Technical Workshop on Sustainable Peatland Management
Nay Pyi Taw

# Best Management of Peatland in Myanmar: Experience of Agriculture on Peatland:
# A Case Study of Taung Poe Gyi Village

Dr. Aung Kyaw Myint
Assistant Lecturer, Dept. of Agric. Chem
Yezin Agricultural University

European Union

Global Environment Centre

MOECAF

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# Introduction

## Peat soil

- classified as organic soil or a Histosols
- more than half of the upper part 80 cm of the soil is organic
- an organic soil with more than 65% organic matter, composed of partly decomposed plant remains.
  - In contrast, mineral soils have less than 20% organic matter.
- Peat soils develop in waterlogged area.

## Agriculture on Peatland

- Peatlands cover an estimated area of 400 million ha, equivalent to 3% of the Earth's land surface.
- About 14 – 20 % of peatlands in the world are currently used for agriculture
- For agricultural use, the land have to be drained in order to regulate the air and water conditions in the soil to meet the requirements of cultivated crops.

# Peatland in Myanmar

- In Myanmar, surveys for peat soil areas are in the beginning stage and the estimated area will increased as more information becomes available.
- After estimation by aerial photo, GIS and RS methods, ground surveys will be necessary to confirm and to quantify the area of peatland.
- Heho and Inle regions were locally accepted as peatland for their topographical and hydrological situation.
- In those areas, peatland soils were widely used for agriculture. But, awareness to wise-use and sustainable management is needed to be exercised.

## Wise Use of Peatlands

- Minimum drainage or no drainage
- The minimum water table - maintained above 40 cm.
- It is essential that future land use of peatland incorporates the principles and practices of wise use in order to promote sustainable management
- However, every type of human intervention on peatland leads to injury or even loss of natural resource functions (ecology, hydrology, biodiversity, carbon storage).
- Effective peatland management also requires engagement between scientists, policy makers and stakeholders.

# Site Description

## Taung Poe Gyi

- One of the villages on north-western shore of Inle Lake.
- 124 households, a population of 360
- Main livelihood activities is agriculture and fishing
- Major cultivating crops: vegetables such as tomato, cabbage, onion, eggplant, flowers, etc.
- Surrounding area is covered with floating peat at the lake side and, on the other hand, the agricultural lands those were peat soils.
- In the ancient time, the whole village area can be assumed to be under the water level of the Inle Lake.

## Inle Lake

- Second largest inland lake in Myanmar
- 14 miles long and 7 miles wide
- 20° 10′ N and 97° 02′ E
- Globally important for fish diversity, endemism and highest macrophyte diversity in Myanmar
- The flora of the lake is very diverse and has a very high biomass.
- Much of the lake bottom is covered by water plants.

