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For the Sustainable Use of Peatland and Mangrove:
Female Empowerment in Research and Practice
through ASEAN-Japan Collaboration

SUSTAINABLE TRADITIONAL-KNOWLEDGE ON PEATLAND HYDROLOGICAL MANAGEMENT REDUCE SOIL CO_2 EMISSION, FIRE RISK AND BIOMASS LOSS

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INTRODUCTION

Tropical peatlands are complex, multi-functional natural systems

As an ombrogenous peatland, water and nutrient inputs from precipitation have important roles in maintaining peatlands
Previous study delivered that hydrology is the most important factor influencing peatland ecology, development, function, and processes

Peatland in Indonesia spans ~21M ha distributes in Sumatra, Kalimantan, and Papua. In West Kalimantan span 1,7M ha, only ~30% forest covered left
Deforestation or any disturbance and environmental changes, can transform natural hydrological patterns and processes for peatland water movement, and thus alter both carbon pools and fluxes

OBJECTIVE

To search the scientific facts about the local wisdom and its role to peat soil CO_2 emission and fire risks accident

To distribute the traditional wisdom and scientifically proven for sustainable future of peatlands be managed properly and accordingly

To share experience on the efforts of reducing peatland degradation involving the local communities and their wisdoms

AGRICULTURE PRACTICES ON PEATLAND

Peatland development and management for agricultural land not as easy as other lands management

It takes some time to be able to change the peatlands into productive land suitable land for agricultural activities

Needs a variety of soil improvement and treatments

Need carefull handling due to its functions as an environmental buffer

The increased of peat organic matter decomposition, concomitantly increasing the CO_2 emission to atmosphere.

TRADITIONAL KNOWLEDGE IN AGRICULTURAL PRACTICE

Non-developed peatland area inundated by water both due to rain water or tide.

Peatland traditional farmers in West Kalimantan already have provisions to manage peatlands.

Farmer mostly develop 'parit cacing', small trenches of 30-40 cm depth are built on each farmer land margin, to reduce puddles during high water levels.

The existing practices are passed on to the next generation through oral tradition

RESEARCH ACTIVITIES

Case Study Site: Peatland of Kubu Raya, West Kalimantan Province, Indonesia

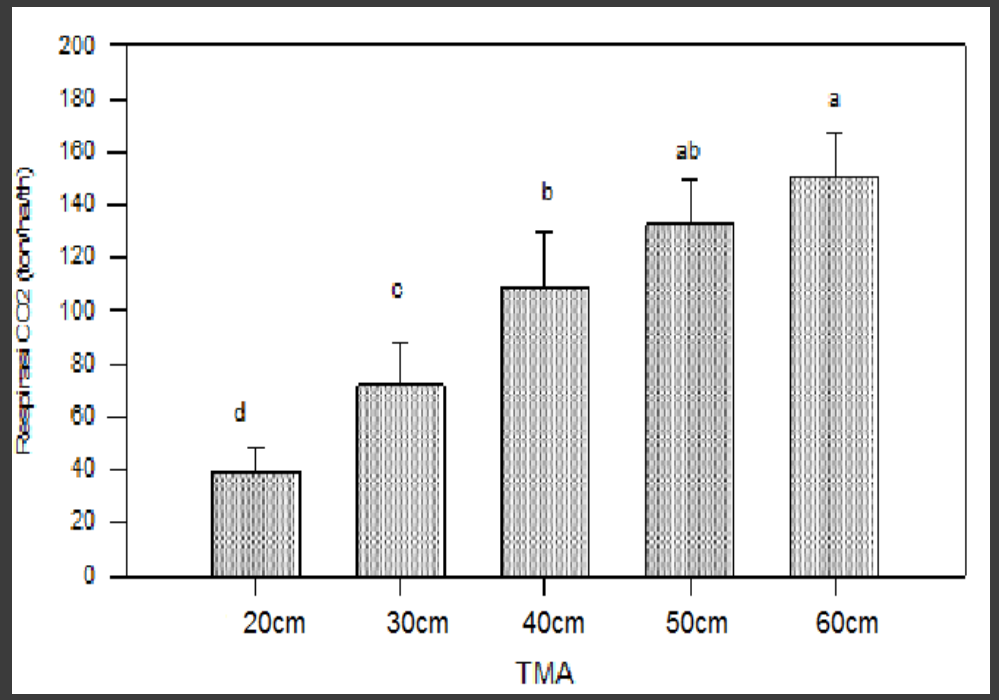
- The village communities of Kubu Raya district were developed in year 2002, most of them traditional farmers
- The land covered partially by degraded forest, shrub, and open non-cultivated areas.
- Each family processed the land into arable land, planting mixed crops, corn, sweet potato, cassava, pineapple, ginger and some vegetables.
- At the beginning of their inhabitant in the area, they relied on the traditional farming knowledge to cultivate the land.

