Suboptimal Land Series - Part 2

Can We Practice Sustainable Agriculture on Suboptimal Land?

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INTRODUCTION

Suboptimal land agriculture is often seen undesirable as it requires more complicated land preparation, high maintenance, which result in higher cost. Nevertheless, utilization of this land is inevitable as arable land continues to shrink over the years due to conversion to non-agricultural purposes.

Among many suboptimal lands that are either too wet or too dry, agriculture practice on peatland is considered the most controversial. In Indonesia, peatland agriculture's misconception equals unprecedented environmental degradation is mostly dominated by poor management of numerous peatland plantations. In 1995, the government avoided concerns about environmental sustainability to achieve rice self-sufficiently through Mega-Rice Project (MRP) where they would cultivate rice in one million hectares of peatland (Suriadikarta, 2009). The improper execution caused major errors, among others, the excessive drainage areas with peat domes. As the domes served as a water reservoir, water supply diminished (Notohadiprawiro, 1997). This made the soil highly flammable which turned the project into mega-scale forest fires with million tonnes of carbon emission, not to mention the agrarian conflicts.

While suboptimal wetland (including peatland) is challenging due to excessive water content, suboptimal dryland is on the other hand experiencing water shortage (Lassa et al., 2018; Li et al., 2017). Both acidic dryland or dryland in dry climate cover more than half of Indonesia's land. The failure of dryland farming often because of drought and poor irrigation systems. More than a million hectares of farmland are facing high risk of annual drought and thousands of hectares undergo harvest failure. The declining production due to ecosystem destruction also occurred in tidal swampland (Adam et al., 2013). The degradation made the farmer income decrease and worsened the welfare of farmers.

In the first part of this series, we introduced the characteristic of suboptimal land and its distribution in Indonesia. This type of land needs a technology application to improve the soil's physical, chemical, and/or biological characteristics. Water management and irrigation systems play an essential part in ensuring the sustainability of agricultural practice. Many other technologies have been invented to make the idea viable, such as ameliorants, fertilizer, and cultivar that is adaptive to suboptimal conditions. However, based on economic perspective, the implementation of the technology is often costly. Ultimately, can suboptimal land become the alternative farmland to produce food with minimum environmental damage?

ADDRESSING CHALLENGES FOR SUSTAINABLE AGRICULTURE IN SUBOPTIMAL LAND

The demand for food will rise to 70-100% in the next three decades (Kastner et al., 2012). The world will become more competitive in utilizing available lands for agriculture which often bring adverse impact to the natural ecosystem and to society. The sustainable agriculture term has been globally recognized as a method where we can plant and harvest a crop without devaluing the land and environment (Keeney, 1990). While various regulations have been implemented to foster this notion, the result is often unsatisfactory due to arbitrary boundaries of sustainability, low stakeholders' capability and weak law enforcement.

The gap between food demand, food production, and land availability needs to be resolved. Suboptimal land has a promising potential to support food security but might open a Pandora's box in the future. The land conditions are very sensitive to natural change and mismanagement, yet there is increasing evidence that indicate suboptimal land can be enhanced into productive lands by improving its functions and soil characteristics.

1. On Suboptimal Wetlands

The root of the problem in wetland suboptimal is how we manage water system properly. Denial of improper management will produce environmental degradation in long-term food production (Wijedasa et al., 2017). Conventionally, the measure to tackle water inundation in peatland, which is bad for crops growth, is to drain the water through canal system. The combination of some crops' requirement for less water and uncontrolled draining change the peatland's agriculture as a carbon emitter. The carbon source comes from repeated fired and high-rate subsidence, especially in El Niño Southern Oscillation (ENSO) season. The carbon emitted from peatland fires is 4,037 – 14,680 tons of carbon dioxide released per hectare (Mg CO2 ha-1) (Hafni et al., 2018; Page et al., 2002). The subsidence, not even seen and correlated with a low groundwater table, also produces carbon because drained peatland made peat soils oxidize faster in aerobic conditions (Evans et al., 2019). This high risk of carbon emission, from subsidence and fires, are the underlying causes that most people, especially environmental activists, label peatland agriculture as "a problem" and should be "banned."

However, sustainable wetland's agriculture, especially on peatland, can be done with proper application of water management systems. The key is to manage the water – lowered groundwater table for crops without increasing the aerobic condition of peatland. The canals must be equipped with dams to prevent water loss and water gates to regulate "desirable" water tables. This management could reduce the fire risk because the soil is always saturated and minimize subsidence while maintaining yield productivity. In a coconut plantation in Riau (figure 1), the water management has been proven to reduce carbon emission up to 70% (Fawzi et al., 2020).

