TAY JUHANA FOUNDATION

Suboptimal Land Series - Part 4

Sustainable Use of Peatland to Improve Locally Sourced Food Production

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What is peatland? There is no single formal definition of peat and peatland, with different interest groups often using their own terms. In short, the distilled definition of peatland is organic matter from the plant detritus accumulated in anaerobic conditions (Craft, 2016). The anaerobic state is attained under inundated conditions in the freshwater swamps or basins, slowing the decomposition to develop peat formation. Peatland in natural condition is always wet and moist to prevent it from burning. This condition makes the peat considered as suboptimal land, which inhibits plants to optimally grow because of water inundation. The soil is like a sponge with a critical function to store water (Bacon et al., 2017). Figure 1 shows typical development of tropical peat soil from the accumulation of organic material in the swamp area, mostly between two rivers. The long period of layered accumulation becomes peat formation.

Peatland is a fragile ecosystem. When the water level drops, it becomes vulnerable to fire. Canals development drains the peat water to the rivers and disturbs the hydrological aspect. During the dry season, improper drainage systems remove its water storage function that leads to wildfire. Hence many people correlate peatlands utilization with concurrent massive haze and destruction on an unprecedented scale.

Globally, around 11% or 50.9 millions of hectares (Mha) of peatlands are degraded, where more than half occurred in tropical peatlands (Leifeld & Menichetti, 2018). Indonesia is home to 3.5% of the global peatlands, covering nearly 15 Mha which are distributed around Sumatra, Kalimantan, and Papua (Xu et al., 2018; Mulyani & Sarwani, 2013). The peatlands only contribute to 8% of Indonesia's land but store biomass more than 30% from all of its forests, and 9.4% of carbon from the world's carbon storage (FAO, 2016; Warren et al., 2017).

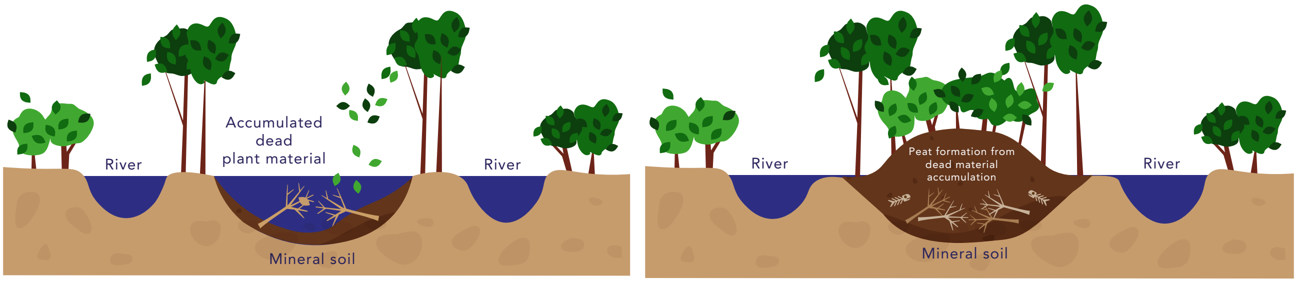

Figure 1. Schematic of the development of peat from initial to become peat formation

Peatlands Role in Meeting the Food Demand

It is undeniable that farming on mineral soil has higher productivity and is less risky compared to peatlands. However, with the decreasing arable land and rising population growth, the pressure to meet the national food demand cannot rely on intensification alone. Other types of lands may be utilized to support the food production.

Despite its availability, not every peatland is compatible for agriculture use. There are plenty of specific physical characteristics required to enable the cultivation practice such as decomposition level, peat depth, water content, bulk density, bearing capacity, subsidence, and irreversible dryness (Agus & Subiksa, 2008). The soil decomposition level can be divided into sapric (decomposed), hemic (medium decomposed), and fibric (less decomposed). Shallow peat with thickness less than 3 m, hemic to sapric soil, and clayey substratum may be recommended for agriculture (Hikmatullah & Sukarman, 2014). With compatible peat characteristics, effective water management, and proper cropping methods, this land can optimally produce various commodities including crop plants, secondary plants, vegetables, and fruits as shown in Table 1.