10 year later, local government program built larger canals close to community crop farms, significant effects on crops

CO_2 Emission assessment

- ✓ Emission was assessed weekly in along two years on farmer cropland and post larger canals development, with Li-Cor 8100 Automated soil CO_2 flux
- ✓ The result on soil CO_2 respiration then converted to soil CO_2 emission following Malhi et al. (2012) by separating root respiration activity of the plant and peat decomposition process
- ✓ Water table levels and other hydrology condition were measured at the time of emission assessment

The Effect of Water Level on Soil CO_2 Emission

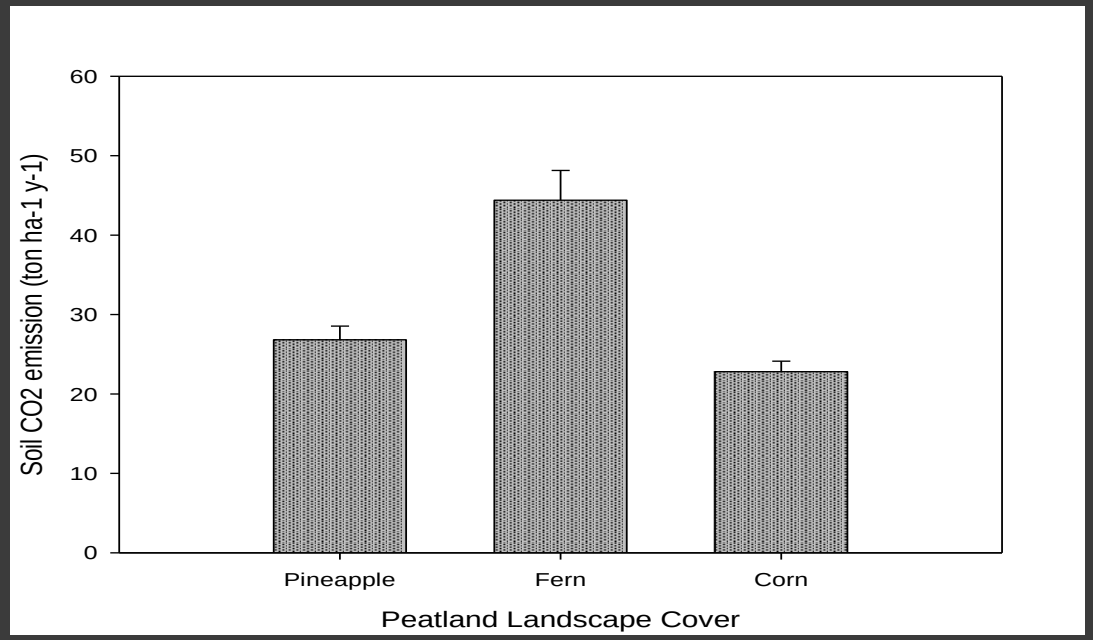


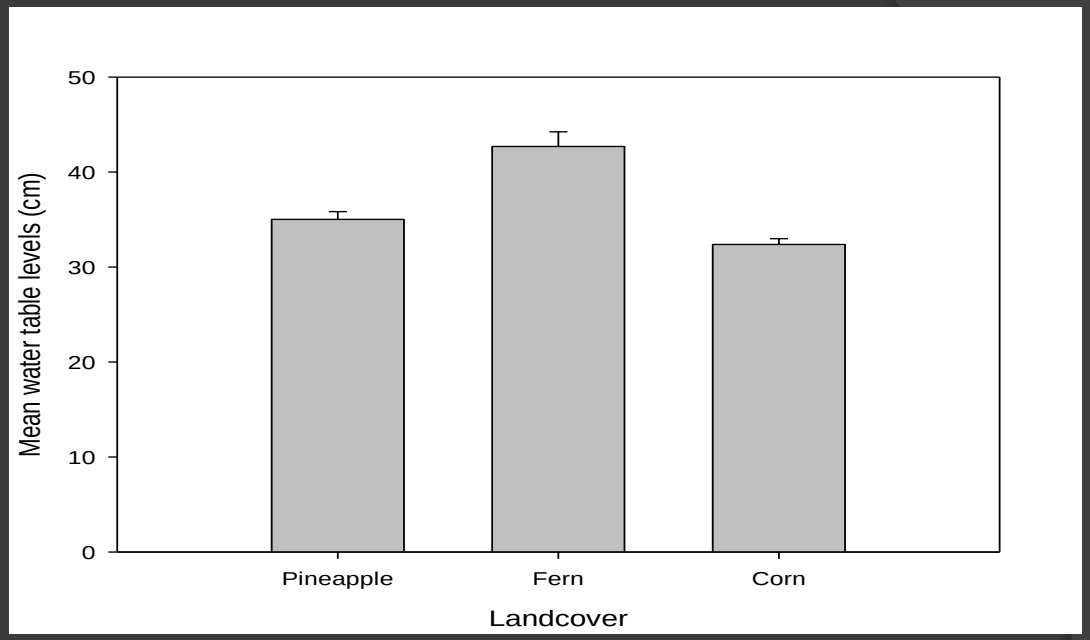
Soil CO_2 emission on peatland increased when water table level was deeper

The increased of water level from 20 cm to 30, 40, 50, & 60cm increase peatland CO_2 emission proportionally. The shift of WL from 20cm to 60cm, triple soil CO_2 emission

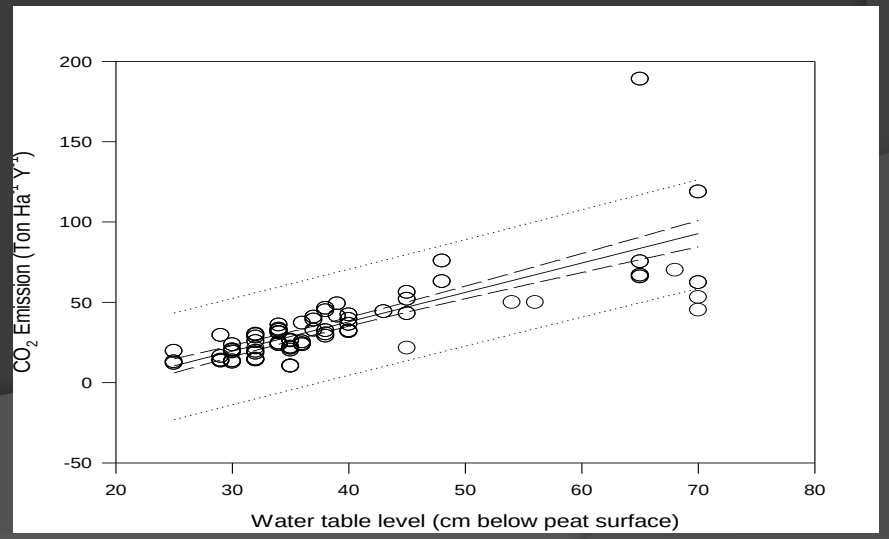
- Other finding in peatland landscape was that some environment factors simultaneously influencing soil CO_2 emission
- Some environment factors that significantly regulating CO_2 in peatland were water level, water content and soil temperature

