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Suboptimal Land Series - Part 3

Inland Swamp Agriculture: Opportunities and Challenges

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INTRODUCTION

Contrary to popular belief that perceived Indonesia has abundance of arable land, the soil types in this country are, in fact, dominated by suboptimal lands. Out of 192 million ha of the total land area, only 26.3 million ha are fertile soil that is mostly concentrated in Java (World Bank, 2018). Meanwhile, the rest is dominated by acidic dryland, wetlands, and peatland that cover almost 150 million ha combined (Mulyani et al., 2016). These types of land are less fertile, which is defined as suboptimal land. In fact, these lands, including wetlands, can become an alternative to support food production and community welfare (Kang et al., 2013; Lakitan, 2014; Preissel et al., 2017).

Wetlands cover around 19 million ha. Out of this number, 9.53 million ha are considered suitable for agriculture (Suwanda & Noor, 2017). However, due to lack of access to the needed resources, including to affordable technology, and low potential economic benefit, farmers had only able to utilize 2.2 million ha of wetlands. If wetlands could be optimally developed, the nation's target in producing 10 million tons of rice surplus would be achieved. This also can create five million new jobs for farmers (Haryono, 2012).

As explained in the first TJF Suboptimal land series, suboptimal wetlands in Indonesia are mainly divided into two types: Tidal swamp (rawa pasang surut) and inland swamp (rawa lebak). The first is located on the wetland that is directly affected by the sea water during high tides, particularly adjacent to the estuaries of large rivers. Its water level fluctuates depending on the sea surface and season. Inland swamp is situated on river floodplains that are not influenced by sea tides (Subagio et al., 2015). Based on their distance to the sea, wetlands are divided into three zones as described in the following figure 1.

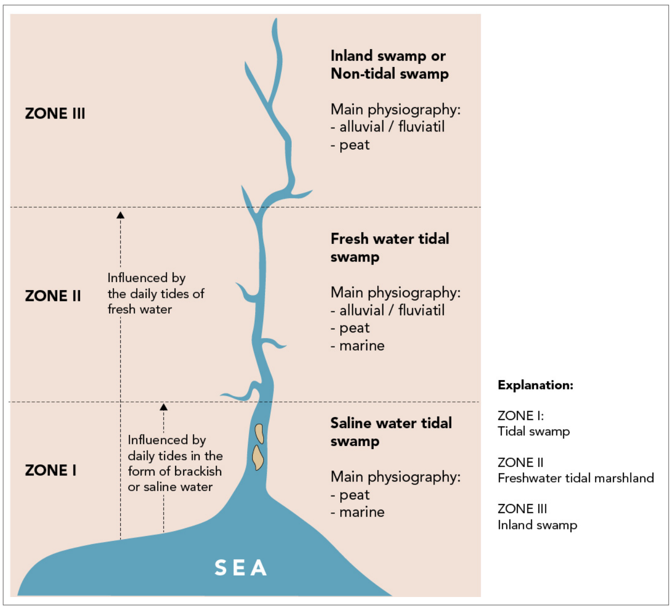

Figure 1. The zones in wetlands, based on distance from seas
Source: Haryono (2012)

The tidal swamp in Zone I is influenced by daily tides in the form of brackish or saline water overflow. This land consists of mainly peat and marine physiography. As for Zone II, it is influenced by the tides of fresh water. Hence, this land is known as a freshwater tidal marshland. The main components of this land are alluvial, peat, and marine. Whereas swamps Zone III are not affected by tides and consist of alluvial and peat. The shallow non-tidal swamp (inland swamp) in Zone III with less than 100 cm depth during the rainy season is the most suitable for agriculture since a short period and shallow inundation level enables crops to grow better.

STRATEGIES TO ENABLE SUSTAINABLE INLAND SWAMP AGRICULTURE

Indonesia with its abundance of suboptimal land resources has been struggling to implement sustainable agriculture on inland swamps. The country has envisioned a food estate program which involves a massive conversion of wetlands i.e., swamps and peat area to produce various food commodities. The plan has sparked a handful of public criticism due to poor accountability and failure of similar programs in the past. Despite the controversy, swamp cultivation can offer contribution to achieve food security. To provide a more balanced perspective, the pro(s) and con(s) can be identified in the following table.

