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WATER MANAGEMENT OF SWAMPLAND AS ADAPTATION TOWARD THE CLIMATIC CHANGE IN SOUTH SUMATRA

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WATER MANAGEMENT OF SWAMPLAND AS ADAPTATION TOWARD THE CLIMATIC CHANGE IN SOUTH SUMATRA

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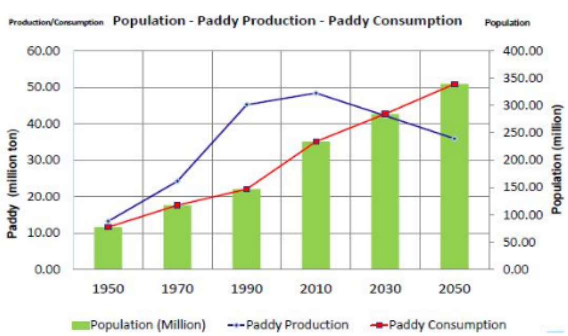
ABSTRACT

Increasing of population spurs the increase for foods and shelters requirement. Agricultural extensification on non-tidal lowlands or swampland, especially in South Sumatra, should be done in order to fulfill yearly increase for foods requirement. However, swampland frequently had been changed into non-agricultural usages such as for settlement and office areas. Moreover, the decrease of land and water resources quality had occurred due to climatic change such as *El Nino* (drieness) and *EL Nina* (flood). The hotter temperature and uncertain seasonal change results in planting and harvesting failures, diseases outbreak and agricultural land degradation. Swampland can be utilized by using optimum water management method. This paper has an objective to give overview in term of strategic alternative and opportunity of water management technology and irrigation system as an adaptation toward climate change in South Sumatra. The method used in this paper was literatures review and secondary data from several studies related to non-tidal lowland or swampland. The conclusion from this paper were as follows : 1). Water management strategy in swampland can be conducted by using several technological alternatives and irrigation system taken into account swampland characteristics and soil properties as well as topography in this area; 2). Water management was conducted by controlling water table depth that can be determined from hydrological, climatological and water requirement aspects. By considering these perspectives, water management on swampland can adapt to the climatic change.

***Keywords* : swampland, water management, irrigation system, climate change**

INTRODUCTION

The current increase of Indonesia population requires additional requirement of foods and settlements. Self sufficiency of rice that had been achieved in Indonesia will no longer prevail because the rate of population increase was faster than the rate of food supply. Rice productivity, population numbers and rice consumption predicted from years 1950 to 2050 can be seen in the following figure.



Source : Suryadi, F.X. 2013. *Capacity building in Lowland development, food production and food security*. Lowland Symposium, 2013.

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The decrease of land and water resources quality had occurred due to climate change such as *El Nino* (drieness) and *EL Nina* (flood). The hotter temperature and uncertain seasonal change results in planting and harvesting failures, diseases outbreak and agricultural land degradation.

Food crisis had also occurred due to function shifting of agricultural land into settlement area and non-agricultural area. The National Food Security Council had reported that agricultural land conversion in 2009 had magnitude of 110 thousand hectares per year that was used for other activities (Sutjahjo, 2011). Pressure for function shifting of irrigation paddy field had increased every year that was used for non-agricultural activities (Susanto, 2010). According to Irawan and Friyatno (2005), the rate of land function shifting in outside Java (132 thousand hectares per year) was higher than that of Java island (56 thousand hectares per year). In order to balance this land function shifting, the government had conducted agricultural intensification in Java and Bali islands. On the other hand, government had conducted agricultural extensification in Sumatra, Kalimantan, Sulawesi and Papua islands due to availability of extensive swampland in these areas. The area of swampland in Indonesia was about 33,393,570 hectares consisting of 20,096,800 hectares (60.2%) tidal lowland and 13,296,770 hectares (39.8%) non-tidal lowland (swampland). Total area that had been developed by government was 1.8 million hectares consisting of 1,452,569 hectares tidal lowland and 347,431 hectares non-tidal lowland (swampland)(Dit. Rawa dan Pantai, Departemen PU, 2009 *in* Susanto, 2010). Total area of swampland in South Sumatra that had been reclaimed up to 2010 was 373,000 hectares (BSWVII, 2010).

