parastromateus niger* Bloch | Black Pomfret | Nga Moke Mei |
| | | | *Selar* | 13 | *Selar boops* Valenciennes | Oxeye Scad | Pann Zinn |
| | | Latidae | *Lates* | 14 | *Lates calcarifer* Bloch | Giant Seabass | KaKa Tit |
| | | Sciaenidae | *Johnius* | 15 | *Johnius belangerii* Cuvier | Belanger's Croaker | Nga GaunnPwa |
| | | | *Pennahia* | 16 | *Pennahia anea* Bloch | Greyfin Croaker | Nga GaunnPwa |
| | | Nemipteridae | *Nemipterus* | 17 | *Nemipterus japonicas* Bloch | Japanese Threadfin Bream | Shwe Nga |
| | | Stromateidae | *Pampus* | 18 | *Pampus argenteus* Euphrasen | Silver Pomfret | Nga MokePhyu |
| | | Drepanidae | *Drepane* | 19 | *Drepane punctata* Linnaeus | Spotted Sickle fish | Sin NarrYwet |
| | | Gerreidae | *Gerres* | 20 | *Gerres filamentosus* Cuvier | WhipfinSilverbiddy | Nge Se Oe |
| | | Lutjanidae | *Lutjanus* | 21 | *Lutjanus johnii* Bloch | John Snapper | Nga Parr Ne |
| | | Pomadasyidae | *Pomadasy* | 22 | *Pomadasys hasta* Bloch | Spotted Javelin Fish | KaLarrGoke |
| | | | *Pomadasy* | 23 | *P. maculatus* Bloch | Saddle Grunt | KaLarrGoke |
| | | Sillaginidae | *Sillago* | 24 | *Sillago sihama* Forsskal | Silver Sillago | Nga The Htoe |
| | | Serranidae | *Cephalopholis* | 25 | *Cephalopholis argus* Bloch & Schneider | Peacock Hind (Grouper) | Kyauk Nga |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | *Cephalopholis* | 26 | *C. miniata* Forsskal | Coral Hind (Grouper) | Kyauk Nga |
| | | Cynoglossidae | *Cynoglossus* | 27 | *Cynoglossus lingua* Hamilton - Buchanan | Long Tongue Sole | Nga KhwyeShar |
| | | Platycephalidae | *Platycephalus* | 28 | *Platycephalus indicus* Linnaeus | Bartail Flathead | Nga Sin Ninn |
| | | Muraenesocidae | *Congresox* | 29 | *Congresox talabon* Curvier | Yellow Pike Conger | Nga Shwe |
| | | Holocentridae | *Ostichthys* | 30 | *Ostichthys japonicas* Vanenciennes | Soldierfish | Nga Ni |
| | | Priacanthidae | *Priacanthus* | 31 | *Priacanthus macracanthus* Cuvier | Red Bigeye | MyetLonnKyee |

Table 2. The price of marketable fish species (US$ per 1 kg), (Source: Department of Fisheries)

| Sr. No. | Scientific Name | Price (US$/kg) |
|---|---|---|
| 1 | *Tenualosa ilisha* | 1.15 |
| 2 | *Sphyraena barracuda* | 1.46 |
| 3 | *Ilisha elongate* | 1.03 |
| 4 | *Lepturacanthus savala* | 1.35 |
| 5 | *Rastrelliger brachysoma* | 0.92 |
| 6 | *R. kanagurta* | 0.80 |
| 7 | *Scomberomorus commerson* | 2.10 |
| 8 | *Eleuthronema tetradactylum* | 2.51 |
| 9 | *Carangoides chrysophrys* | 0.70 |
| 10 | *C. ferdau* | 1.14 |
| 11 | *Megalaspis cordyla* | 1.08 |
| 12 | *Priacanthus macracanthus* | 0.82 |
| 13 | *Selar boops* | 1.08 |
| 14 | *Lates calcarifer* | 3.50 |
| 15 | *Johnius belangerii* | 1.10 |
| 16 | *Pennahia anea* | 1.10 |
| 17 | *Nemipterus japonicas* | 0.97 |
| 18 | *Pampus argenteus* | 5.37 |
| 19 | *Drepane punctata* | 0.49 |
| 20 | *Gerres filamentosus* | 0.70 |
| 21 | *Lutjanus johnii* | 3.50 |
| 22 | *Pomadasys hasta* | 2.00 |
| 23 | *P. maculatus* | 2.00 |
| 24 | *Sillago sihama* | 0.71 |
| 25 | *Cephalopholis argus* | 3.20 |
| 26 | *C. miniata* | 3.20 |
| 27 | *Cynoglossus lingua* | 1.56 |
| 28 | *Platycephalus indicus* | 0.56 |
| 29 | *Congresox talabon* | 1.85 |
| 30 | *Ostichthys japonicas* | 1.36 |
| 31 | *Priacanthus macracanthus* | 0.82 |

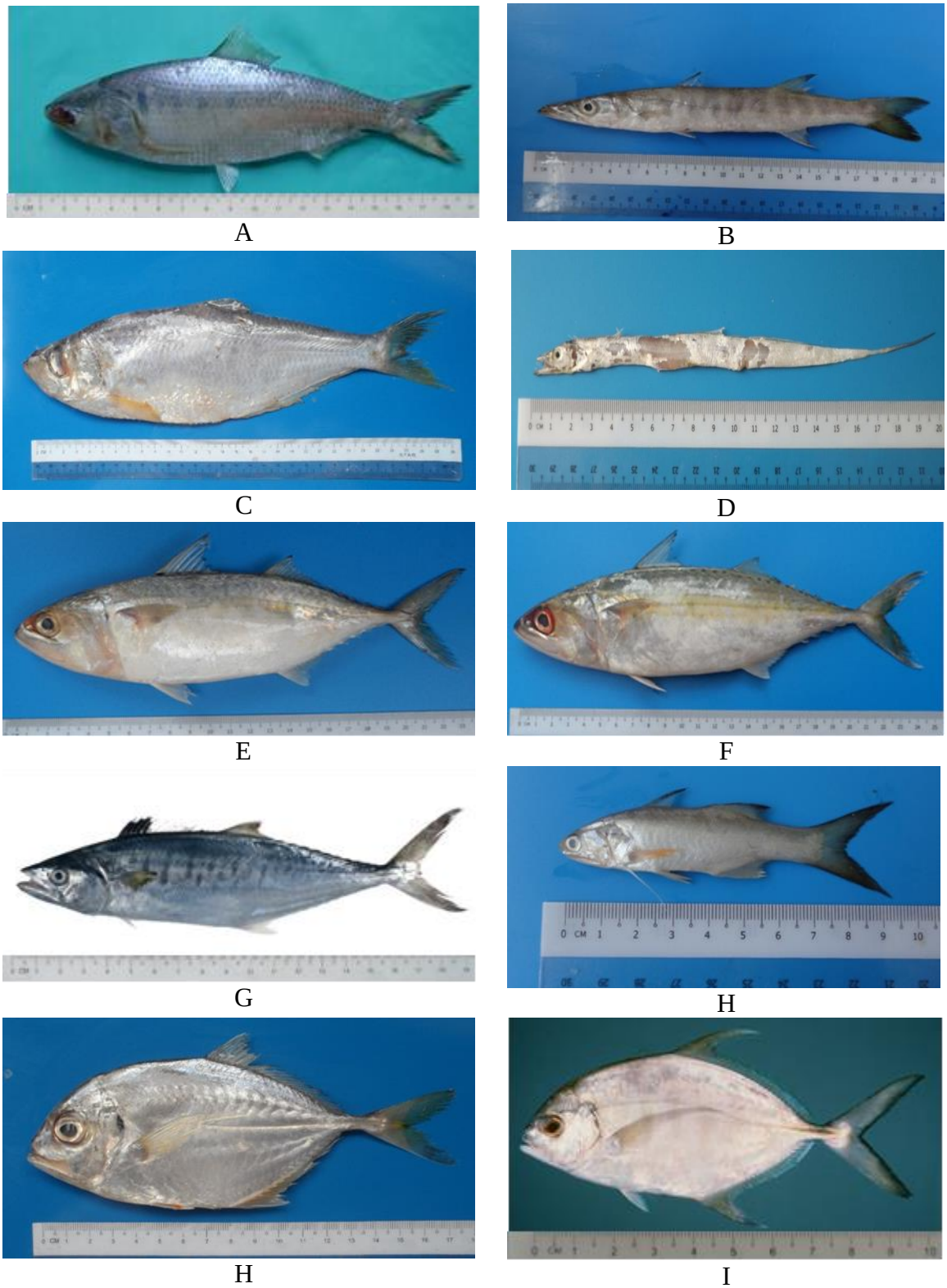


Figure 1. Species found in Myeik Water A) *Tenualosailisha*, B) *Sphyraena barracuda*, C) *Ilishaelongata*, D) *Lepturacanthussavala*, E) *Rastrelligerbrachysoma*, F) *R. kanagurta*, G) *Scomberomoruscommerson*, H) *Eleuthronematetradactylum*, I) *Carangoideschrysophrys*, J) *C. ferdau.*

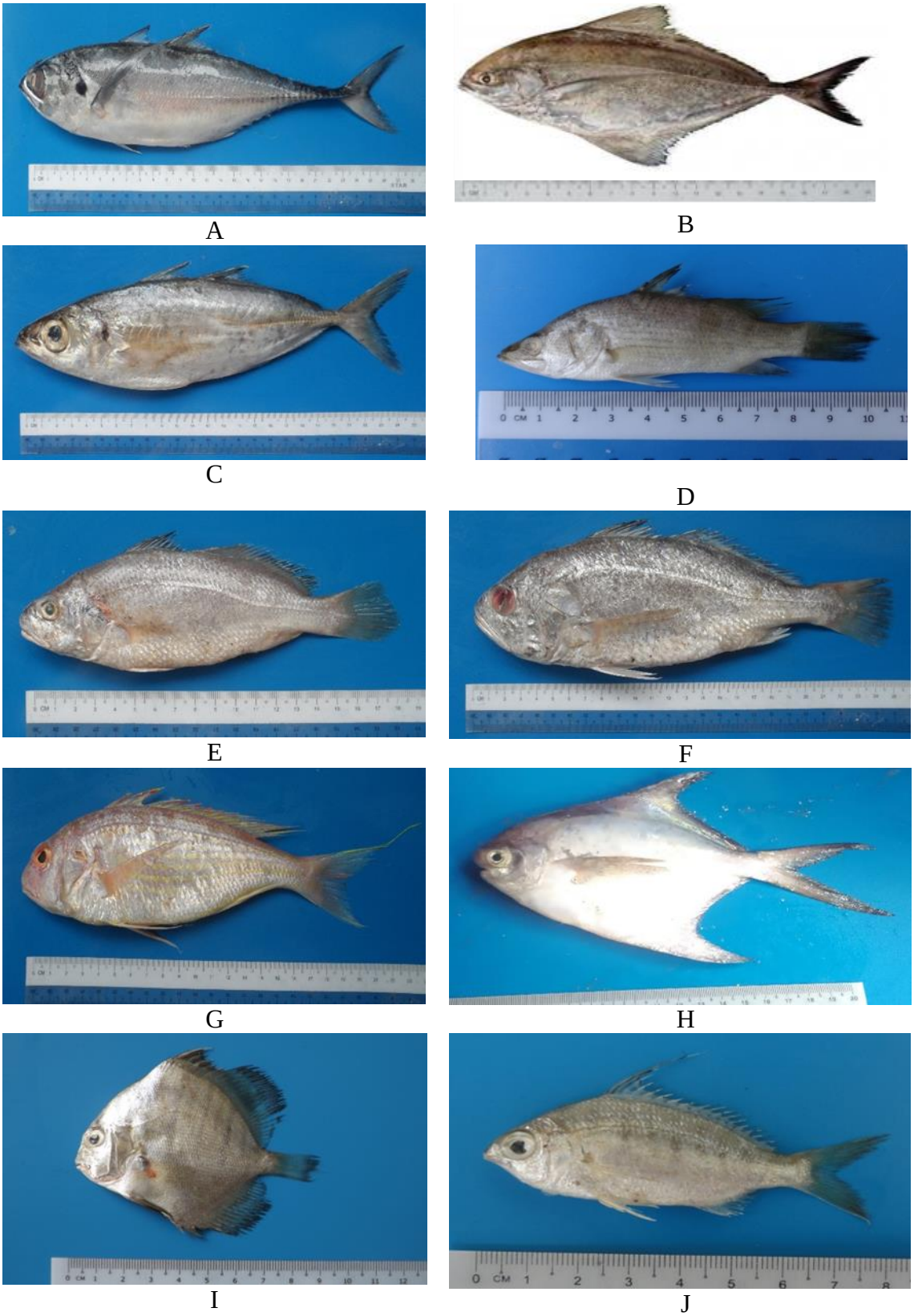


Figure 2. Species found in Myeik Water A) *Megalaspiscordyla*, B) *Parastromateusniger*, C) *Selarboops*, D) *Lates calcarifer*, E) *Johniusbelangerii*, F) *Pennahiaanea*, G) *Nemipterus japonicas*, H) *Pampus argenteus*, I) *Drepanepunctata*, J) *Gerresfilamentosus.*