# Map of Myanmar


# Inle lake

# Methodology

## Field Survey

### Collecting of Information

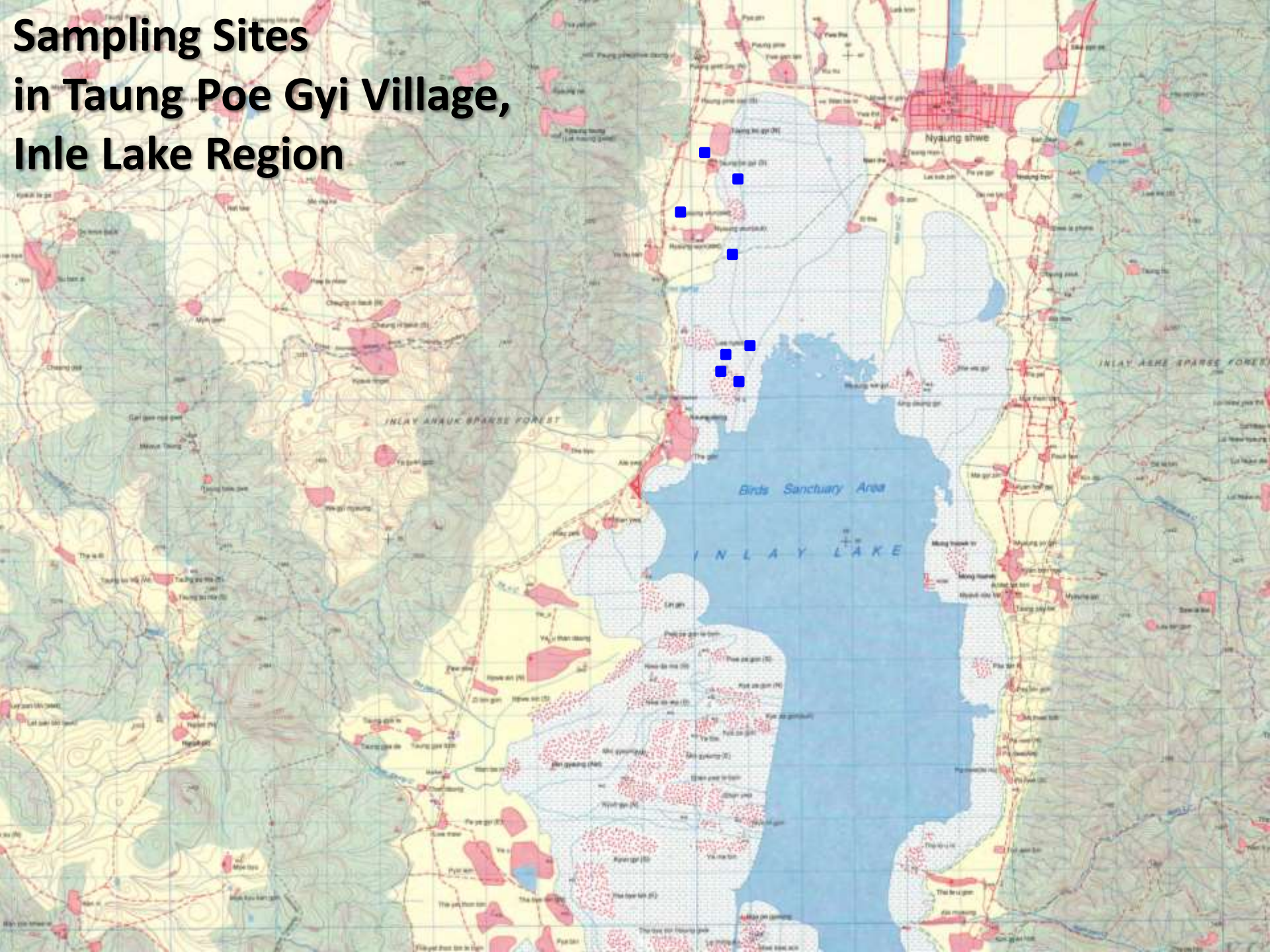
- collected general information of Inle Lake and Taung Poe Gyi area in March, April and June, 2013.
- Survey was conducted a questionnaire–based survey with some households in the village, to explore their socio-economic situation, educational levels, and incomes.
- Some in-depth interview in order to understand how peatland played an important role in their agriculture practices. Informal discussions on the different experience of the local farmers.

# Soil and Water sampling and analyses

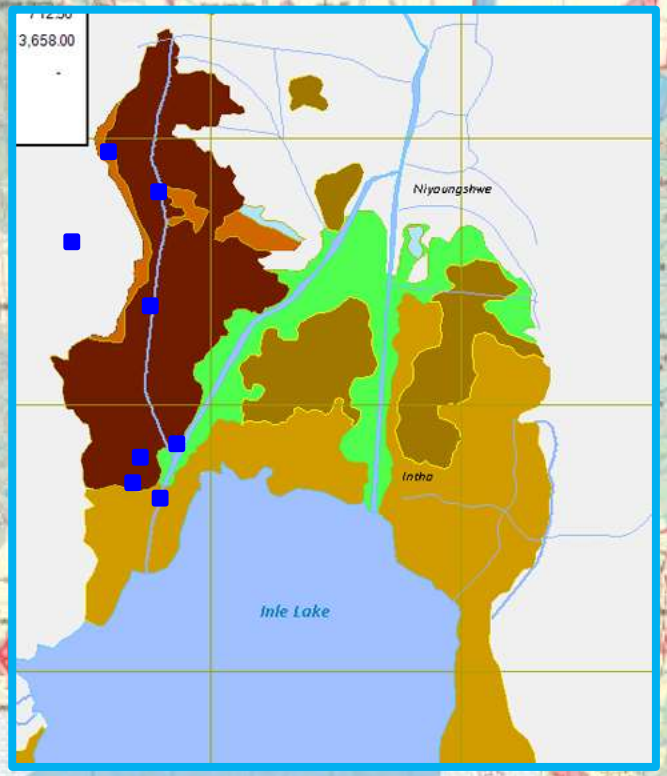
**Collecting of Soil and Water samples**