Local Wisdom on Planting Crops on peatland: Emission vs Water Table Levels

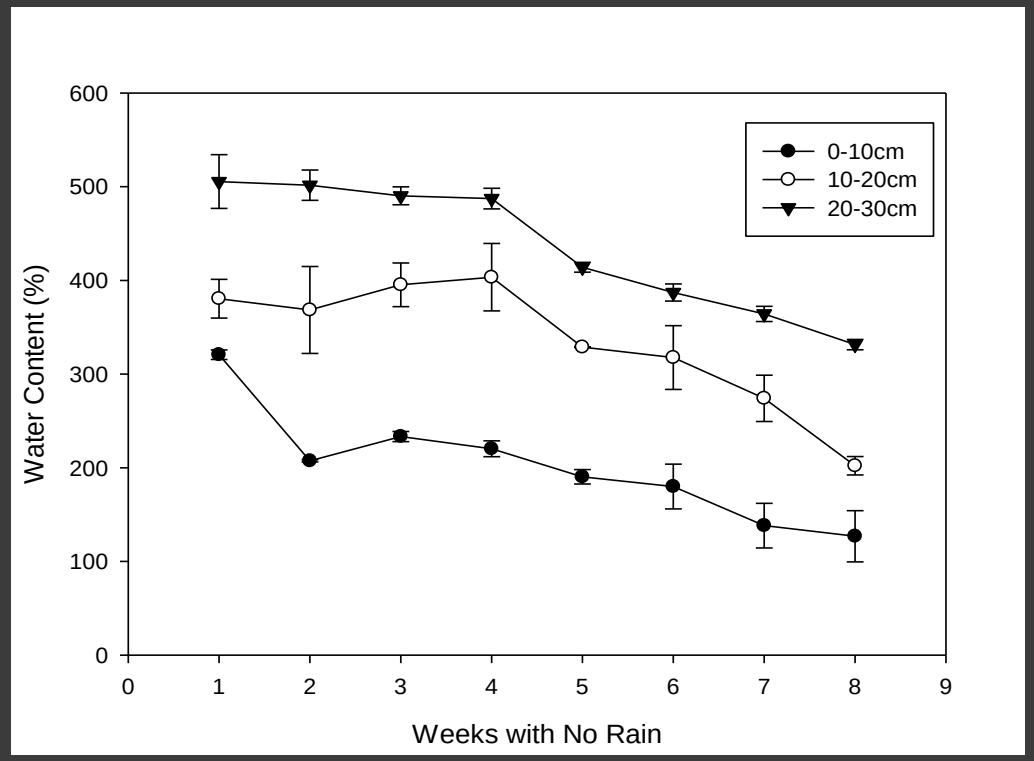




Results justify that the hydrology management such as practiced by West Kalimantan farmers on peatland resulted lower CO_2 emission, ~ mean < 22 ton ha^{-1} y^{-1} lower when compared to abandoned-fern peatland cover.



Drought Impact On Peat Surface Water Contents



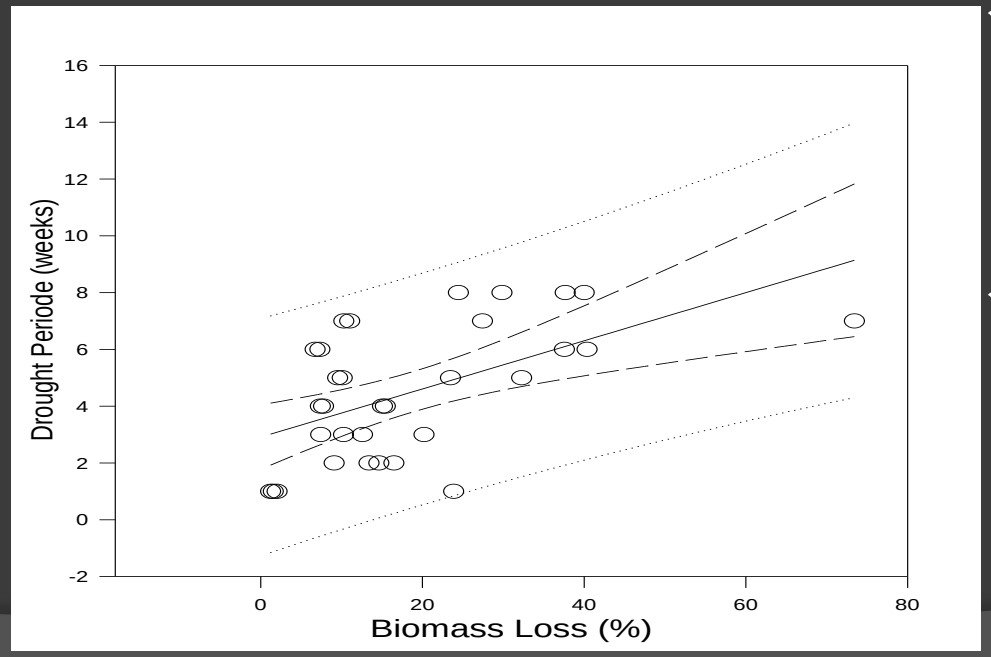
Within eight weeks drought, the first 10 cm peat depth reduced the highest lost of % water content (198%).
The 10-20cm depth lost 178%, and 20-30cm 174%
These WC critical to fire to be started.
It is essential to set up water table level close to soil surface, to maintain the water contents