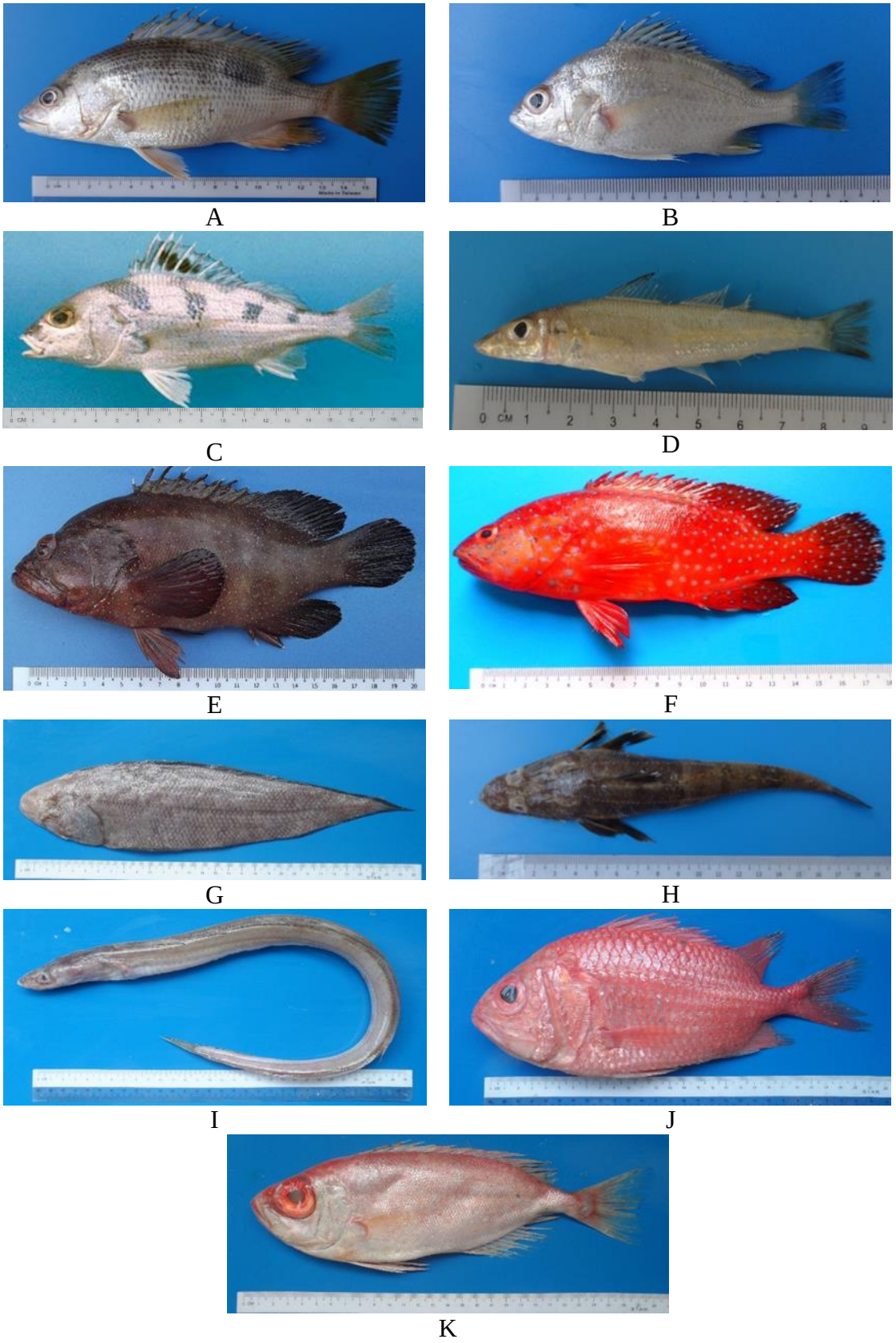


Figure 3. Species found in Myeik Water A) *Lutjanusjohnii*, B) *Pomadasyshasta* , C) *P. maculatus*, D) *Sillagosihama*, E) *Cephalopholisargus*, F) *C. miniata*, G) *Cynoglossus lingua*, H) *atycephalus indicus*, I) *Congresoxtalabon*, J) *Ostichthys japonicas, K) Priacanthusmacracanthus.*

## Discussion

A total of 31 species of fishes including 22 families were recorded in the present study. Among the families, family of Carangidae, *Carangoides chrysophrys*, *C. ferdau*, *Megalaspis cordyla*, *Selar boops* and *Parastromateus niger* were commonly found in the study period. Among this species, *C.ferdau* gets the highest price (1.14US $/kg) and *C. chrysophrys* gets the lowest price (0.69US $/kg). Some of the most commercially important species of demersal and pelagic fishes in Myanmar were the sea catfish, trevally/scad, herring/shad/sardines, snapper, goatfish, sea eel/pike conger, threadfin bream, threadfin, grunt/javelin fish, croaker/drum, mackerel, grouper/sea bass, pomfret, lizard fish, hair tail/ ribbon fish (Marine Capture Fisheries, 2015). Silver pomfret, Snapper fish, grouper, Spanish mackerel, threadfin, Black pomfret, javelin fish and sea eel were also important commercial species in Myeik. Their prices were 5.380US $/kg, 3.5US $/kg, 3.2US $/kg, 2.5US $/kg, 2.51US $/kg, 2.16US $/kg, 2.0US $/kg and 1.85US $/kg respectively. *Pampus argenteus* (silver pomfret) gets the highest price but *Drepane punctata* (spotted sickle fish) gets the lowest price among commercial species in Myeik.

Mya Than Tun (2001) illustrated 351 species of pelagic and demersal fishes belonging to 86 families in Myanmar. He recorded their distinct morphological characters, synonyms, local name, usage, habitat, biology and effective fishery gears. Hla Win *et al.* (2008) listed a total of 248 species as commercially important fishes of Myanmar with marine, freshwater and aquarium fishes, lobsters, crabs, shrimps, squids and cuttlefish of Myanmar with their description, measurements, environment, morphology and biology. But in the present study a total of 31 species as commercially important fishes of Myeik water with marine.

Su Su Hlaing (2018) studied the commercial fishes of Thanlwin River and adjacent waters, Mon State. She observed a total of 96 species of commercial fishes. Among them, nine species of freshwater fishes and 20 species of marine fishes were sold to the foreign. In Myeik, fishes and fish products were exported to neighboring countries especially Thailand. It was important for the local people and it is the main income for them.

## Conclusion

The present study examined the commercial fish in Myeik Coastal Water. The sizes of some commercially important fishes were reducing. And some of them were being over-exploited. The closing of the fishing season can lead to sustaining the replenishing of marine resources especially fishes. The findings will benefit marine fishery studies, and provide baseline information for further studies.

## Acknowledgements

We wish to express our special thanks to Dr. Ni Ni Oo, Rector and Dr. Win Win Than, Pro-Rector of Myeik University for permitting to undertake this research. We wish to extend our deep gratitude to Dr. Nyo Nyo Tun, Professor and Head, Marine Science Department of Myeik University, for giving valuable advice, providing facilities and permitting us to conduct this research.

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# Stomach Contents of *Cynoglossus bilineatus* in Myeik Waters

Sabai Soe[1], Wai Zar Phyo[1], Thet Lyar Win[1] and Hein Zar Htwe[1]

## Abstract

The stomach contents of the *Cynoglossus bilineatus* were studied from June 2017 to May 2018. Stomach contents were studied based on the occurrence method. The composition of food that is related to different size groups was calculated. Crustaceans, molluscs, detritus and miscellaneous were observed in the gut of *C. bilineatus*. Feeding intensity related to size groups and maturity stages showed no significant difference.

**Key words:** Crustaceans, *Cynoglossus bilineatus*, molluscs, detritus

## Introduction

Tonguefishes (Cynoglossidae) are demersal flatfish that are economically and ecologically important in coastal areas throughout the world. Family Cynoglossidae (Tonguesole) consists of 3 genera and 145 species (Gibson 2005 and Nelson 2006). *Cynoglossus* species mainly inhabits the soft muddy bottom, but some inhabit the areas of gravel and sand. The feeding habits of most marine fishes are categorized as carnivorous, omnivorous and herbivorous. The food items of *Cynoglossus* species can be grouped as crustaceans, small mollusks, polychaetes, amphipods, copepods and detritus. The food and feeding habits of *Cynoglossus* species have been studied by various authors (Rao 1989, Seshappa and Bhimachar 1955, Kuthlingham 1957, Khalil 2012). The food and feeding habits of *Sardinella* spp., *Mugil* spp., silver bellies species were conducted in Myeik Coastal Water (Nyo Nyo Tun 2013, Nang Mya Han 2014 and Khin May Chit Maung 2016). There was no study on the stomach contents of *Cynoglossus bilineatus* in Myeik. Therefore, this study aims to identify the food items in the diet of *C. bilineatus* and to know the changes in food items related to their size.

## Material and Methods

Samples were collected from fish landing sites of Myeik from June 2017 to May 2018. A total of eighty-three samples were used for stomach contents. The total length, standard length, body weight was measured. The fish was cut open and removed the stomach. Then, the maturity stages of the gonad were recorded to determine the feeding intensity related to their maturity stages. The feeding intensity was determined by the degree of fullness of the stomach and expressed as actively fed when the stomach was full or ¾ full; moderate when it was ½ full and as poor when it was ¼ full and trace. The occurrence method (Hyslop, 1980) was used for quantitative analysis of food. The frequency occurrence of each food item was examined as:

$$\text{Frequency of occurrence (F\%)} = J_i / P$$

where $J_i$ is the number of fish containing prey i and P is the number of fish with food in their stomach.

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Figure 1. Map showing the study area

## Results

### Food and relation to season

The stomach contents of *Cynoglossus bilineatus* were divided into four main items: crustaceans, molluscs, detritus and miscellaneous. Eighty-three stomachs were examined for the gut contents of *C. bilineatus*. The seasonal occurrence of food items in the stomach contents of *C. bilineatus* was described in Table 1 and Figure 2. All food items were observed throughout the year. Shrimps, small crabs and crab larves included in the Crustacean groups. Molluscs group consists of bivalves and gastropods shell, and *Tellina* species. The percentage composition of different food items in the stomach of *C. bilineatus* was shown in Figure 3.

Table 1. Percentage occurrence of various groups of food items in the stomach of *Cynoglossus bilineatus* in different seasons

| | Pre-monsoon % | Monsoon % | Post- monsoon % |
|---|---|---|---|
| Crustaceans | 22 | 37 | 29 |
| Molluscs | 9 | 7 | 9.5 |
| Detritus | 65 | 43 | 52 |
| Miscellaneous | 4 | 13 | 9.5 |

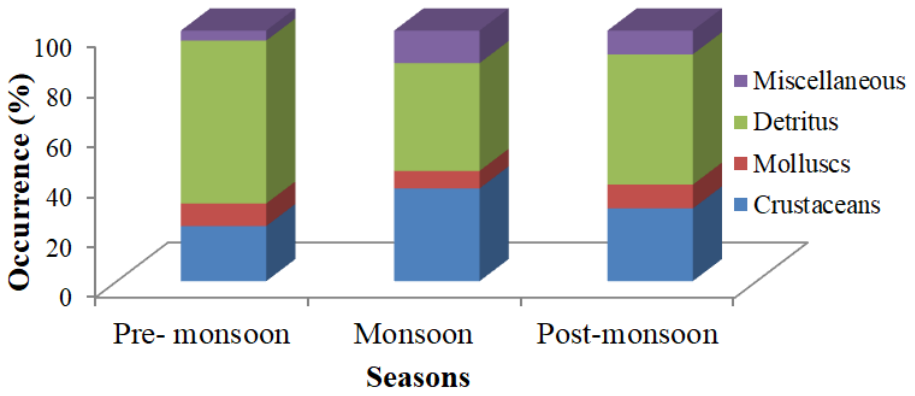


Figure 2. Seasonal percentage occurrence of various food items found in the stomach of *C. bilineatus.*

**The relation between the food and size groups of fish**

The percentage occurrence of various food items of *C.bilineatus* in different size groups was illustrated in Table3. In all size groups of *C. bilineatus*, detritus was observed with high quantity. Crustaceans were observed in all size groups except 18.1-20cm, 24.1-26cm, 28.1-30 and 30.1-32cm size groups. Molluscs occurred only18.1-20cm size group during the study period.

Based on the degree of fullness, the stomach contents of *C. bilineatus* were classified into three categories: actively fed, moderately fed and poorly fed. Actively fed and moderately fed were not observed in all size groups except 10% moderately fed were found in 28.1-30.0 cm size class. Empty stomachs were encountered in all size groups. The relationship between feeding intensity and maturity stages was shown in Figure 3. According to the result, poor feeding activity was encountered at all maturity stages but a few moderately fed was observed at the ripe stages.

Table 2. Percentage occurrence of food items in the stomachs of different size groups of C. bilineatus

| Size groups (cm) | Crustaceans | Molluscs | Detritus | Miscellaneous |
|---|---|---|---|---|
| 12.1-14.0 | 40 | - | 60 | - |
| 14.1-16.0 | 50 | - | 50 | - |
| 16.1-18.0 | 75 | - | 25 | - |
| 18.1-20.0 | - | 33.3 | 66.67 | - |
| 20.1-22.0 | 50 | - | 50 | - |
| 22.1-24.0 | 33.34 | - | 66.67 | - |
| 24.1-26.0 | - | - | 60 | 40 |
| 26.1-28.0 | 50 | - | 40 | 10 |
| 28.1-30.0 | - | - | 90 | 10 |
| 30.1-32.0 | - | - | 100 | - |

Table 3. Feeding intensity of *C. bilineatus* in relation to their size groups

| Size groups (cm) | Actively fed full or ¾ full | Moderately fed ½ full | Poorly fed ¼ full or trace |
|---|---|---|---|
| 12.1-14.0 | - | - | 100 |
| 14.1-16.0 | - | - | 100 |
| 16.1-18.0 | - | - | 100 |
| 18.1-20.0 | - | - | 100 |
| 20.1-22.0 | - | - | 100 |
| 22.1-24.0 | - | - | 100 |
| 24.1-26.0 | - | - | 100 |
| 26.1-28.0 | - | - | 100 |
| 28.1-30.0 | - | 10 | 90 |
| 30.1-32.0 | - | - | 100 |

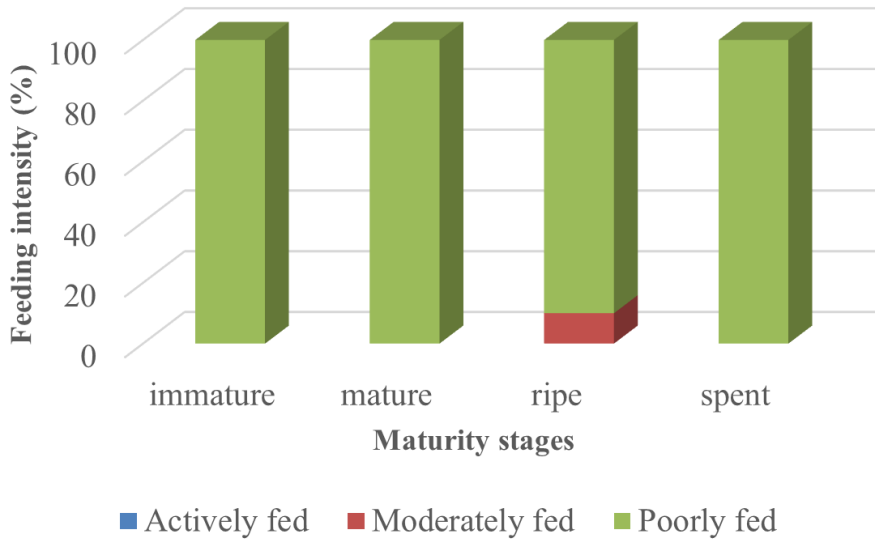


Figure 3. Feeding intensity of *C. bilineatus* in relation to maturity stages

## Discussion

The diet of the fish is related to their intestinal morphology and mouth structure. Morphology of the alimentary canal varied considerably in different fishes with different feeding habits. Stickney, *et al.* (1974) found that the size of the mouth relative to body length was correlated with the size of food. Flatfishes that feed on polychaete and mollusks typically have smaller stomachs, larger intestine, but small gill rakers with fewer teeth were observed in those flatfishes that feed on other items (Tyler, 1973).