- 11 water samples were collected from Inle Lake, stream near the village, natural water resources around the village in March, 2013.
- 23 soil samples for lab analysis during March - June, 2013 were collected and sent water and soil samples to the laboratory of Department of Agricultural Research (DAR).
- Analyzed the soil and water sample for their physicochemical properties

# Sampling Sites in Taung Poe Gyi Village, Inle Lake Region

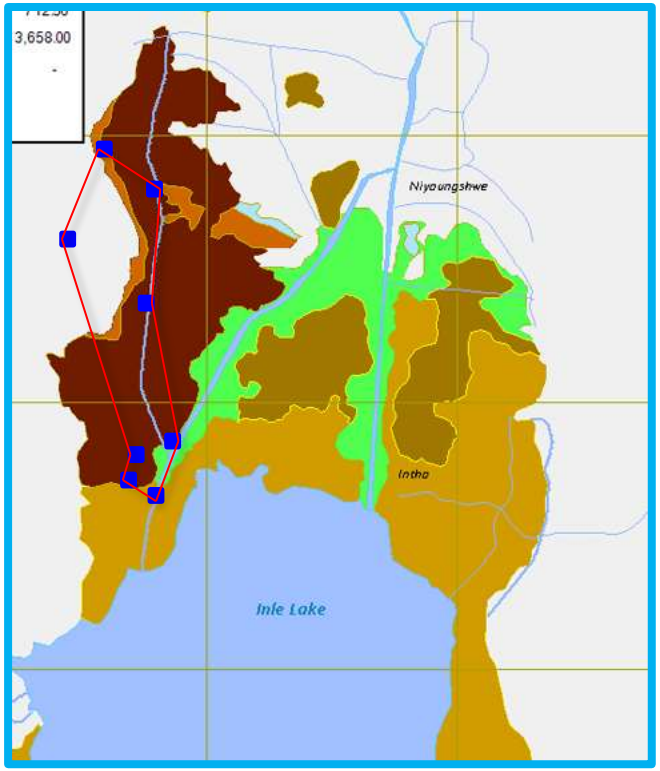


# Sampling Sites in Taung Poe Gyi Village, Inle Lake Region



# Sampling sites comparing to peatland and potential peatland in Inle Lake area

## (based on the Dr. Quoi's GIS map)




- Potential Peatlands
- Colluvials/ Peatlands
- Peatlands
- Floating Peatlands
- Floating vegetation area
- Water Body (Lake)

**Table 1. List of places where soil samples were collected around Taung Poe Gyi (TPG) and Inle Lake Region, NyaungShwe Township, Southern Shan State**