When farmer set up their land with 30-40 cm water level, with similar lost of water portion on evaporation, the water content could be higher due to capillary movement of soil water from lower peat layer. The capillary movement in peat soil may reach 20-30 cm above peat water table level

Laboratory Scale Fire Experiment

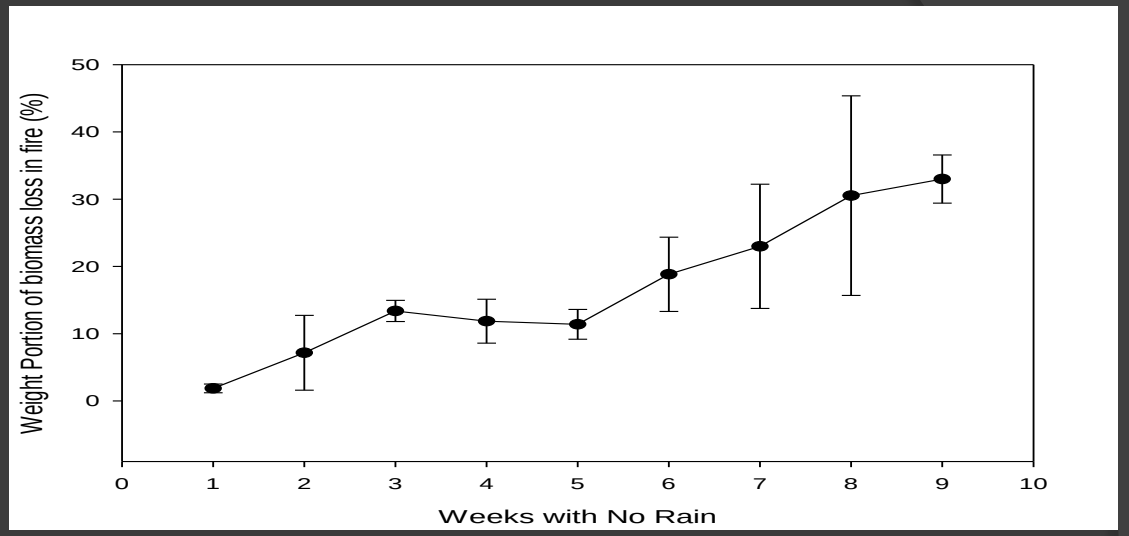
- Fire experiment was conducted to explore peat hydrology condition (i.e. water table levels) impacts on peat water content and biomass loss.



- ✓ Reducing water content of peat, dictating biomass loss on peat fire event. Critical peat water content (200% of weight based) which could start fire easily on peat surface was reach on the ~5-6 week dry season.
- ✓ This critical time may be shorter on field based measurement when other environment/weather factors also taking part such as wind, ambient temperature and humidity, soil temperature and humidity, air density, and aboveground fuel sources, and esp peatland water table, which influences water content.