On analysis of the gut content, the frequency of occurrence methods was used. The food items were divided into four groups. The seasonal variation of food items was not observed in this study. The present study indicates that *C. bilineatus* are carnivores. Crustaceans are the most favored diet of *C. bilineatus.* Bivalves like *Tellina, Nucula, Arca* and *Cardium* were noticed in the diet of the *C. macrostomus* (Jayaprakash, 2000). In the present study, bivalves: *only Tellina* species were observed in the diet of *C. bilineatus.* The mud and detritus were found in the stomach significantly. Anayzing 83 stomachs, 74 (89.2%)

were found with food and 9 (10.2%) without food. Among them, 1 (1.2%) was ½ full, 73 (87.9%) were ¼ full and 9 (10.9%) were empty.

Asta (2010) observed that the *Cynoglossus* mostly consumed crustaceans which constituted more than 50% of the total food items. These main food items (crustaceans) include the juvenile penaeids, amphipods, prawn, crabs and squilla. In the present study, crustaceans including shrimps and crabs were observed.

The feeding habits of the different size groups indicated differences in their prey preference (Rao, 1989). Even though the sample consists of a size range from 12cm to 32cm (TL) including both juveniles and adults, the variation was not observed in the gut content of *C.bilineatus* throughout the study period. A similar result has been observed by Khalil and Ibrahim (2016). Poorly feed activity was observed in all size groups except 28.1-30.0 cm. Feeding intensity related to maturity stages were not significant. Detritus occurred in the diet throughout the study period. This was the same reported by Jayaprakash (2000). He stated that the food association in fishes is generally ecological and seldom taxonomical. Polychaetes were the favored prey of *Cynoglossus* species (Jayaprakash, 2000; Khalil, 2012, 2016). In the present study, polychaetes were not found in the diet of *C. bilineatus.*

## Conclusion

The result of this study confirmed that *Cynoglossus bilineatus* was carnivores, feed mainly on crustaceans, and mollusks. Detritus were observed significantly throughout the study period.

## Acknowledgements

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# Macrofauna in Restored Mangrove Areas of Magyi, ShweThaung Yan Sub-Township, Pathein

Thet Lyar Win[1], Lett Wai Nwe[1], Thinzar Lwin Lwin[1], Pann Mo Mo[2], Wai Zar Phyo[1]and Chaw Su Lwin[1]

## Abstract

The present study was conducted in mangrove areas of Magyi, Shwe Thaung Yan Sub-Township, Pathein District from 22 April to 26 April 2019. In the present study, a total of 31 species of macrofauna were recorded. Gastropods (21species), bivalves (6species), and crustaceans (4 species) were observed from the study areas. Under the gastropod, the Potamididae was the most represented family with 4 species, followed by Nerithidae, Cerithiidae and Ellobiidae with each of 3 species, respectively. Littorinidae and Nassariidae were consisted of two species in each of both families. In each family of Muricidae, Melongenidae and Assimineidae were described by one species. Bivalve had 6 families (Mytilidae, Isognomonidae, Ostreidae, Cyrenidae, Veneridae and Anomiidae) and each species belonged to each family. Four families (Portunidae, Ocypodidae, Sesarmidae and Alpheidae) under the crustacean were defined by a single species in each family. Sorensen similarity indices of macrofauna were between 0.4 and 0.5 at all stations, that macrofauna similarities were distinct among the stations.

**Keywords:** bivalve, gastropod, crustacean, Magyi mangrove areas

## Introduction

Mangroves are home for many diverse groups of benthic invertebrates such as crabs, gastropods, bivalves, hermit crabs, barnacles, sponges, tunicates, polychaetes and sipunculids (Nagelkerken*et al*., 2008). Macrofauna is one of the benthic invertebrate group which lives on the substrates of mangrove forests such as lower tree trunks and surface sediment and their communities widely separated in high and low intertidal mangroves related to different environmental conditions. Mangroves are widely allocated in all coastal areas of Myanmar. The mangrove forest in Myanmar was 320,106 ha in the early 20$^{th}$ century and about 275,000 ha in Ayeyarwady Delta (Ohn, 1992). Protecting and managing mangrove ecosystems are important for the biodiversity population and also for the economy of the country.

The present study is conducted in Magyi mangrove areas, Shwe Thaung Yan Sub-Township, Pathein District. It has a large mangrove forest along the coast. But before 2015, 75% of mangroves were destroyed in Shwe Thaung Yan. Hence in 2015, the mangrove areas have been restored and protected by plantation cooperated with Worldview International Foundation (WIF)(*https://***www.globalissues.org***/news/2019/01/04/24859)*. The present study aims to record the diversity of mangrove macrofauna in the restored mangrove areas of Magyi.

## Materials and Methods

### Study area

The present study was conducted from 22 April to 26 April 2019 in mangrove areas of Magyi, Shwe Thaung Yan Sub-Township, Pathein District.The location of the study is shown in Figure 1. The sampling sites were restored with mangrove plantation. They were 1 year old and 2 years old. The stations 1,3,4,5,6,7 and 8 were replanted in 2017 whereas station 2 was replanted in 2018.The stations are Station 1 (Lat. 17° 4' 8.080" N, Long.94° 28'

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2.881" E), Station 2(Lat. 17° 4' 45.171" N, Long.94° 28' 12.252" E ), Station 3 ( Lat. 17° 4' 19.062" N,Long.94° 28' 12.389" E), Station 4(Lat. 17° 4' 20.364" N, Long. 94°28'46.242" E), Station 5 (Lat. 17° 4' 2.189" N, Long.94° 29' 8.403" E), Station 6 ( Lat. 17° 3' 50.496" N, Long. 94°29' 29.347" E), Station 7 ( Lat. 17° 3' 33.664" N, Long. 94° 29' 29.732" E) and Station 8 ( Lat. 17° 3' 53.323" N, Long. 94° 29' 58.643" E).

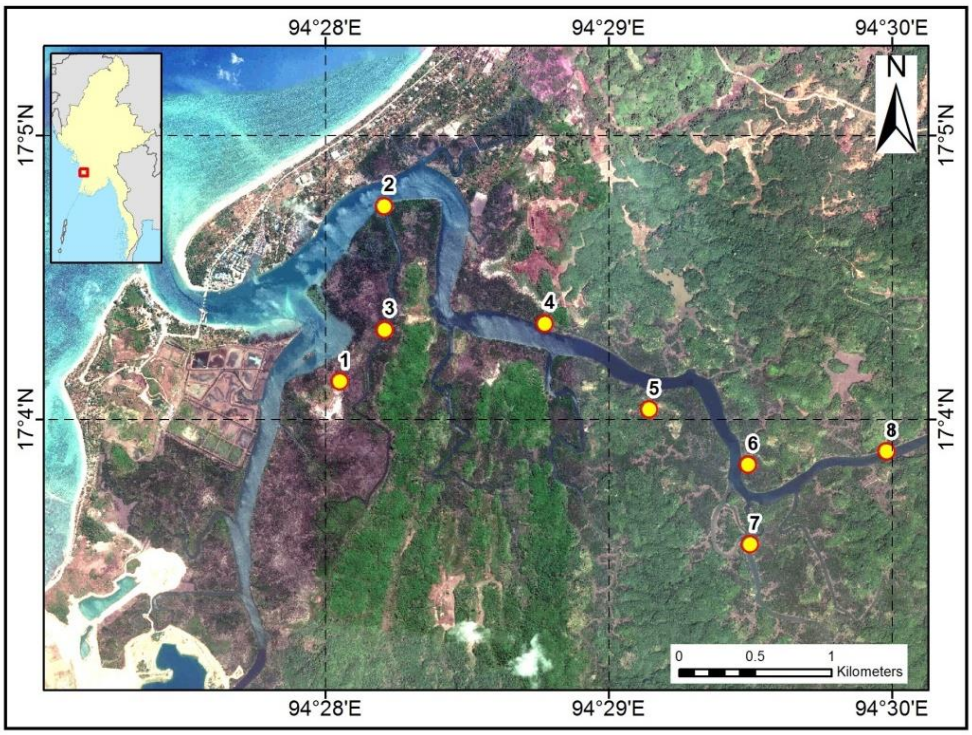



Figure 1. Map showing the study area

**Sample collection and identification**

The research was carried out in the Magyi mangrove tidal creek, and the specimens were collected along the tidal creek at 8 stations. Alive specimens were studied for species diversity and distribution. Gastropods, bivalves, and crustaceans were picked by hand from the mud-flat (substratum), mangrove stems, leaves, roots and pneumatophores throughout the mangrove forests from seaward site to landward site to explore their habitats. Mangrove mud crabs were collected by the trap. Samples obtained for identification were washed, cleaned, photographed and stored in 10 % ethanol. Samples were classified using the following references: Zvonarewva & Kantor (2016) and Carpenter and Niem(Eds,1998). Besides, environmental parameters (salinity and temperature) were measured by refractometer and thermometer respectively at all stations.

**Sorensen similarity index**

The macrofauna similarities between the 8 stations were calculated based on the species presence / absence data using the Sorensen index ( Sorensen, 1948); ( as cited in Chao *et al*.,2005)

$$S_S = 2a / 2a+b+c$$

Where; a= the number of shared species in both sites, b = number of species found in site 1, c = number of species found in site 2.

## Results

A total of 31 mangrove fauna species were recorded from Magyi mangrove areas. The percentage contribution ofthegastropods 68%with (21) species were dominated in the mangrove areas, while bivalves and crustaceans were represented 19% (6 species) and 13% (4) species, respectively (Figure 5). Rich gastropod diversity was recorded at all study sites. The most dominant family of gastropod was Potamididae (4), followed by Ellobiidae (3), Cerithiidae (3), Neritidae (3), Nassariidae (2), Littorinidae(2), Melongenidae (1), Muricidae (1), Assimineidae(1) and Onchidiidae (1), respectively. In bivalves, Mytilidae(1), Isognomonidae(1), Ostreidea(1), Cyrenidae(1),Veneridae(1), Anomiidae (1) were occurred. Portunidae(1), Ocypodidae (1), Sesarmidae (1) and Alpheidae (1)were recorded among crustaceans. The Sorensen similarity indices were less than 0.5 between all stations (Table.4).

Table 1. Lists of mangrove macrofauna occurring in the study areas

| Phylum | Sub phylum | Class | Family | Genus | Sr. No. | Species |
|---|---|---|---|---|---|---|
| Mollusca | | Gastropoda | Neritidae | *Nerita* | 1 | *Nerita planospira* |
| | | | | | 2 | *N. balteata* |
| | | | | *Neripteron* | 3 | *Neripteron violaceum* |
| | | | Littorinidae | *Littoraria* | 4 | *Littoraria carinifera* |
| | | | | | 5 | *L. intermedia* |
| | | | Cerithiidae | *Clypeomorus* | 6 | *Clypeomorus pellucida* |
| | | | | | 7 | *C. bifasciata* |
| | | | | *Cerithium* | 8 | *Cerithium coralium* |
| | | | Potamididae | *Telescopium* | 9 | *Telescopium telescopium* |
| | | | | *Cerithridea* | 10 | *Cerithidea cingulata* |
| | | | | | 11 | *C. obtusa* |
| | | | | | 12 | *C. quoyii* |
| | | | Muricidae | *Chicoreus* | 13 | *Chicoreus capucinus* |
| | | | Nassariidae | *Nassarius* | 14 | *Nassarius olivaceus* |
| | | | | *Hebra* | 15 | *Hebra nigra* |
| | | | Melongenidae | *Volegalea* | 16 | *Volegalea cochlidium* |
| | | | Ellobiidae | *Cassidula* | 17 | *Cassidula aurisfelis* |
| | | | | | 18 | *Cassidula sp.* |
| | | | | *Melampus* | 19 | *Melampus sp.* |
| | | | Assimineidae | *Assiminea* | 20 | *Assiminea brevicula* |
| | | | Onchidiidae | *Onchidium* | 21 | *Onchidium sp.* |
| | | Bivalvia | Mytilidae | *Brachidontes* | 22 | *Brachidontes sp.* |
| | | | Isognomonidae | *Isognomon* | 23 | *Isognomon ephippium* |
| | | | Ostreidae | *Saccostrea* | 24 | *Saccostrea sp.* |
| | | | Cyrenidae | *Polymesoda* | 25 | *Polymesoda erosa* |
| | | | Veneridae | *Gafrarium* | 26 | *Gafrarium tumidum* |
| | | | Anomiidae | *Enigmonia* | 27 | *Enigmonia aenigmatica* |
| Arthropoda | Crustacea | Malacostraca | Portunidae | *Scylla* | 28 | *Scylla sp.* |
| | | | Ocypodidae | *Uca* | 29 | *Uca sp.* |
| | | | Sesarmidae | *Episesarma* | 30 | *Episesarma versicolor* |
| | | | Alpheidae | *Alpheus* | 31 | *Alpheus sp.* |

Figure 2.(1, a-b) *Nerita planospira* 20mm, (2,a-b) *Nerita balteata* 30.5mm, (3,a-b) *Neripteron violaceum* 20mm,(4,a-b) *Littoraria carinifera*10.5mm,(5,a-b) *Littoraria intermedia* 20mm, (6, a-b) *Clypeomorus pellucida*20.2mm, (7,a-b) *Clypeomorus bifasciata* 10.5mm,(8,a-b) *Cerithium coralium* 20mm,(9,a-b) *Telescopium telescopium*70mm,(10, a-b) *Cerithidea cingulata* 20.5mm,(11,a-b) *Cerithidea obtusa* 50mm, (12,a-b)*Cerithidea quoyi i* 30.8mm, (13,a-b)*Chicoreu scapucinus* 50mm,(14,a-b) *Nassarius olivaceus* 40mm

Figure 3.(1,a-b) *Hebra nigra*10.5mm,(2,a-b)*Volegalea cochlidium* 70.5mm, (3,a-b) *Cassidula aurisfeli*s 20.3mm, (4, a-b) *Cassidula sp*.20mm, (5, a-b) *Melampus sp*.10mm,(6) *Assiminea brevicula* 5mm, (7) *Onchidiumsp*.30.2mm, (8, a-b) *Brachidontes sp*.20mm,(9, a-b) *Isognomon ephippium* 60mm,(10, a -b) *Saccostrea sp*. 30mm,(11, a-b) *Polymesoda erosa* 60mm,(12, a-b) *Gafrarium tumidum* 20.5mm,(13, a-b) *Enigmonia aenigmatica* 30.3mm