| Sample Number | Place Description | Lat/ Long | Sampling Depth (cm) |
|---|---|---|---|
| S-1 | TPG north (flower field) | N 20 39 12.8, E 96 53 14.2 | 0 - 30 |
| S-2 | TPG north (Tat Twin Gon, cauliflower field) | N 20 39 02.8, E 96 53 20.6 | 0 - 30 |
| S-3 | TPG north (Tat Twin Gon) | N 20 39 02.8, E 96 53 20.6 | 0 - 30 |
| S-4 | TPG north (Say Taung) | N 20 39 34.9, E 96 53 35.8 | 0 - 30 |
| S-5 | TPG north (beside the monastery) | N 20 39 03.0, E 96 5624.8 | 0 - 30 |
| S-6 | TPG (U Shwe, DawNyeinHtwe's farm) | N 20 39 16.5, E 96 53 14.2 | 0 – 15 |
| S-7 | TPG (U Shwe, DawNyeinHtwe's farm) | | 15 - 30 |
| S-8 | TPG (Tat Twin Gon) | N 20 39 06.6, E 96 53 10.8 | 0 – 15 |
| S-9 | TPG (Tat Twin Gon) | | 15 - 30 |
| S-10 | In-Oo (U Mya's tomato farm) | N 20 36 45.0, E 96 53 40.3 | 0 – 15 |
| S-11 | In-Oo (U Mya's tomato farm) | | 15 - 30 |
| S-12 | LweNyaint (U KhinMaung Aye's Eggplant farm) | N 20 37 05.3, E 96 53 02.8 | 0 – 15 |
| S-13 | LweNyaint (U KhinMaung Aye's Eggplant farm) | | 15 - 30 |
| S-14 | NyaungWunLaeShae (Cauliflower farm) | N 20 3831.9, E 96 53 34.5 | 0 – 15 |
| S-15 | NyaungWunLaeShae (Cauliflower farm) | | 15 - 30 |
| S-16 | TPG north (Tomato farm) | N 20 38 07.3, E 96 53 29.5 | 0 – 15 |
| S-17 | TPG north (Tomato farm) | | 15 - 30 |
| S-18 | Mid NyaungWun (Tomato farm) | N 20 39 12.8, E 96 53 14.2 | 0 – 15 |
| S-19 | Mid NyaungWun (Tomato farm) | | 15 - 30 |
| S-20 | TPG south (Corn farm) | N 20 38 54.5, E 96 53 23.6 | 0 – 15 |
| S-21 | TPG south (Corn farm) | | 15 - 30 |
| S-22 | TPG north (U Sa Paw, DawKyiAung's farm) | N 20 39 12.8, E 96 53 29.2 | 0 – 15 |
| S-23 | TPG north (U Sa Paw, DawKyiAung's farm) | | 15 - 30 |

# Water resource on the Peat Dome (Taung Poe Gyi Village)

**Table 2. Some characters of water used for household purposes around Taung Poe Gyi (TPG) and Inle Lake Region where in relation to peat soil**

| Character Description | Unit | Taung Poe Gyi village and nearby area | | | | | | Inle Lake | Allowable limit for drinking water |
|---|---|---|---|---|---|---|---|---|---|
| | | TPG Stream | Above PD | PD foot | PD side | PD lower side | Near PD (monastery) | | |
| pH | - | 7.74 | 7.53 | 7.51 | 7.42 | 7.40 | 7.28 | 7.48 | 6.5 – 8.5 |
| EC | dS $m^{-1}$ | 0.49 | 0.63 | 0.66 | 0.64 | 0.63 | 0.63 | 0.59 | 0.25 – 0.75 |
| Ca | ppm | 90.35 | 144.35 | 146.30 | 147.2 | 149.0 | 151.33 | 62.25 | 75 – 250 |
| Mg | ppm | 7.52 | 8.06 | 8.55 | 7.89 | 8.95 | 9.31 | 28.33 | 50 – 125 |
| Na | ppm | 2.22 | 2.49 | 2.74 | 2.58 | 2.68 | 3.03 | 8.87 | 200 |
| K | ppm | 1.06 | 0.80 | 0.83 | 0.76 | 0.76 | 0.98 | 1.50 | 20 |
| $CO_3$ | ppm | Nil | Nil | Nil | Nil | Nil | Nil | Nil | 350 |
| $HCO_3$ | ppm | 274.5 | 285.48 | 362.32 | 395.28 | 373.32 | 384.3 | 395.28 | 1000 |
| Cl | ppm | 40.99 | 34.16 | 40.99 | 40.99 | 34.18 | 27.33 | 47.83 | 200 |
| $SO_4$ | ppm | 9.0 | 43.5 | 39.0 | 37.5 | 45.0 | 39.0 | 7.50 | 250 |
| Fe | ppm | 0.1033 | 0.6754 | 0.0498 | 0.1799 | 0.1387 | 0.1124 | 0.1213 | 0.10 – 0.30 |
| Mn | ppm | 0.0237 | 0.0199 | 0.0193 | 0.0159 | 0.0188 | 0.0204 | Nil | 0.3 |
| Cu | ppm | 0.0507 | 0.0451 | 0.0442 | 0.0453 | 0.0366 | 0.0370 | Nil | 1.00 |
| Zn | ppm | 0.0744 | 0.0668 | 0.0685 | 0.0692 | 0.0928 | 0.0846 | 0.0581 | 5 – 10 |
| SAR | - | 0.06 | 0.05 | 0.059 | 0.056 | 0.057 | 0.0645 | 0.2332 | - |

Note: PD = peat dome; EC = electrical conductivity; SAR = sodium adsorption ratio; dS $m^{-1}$= deci Siemens per meter; ppm = parts per million.