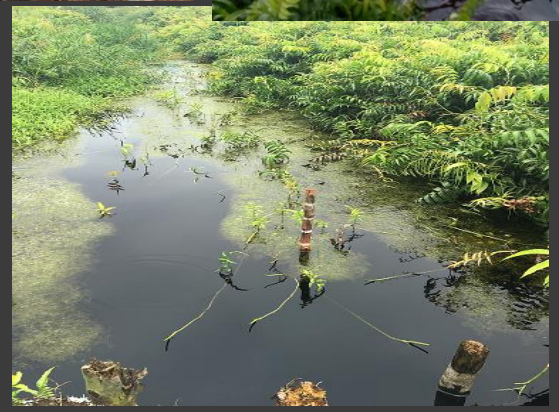
Peat Biomass Loss on Fire



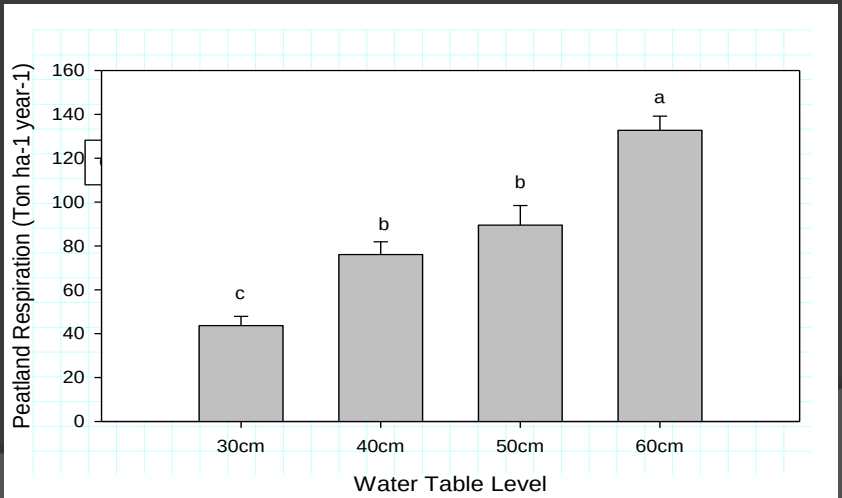
- Before large canal development, fire events rarely occur in the site. The water table position close to peat surface, keep the peat surface moist, make it difficult to start fire.
- A fire event will start when there are available fuel sources, oxygen and heat. Therefore, when upper peat soil is moist, the both intentional and escaped fire event is rarely started.

Hydrological Set up Reduces Peat Biomass Loss, Soil CO_2 Emission & Fire Risk

Canal and landcover shifted

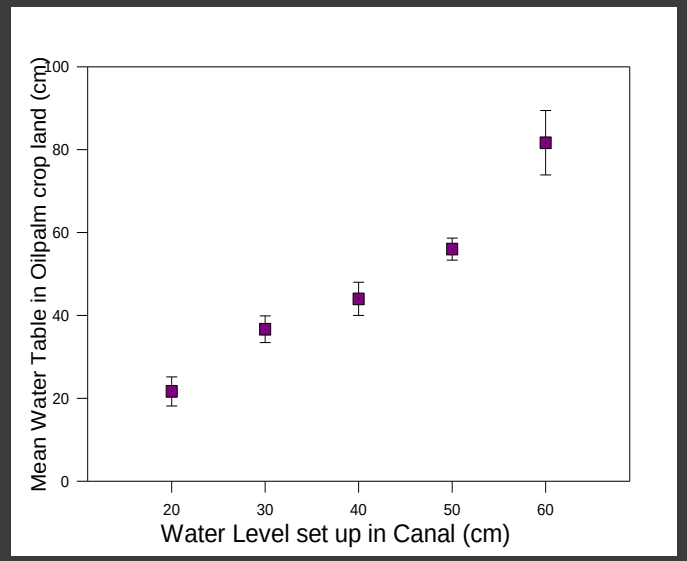


water tables set up decrease CO2 emission from peatland

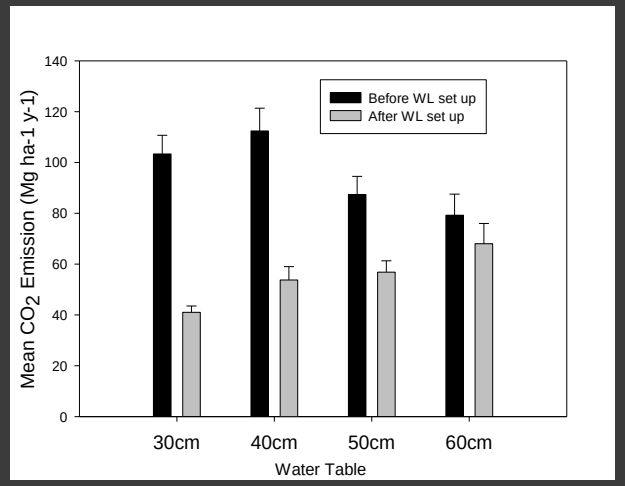


Water Table level (cm)	Soil CO_2 Emission ($Ton\ ha^{-1}\ year^{-1}$)	
	1st year	2nd year
30	26.8 ± 4.3	18.4 ± 1.8
40	36.6 ± 4.9	32.0 ± 2.3
50	41.4 ± 5.0	41.4 ± 3.7
60	51.9 ± 5.3	55.7 ± 2.6