Figure 4. (1) *Scylla sp*. 50.5mm,(2) *Uca sp*.20mm, (3) *Episesarma versicolor* 40mm, (4) *Alpheus sp*.40mm

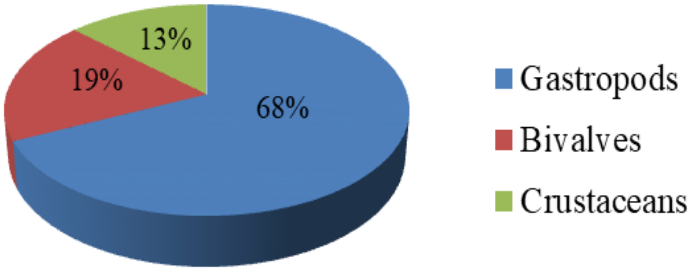
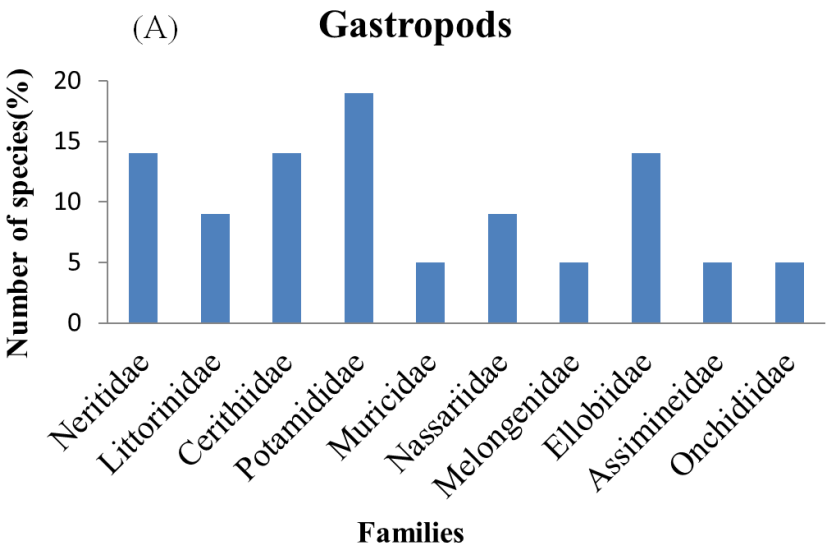
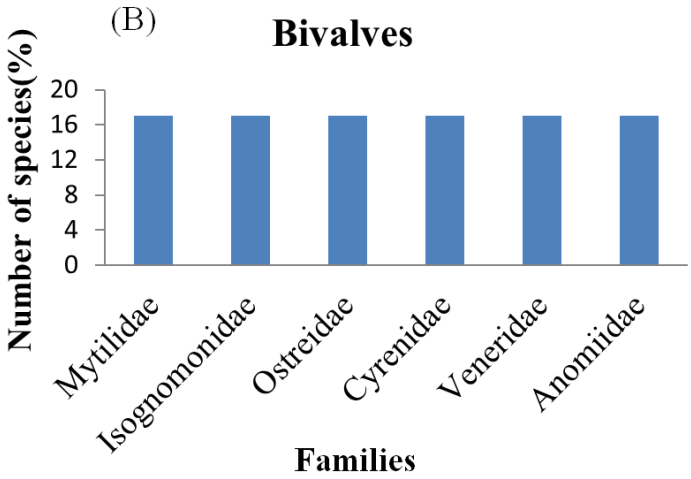



Figure 5. Percentage composition of macrofauna from the study areas





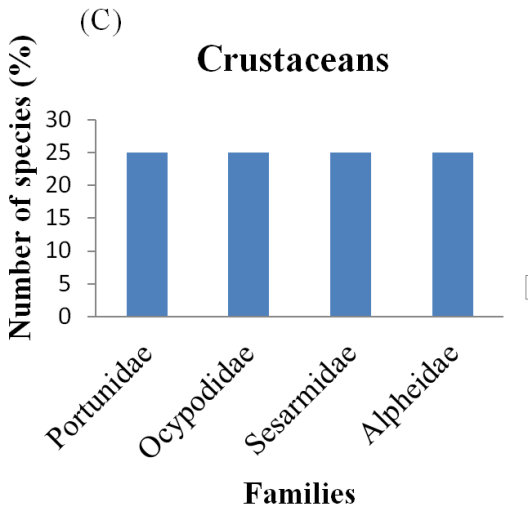




Figure 6. (A, B and C) Family occurrences of gastropods, bivalves and crustaceans

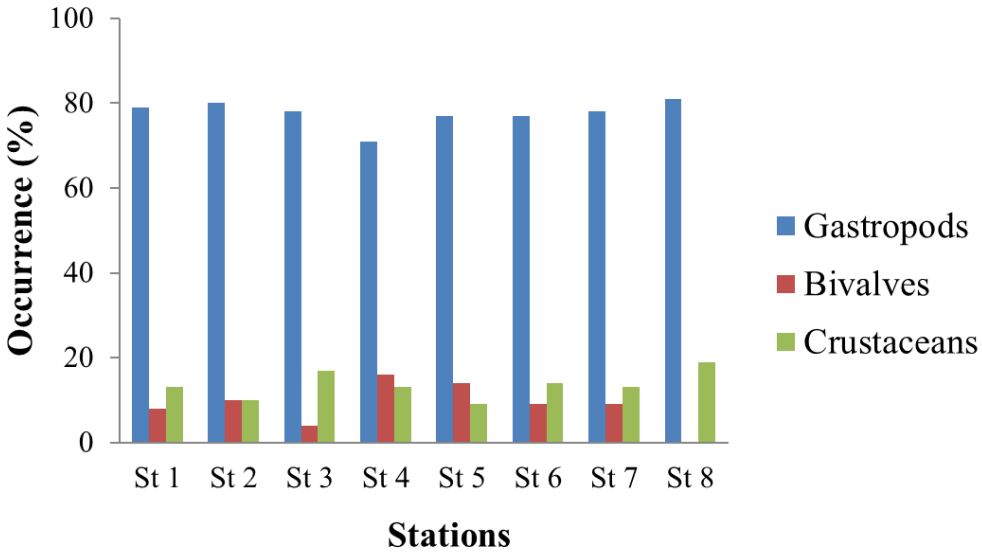



Figure 7.Occurrences of macrofauna at all stations

Table 2. Abundance and habitats of macrofauna( Substratum, Deadwood, Mangrove root, Mangrove stem) from Magyi mangrove areas

| No. | Species | Common name | Abundance | Habitat |
|---|---|---|---|---|
| 1 | *Nerita planospira* | Flat- spire nerite snail | Rare | Mangrove roots and stems |
| 2 | *N. balteata* | Lined nerite | Common | Near mangrove roots |
| 3 | *Neripteron violaceum* | Red mouth nerite snail | Rare | Mangrove stems and roots |
| 4 | *Littoraria carinifera* | Carinate periwinkle | Common | Mangrove roots, leaves, stems |
| 5 | *L. intermedia* | - | Common | Mangrove roots, leaves, stems |
| 6 | *Clypeomorus pellucida* | Mangrove creeper snail | Common | Substratum under the mangrove roots |
| 7 | *C. bifasciata* | Two-banded cerith | Common | Mangrove roots, clusters on the substratum |
| 8 | *Cerithium coralium* | Coral cerith | Common | Clusters on substratum |
| 9 | *Telescopium telescopium* | Horn snail or Telescope snail | Common | Substratum |
| 10 | *Cerithridea cingulata* | Girdled horn shell | Common | Clusters on the substratum under the mangrove roots |
| 11 | *C. obtusa* | Obtuse horn shell | Common | Substratum, mangrove stems |
| 12 | *C. quoyii* | - | Common | Substratum, mangrove stems |
| 13 | *Chicoreus capucinus* | Murex snail or rock snail | Common | Mangrove stems, substratum |
| 14 | *Nassarius olivaceus* | Olive whelks | Common | Substratum under mangrove trees |
| 15 | *Hebra nigra* | Nassa mud snail or Dog whelk | Common | Substratum |
| 16 | *Volegalea cochlidium* | Spiral melongena | Common | Substratum |
| 17 | *Cassidula aurisfelis* | Cat's ear Cassidula | Common | Mangrove stems, substratum between mangrove roots |
| 18 | *Cassidula sp.* | Pulmonate snail | Common | Mangrove stems, substratum between mangrove roots |
| 19 | *Melampus sp*. | - | Common | Mangrove stems, mangrove roots, substratum |
| 20 | *Assiminea brevicula* | Red mangrove snail | Common | Substratum |
| 21 | *Onchidium sp*. | Shell-less marine pulmonate | Rare | Substratum |
| 22 | *Brachidontes sp*. | - | Rare | Mangrove roots |
| 23 | *Isognomon ephippium* | Saddle tree oyster | Common | Rocks and mangroves roots |
| 24 | *Saccostrea sp.* | Edible oyster | Common | Rocks and mangroves roots |
| 25 | *Polymesoda erosa* | Common geloina | Common | Substratum between mangrove roots |
| 26 | *Gafrarium tumidum* | Ribbed venus clam | Rare | Substratum |
| 27 | *Enigmonia aenigmatica* | Mangrove jingle shell | Rare | Roots of *Nypa*plams |
| 28 | *Scylla sp*. | Mud crab | Common | Substratum |
| 29 | *Uca sp*. | Fiddler crab | Common | Substratum |
| 30 | *Episesarma versicolor* | Violet vinegar carb | Common | Substratum |
| 31 | *Alpheus sp*. | Mangrove snapping shrimp | Rare | Substratum |

Table 3. Species composition of macrofauna from different stations of Magyi mangrove areas

| No. | Species | Stations | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | St. 1 | St. 2 | St. 3 | St. 4 | St. 5 | St. 6 | St. 7 | St. 8 |
| 1 | *Nerita planospira* | + | - | + | - | - | - | - | - |
| 2 | *N. balteata* | + | + | + | + | + | + | + | + |
| 3 | *Neripteron violaceum* | + | - | - | - | + | - | - | - |
| 4 | *Littoraria carinifera* | + | + | + | + | + | + | + | + |
| 5 | *L. intermedia* | + | + | + | + | + | + | + | + |
| 6 | *Clypeomorus pellucida* | + | + | + | + | + | + | + | + |
| 7 | *C.bifasciata* | + | + | + | + | + | + | + | + |
| 8 | *Cerithium coralium* | + | + | + | + | + | + | + | + |
| 9 | *Telescopium telescopium* | + | + | + | + | + | + | + | + |
| 10 | *Cerithridea cingulata* | + | + | + | + | + | + | + | + |
| 11 | *C. obtusa* | + | + | + | + | + | + | + | + |
| 12 | *C. quoyii* | + | + | + | + | + | + | + | + |
| 13 | *Chicoreus capucinus* | + | + | + | + | + | + | + | + |
| 14 | *Nassarius olivaceus* | + | - | + | + | - | + | + | + |
| 15 | *Hebra nigra* | - | - | - | + | - | - | - | + |
| 16 | *Volegalea cochlidium* | + | + | + | + | + | + | + | + |
| 17 | *Cassidula aurisfelis* | + | + | + | + | + | + | + | + |
| 18 | *Cassidula sp.* | + | + | + | + | + | + | + | + |
| 19 | *Melampus sp.* | + | + | + | + | + | + | + | + |
| 20 | *Assiminea brevicula* | + | - | + | - | + | + | + | - |
| 21 | *Onchidium sp.* | - | + | - | - | - | - | + | - |
| 22 | *Brachidontes sp.* | - | - | - | - | - | + | - | - |
| 23 | *Isognomon ephippium* | + | - | - | + | + | - | - | - |
| 24 | *Saccostrea sp.* | - | - | - | + | + | + | + | - |
| 25 | *Polymesoda erosa* | + | + | - | + | + | - | - | - |
| 26 | *Gafrarium tumidum* | - | - | - | + | - | - | + | - |
| 27 | *Enigmoniaa enigmatica* | - | + | + | - | - | - | - | - |
| 28 | *Scylla sp.* | + | - | + | + | - | + | + | + |
| 29 | *Ucasp.* | + | + | + | + | + | + | + | + |
| 30 | *Episesarma versicolor* | + | + | + | + | + | + | + | + |
| 31 | *Alpheus sp.* | - | - | + | - | - | - | - | + |
| | Total | 24 | 20 | 23 | 24 | 22 | 22 | 23 | 21 |

Symbols;+ denote Present, - denote Absent

Table 4.Sorensen's similarity index of macrofauna composition among the stations

| Stations | St. 1 | St. 2 | St. 3 | St. 4 | St. 5 | St. 6 | St. 7 | St. 8 |
|---|---|---|---|---|---|---|---|---|
| St. 1 | - | 0.45 | 0.47 | 0.46 | 0.47 | 0.46 | 0.45 | 0.45 |
| St. 2 | 0.45 | - | 0.45 | 0.45 | 0.46 | 0.44 | 0.44 | 0.45 |
| St. 3 | 0.47 | 0.45 | - | 0.43 | 0.44 | 0.47 | 0.46 | 0.46 |
| St. 4 | 0.46 | 0.45 | 0.43 | - | 0.46 | 0.46 | 0.47 | 0.47 |
| St. 5 | 0.47 | 0.46 | 0.44 | 0.46 | - | 0.46 | 0.45 | 0.44 |
| St. 6 | 0.46 | 0.44 | 0.47 | 0.46 | 0.46 | - | 0.48 | 0.46 |
| St. 7 | 0.45 | 0.44 | 0.46 | 0.47 | 0.45 | 0.48 | - | 0.46 |
| St. 8 | 0.45 | 0.45 | 0.46 | 0.47 | 0.44 | 0.46 | 0.46 | - |

Table 5.Soil temperature and salinity from different stations of Magyi mangrove areas

| Parameters | St. 1 | St. 2 | St. 3 | St. 4 | St. 5 | St. 6 | St. 7 | St. 8 |
|---|---|---|---|---|---|---|---|---|
| Temperature(ºC) | 28.8 | 29.1 | 30.2 | 29.7 | 30.9 | 30.2 | 29.3 | 31.6 |
| Salinity ( ppt) | 32.0 | 32.0 | 32.0 | 31.0 | 32.0 | 32.0 | 32.0 | 32.0 |

## Discussion

Mangroves supplied with rich biodiversity resources from microbial diversity to macrofaunal populations (Khade and Mane, 2012). Magyi mangrove areas are dominated by the family Rhizophoraceae and *Avicennia marina*. These genera supports high molluscan diversity.*Molluscs are one of the most abundant invertebrates in the mangrove community.The present study found less bivalve species associated with mangrove forest than gastropod species.* Hein Zar Htwe and Naung Naung Oo (2019) observed a total of 23 species of marine gastropods and bivalves in the mangrove swamps of Myeik Areas, Taninthayi Region, Myanmar.