Although the deep peat is not recommended for agriculture, exceptional cases may apply to decades old community-based or industrial plantations that have been cultivated long before the regulation related to peat depth was issued (Presidential Decision No.32/1990). For example, there are hundreds of Dayak tribe households that live in deep peat areas in Central Kalimantan for centuries (Limin, 2006). The government transmigration scheme in the 1980s also relocated Javanese people in a similar peat landscape in Sumatera. Essentially, peat with >3 m depth may be used for agriculture under certain conditions such as the mineral layer underneath the peat is not quartz sand or pyrite clay, and the peat decomposition level is not fibric (Pangaribuan, 2018). With the right cropping methods this would result in a slow oxidation rate and stable crops yield. However, due to its ecological importance and soil fragility, the deep peat should be prioritized for conservation purpose.

Efforts in enabling agriculture on peatlands have been conducted from time to time to help the local communities produce their own food. With a thorough preparation, peatland can be one of the solutions to support food production. For example, the soy farming in peat soil indicated a promising result in Mempawah

Table 1. General estimation of plants compatibility based on the peat depth

Species Group	Peaty Soil	Shallow	Moderate	Deep	Very Deep
	(0,5 m)	(0,5 - 1 m)	(> 1 - 2 m)	(> 2 - 3 m)	(> 3 m)
Food crops (rice, corn, cassava, sweet potato, etc.)	+++	+++	++	--	-- Conservation/ Protected Area
Secondary crops (soybeans, nuts, green beans, etc.)	+++	+++	++	+	-- Conservation/ Protected Area
Horticultural crops, vegetables (chilli, eggplant, tomatoes, cucumbers, etc.)	+++	+++	++	+	-- Conservation/ Protected Area
Horticultural fruit crops (pineapple, banana, rambutan, jackfruit, etc.)	+++	+++	+++	++	-- Conservation/ Protected Area
Medicinal plants (pepper, ginger, aromatic ginger, lemongrass)	+++	+++	++	+	-- Conservation/ Protected Area
Plantation crops (rubber, coconut, palm oil, coffee, sago)	+++	+++	+++	++	+ Conservation/ Protected Area

Source: Mulyani et al. (2016)

Notes: +++ = Relatively suitable; ++ = moderately suitable; + = marginally suitable; -- = not suitable.

and Kubu Raya Regencies, West Kalimantan (Dewi, 2017; Kilmanun, 2016). Other commodities such as dragon fruits, pineapples, and candlenuts are also commonly grown on peat in Pulang Pisau and Gunung Mas Regency in Central Kalimantan (Uda et.al, 2020). Furthermore, rice farming in peatland is considered the first alternative of rehabilitating degraded peatland by ensuring its environmental sustainability (Surahman et al., 2018). This alternative is coherent with Indonesian Peatland and Mangrove Restoration Agency (BRGM) methods in Papua Province that restore peatland with planting sago, rice farming, and freshwater fisheries (Prima, 2020).

Local Food Production to Prevent Food Shortage

In many regions in Indonesia, peatlands have been the source of food and livelihood for many generations, especially in the provinces with substantial amounts of these soil types. About 44% of the Riau Province area consists of peatlands (Osaki et al., 2015). In one of its regencies, Indragiri Hilir, it even covers up to 90% of land which made it inevitable to utilize peatlands for local food production. There are three principles to ensure the sustainability of its agricultural practice:

1. Optimize the use of degraded or abandoned peatlands for agricultural purposes. Clearing the pristine peat forests would likely add another problem to the ecosystem.
2. Peat soil has different farming methods compared to mineral soil. It is a suboptimal land type that requires more advanced water management, soil modification, and adaptive cultivar to produce optimum yield.
3. All stakeholders, including the government, private companies, communities, and NGOs, should work together under the agreed sustainability framework. This would result in integrated local food production facilities that involve proper infrastructures, responsible farming methods, and effective supply chain.

The COVID-19 pandemic has shown the vulnerability of our food system. Development of local food barn, including in the peatland regions, can address three main problems: inequality of food production centres, long food distribution, and farmers welfare. As an archipelagic country, most of Indonesia's food production centres are unfortunately still concentrated in Java. The food distribution takes a longer time to reach thousands of other regions in the country. Ineffective supply chains can cause oversupply in one area and shortage in another.

Developing a local food barn would increase labor employment. It also means shortening the food supply chain to meet the local needs. The regional governments should strengthen their food self-sufficiency to increase resilience in unpredictable events like disasters, epidemics, or unforeseen shocks. Various benefits can be obtained as seen in the Table 2 below.