Lowland area, especially swampland, has high potential to be used as strategic choice for development of agricultural production area to cope with climate change and food security (Alihamsyah, 2002). Swampland can be developed as productive agricultural area by using proper management and by considering land characteristics as well as appropriate application of technology (Ismail *et al*., 1993). Activity and operation at swampland are highly depended on water management system. Lack of water or excessive of water will create disaster. Crops that experience water deficit will result in decrease of product quality and quantity. Excessive water will create the decrease of harvesting yield and diseases outbreak. Extreme condition of excessive water will results in soil leaching, erosion and flood.

There are many constraints for water management on swampland so that the previous water management was not optimum. The important point for successful agricultural effort on lowland swamp is water management technology and irrigation system in this area. Therefore, proper water management technology and irrigation system on swampland are very important.

Based on the above description, this paper has an objective to give overview in term of strategic alternative and opportunity of water management technology and irrigation system as an adaptation toward climate change in South Sumatra. The method used in this paper was litratures review and secondary data from several studies related to swampland.

DISCUSSION

Water management condition in swampland

Lowland area is the land that is always wet or water logged for all year long or several months in a year or has shallow water table, or even flooded (Daryono, 2009). Lowland area can be differentiated into two categories, i.e. tidal lowland and non-tidal lowland (swampland). Tidal lowland is the land in which its flooding condition is affected by sea water tidal movement, whereas lowland swamp is the land found in the right and left sides of

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main rivers and their branches, having flat topography, water flooded during wet season and dry or constantly flooded during dry season (Susanto,2010). Based on land surface variation, altitude and flooding period, swampland can be classified into three types : bund swampland, middle swampland and deep swampland (Ditjen Pengairan, DPU, 1996). Bund and middle swamplands have higher potential to be developed as rice crops and paddy field areas, whereas deep swampland can be utilized as fresh water fishes or water fowl husbandry such as ducks (Direktorat Rawa, 1991). swampland is the land that has water regime affected by topography and rainfall which occurred either locally or from surrounding areas and has relatively low topography, but it has high potential in term of land and water resources for agricultural, fishery and husbandry production. Nearly 91 percent of cultivated swampland was for rice production with one time planting pattern and the rest of 9 percent had two times planting. The province that had the most extensive area with one time planting pattern of rice was South Sumatra which covered about 146,279 ha (Alihamsayah , 2004).

The current problems related to utilization of swampland for agricultural sector are as follows : 1). Uncontrolled water management or water gates, 2). Low level of soil fertility, 3). Biological problems related to pests, diseases and weeds, 4). Socioeconomic problems such as manpower or labor, capital deficiency, educational level, farmers empowerment, institutions, soil status, farm labors, lack of coordination as well as structures and infrastructures (Direktorat Rawa, 1991).

Problems related to swampland in South Sumatra were low production due to improper water management system in addition to biophysical factors and low fertility of soil. These problems were initiated during swamp reclamation process by digging out huge channels such as primary, secondary and tertiary channels (Subagyo, 2006). Water gates on tertiary channels were in improper function which results in uneven water availability. Water flow can not be controlled so that land was flooded during rainfall for long period and produced farm enterprise failure.

Rice is the main commodity cultivated on swampland in South Sumatra. Rice variety having relatively high yield was IR42 especially in Lematang with average yield of 4 to 5 ton/ha. Second crops having good adaptation such as corn, soybean and greenpeal were cultivated on shallow swamp. Tubers crops and chilly were also cultivated on swampland in South Sumatra.

Potential of Technology and Irrigation System on Swampland

Operational activities on swampland were highly depended on water management system. Water flooding during wet season and dryness condition during dry season results in oxidation and reduction processes within soil which produce low soil pH and low nutrients availability for crops. Swampland having shallow water flooding can be managed as rain-fed paddy field or combination of paddy field and bund (*surjan* system). This technology had been developed by Balai Penelitian Pertanian Lahan Rawa (Balitra). Results study by Waluyo *et al*. (2002) showed that application of surjan system on swampland produced more efficient utilization of land because land can be cultivated all year long. Moreover, crops rotation will produce more fertile soil, increase land productivity and it is hoped capable to increase farmers income.