Figure 1. Water management serves as water storage at the main canal and transportation system in coconut plantation at Pulau Burung, Riau. Photo © Tay Juhana Foundation

In many cases, the cropping practices, such as mentioned above, are mainly used for industrial food production. Meanwhile, smallholder farmers might need a different approach to utilize the same water management principle. For example, regular and unpredicted floods in lowland swamp, often in riparian areas, with the occurrence of drought, became the primary problem for farmers (Lakitan et al., 2018). These problems are solvable, but require support from the government to adopt the technology, for instance, to build flood control. Improving water control could increase food production up to 300% and intensify the cropping patterns from once to three times per year in lowland swamp in Ogan Komering Ilir Regency, South Sumatra (Djamhari, 2009).

In tidal swampland, a threat comes from the reliance on aquaculture commodities for food production. Unsustainable farming activities can cause pyrite poisoning and abrasion that decrease productivity. As a result, some farmers left the unproductive pond, others still seek for the solution. Empowerment activities in Demak show improving the knowledge and capacity of farmers could improve the quality and sustainability of their ponds (Bosma et al., 2019). This kind of development program has been implemented in Demak where aquaculture farmers managed to increase their productivity as shown in Figure 2 (Van Wesenbeeck, 2014).

Figure 2. Empowerment activities in Coastal Field Schools to improve aquaculture practice sustainably at the coast of Demak Regency, Central Java. Photo © Blue Forest Foundation

2. On Suboptimal Drylands

Drylands cover approximately 47% of the world's land area (Inanaga et al., 2005). Around one billion people rely directly on dryland ecosystem services, whether through rain-fed or irrigated farming, or through widespread pastoralism. To make the soil applicable for agricultural production, it needs to have a proper water holding capacity and ability to supply nutrients to plants. In drylands, the organic content of the soils is low and, therefore, natural soil fertility is also low. To sustain the farming, the land requires an effective irrigation system and soil management which improve its nutrient level.

Principally, to sustain dryland agriculture, the practice must involve following aspects (Inanaga et al., 2005):

1. Efficient use of water, seeding at rates corresponding to the soil water supply,
2. Managing soil fertility and organic matter,
3. Cultivar selection, and
4. Pests resistance.

With the climate change that disrupts rainfall patterns, rain-fed farmland will not be productive. Building the dam and irrigation system is among the solutions to maintain productivity and prevent land degradation. Recognizing this situation, the Indonesian government is underway to build 65 dams by 2022. The dams are especially intended to irrigate arid lands in Eastern Indonesia.

Agriculture technologies are increasingly advanced where each region can experiment which method is the most effective to their land settings. The combination of traditional method and modern technology could overcome the dryland constraints. For an extreme case, in the United Arab Emirates' desert where the land is covered by sandy soil that is unable to retain water. The scientist adopted the traditional wisdom of using clay for soil improvement. Supported by high technology, they transformed the clay into liquid nanoclay to help the water and nutrients to stick to the plants (Lovell, 2020). Figure 3 indicates that the desert farming managed to produce watermelon and pearl millet from April to May 2020.

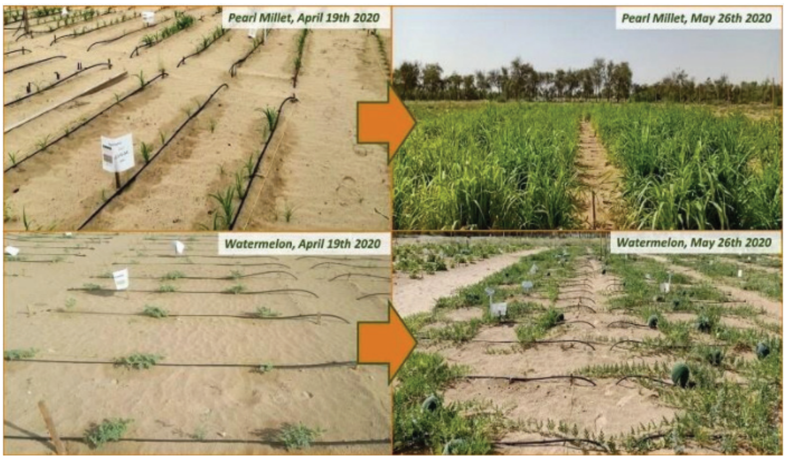

Figure 3. The before and after use of nanoclay for farming in desert areas. Photo © Singularity University

In Indonesia, innovations were utilized too. In Aceh, where the soil was acidic, most of the land had poor fertility. The use of lime to overcome acidic condition and fertilizer to increase nutrients contribute to stability and sustainability of food production in the region (McLeod et al., 2020). The same method was applied in farming in East Nusa Tenggara to improve soil fertility (Matheus et al., 2017). Importantly, with the 140 million of dryland in Indonesia, maintaining the availability of water is the key to sustainability, and it is possible to achieve with the current technology (Haryati, 2014).