Considering the positive and negative sides of agricultural practice in table 1, a comprehensive strategy to sustainably manage the swamplands agriculture should be further developed to optimize the land potential. Ar-Riza et al. (2014) and Sulaiman et al. (2019) revealed at least seven aspects which support the development of wetlands agriculture, including for inland swamp areas, as follows:

1) Synchronization with other regional spatial planning arrangements

Oftentimes, land use policies in Indonesia are lack of consistency. This is one of the major sources of conflicting issues in agriculture conversion. Regional Spatial Planning (Rencana Tata Ruang Wilayah or RTRW) is being formulated at the provincial (RTRWP) or District/Municipal (RTRWK) level while the rate of development on the ground level continues (Wirawan et al., 2019), leaving the plans and the practice disconnected.

2) Regional commodity mapping

Assessment of market demands in accordance with the food demand and production capability has to be conducted to ensure the harvested products will meet the community needs. This will also support food self-sufficiency at regional level.

Table 1. The Pro(s) and con(s) of the cultivation in swamplands

Pro(s)	• Large acreage of wetlands is available. • Have abundant water. • Short seasonal drought. • Growing period can be extended with floating culture during the rainy season. • Great potential to be used as an integrated farming system (crop cultivation, fish culture, and animal husbandry). • Provide new jobs in the agriculture sector. • Scarcity of arable land in Indonesia means that swamplands become the most available lands for agricultural use. • Establishment of a local food barn that shortens the supply chain. • Strengthen food security in some regions with large acreage of the swamplands.
Con(s)	• Important ecosystem services, including for environmental aspect. • Expensive investment with a more complicated farming system. • Low harvest yields. • Concern on probable high pests and disease threats. • Prone to flooding. • Saltwater intrusion for coastal tidal swamps. • A low pH of 3 to 4.5 at some swampland areas. • Pyrite-affected acid sulfate soils • Possibility of high concentrations of toxic elements at some specific swampland areas. • Deficiencies in some soil nutrients as also experienced in acidic drylands.

Source: Modified version of Sulaiman et.al (2019)

3) Land suitability and application of proper water management

Not every swampland is suitable for agriculture. It also heavily relies on effective water management (Fawzi et al., 2020). Rigorous science-based feasibility studies based on land typology, biophysical aspect, social and economic impacts are compulsory to safeguard the practice sustainability in the long term.

4) Technology tailored specifically based on location characteristics and the cultivated crops

Sophisticated technology is not always the answer, especially if it is hardly adopted by the locals. Technology development has to be based on the needs, preference, and absorptive capacity of targeted smallholder farmers (Lakitan et al., 2018). For example, floating seedbeds that use simple materials could be a solution for intensifying harvest frequency and crop diversification.

5) Farmer empowerment and access provision

Farmers in swamplands tend to be poorer since the yields they can produce is low (Syuhada et al., 2020). Provision of access to capital, quality seeds, knowledge, and skill improvement that help smallholder farmers to better manage the crops, soil, and water are essential to enhance the cultivation practice, along with their livelihoods.

6) Agribusiness institution and infrastructure

Supporting institutions that provide soft loans, subsidized high-yielding seeds, and network to consumers are essential. Infrastructure that includes integrated water systems, transportation, and markets that are accessible to farmers could ease the supply chain process.

7) Good governance

An effective and consistent policies that promote sustainability, data availability, land use fairness, affordable investment, additional farmers' incentives, and fair commodity price are urgently needed. If these policies are implemented properly, they would result in enhanced agricultural development, achievable food security targets, as well as attained poverty alleviation in rural areas (Andoko, 2019).

INLAND SWAMP AGRICULTURE PRACTICE IN SOUTH SUMATRA

In South Sumatra Province, around 15% of its total land or 1.4 million ha is covered by swamp and peat. The land has been supporting the region's food security since 70% of the cultivated area is located on this type of land (Prasetyo, 2020). Rice is the main food crop in South Sumatra. About 89.7% of rice were cultivated in wetlands, mainly in Banyuasin, Ogan Komering Ilir and East Ogan Komering Ulu regencies. These three regencies contribute to 73.7% of total rice harvested area in South Sumatra (BPS, 2021).