Water resource of the nearby stream

**Table 3. Some physicochemical properties of soil samplecollected around Taung Poe Gyi (TPG) and Inle Lake Region, NyaungShwe Township, Southern Shan State**

| Sample Number | pH | Bulk density (g $cm^{-3}$) | Available nitrogen (mg $kg^{-1}$) | Available Phosphorus (mg $kg^{-1}$) | Available potassium (mg $kg^{-1}$) | Organic matter (%) | Water soluble Sulphate (mg $kg^{-1}$) | DTPA extractable zinc (mg $kg^{-1}$) | DTPA extractable iron (mg $kg^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|
| S-1 | 6.9 | - | 204 | 5 | 29 | 44 | 938 | 9.0 | 100 |
| S-2 | 7.3 | - | 90 | 18 | 23 | 45 | 293 | 3.6 | 105 |
| S-3 | 7.4 | - | 50 | 8 | 50 | 20 | 59 | 1.9 | 129 |
| S-4 | 7.3 | - | 99 | 8 | 160 | 43 | 368 | 1.6 | 91 |
| S-5 | 8.4 | - | 48 | 5 | 40 | 3 | 14 | 0.3 | 38 |
| S-6 | 7.9 | 0.385 | 213 | 6 | 29 | 23 | 158 | 0.9 | 50 |
| S-7 | 7.7 | 0.327 | 118 | 12 | 33 | 38 | 401 | 0.9 | 46 |
| S-8 | 7.9 | 0.715 | 158 | 13 | 24 | 17 | 40 | 0.2 | 23 |
| S-9 | 8.1 | 0.388 | 98 | 9 | 50 | 18 | 28 | 0.6 | 15 |
| S-10 | 7.0 | 0.105 | 689 | 18 | 81 | 74 | 1374 | 7.8 | 64 |
| S-11 | 7.9 | 0.218 | 423 | 18 | 106 | 42 | 226 | 6.2 | 46 |
| S-12 | 7.5 | 0.645 | 87 | 35 | 72 | 21 | 77 | 2.3 | 58 |
| S-13 | 7.5 | 1.223 | 112 | 29 | 98 | 18 | 242 | 3.9 | 44 |
| S-14 | 7.4 | 0.124 | 360 | 12 | 93 | 79 | 246 | 2.6 | 64 |
| S-15 | 7.6 | 0.174 | 251 | 2 | 25 | 57 | 324 | 0.9 | 35 |
| S-16 | 7.3 | 0.234 | 184 | 5 | 62 | 56 | 345 | 1.8 | 70 |
| S-17 | 6.8 | 0.174 | 289 | 8 | 44 | 81 | 250 | 3.0 | 145 |
| S-18 | 7.4 | 0.391 | 145 | 4 | 71 | 41 | 162 | 5.4 | 37 |
| S-19 | 7.3 | 0.155 | 369 | 4 | 81 | 45 | 204 | 2.2 | 19 |
| S-20 | 7.3 | 0.287 | 133 | 8 | 119 | 44 | 630 | 5.7 | 31 |
| S-21 | 7.2 | 0.284 | 130 | 11 | 119 | 40 | 478 | 5.7 | 52 |
| S-22 | 7.5 | 0.239 | 325 | 17 | 44 | 33 | 550 | 4.1 | 24 |
| S-23 | 7.4 | 0.127 | 247 | 18 | 58 | 71 | 416 | 2.9 | 30 |

# Result Outlines

- Available N content of soil samples were typically high to very high due to the release of N from organic matter decomposition.
- Available N is very important for plants and it was continuously produced by peatland soil whenever partial aeration was favored.
- But, in other soils such as S-12, S-13, S-16, S-17 and S-18, S-19 are under commercial agricultural production with large external inputs, therefore, the available nitrogen was larger in sub-surface layer and that might be due to accumulation and plowing.