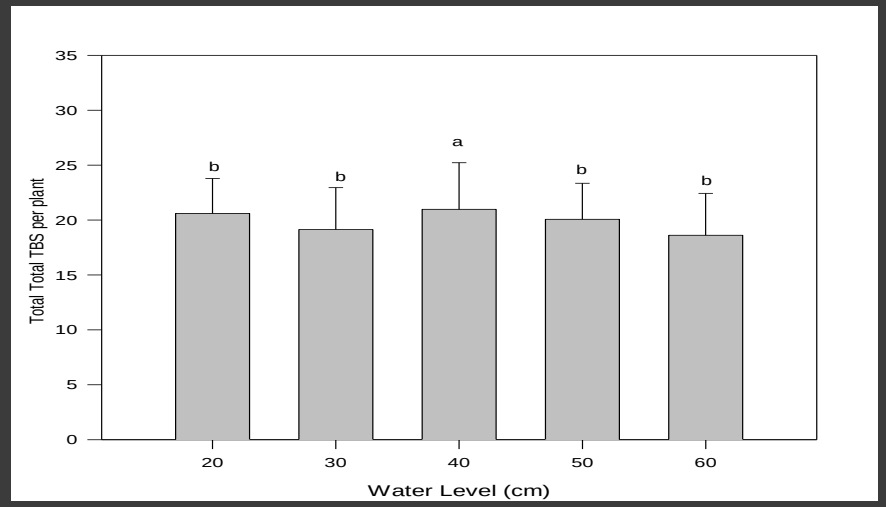
Peat Water-Level Setting in Small-holder Oilpalm Plantation



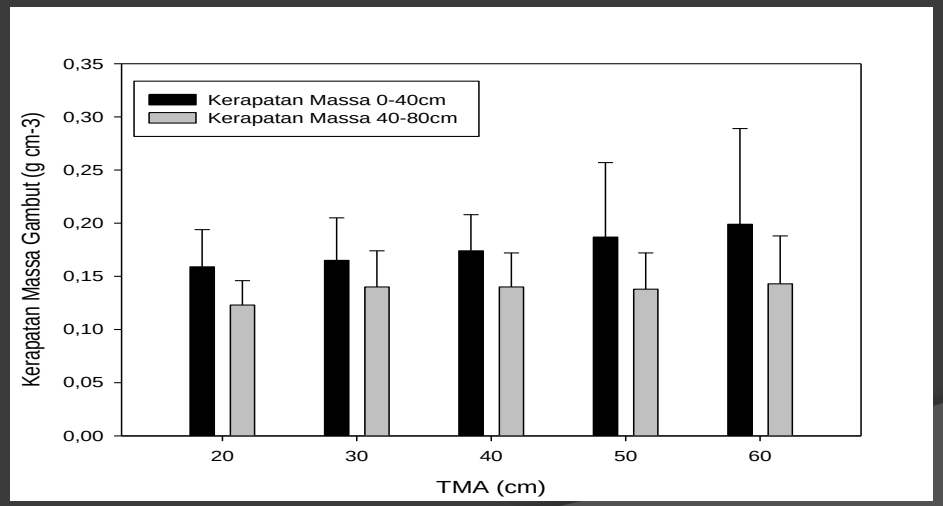
Water level set up in canal regulate water table in oilpalm land area



Before water table set up, mean CO_2 emission 95,5 Mg ha^{-1} y^{-1} (range 48,6−256,7 Mg ha^{-1} y^{-1}), post set up decrease 14.1% , 34.9%, 52.2%, & 60.3% with WT ~60, 50, 40, 30 cm consecutively



Oilpalm fresh fruit bunch production significantly higher in WT 40cm



Peat bulk density were relatively higher in deeper WT, show higher peat subsidence

Community Training on Peatland Water Treatment

Peatland Water Treatment for Community Uses

SUMMARY

- The use of *traditional wisdom* on peatlands as hydrology regulators of irrigation and land boundaries between farmers for generations provides great benefits to farmers. It is scientifically proven to provide better environmental protection such as lower emissions, better fire prevention, and fewer biomass losses.

- The management and conservation of peatlands is a central issue today. Considering that peatland is an alternative answer to the problem of lack in agricultural land in Indonesia.

- Non-forested peatlands are potential to be utilized by farmers to cultivate crop and vegetable farming activities. However, the difficulty in managing peatlands has to be taken care. Therefore, the local wisdom that greatly contributes to the sustainability of peatlands should be continually practiced by farmers.

- Community based peatland include women could be empowered to manage peatland in sustainable manners


Thank You