In the present study, *Nerita balteata, Littoraria carinifera, L.intermedia,Clypeomorus pellucida,C.bifasciata,Telescopium telescopium,Cerithium coralium,Cerithridea cingulata, C.obtusa,C.quoyii,Nassarius olivaceus,Chicoreus capucinus,Volegalea cochlidium, Cassidula aurisfelis, Cassidula sp.*and*Melampus sp*. were recorded from the seaward to the landward through the tidal creek. *The general molluscan species recorded were primarily epifaunal and divided into four occupied habitats (deadwood, plant root, plant stem, and substratum).Gastropods live on both the surface of the mud and mangrove stems while bivalves live mostly in mud (except for Enigmonia aenigmatica and Saccostrea sp.). Chicoreus capucinus was attached to mangrove stems and occurred often on the substratum. Telescopium telescopium was found under mangrove trees , on the substratum and occurred sometimes on muddy banks and flats of soft silt mud.* Puryono and Suryanti (2019) described *T.telescopium* was the most abundant gastropod species in the mangrove forest of Mojo village from Indonesia, In the present study, *T. telescopium* was one of the common gastropod species at all stations.

*Cerithideacingulata, C. obtusa and C.quoyii were found attached to the mangrove stems, rootsand on the substratum.*The genus *Littoraria*(*Littoraria carinifera* and *L. intermeda*) were found mainly on mangrove leaves and stems and roots.The present study agreed withthat record by Khade and Mane (2012)in Raigad district, Maharashtra, West coast of India. Khade (2017) described *Littorina* sp, *Cerithidea* sp, were observed to sandy muddy area swamps, the mud banks, mudflats, mangrove forest, prop-roots and pneumatophores in Raigad district coast of India.Two species of *Nerita* (*Nerita planospira* and *N. balteata* ) were observed on mangrove roots in the present study. In Cerithiidae, three species (*Clypeomorus pellucida, C. bifasciata* and*Cerithium coralium*) were representative of the mangrove areas. The genera *Cassidula* and *Melampus* are restricted to mangroves among Ellobiidae. *Assiminea brevicula* had existed mainly on the substratum.

Bivalve occurrence is generally limited to a very narrow zone of seaward low tide dueto the requirements of feeding and larval settlement. Substrate-living mud clam (*Polymesoda erosa*) is mostly submerged in the substratum, rendering them less visible than epibentic gastropods.*The assemblage of oysters were found on the mud banks, sandy muddy areas, and prop-roots. Isognomon ephippium was attached to wherever hard substratum and between mangrove roots. I.ephippium and Saccostrea sp*.were densely atteached to the hard surface. In the present study, *Enigmoniaa enigmatica* was found attached to roots of *Nypa* plams. It is the similar to the report of Si Thu Hein *etal.*, (2014) in Shwe-pay mangrove in

Myeik Area, Taninthayi Region. Among the crabs, *Uca sp*. and *Episesarma versicolor* were commonly occurred in the study areas. Saravanan *et al.*,(2008) reported that *Uca annulipes* and *Scylla serrata* were caught in Pondicherry mangroves of South India.

## Conclusion

This study provides baseline information of the macrofauna from Magyi mangrove areas, Shwe Thaung Yan Sub-Township. In the present study, 21 species of the gastropods, 6 species of bivalves and 4 species of the crustaceans were observed. Gastropods are generally the abundant groups than the bivalves and crustaceans. *Polymesoda erosa* has potentials for culture in mangrove areas. According to Sorensen similarity index, the values were less than 0.5 between the all stations. These showed that macrofauna similarities were distinct.

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# Morphometric characteristic of Mud Crab, Genus *Scylla* De Haan, 1833 in Myeik and Adjacent Areas

Hein Zar Htwe[1], Sabai Soe[1], Wai Zar Phyo[1] and Thet Lyar Win[1]

## Abstract

The Mud crab (genus *Scylla*) under the family Portunidae collected from Myeik and adjacent areas, such as Kywe-ku, Shwe-Pay, Lighthouse in Myeik Township; Pa-la, Pee-dut, Latt-Ku, Shut-pone in Palaw Township and Taw-Naunk-Le, Ma-Eai, and Pan-Zin in Kyunsu Township were studied to classify the morphometric characteristic during June 2015 to March 2016. Species were monthly collected at landing sites, processing plants, and fishing grounds of Myeik, Palaw and Kyunsu Township. A total of two species of mud crabs namely *Scylla olivaceae* and *S. paramamosain* were recorded. *S. olivaceae* has more abundantly occurred than *S. paramamosain* during the study period. The data conditions of means value ratio, standard deviation and range of analyzed were conducted with 24 morphometric length measurements and 27 morphometric ratios. *Scylla paramamosain* was a higher mean value and deviation ratio exhibiting characters within various size groups than *S. olivaceae*. Moreover, the 27 morphometric ratios of mud crab specimens related to the taxonomic position between the two *Scylla* species. In addition, illustrated descriptions of the male gonopod (G1) of these crabs were described. The differences in morphological characters between the *Scylla* species were categorized into two species during the present study.

**Key words:** Genus *Scylla*, mud crab, Portunidae, taxonomic character

## Introduction

The mud crab is one of the important crustacean species in Myeik Coastal Areas. Among the fishery activities, mangrove-based mud crab fishery is popular in Myeik coastal waters and its vicinity. Reassessment on mud crab fisheries and aquaculture status in Myeik and adjacent water have high economic potential. Intensive fishing activities degraded the size and number of crabs landed. Overharvesting is one of the problems in local crab fishing. And not only this case but also habitat gradually degradation as a result of the development project can factor which may further be degraded what remains after fishing.

The species identification of mud crab (*Scylla* sp.) has been controversial for many years. The difficulties to identify the mud crab species were that they have very similarities of morphology and some overlapping morphometric character between species. Species have similar frontal spine, anterolateral teeth, H- shaped groove present on cardiac region and abdomen or, if different, they overlap from one species to the next (Ng,1998).

In present study focuses on the morphology variations between the *Scylla* species in Myeik and adjacent areas are mixed taxonomic criteria and the morphometric accounts showed the precise data ratio and connective characters within the analysis. The Portunidae may be confused with spanner crabs (Raninidae) and moon crabs (Calappidae: Matutinae), which also possess paddle-like legs. At the same time, the taxonomy of *Scylla* species has been controversial. A precise and sound taxonomic identification of species in the genus *Scylla* is a prerequisite for the hatchery raising of mud crab seeds for aquaculture and also for mud crab fishery's stock enhancement (Viswanathan *et.al* 2012). Thus, baseline systematic morphometric analysis becomes essential in fisheries management.

Therefore, the objectives of the present study on mud crab along Myeik coastal and adjacent areas are: to study the systematic classification of the mud crab, genus *Scylla* in

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Myeik coastal areas, and to high light the morphological characteristic and morphometric account between the two *Scylla* species in Myeik coastal areas.

## Materials and Methods

### Sample collection and identification

Mud crabs were collected from ten stations in the mangrove swamp of Myeik and adjacent areas from June 2015 to March 2016 (Fig.1). The mud crab species were identified mainly through the study of their morphology of shells, color, spine, frontal margin of carapace and teeth. As for taxonomic description and literatures, this study is followed the classification system of genus *Scylla* used by Keenan *et al*. (1998), Ng (1998), Overton (1999), Fushime and Watanabe (2000), Kosuge (2001), Poore (2004), Padate *et al.* (2013) and Trivedi and Vachhrajani (2013). The local name of the studied species was informed by the local crab fishers. A total of 50 individuals of each species was measured for 24 morphometric data analysis by using electronic vernier caliper to the nearest 0.01mm and crab's weight was measured using portable balance to the nearest 0.1 g. The 24 Standardized morphometric data were 12 characters for carapace analysis; Carapace width (CW), Internal Carapace width (ICW), Carapace width at spine 8 (8CW), Carapace length (CL), Posterior width of Carapace (PWC), lateral spine height (LSH), Frontal width (FW), Frontal median spine height (FMSH), Distance between frontal median spines (DFMS), Distance between frontal lateral spines (DFLS), Sternum Width (SW), Abdomen width (AW), 9 characters for cheliped analysis: Dactylus length (DL), Propodus length (PL), Propodus width (PW), Propodus depth (PD), Inner propodus spine (IPS), Outer propodus spine (OPS), Inner carpus spine (ICS), Outer Carpus spine (OCS), Merus Length (ML), and 3 characters for periopod analysis: 5$^{th}$pereiopod dactyl length (5PL), 5$^{th}$pereiopod dactyl width (PW), 3$^{rd}$pereiopod dactyl length (3PML) were also measured in discrimination analysis based on two different species of *Scylla* (Keenan *et al*.,1998). The colouration, localities and date of collection of mud crabs were noted immediately *in situ*.

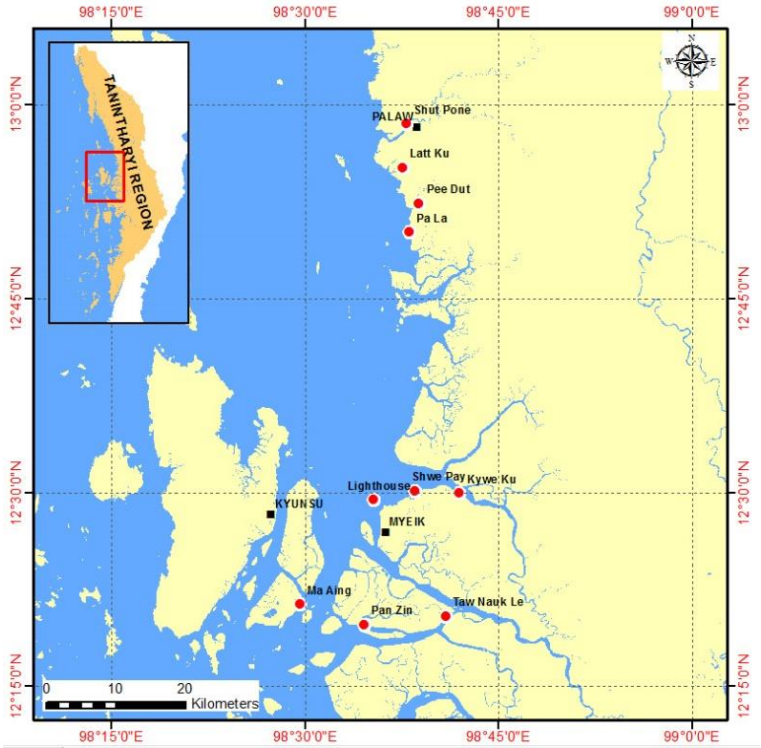


Figure 1. Map showing the study area.

## Results and Discussion

The present study describes the taxonomic account of genus *Scylla* from Myeik. Specimens of crab were collected from 10 different marine sites/ habitats along the coastal region of Myeik and adjacent areas. Of the several species examined on site, 50distinct morphologically samples were selected during the study period. Two different species of genus *Scylla* were identified *viz. Scylla olivacea* and *S. paramamosain.* In general, *S. olivacea* has more abundantly occurred than *S. paramamosain* in the study areas. These mud crabs were the most abundant and economically important species in Myeik Coastal Areas.

**Systematic classification of mud crabs, genus *Scylla* from Myeik and adjacent areas**

Phylum: Arthropoda

Class: Crustacea (Pennant, 1777)

Order: Decapoda (Laterille, 1803)

Family: Portunidae (Dana, 1853)

Genus: *Scylla* De Haan, 1833

Species: (1) *Scylla olivacea* (Herbst, 1796)

(2) *S. paramamosain* Estampodor, 1796

**Key to the species of mud crabs, genus *Scylla* from Myeik coastal and adjacent areas**

1a. Frontal margin usually with low and rounded with shallow interspaces; palm usually with reduced, blunt spine……..….*Scylla olivacea*

1b. Frontal margin usually with high, typically triangular with straight margins and angular interspaces; palm usually with distinct, sharp spine……..……..…..….*S.paramamosain*

***Scylla olivacea* (Herbst, 1796) (Figure-2-3)**

Keenan *et al*, 1998: 233, Figs 7D, 8D, 9D, 14; Ng, 1998: 1118(key), 1127, Kosuge, 2001, Figs 2A,2C

Common name **:** Mud crab (Orange mud crab)

Local name **:** Shunt-Ganunn or Ganunn-me

Description **:** Carapace smooth and glabrous with exception of granular lines on the gastric regions and an epibranchial line starting from the tip of the last antero-lateral tooth and reaching to the brachial regions; antero-lateral margin of carapace longer than postero later margin borders divided into 9 sharp spine and sub equal teeth, last one smallest; H- shaped groove present on cardiac region; Color of carapace and chelipeds are light yellow or rusty brown; Carpus of chelipeds no spine on outer margin; Palm of chelipeds have usually pair of spines on dorsal margin behind insertion of the dactyl, inner lager than outer, outer one is blunt spine; Frontal lobe spines was low and rounded with shallow interspaces. Chelipeds, legs and abdomen for both sexes are not obvious polygonal patterning. Habitat: Associated with mangrove forests and coastlines inundated with reduced salinity seawater. Distribution: South China Sea, Indian Ocean, South East Asia, Pacific Ocean moderately widespread (Keenan *et al*, 1998). Economic importance: Edible species and main exportable crustaceans.

***Scylla paramamosain* Estampador, 1949(Figure-4-5)**

Keenan *et al*, 1998: 232, Figs 7C, 8C, 9C, 13; Ng, 1998: 1118(key), 1128, fig.