Crop cultivation method in the swamp area largely depends on the land typology, especially the water table level that is influenced by seasons and rainfall. The practice is divided into two types: a) dry season cultivation and b) rainy season cultivation. The seedbed during the dry season is normally conducted in January – February for shallow swamp (Simatupang & Rina, 2019); however, seedling preparation in inland swamp could vary significantly depending on depth of floodwater at the specified location. The nurseries are carried out on non-waterlogged soil conditions, usually at yards, embankments, or riverbanks.

One of the main obstacles of inland swamp agriculture is the possibility of sudden flooding due to heavy rainfall in the upper regions which could seriously damage the crops. The incoming water is difficult to drain out because the surface of the area is very flat (Putri & Wurjanto, 2016). There are multiple methods to regulate water supply and maintain water table. The method includes constructing embankment and pumping out the floodwater to the nearest river (Suparwoto & Waluyo, 2011). As for large scale rice estate, full water management requires at least four main components, i.e., full polder surrounding the large-scale rice field, inlet-outlet canals connected to main river, well-designed water gate system within the polder, and pair of high-capacity pumps installed on polder for pumping out excess water into outlet canal and the other pump for taking water from inlet canal.

Prior to cultivation, ameliorants such as biochar, limestone, and rice husk ash can be added to increase soil pH. Rice varieties commonly cultivated by farmers include IR-64 and Ciherang. Recently some new rice varieties were introduced to farmers. Modern rice variety can be harvested within four months, but rice production cycles may take five months depending on time needed for soil and land preparation. While average rice productivity in Indonesia around 5.1 ton/ha on average (BPS, 2020), these irrigated rice fields may produce 7 ton/ha or higher.

Without proper technology and management, rice crops cultivated at inland swamp can only produce yields once a year due to prolonged flooding during the rainy season. Farmers hesitate to cultivate the swamp due to low productivity also unpredictable and prolonged flooding duration. During the rainy season, the land could be flooded up to six months and prevent the farmers from doing any agricultural activities (Irmawati et al., 2015). Timetable for rice cultivation at inland swamp or riparian wetlands had been suggested by Lakitan et al. (2018). To adapt with flood occurrence, floating seedbeds can be one of the solutions that enable farmers to harvest their yields twice a year. Experiment in cultivating rice on the floating raft is shown on figures 2, 3, and 4 below.


Figure 2. Rice planting in the polybags on the float


Figure 3. The rice plant has reached the age of 2 weeks after planting


Figure 4. The rice plant has reached the age of 5 weeks after planting

Source: Saleh et.al (2019)

Crop cultivation practices during prolonged annual flooding has been intensively studied, including floating system for rice seedling preparation using local biomaterials (Ramadhani et al., 2018; Siaga et al., 2019) and floating culture of some vegetable crops, i.e., chili pepper (Siaga et al., 2018), green apple eggplants (Jaya et al., 2019). Floating bed cultivation has been recognized to be a successful means of agricultural crop production in different wetland areas of the world (Islam & Atkins, 2007). While the indigenous farmers initially used natural materials such as decomposing heaps of water hyacinth that is stuffed with mud or soil, today's farmers in South Sumatra Province managed to use waste materials like used plastic bottles to build a floating raft (Siaga at al., 2018; Lakitan et al., 2019).

Based on the study conducted by Siaga et al. (2018) Floating Culture System (FCS) using plastic bottle rafts has been proven to increase chili pepper yields in riparian wetlands. Not only the material and the technique are easily adopted by smallholder farmers, but it also brought a higher productivity rate compared to conventional cultivation. The research concluded that the most important principle of FCS was direct contact between growing substrate and water surface. This provides a continuous water availability regardless of climatic condition which resulted in a better growth and harvest quality.

FUTURE PROSPECT

Indonesia is endowed with enormous areas of wetlands. With the decreasing arable land availability, suboptimal land such as inland swamp can be an alternative to produce food. This practice however brings both benefits and challenges. In the region where wetlands cover a large part of its area, such as in South Sumatera Province, wetlands cultivation has been tremendously contributed to the local food security. Despite the constraints, various studies and indigenous practices have indicated evidence that wetland agriculture can generate desired yields and be implemented sustainably. Stakeholders' collaboration to realize seven strategies discussed above will enhance the nation's path towards the betterment of suboptimal wetlands management and 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.

CONTACT US

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