- water soluble sulphate was very high in all soil samples and it was typical for organic rich soil.
- Those were assumed to be derived from the organic sources such as plant residues.
- DTPA extractable zinc and iron are within the normal range for cultivable soil.
- Generally, the analytical results suggest that the physicochemical properties of soil samples are suitable for agricultural crop production.

# Good Governance of Peatland Soil

## Proper drainage

- Effective drainage is a key factor in the management of peat soils.
- However, drainage certainly damages the peat resource. As soon as peat is drained, the natural process of accumulating organic matter stops.
- Managing water table is the key for peatland management and the best way for farmers to sustain the agricultural production.
- There are two factors for drainage management; depth of drain and spacing between the drainage canals.
- Water table should not be lower than 30 – 45 cm below the soil surface; depth of drainage canal 1 – 1.5 m; and not closer spacing than 100 m.
- Drainage requirement depend on cultivated crops and care must be taken for seasonal plan to reduce the risks.

# Minimum to zero tillage

- **Peatland stability depends largely on the time and type of cultivation practices during agricultural production.**
- **Cultivation should ideally have a minimal impact on soil structure.**
- **The less cultivation that we do, the longer our peat soil will last.**
- **Continuous cultivation accelerates the rate of shrinkage (peatland degradation) to more than twice that of peat soil under uncultivated peatland soil.**
- **Cultivation increases aeration and mechanical breakdown of soil particles and decreases water permeability, in turn affects finally on crop production.**

## Equipment and methods

- Cultivation equipment should be selected to avoid pulverizing and chopping the peat too fine, which can destroy the fibrous structures of the soil.
- Avoid using rotary hoes at all on peat soils.
- Selection of suitable equipments and methods, such as direct seeding, those are avoiding direct effects on soil, saving time in land preparation and reducing costs, is essential.

## Avoiding peat fire

- Peat soils are highly flammable during dry period and will burn underground for months.
- And it is very difficult and costly to extinguish a peat fire. Therefore, never burn anything on or near peat during day periods.
- Knowledge on the nature of peat must be shared to the local community.


peatland fire

# Good fertilizer application

- **Using as an agricultural land, applying the correct amounts of the right kind of fertilizer will be necessary.**
- **However, in some fields in Taung Poe Gyi, large amount of fertilizer application and residual nutrients in the soil were observed.**
- **Leach fertilizers in the soil go to the underground water and that may affect on the quality of drinking water and the environment.**
- **Timing of fertilizer application should be so that plant uptake is maximized and any potential effects on the environment are minimized.**
- **Fertilizer split application reduced the losses and promoted the higher the accuracy of application (rate and distribution) and in turn minimize the impacts on animal, human and environment.**

# Crop selection

- **Peat is naturally anaerobic and very acid.**
- **The plants that grow naturally on peat are not only tolerant to acidity by also have shallow spongy roots which carry oxygen down to the root tips.**
- **For plants without these special features, the soil must be aerated and the acidity reduced.**
- **Cultivation created a layer of peat which is sufficiently aerated and has the correct pH to support the growth of crops.**
- **On the other hand, drain peat and intensive agricultural management may increase the rate of peat decomposition and influenced on its physical properties.**
- **Therefore, selection of suitable crops that grow well with minimum cultivation and drainage is necessary.**

# Conclusion

- In most area in the world, drained peatlands are used mostly for agriculture and forestry but also for peat extraction to provide energy, growing media and other products.
- However, in Taung Poe Gyi area, cultivation of seasonal crops such as paddy and some vegetables is the major use for peatland.
- Exploitation of land for extensive commercial agriculture and production of peat for fuel wood was not observed in recent times.
- Moreover, artificial drainage for land preparation is rarely done.
- The farmers in the area are using agricultural system with minimum disturbance to peatland because their ordinary decision is commonly to choose suitable crops compactable for peatland's seasonal condition and not to perform undesirable risks.

- **However, major and trace nutrient elements accumulation was high due to high rate of fertilizer application.**
- **Trace element accumulation in peat has been studied throughout the world. The upper layers of peat profiles are most heavily contaminated by human action. But, no investigation was carried out in this area.**
- **Therefore, it is important to study heavy metals concentrations in peatlands of Taung Poe Gyi as a future perspective.**

**Thank you for your attention!**