Common name : Mud crab (Green mud crab)

Local name : Shunt-Ganunn or Ganunn-me

Description : Carapace smooth and glabrous with exception of granular lines on the gastric regions and an epibranchial line starting from the tip of the last antero-lateral tooth and reaching to the brachial regions; antero-lateral borders with 9 very acute and sub equal teeth, last one smallest; H- shaped groove present on cardiac region; Color of carapace and chelipeds display greenish or brownish grey; Carpus of chelipeds on distal half of outer margin, no two obvious spines; Palm of chelipeds normally a pair of distinct spines on dorsal margin behind insertion of the dactyl; Frontal lobe have typically triangular with straight margins and angular interspaces; Chelipeds and legs with weak polygonal patterning for both sexes. Habitat: Shallow subtidal flats, and mangrove forests. Distribution : South China Sea, Japan, Taiwan, Vietnam, Cambodia, Singapore, Indonesia, South East Asia, Java Sea an abundant species where it occurs (Keenan *et.al*, 1998). Economic importance: Edible species and main exportable crustaceans.

**Comparison of the key morphological character of *S.olivaceae* and *S.paramamosain***

Mud crabs were primarily identified using phenotypic criteria such as the presence of morphological characters: colored of carapace and chelipeds, spine on the carpus of chelipeds, frontal lobe shape, spine on dorsal margin behind insertion of the dactyl, presence with polygonal patterning of legs and abdomen and gonad shape of the male from 10 sampling site. The comparison of the significant key morphological character of both species was shown in Table 1.

Color: light yellow or rusty brown in *Scylla olivacea* and greenish or brownish grey in *S. paramamosain*. Kaliola *et.al* (1993) pointed out that the color of the mud crab can vary from dark to brown to mottled green, depending on the environment. However, Sangthong and Jondeung (2006) classified into three morphs, “black”, “white” and “violet” into three distinct species of *S. olivacea*, *S.paramamosain* and *S. tranquebarica*, respectively.

Spine on the carpus of cheliped: In two species, *S. olivacea* and *S. paramamosain* have the same character on the only spine but some species have one knob. This taxonomy strongly agrees with Keenan (1998) and Ng (1998).

Frontal lobe shape: low and rounded with shallow interspaces in *S. olivacea* and *S. paramamosain* has high and rounded with triangular shallow interspaces. This taxonomic account of lobe character liked as Trivedi and Vachhrajani (2013).

Palm spine on dorsal margin behind insertion of the dactylus: *S. olivacea* has two spines as similar as *S. paramamosain* but the outer spine has short and blunt in *S. olivacea* while the inner spines have long and sharp in both species. It is pertinent to note that these crabs share the character “Palm of chelipeds with pair of distinct spines on dorsal margin behind insertion of the dactyl” with two species *S. olivacea* and *S. paramamosain* described by Keenan *et.al* (1998).

Presence with polygonal patterning of legs and abdomen: Chelipeds, legs and abdomen all without obvious polygonal patterning for both sexes in *S. olivacea* and *S. paramamosain* was chelipeds and legs with weak polygonal patterning for both sexes. This examined agree to morphological character Keenan *et.al* (1998) used morphometric study in two species from its congeners.

Gonad shape of male: *S. olivacea* has long and bluntly pointed apex and slightly convex in outer margin while *S. paramamosain* has short and sharply pointed apex and slightly convex in outer margin. This morphological observation was similar that the study of Keenan *et.al* (1998) and Padate *et.al* (2013) in *S. olivacea*.

All of the distinguished morphometric characters similarly agreed with Keenan (1998), Ng (1998), Fushime and Watanabe (2000), Padate *et al* (2013) and Trivedi and Vachhrajani (2013). Typically, mud crab genders are differentiated based on the shape of the abdomen. Males have a narrow V-shaped; light colored abdomen while those of the females are wider, U-shaped and dark colored. Generally, males often have larger claws. Distinguished via its abdominal shape, having a wider V-shaped than males but not quite the wide U-shaped of female that has lighter color typical of the male are called immature crab or intermediate crab, locally called "Ganunn-gan-duu".

In Myanmar, the first record on the study of crustacean was carried out by De Man (1889) who had reported the fauna of Mergui and its Archipelago. Then, Soe Thu and KhinKhin Than (1988) studied the taxonomy and distribution of Myanmar brachyuran crabs during a period of 38 years ago. Kathy Myint *et al* (2014) were recorded the specie of *S. paramamosain* in Myeik Environments in which the description of specie was generally explained. It may be confused to confirm the specie *S.serrata*. However, there is still no information available for all mud crabs of the Myeik Coastal Areas.

Table 1. Comparison of key morphological characters in determining the species of genus *Scylla* in Myeik and Adjacent Areas

| Morphological characters | *S. olivacea* | *S. paramamosain* |
|---|---|---|
| Carapace and chelae color | light yellow or rusty brown | greenish or brownish grey |
| Frontal margin of carapace | low and rounded with shallow interspaces | high and rounded with triangular shallow inter spaces |
| Carpus spine of chelipeds | absent | absent |
| Spine on palm of chelipeds | one sharp and one blunt spine | two sharp spine |
| Pattern of swimming leg | absent | last two pairs of legs with strong polygonal pattern |
| Gonad shape of male | long and bluntly pointed apex and slightly convex in outer margin | short and sharply pointed apex and slightly convex in outer margin |

**Morphometric characters of *Sylla olivaceae* and *S. paramamosain***

The total of 50 specimens of mud crab species in 10 sampling sites were collected and computed to find the different characters as a part of their metric role. The data conditions of the mean value ratio, standard deviation and range of analyzed were mentioned in Table 2 and Table 3. The discriminate analysis of different shell characteristics of *S. olivacea* and *S. paramamosain* indicated that the accounts (27 distinct parts) contributed mostly to analyze of these confirmed data. This was followed by range (different value of two means), standard deviation and other morphometric characters.

The present observation showed the morphometric ratio of two mud crabs *Scylla* species which were the main 12 characters for carapace analysis, 9 characters for cheliped

analysis and 3 characters for periopod analysis for all data and crabs which were the second most important data is standard deviation ratio for median size groups. From the investigation made it can be suggested that *S. paramamosain* was highly mean and deviation ratio exhibiting a selectivity of characters within various size groups. The value of mean, standard deviation and range of analyzed morphometric character of crabs' specimens of different characteristics of *S. olivacea* were higher than S. *paramamosain* indicated that the ratio of morphological contributed mostly to the external shell structures of these sampled characters. This was followed by carapace length and width, cheliped length and width and periopod length and width. The present study revealed that the nature of shell characters was the mainly standardized, analyzed and 27 morphometric ratios based on their distinctive features. This proved that the 27 morphometric ratios of mud crab specimens related taxonomic position between the two *Scylla* species. And the morphometric analysis was the basic unit with possible preference to mud crabs and their morphotaxonomy.

Figure 2, A – D: Morphology character of *Scylla olivacea*

**A)** General Morphology of *S. olivacea*

**B)** Palm of cheliped **(**Inner one is sharp pointed and outer one is blunt)

**C)** Frontal teeth (round and low)

**D)** Gonopod (G1)

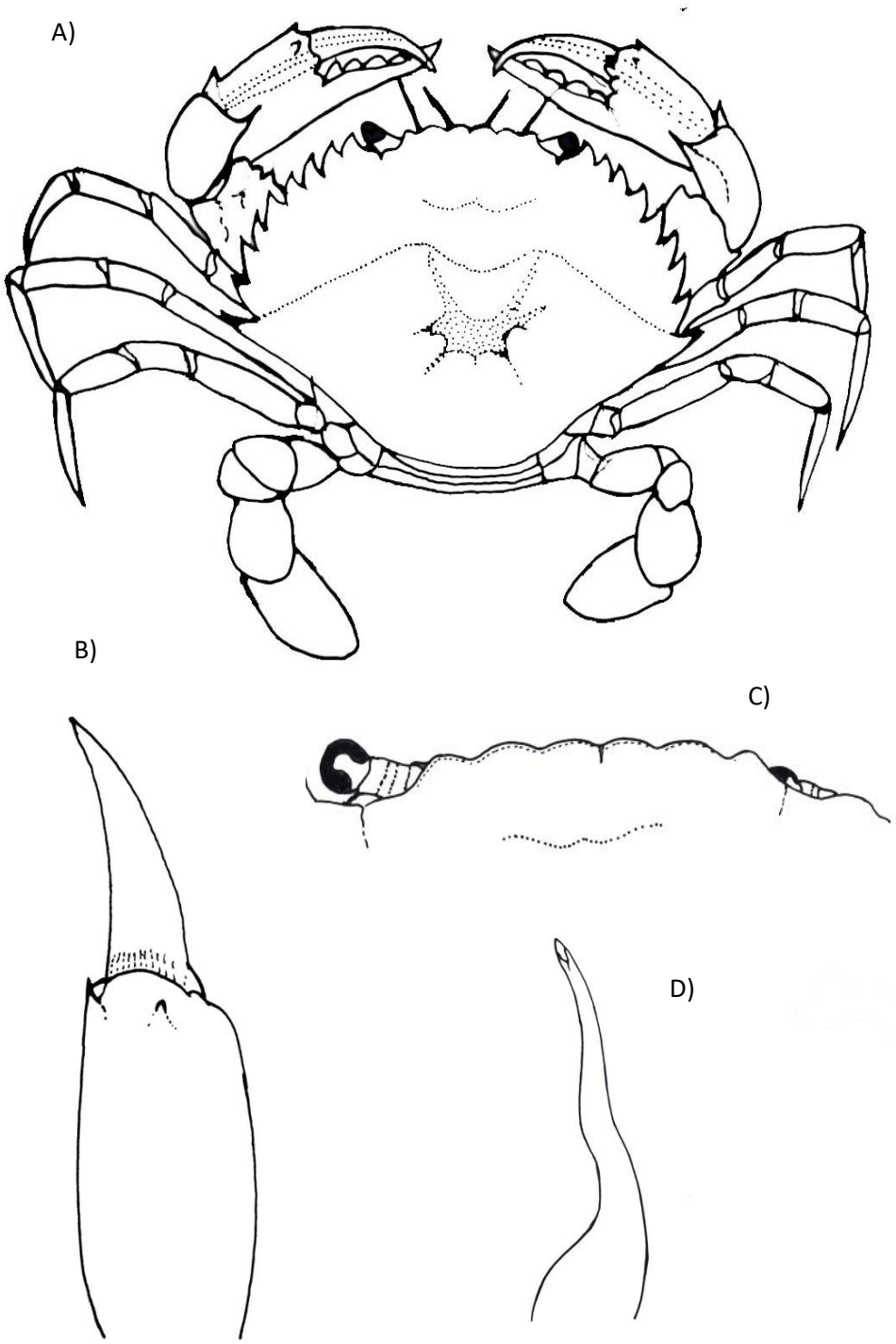


Figure 3, A – D: Sketch diagram of ***Scylla olivacea* (Herbst, 1796)**

**A)** General sketch morphology of *S. olivacea*

**B)** Palm of cheliped **(**Inner one is sharp pointed and outer one is blunt)

**D)** Frontal teeth (round and low)

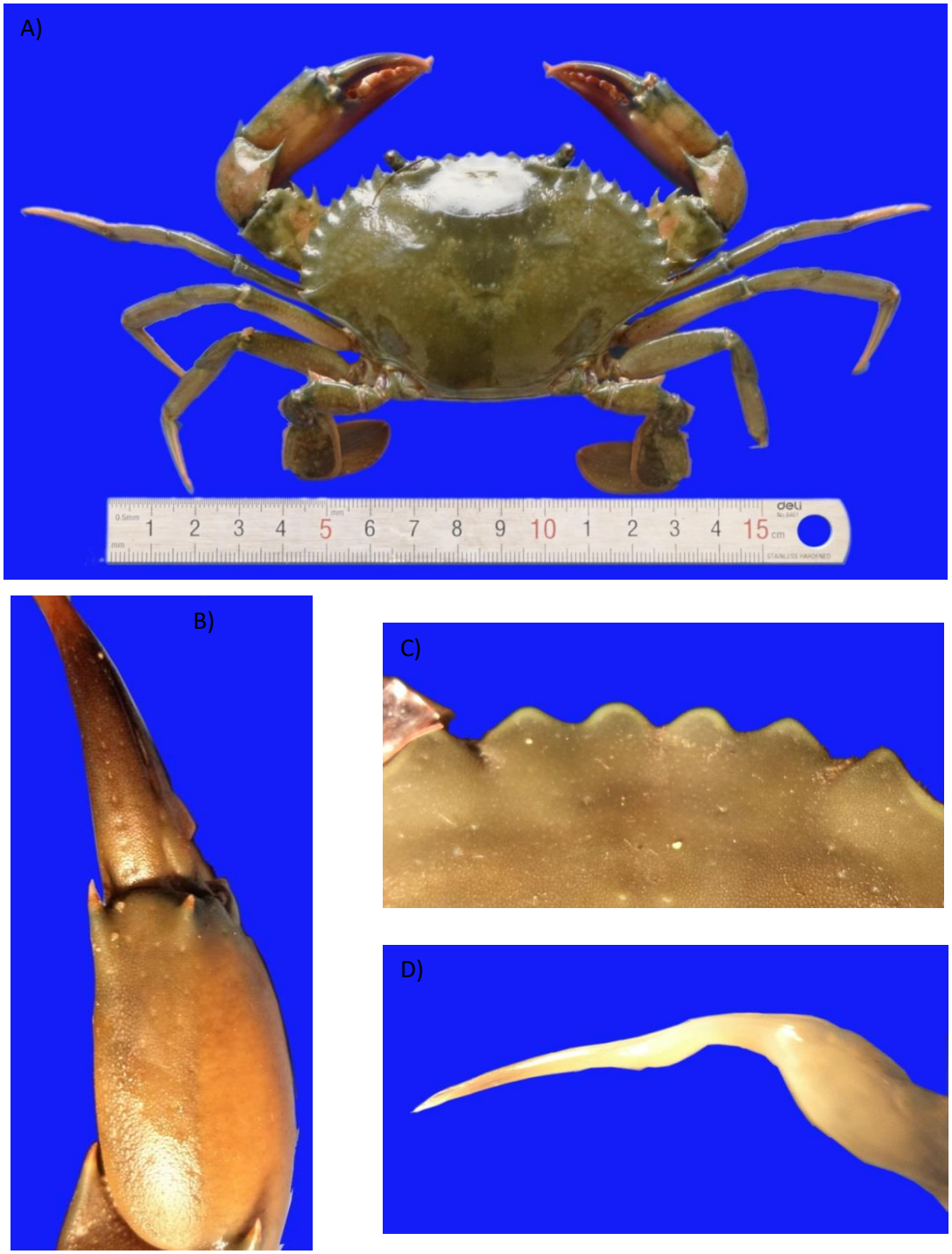


Figure 4, A – D: Morphology character of ***Scylla paramamosain*** Estampador, 1949

A) General Morphology of *S. paramamosain*

B) Palm of cheliped (Inner one is sharp pointed and outer one is reduced sharp on cheliped)