Table 2. The benefits of developing local food barn/shorten the food system

Economy	• Increase the income of farmers, • Provide additional jobs, and • Alleviate poverty
Social	• Strengthen social bonding due to many farming-related involvements • Women can contribute more
Environment	• Reduce carbon emission from the omitted longer food chain • Promote environmentally friendly practice • Reduce unused degraded peatland
Health	• Prevent food shortage and food crisis • Constant supply of nutritious and healthy food

Adopted from: (Chiffoleau & Dourian, 2020)

Is Sustainable Farming in Peatland Feasible?

The International Peat Congress (IPC) held by the International Peatland Society (IPS) defined peatland drainage as part of unsustainable agricultural practice (Wijedasa et al., 2017). Thus, if the practice does not cause peatland drainage, would it be sustainable? The term sustainable is generally understood as an effort to balance the human benefit and environmental concern. Good agriculture practice seeks to sustain yield for socio-economic improvement and minimize negative impacts on the environment. To create this balance in peatland agriculture, the main principle is to set up the effective water table level where plants can grow with minimum carbon release.

In natural condition, peatlands emit CO2 through heterotrophic respiration. Planting non-native species requires a lower water table to grow. It accelerates the oxidation which produces greater emission and makes the soil susceptible to fires. Applying a water system to regulate water supply and maintain the water table level is crucial, along with implementing burn-free practice. These can significantly lower risk of fire due to high soil moisture. That way, socio-economic development can also grow as a result of farming. There is growing evidence that shows opportunities to sustainably cultivate this land with a controlled water system (Nursyamsi et al., 2015; Surahman et al., 2018).

An exemplary case can be found in Pulau Burung District, Riau Province. The peatland has been utilized for coconut agriculture for more than 30 years with the application of "Water Management Trinity" or WMT. Although one of the WMT's components is a canals network, its primary function is to regulate, not to drain the water. Principally, the peat landscape is undrained. WMT engineers the surrounding environment by modulating the water table to keep the peat soil wet and minimize carbon emission. WMT successfully manages the average subsidence below 2 cm per year based on field measurement (Fawzi et al., 2020). The rate is lower compared to other plantations which range from 2.4 cm to 7.4 cm (Carlson et al., 2015). Despite the promising results, the water management practice in Pulau Burung is still unheard.

Theoretically, the principle used in WMT is also workable for paludiculture practice. The word paludiculture is originally from Latin word 'palus' which means swamp, hence this practice aims to imitate the condition of natural peatland which is always wet (Tan et al., 2021). Paludiculture uses native species though its feasibility for large scale cultivation is not yet proven. Managing water resources in peatland should always aim to maintain the soil water content. Thus, reduce microbial peat oxidation and prevent fire hazard, while providing economic value for the community. This objective is aligned with the concept of paludiculture.

Oppose the Negative Practice and Stigma with Growing Evidence

Based on the aforementioned cases, sustainable farming in peatland is possible under certain circumstances such as compatible landscapes and advanced water systems. The practice needs essential components including providing human resources, hefty investment, and technological development. Technology development and continuous improvement are needed to enhance the long term benefits for the community and nature. It requires years of research and practice to sustainably utilize the land with a stable productivity rate.

However, the stigma around peatland utilization persists. Due to human inherent negative bias, people tend to pay more attention to negativity and decide based on them to averse adverse risk. The same reason might be the one behind the unfamiliarity of sustainable peatland agriculture. The negative impact of irresponsible practices is amplified and makes all practices look the same without knowing the context.
Ideally, the focus should be finding solutions to allow humans to thrive and prevent future disasters.

Collaboration is needed to gather the best practices, identify the necessary trade-off, and eventually do check-and-balance. In Indonesia, the time is never more appropriate than now since the government has been developing the Food Estate in the peatland area in Central Kalimantan. Although the program aims to prevent food crises, without proper methods, it could instead create a disaster similar to the Mega Rice Project in 1995. We must prevent bigger risks from large-scale peatlands clearing with poor water management and governance. Local action that encourages smaller scale plantations, more diverse crops that are peat-friendly, and responsible farming methods are more essential to strengthen food security.

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ABOUT TJF

Tay Juhana Foundation (TJF) is a nonprofit organization dedicated to promote the advocacy of the conversion and cultivation of suboptimal lands into productive lands, through the most environmentally, economically, and socially sustainable manner.

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