MAINSTREAMING SUSTAINABLE PRACTICE OF SUBOPTIMAL LAND AGRICULTURE

While the evidence of the suboptimal land farming viability keeps growing, it is still a challenge to change the negative perception of suboptimal land cultivation, especially since many irresponsible agents implement it in a destructive way. On the other hand, suboptimal land offers a strong potential for securing the food production. It is essential to understand and implement the best practice to avoid any detrimental effect on the environment and the human living within the ecosystem.

Besides the complexity of suboptimal land itself, the multi-faceted challenge hampers its sustainability. The maximum gain mindset drives the farming system to only focus on achieving high productivity yield which encouraged exploitation of the land (Bennett, 2017). The practice put the land at risk of irreversible degradation such as drying peat or dryland desertification. These practices undermine the environmental part of sustainability. It should always be noted that farming in suboptimal land should be intended for optimum yields, instead of maximum.

A comprehensive approach to mainstream the sustainable agriculture practice on suboptimal land should be enforced through farmers capacity building, governmental regulation, investment, and supporting the research and technological development (UNEMG, 2011). Providing farmers with technical farming skill, access to capital, and knowledge on agribusiness management can significantly accelerate the efforts to achieve sustainability (HLPE, 2013). This approach can be a reliable solution for a country with abundant numbers of farmers and infertile lands like Indonesia.

Next, fostering integration between cross-sectoral stakeholders, particularly regulations pertaining to agriculture relevant to environment, economy and social development. There might be a low level of interest among farmers to cultivate the suboptimal land since the soil type is less favorable. Regulation in the form of assistance, farmers' incentive, and facilitation to market the commodities with a fair price could stimulate responsible farming (Curtis, 2013). Simultaneously, the policy makers need to address the weak governance issues as they seem to ignore a large number of company violations that caused intense forest fires and unprecedented environmental hazards.

Suboptimal land agriculture requires higher investment compared to the one in arable area. To ensure sustainability, affordable technique in increasing crop and maintaining environment quality is important (Lakitan, 2019). Farming in suboptimal conditions needs additional capital to improve soil condition. The available infrastructure such as quality seeds, irrigation systems, or roads for transportation are often inadequate. Low accessibility to and from the location of production fields leads the price of the produced commodity to rise since the production cost is high.

Research on viable and affordable technologies to sustain farming in undesirable land conditions should be maintained to make reliable technology. Research should address agro-ecological management's implications in different cultural and environmental settings, to further develop sustainable production techniques (Wibbelmann et al., 2013). The stakeholders, especially policy makers, need to recognize it takes a series of experiments and market access to make the technology applicable and profitable.

Beside all the challenges, opportunities keep emerging in our step. Surahman et al. (2018) showed the opportunity of sustainable farming of rice, oil palm, and rubber on peat. Of course, with multiple considerations to prevent decreasing value of peatland such as using an integrated ecological approach. Another peatland research in Riau Province, indicated that several varieties of rice could yield the same amount of grains as in Java Island as long as the water management was conducted properly (Fawzi and Qurani, 2020). In the future, due to complications of climate change, we need an extra effort to achieve sustainable agriculture and produce more food.

CONCLUSION AND RECOMMENDATION

In recent decades, the growing interest to optimize the suboptimal land came from the realization that the implemented efforts in increasing agricultural productivity have become agronomically more difficult and economically less feasible. This growing interest has produced sustainable ways to produce food in suboptimal lands. However, despite the available technology and innovation, follow-up measures should be taken to ensure a wider adoption. An approach that consists of farmers empowerment, good governance, investment, research, and technology can be used to mainstream the suboptimal land agriculture. A set of strategy and plan, both on suboptimal wetland and dryland, should be devised based on the existing potential economic benefits, socio-cultural values of the locals, and ecological impacts to the environment.

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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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