C) Frontal teeth (high and angular interspace)

D) Gonopod (G1)

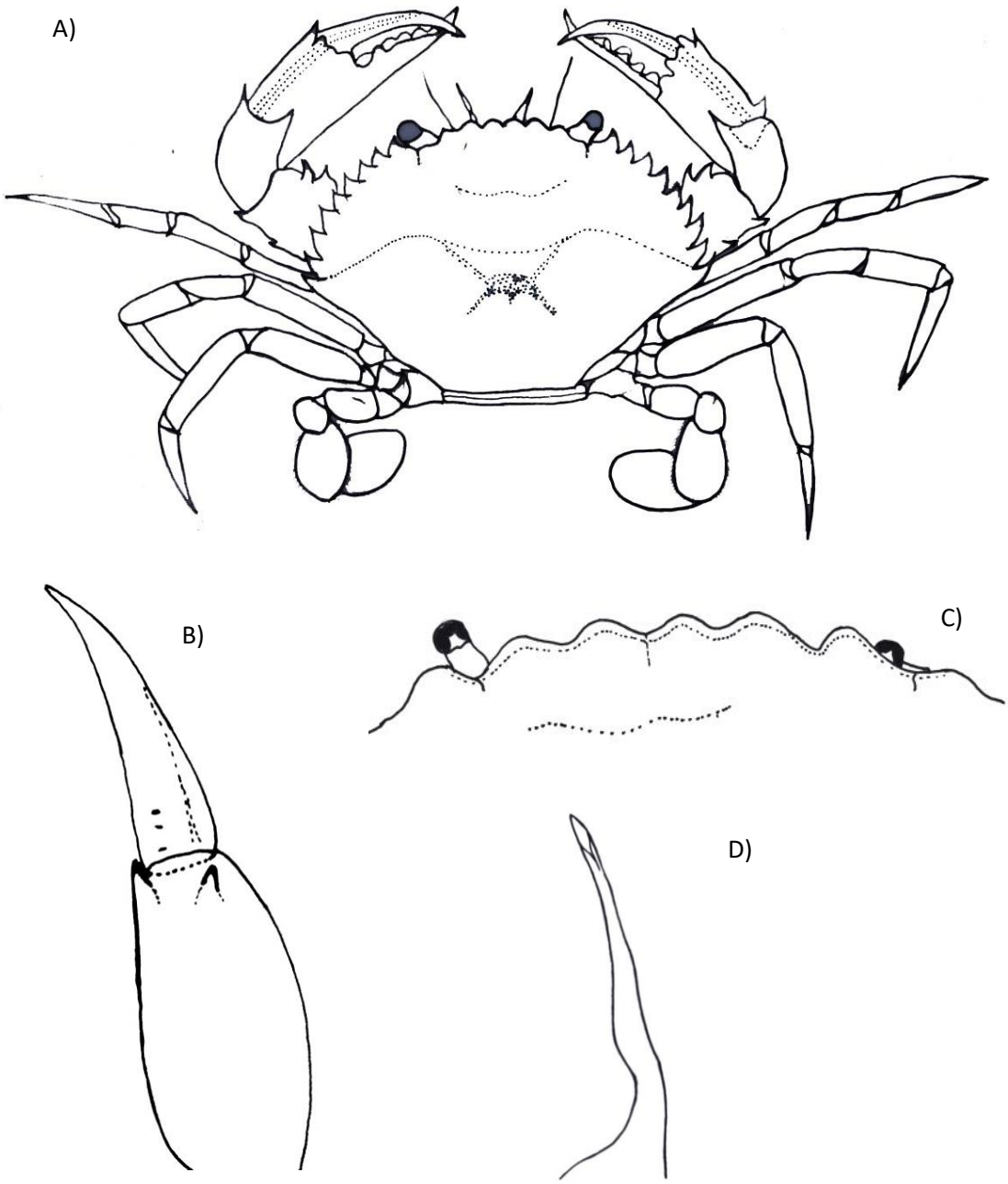


Figure 5, A – D: Sketch diagram of ***Scylla paramamosain*** Estampador, 1949

A) General Sketch Morphology of *S. paramamosain*

B) Palm of cheliped (Inner one is sharp pointed and outer one is reduced sharp on cheliped)

C) Frontal teeth (high and angular interspace)

D) Gonopod (G1)

Table 2. Mean ± SD (Standard deviation) and range of analyzed morphometric character of crab specimens

| No. | Morphometric character | *Scylla olivaceae* | | *Scylla paramamosain* | |
|---|---|---|---|---|---|
| | | Mean ± SD | Range | Mean ± SD | Range |
| 1 | Carapace width (CW) | 90.16±13.00 | 41.75 | 99.60±17.28 | 57.00 |
| 2 | Internal Carapace width (ICW) | 84.89±12.16 | 38.83 | 93.26±14.03 | 45.00 |
| 3 | Carapace width at spine 8 (8CW) | 89.62±12.12 | 35.77 | 93.91±20.94 | 84.00 |
| 4 | Carapace length (CL) | 64.77±8.87 | 26.10 | 74.88±13.74 | 45.00 |
| 5 | Posterior width of Carapace (PWC) | 30.62±6.87 | 22.80 | 36.71±9.36 | 32.00 |
| 6 | $9^{th}$ lateral spine height (LSH) | 2.80±0.87 | 2.76 | 3.10±1.94 | 6.5.00 |
| 7 | Frontal width (FW) | 36.30±5.37 | 24.32 | 40.41±5.03 | 19.00 |
| 8 | Frontal median spine height (FMSH) | 1.08±0.70 | 1.80 | 0.75±0.38 | 1.31 |
| 9 | Distance between frontal median spines (DFMS) | 1.79±0.96 | 4.85 | 0.78±1.09 | 0.20 |
| 10 | Distance between frontal lateral spines (DFLS) | 2.29±3.22 | 5.70 | 0.62±0.60 | 0.11 |
| 11 | Sternum Width (SW) | 44.83±6.91 | 22.36 | 47.87±8.51 | 28.01 |
| 12 | Abdomen width (AW) | 29.32±8.11 | 23.27 | 37.46±13.05 | 38.00 |
| 13 | Dactylus length (DL) | 28.35±4.31 | 12.38 | 30.69±4.53 | 18.00 |
| 14 | Propodus length (PL) | 56.77±9.75 | 32.90 | 59.03±8.10 | 30.00 |
| 15 | Propodus width (PW) | 15.88±12.72 | 10.10 | 15.67±3.88 | 10.00 |
| 16 | Propodus depth (PD) | 20.35±6.38 | 16.19 | 25.248±4.588 | 16.00 |
| 17 | Inner propodus spine (IPS) | 0.63±0.70 | 2.02 | 0.312±0.149 | 0.50 |
| 18 | Outer propodus spine (OPS) | 0.56±0.87 | 2.99 | 0.194±0.055 | 0.10 |
| 19 | Inner carpus spine (ICS) | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | Outer Carpus spine (OCS) | 0.62±0.746 | 1.94 | 0.79±0.72 | 2.00 |
| 21 | Merus Length (ML) | 30.38±4.61 | 16.40 | 32.04±4.34 | 14.00 |
| 22 | $5^{th}$pereiopod dactyl length (5PL) | 25.21±4.83 | 13.10 | 27.28±6.48 | 21.00 |
| 23 | $5^{th}$pereiopod dactyl width (PW) | 12.77±2.75 | 6.79 | 15.06±3.79 | 7.70 |
| 24 | $3^{rd}$pereiopod dactyl length (3PML) | 30.76±6.86 | 23.50 | 32.84±4.20 | 13.00 |

Table 3. Mean, Standard deviation and Range of 27 morphometric ratio of mud crab specimens collected during the present study

| No. | Morphometric ratios | *Scylla olivaceae* | | *Scylla paramamosain* | |
|---|---|---|---|---|---|
| | | Mean ± SD | Range | Mean ± SD | Range |
| 1 | LSH/ICW | 0.0330±0.010 | 0.03 | 0.0320±0.016 | 0.06 |
| 2 | CW/8CW | 1.0057±0.042 | 0.18 | 1.1010±0.263 | 1.02 |
| 3 | CL/ICW | 0.7640±0.047 | 0.16 | 0.8010±0.067 | 0.20 |
| 4 | PWC/ICW | 0.3590±0.049 | 0.19 | 0.3880±0.049 | 0.16 |
| 5 | FW/ICW | 0.4280±0.026 | 0.09 | 0.4360±0.031 | 0.14 |
| 6 | PWC/FW | 0.8390±0.118 | 0.39 | 0.8960±0.149 | 0.43 |
| 7 | FMSH/FW | 0.0310±0.020 | 0.06 | 0.1890±0.009 | 0.03 |
| 8 | FMSH/DFMS | 1.7100±1.140 | 3.03 | 2.1210±1.275 | 4.81 |
| 9 | DFMS/FW | 0.1100±0.040 | 0.13 | 0.0210±0.022 | 0.09 |
| 10 | DFLS/FW | 0.0630±0.050 | 0.13 | 0.0160±0.003 | 0.01 |
| 11 | DFMS/DFLS | 0.5776±0.295 | 1.02 | 1.1840±1.153 | 4.44 |
| 12 | SW/ICW | 0.5280±0.029 | 0.10 | 0.5130±0.041 | 0.12 |
| 13 | AW/SW | 0.6470±0.125 | 0.43 | 0.7610±0.164 | 0.50 |
| 14 | PL/ICW | 0.6700±0.074 | 0.30 | 0.6350±0.043 | 0.15 |
| 15 | DL/PL | 0.5020±0.035 | 0.11 | 0.5210±0.044 | 0.17 |
| 16 | PW/PL | 0.2820±0.058 | 0.21 | 0.2660±0.060 | 0.21 |
| 17 | PD/PL | 0.3520±0.077 | 0.24 | 0.4281±0.001 | 0.16 |
| 18 | PWxPDx0.7854/PL | 4.3820±1.288 | 4.23 | 5.2902±1.521 | 4.90 |
| 19 | IPS/PL | 0.0121±0.015 | 0.05 | 0.0050±0.002 | 0.01 |
| 20 | OPS/PL | 0.0121±0.020 | 0.07 | 0.0030±0.001 | 0.00 |
| 21 | IPS/OPS | 1.4070±1.045 | 2.50 | 1.7051±0.840 | 2.83 |
| 22 | ICS/PL | 0.000 | 0.00 | 0.00 | 0.00 |
| 23 | OCS/PL | 0.0120±0.010 | 0.00 | 0.0200±0.011 | 0.03 |
| 24 | ICS/OCS | 0.000 | 0.00 | 0.00 | 0.00 |
| 25 | ML/PL | 0.5380±0.031 | 0.12 | 0.5480±0.073 | 0.28 |
| 26 | 5PW/5PL | 2.5100±0.052 | 0.23 | 0.5490±0.046 | 0.15 |
| 27 | 3PML/ICW | 0.3610±0.058 | 0.179 | 0.3590±0.064 | 0.23 |

## Conclusion

A total of two species of genus *Scylla* were identified as *S. olivacea* and *S. paramamosain* at the Myeik and Adjacent Areas. Taxonomic descriptions for all these 2 species together with artificial key, photographs and sketch drawings were provided. The revision of the taxonomy of the mud crab species of genus *Scylla* collected from along Myeik Coastal Areas has been carried out mainly based on their external and internal structures such as colored of carapace and chelipeds, spine on the carpus of chelipeds, frontal lobe shape, spine on dorsal margin behind the insertion of the dactyl, presence with polygonal patterning of legs and abdomen and gonad shape of male presented. In standardized morphometric data of genus *Scylla*, the present paper emphasis on the 12 characters for carapace analysis, 9 characters for cheliped analysis and 3 characters for periopod analysis for discrimination analysis. In both species, the morphological characteristics and morphometric ratios were not

differing very much during the study period. However, these were approved that the 27 morphometric ratios of mud crab specimens related taxonomic position between the two *Scylla* species.

## Acknowledgements

We would like to express our gratitude to Dr Ni Ni Oo, Rector of Myeik University and Dr Win Win Than, Pro-rector of Myeik University, for giving permission to conduct this research. We are grateful to Professor Dr Nyo Nyo Tun, Head of Marine Science Department, Myeik University, for her provision of laboratory facilities and reading this research. Thank is also due to Professor Dr. Su Su Hlaing, Marine Science Department for checking and valuable suggestions.

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# Stomach Contents of Cuttlefish (*Sepia aculeata*) in Myeik Area

Pann Mo Mo[1], Thinzar Lwin Lwin[2], Khin Yu Nwe[2],
Aung Aung Aye[2] and Zin Lin Khine[3]

## Abstract

The diet of the cuttlefish, *Sepia aculeata* (Needle cuttlefish) was studied from stomach contents. This analysis was carried out on monthly samples between September 2018 and February 2019. The highest percentage (25%) of full stomachs was recorded in five degrees of fullness: empty, quarter full, half full, three-quarters full and full during the study period. The stomach contents of female were higher than the male. Stomach contents consist of four groups: fishes, crustaceans (shrimps, crabs), cephalopods, and miscellaneous. Among them, 40% of fish were observed and followed by 34% of crustaceans. Fish became the most important prey for *Sepia aculeata*. The dominant diet of males was fish but crustacean dominated in the stomach of females.

**Key words***:* Cuttlefish, *Sepia aculeata*, stomach, diet

## Introduction

Cephalopods are active predators that feed upon shrimps, fishes, other cephalopods, and other mollusks. In turn, cephalopods are major food items in the diets of toothed whales, seals, pelagic birds, and both benthic and pelagic fishes. Cephalopods are extremely important as food for human consumption, and over 3 million tons are caught each year (Boucher-Rodomi *et al.*, 1987).

The cuttlefish, *Sepia aculeata* (Needle cuttlefish), one of the cephalopods species common in trawl catches, has a wide distribution and has been recorded from Indo-Pacific: India to the Andaman Sea and the Gulf of Thailand, South China Sea, Taiwan Province of China, East China Sea, Indonesia and possibly the Timor Sea (Reid *et al*., 2005). This species is one of the most important commercial cuttlefish in the Indo-Pacific region. In Myanmar, especially in Myeik cuttlefish, *S. aculeata* is highly market demands, not only in local but also for export.

*Sepia* species were carnivores and cannibalism cases were also occurring and primarily feed on crustacean, shell molluscs, fishes, and other cephalopods. Abundant information on the diet of *Sepia* in captivity is available (Boletzky and Hanlon 1983). However, there is gap knowledge on the natural food of the species *Sepia aculeate*. In the present study, an attempt had been made to define the food categories in the diet of *S. aculeata* in Myeik Area and to determine the major food items of this species.