The other alternative technologies for water management on swampland were consisted of : a). Water channel system equipped with partition gate (*stop log)* on the left and right sides of tertiary channel; b). Channel system with partition gate *(stop log)* on the left side of tertiary channel and flap gate on the right side of tertiary channel. These technologies showed that stop log can maintain water level elevation in tertiary channel during dry season;

water circulation can be developed through flap gate installation which facilitate land leaching process; land drainage function can be achieved as well as primary and secondary channels can be used as transportation lanes without deepening process on both channels during wet season or dry season. Therefore, water management system equipped with water gates having proper types and numbers is capable to provide supply function and create flow circulation which results in optimum perfomance for water management network (Budi, 2007).

Technology for swampland management can be put into effect through amelioration, balance fertilizing as well as soil and water treatments (Adnyana *et al.,* 2005). Water management technology is directed toward maximum utilization of water resources to fulfill crop water requirement as well as to regulate the balance between water inflow and outflow. Proper arrangement of water channel is very important to control water flow. Water management on land can be done by using surjan system, kemalir system and caren system. Water inflow and outlow processes can be easily controlled by using these systems. Technology of water balance is the one that capable to regulate water inflow and water outflow. One of important conclusion from hydrologic cycle is that water quantity in certain area is determined by water balance of land . Water balance technology for land is capable to determine agroclimatic condition, especially the dynamics of soil water content on swampland which subsequently can be used to design the general planting pattern. Water balance needs input and output data in forms of rainfall, evapotranspiration and soil water content (Salwati *et al,* 2007).

The choice of water management network type is depended on swampland characteristics as well as rainfall and land topography. Some swampland s used *handil* system as traditional water management system having very simple design in form of channel that protrude into river estuary (Muhammad, 2001:100). Handil generally has 2-3 m width, 0.5-1 m depth and entrance length from river estuary of 2-3 km. Anjir system, which is also called as canal system, is water system having big channel that connects two main rivers. This channel has function to irrigate and distribute the inflow water from river in case of high tidal period as well as to collect drainage water during low tide period through handils which are developed a long anjirs. Therefore, river water can be utilized for crops in more extensive and unimpeded ways. Anjir provision made areas in the right and left sides of channel can be irrigated by handils development (tertiary channels) which are perpendicular to canal. Garpu system is water management system designed with channels which are developed from river edge protrude into inland in forms of navigation channels and primary channels followed by secondary channels which may consisted of two branches channel so that water network resemble garpu or fork (Noor, 2001 : 103).

Water management strategy on lowland swamp

Alternative for water management strategies on swamplands were as follows :

1. The choice of system and technology for water management on swampland should be in accordance to tipology and water flow within this area because swampland conditions are different from one area to the others, especially for swamplands in South Sumatra that have different characteristics. Physical and chemical conditions of soil, rainfall, crop types and topography affect the discharge magnitude for irrigation water supply.
2. The land function shifting can be minimized by analyzing land change for several years obtained from landsat image which was interpreted in form of land cover map and development of Regional Space Order Plan for South Sumatra Province so that

land can be used according to its allotment. Therefore, swampland can adapt toward the change of climate and weather.

3. Water management should take into account the calculation of design flood discharge in order to determine water table level on swampland so that water table level can be controlled in proper manner. swampland condition is affected by climate and weather. Therefore, water balance calculation should be done in term of rainfall, evapotranspiration and water availability. This was conducted through analysis of hydrology, climatology and water requirement. Planting pattern regulation is required in order to facilitate water management so that crop water requirement is in accordance to availability of water supply. Planting pattern give the description of periods and crop types to be planted during one year period. Water management pattern was conducted through two activities as follows. Water at wet season (rice planting period) is used for leaching process in order to improve quality of water and soil. Water gate structures were provided at secondary channel to minimize water losses from paddy field areas as well as development of land surface levelling. Soil water during dry season (secondary crops planting period) should be maintained by operating water gate structures on tertiary channels in order to control water table level.

CONCLUSION AND RECOMMENDATION

CONCLUSION

1. Water management strategy on swampland can be conducted by using several alternatives of technology and irrigation system by taking into account land tipology, swampland characteristics, soil condition, water flow regimes and swampland topography so that it can be converted from marginal condition into optimal condition.
2. Water management was done by controlling water table level. Water table level can be determined from hydrological, climatological abd water requirement aspects. Therefore, water management at swampland can adapt toward climate change.

RECOMMENDATION

Water management technology on the swampland should be take into account condition of land tipology and water regime in order to control water table level. Proper water management is the key point for successful development on swampland

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