## Materials and Methods

Monthly *Sepia aculeate* samples from fish landing sites were conducted between September 2018 and February 2019. One hundred and twenty specimens of *S. aculeata* of both sexes were examined. Their sizes (dorsal mantle length) ranged from 80 mm to 180 mm. Empty stomachs, 14 were removed from the analysis; 106 stomachs were retained. For studying the stomach contents of *Sepia aculeate*, the degree of fullness of the stomachs was determined as empty (0%), quarter full (25%), half full (50%), three-quarters full (75%), and full (100%). Each stomach was dissected out, and stored in 70% ethanol.

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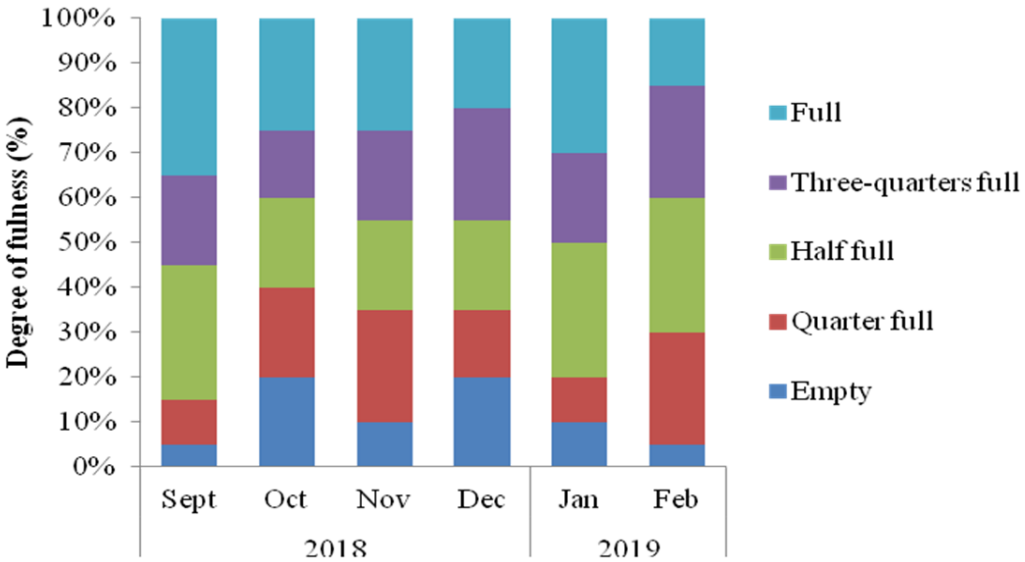
In this study, food composition was examined only based on volume. Stomach contents will be examined into four different food categories: fish, crustacean, cephalopod, and miscellaneous under the dissecting microscope. For each of the different items that constitute the categories will be sorted; remarkable organs have been used to assess the number of prey in the stomach. The percentage of the frequency occurrence was calculated as follow: (Hyslop, 1980)

$$\text{Percentage of the frequency occurrence} = \frac{\text{Number of Stomachs with particular category}}{\text{Total number of stomachs with food}} \times 100$$

## Results

During the study period, 14 stomachs (12%) were with the food and 106 stomachs (88%) were without food. Among them, 17.5% quarter full, 24.67% half full, 20.83% three-quarters full, and 25% full of food were observed. (Fig. 1).




Figue 1. Degree of the fullness of stomach of *Sepia aculeata*

Fish were recorded from their scales, fins, and undigested matters. Crustaceans (shrimp, crabs) were recognizable from their antennae, eyes, mandibles, legs, and various other fragments. Cephalopods were identified from beaks, pieces of arms, suckers, hooks, or photophores on the undigested pieces of the mantle. Miscellaneous contained well-macerated as prey items (crustacean, cephalopod, and other unidentified items) being bitten into small particles by beaks before swallowing. In the present observation, the fish remains consisted mainly of the *Siganus sp*, and the crustacean remains included mainly *Penaeus*, crabs, and isopods.

The percentage of the contents of fish in *Sepia aculeata* was 40%, followed by crustaceans (34%), cephalopod (12%), and miscellaneous (14%). Fish were observed the major food items found in the stomach of *S. aculeata* (Fig. 2). The occurrence of fish in the stomach was significantly higher than the other food groups in this study. The highest percentage of fish contents (43.75%) were recognized in the gut of *S. aculeata*. The contents of crustaceans were higher in September (35.89%) and October (37.03%), 2018. Cephalopod remains were calculated as in a small percentage with the range of 7.68% to 16.28% in the

stomach of *S. aculeata* (Table 1). In October 2018, the frequency of food in the stomach was lower than those observed in the other months. The greatest percentage of prey was found in September 2018 and February 2019 (Fig. 3).

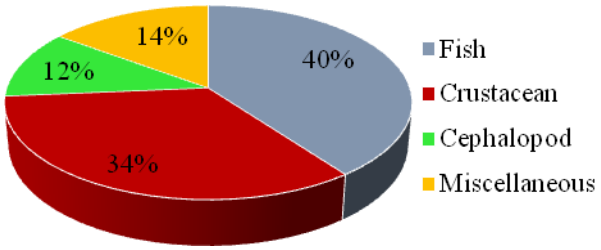



Figure 2. Percentage food composition of various food items in the occurrence of *Sepia aculeate* in Myeik Area

Table 1. Monthly food composition of *Sepia aculeata* in Myeik Area

| Food Categories | Percentage Composition (%) | | | | | |
|---|---|---|---|---|---|---|
| | September | October | November | December | January | February |
| | 2018 | | | | 2019 | |
| Fish | 41.01 | 37.14 | 37.49 | 42.04 | 43.75 | 36.53 |
| Crustacean | 35.89 | 37.03 | 32.85 | 34.02 | 31.25 | 31.32 |
| Cephalopod | 7.68 | 11.10 | 10.67 | 11.90 | 12.37 | 16.28 |
| Miscellaneous | 15.38 | 14.72 | 18.75 | 11.59 | 12.10 | 15.78 |

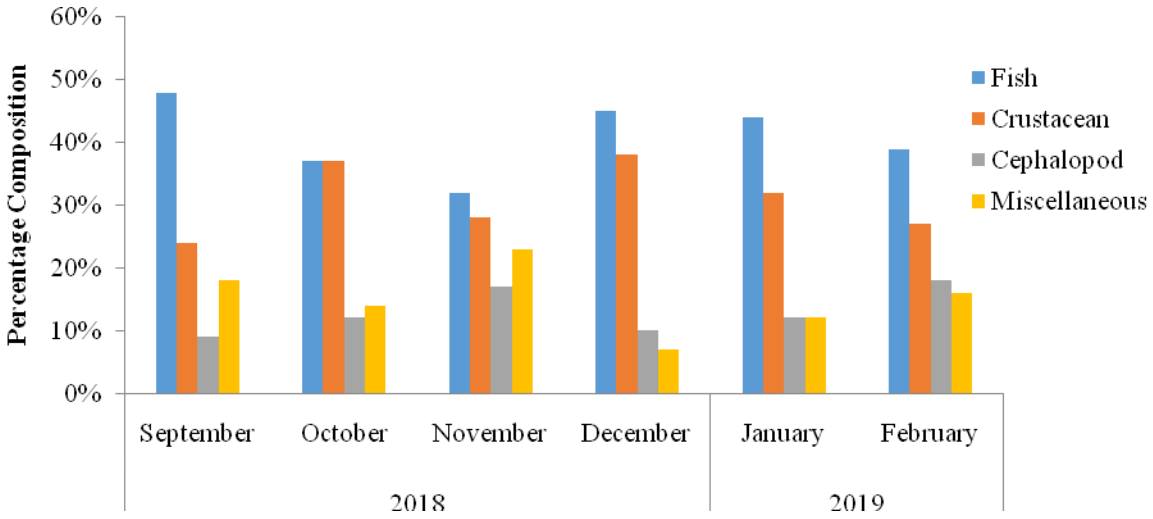



Figure 3. Percentage composition of different food items in the stomach of *Sepia aculeata*

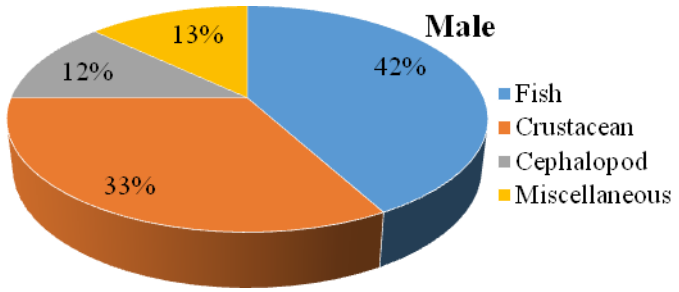



Figure 4. Frequency distribution of different food items in the male cuttlefish in *Sepia aculeata*

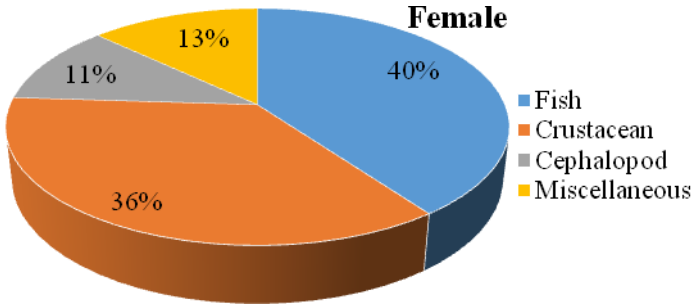



Figure 5. Frequency distribution of different food items in the female cuttlefish in *Sepia aculeata*

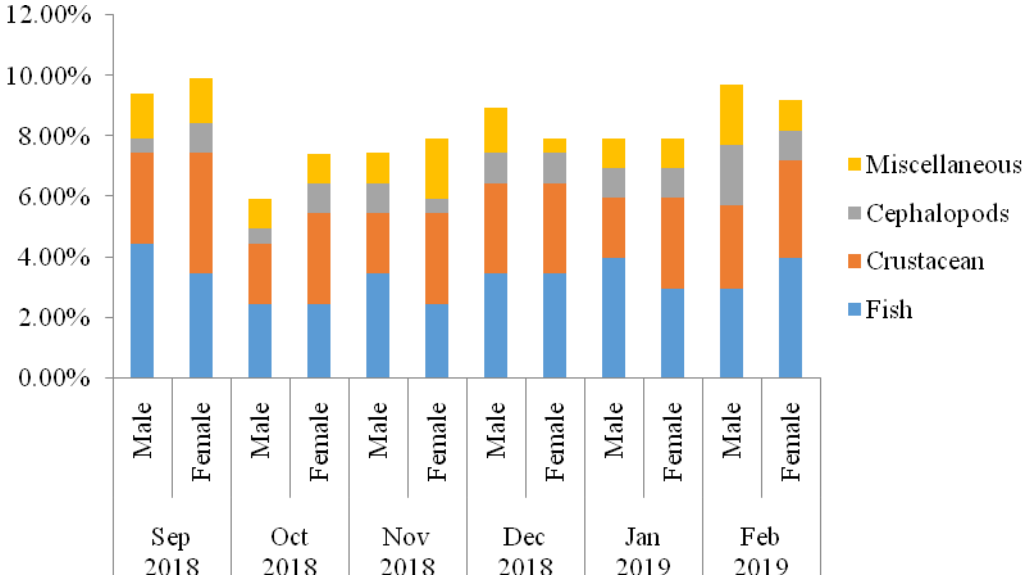



Figure 6. Percentage of feeding condition of *Sepia aculeata* by sex

In Figures 4 and 5, the percentages of each type of prey found in both males and females are given. The frequency percentage of fish was 42% of the total diet in males and 36% of the total diet in the female. The percentage composition of the crustaceans was 33%of the total in males and 40% of total food items in the female. The percentages of miscellaneous were similar (13% of the total) in both sexes and the lowest proportion in cephalopod items; 12% in males and 11% in the female of the total food. The frequent prey items were fish in males and crustaceans in the female. In September 2018, the abundance of food of females was the highest (10% of the total diet of both sexes) during the study period. There was the lowest food composition (6%) was observed in the male stomach in October 2018 (Fig. 6).

## Discussion

The present study revealed that the stomach contents of *Sepia aculeata* common in Myeik area. Four major food groups; fish, crustacean, cephalopod, and miscellaneous were observed in all months of the study period. Fish and crustacean remains were the main food preys in the present study. The fish remains (36.53% to 43.75%) were major prey and followed by crustacean (31.25% to 37.03%) during the study period. There were slight differences in total food groups between males and females. The highest composition of prey in the stomach was found in September and January in both sexes. The full stomachs were recorded in female *S. aculeata.*

Nalwa *et al.,* (2005) have reviewed that the degree of fullness in the stomach of *Sepia aculeata* from Mumbai Coast, India. In their research, full of the stomach was observed a high percentage in four types of fullness. The gorged stomachs were found in the male. Although our present study revealed that the greatest percentage of full of the stomach was recorded in four degrees of fullness, the high numbers of gorged stomachs were found only in female and empty food stomachs were higher in males.

Alves *et al*., (2006) reported that the main diets of *Sepia* species off the south coast of Portugal (eastern Algarve) were fish, and followed by cephalopod and crustacean in their research. During this observation, the main foods of *Sepia aculeata* were fish and crustacean, but cephalopods were found in the lowest proportion.

Oommen (1977) observed that the food of the *Sepia* species from the west coast of India consisted primarily of fishes among crustaceans, molluscs, polychaetes, and cephalopods. Fish was the dominant food for *Sepia aculeata* in my study. It was also noted in the present study that indicated that the stomachs of *Sepia aculeata* consisted of fish, crustaceans, cephalopods but not polychaetes.

The diets of males and females are not significantly different, but gorged stomachs were noticed only in females. Najai and Ktari (1979), and Castro and Guerra (1990) also verified that the diet of males and females was similar in *Sepia* species. Therefore, the present study agreed with their research. The types of prey eaten by both sexes of *Sepia aculeata* are similar. There was no significant difference in both sexes.

## Conclusion

In the present study, fish was the main food items for *Sepia aculeata* in the whole research period. The stomach contents of female were higher than the male. Fish and crustaceans are the most frequent prey in both sexes. Fish were the major components of food in males and crustaceans were the dominant prey in females in all food categories. Overall, there were no significant differences between males and females. This observation can provide for the basic knowledge on the diets of *S. aculeata*. But the further study will be

carried on to the main food of *S. aculeata* according to the seasonal and their size and aged, and their nutritional value.

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