POTENTIAL AND CONSTRAINTS OF RICE FARMING IN TIDAL SWAMP LAND

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Abstract - Sub-optimal land has the potential to be developed as agricultural land, especially rice plants. Agricultural land in Central Kalimantan reached 3,709,887 ha, of which arable land for the cultivation of rice is 646 379 ha (17.4%). Land potential in the form of tidal swamp, freshwater swamp/lebak, and peat, dry land and irrigated land non-functional. Constraints to be faced are land productivity, farmer education, cropping index is still low, the infrastructure is still inadequate, pest attack is high. The application of technological innovation and the quality of human resources (HR) and institutional support is an opportunity in the development of sub-optimal land.

Keyword - Sub-optimal Land, Constraints, Innovation and Human Resources

I. INTRODUCTION

In the period of 1995 to 1999, the wetland rice area in Sulawesi and Kalimantan reduced around 102,000 to 170,000 ha. Meanwhile, in the period 1999 to 2002 an average of wetland conversion ranges from 187,720 ha/year. Efforts agricultural expansion is possible will happen to the sub-optimal land pretty much spread in Indonesia, one of which is in the province of Central Kalimantan.

Agriculture in sub-optimal land generally have some constraints, such as: water (both flood or drought), high soil acidity, salinity, poor nutrient and the stratum of pyrite which interfere the root system. Swampy land classified as marginal and fragile, so that technical aspects should be the basis for site selection and application of technology. However, social and economic aspects also play an important role for achieving agricultural development in swampy land. Experience shows mistake in site selection and application of technology resulted in the emergence of degraded lands (bongkor land, unused land) in Sumatra and Kalimantan (Suardikarta and Sutriadi, 2007).

Lakitan and Gofar (2013) adds that sub-optimal land management need to be prioritized in the development of technologies that are technically relevant to each of these sub-optimal land characteristics, economically affordable by local farmers, and is expected also in line with the socio-cultural and preferences of local communities. Two approaches can be performed in parallel and interactively is [1] to optimize the physical, chemical, and (micro) biological soil parallel with the optimization of water resources management in order to effectively and more efficiently; and [2] the selection of appropriate kinds of commodities and the development of adaptive varieties specifically for each characteristic sub-optimal land.

Central Kalimantan has a total area of 15.3564 million ha with major agro-ecosystems are swampy land and dry land (BPS, 2014). Area which can be developed as agricultural land is 3,709,887 ha consisting of 2.66151 million hectares, or approximately 71.7% for perennial crops, 401,980 ha (10.8%) for annual crops and 646,397 ha (17.4%) for wetland rice (Balitbangtan, 2008). Most of the wetland rice fields belonging to a sub-optimal land, such as tidal swamps, lebak and peat, dry land and non-functional irrigated land. The area is quite a potential for agriculture and new national food barns. Broad distribution of swampy land in Central Kalimantan are presented in Table 1.

Ex-PLG area spread over four districts, that is Kapuas district (629,827 ha), Pulang Pisang district (618,543 ha), South Barito district (197,601 ha) and Palangkaraya municipality (16,324 ha). At the beginning of the area occupied by a transmigration family of about 15,594 migrants, currently reported just 350,000 persons. Approximately 532,000 hectares of land (1,462,295 ha) is a mineral soil, suitable for agriculture.

Besides swampy lands, in Central Kalimantan, there is also a dry and irrigated land in agricultural use. An area of dry and irrigated land in Central Kalimantan are presented in Table 2 and Table 3. The dry land is 15,083,194 hectares (92.22%). Most have been cultivated, and about 1.60914 million hectares or 10.67% does not/has not been utilized. Various secondary and horticulture crops grown in this area, such as corn, soybean, peanut, eggplant, spinach, onion, etc.

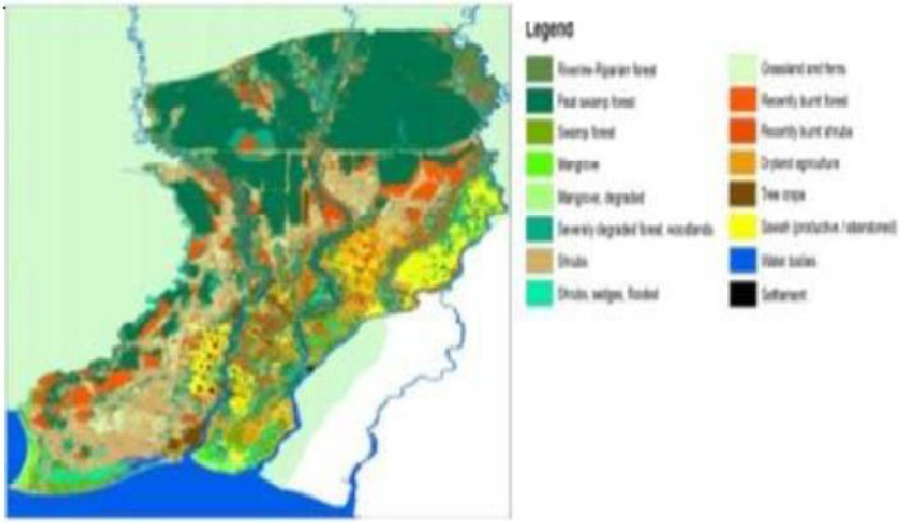

Figure 1. The use, classification and analysis of ex-PLG land

Table 1. Area distribution of swampy land in Central Kalimantan

No.	District/City	*Lebak*	Tidal land			Total of tidal and *lebak*		
			C	D	Total			
1	Kapuas	0.0	0,0	132,415.0	54,559.0	186,974.0	186.974.0	63,390.0	123,584.0
2	Palangka Raya	0.0	0.0	0,0	0,0	0.0	6.325.0	195.0	6,130.0
3	Kotawaringin Barat	0.0	0.0	12,350.0	9,750.0	22,100.0	29.531.0	3,858.0	25,673.0
4	Lamandau	0.0	0.0	0.0	0.0	0.0	5.539.0	1,639.0	3,899.5
5	Sukamara	4,213.0	1,974.0	1,720.0	0.0	7,907.0	15.170.0	1,912.0	13,258.0
6	Seruyan	0.0	0.0	0.0	31,354.0	31,354.0	49.428.0	3,760.0	45,668.0
7	Kotawaringin Timur	1,350.0	12,352.0	13,728.0	2,578.0	30,008.0	42.256.0	12,353.0	29,903.0
8	Katingan	0.0	0.0	16,540.0	0.00	16,540.0	31.698.0	20,428.0	11,270.0
9	Pulang Pisau	15,361.0	39,822.0	6,350.0	0.00	61,533.0	114.493.0	37,550.0	76,943. 0
10	Barito Timur	0.0	0.0	0.0	0.0	0.0	8.745.0	350.0	8,395.0
11	Barito Selatan	0.0	0.0	5,340.0	0.0	5,340.0	17.067.0	6,211.5	10,855.0
12	Barito Utara	0.0	0.0	0.0	0.0	0.0	3.724.0	78.0	3,646.0
13	Murung Raya	0.0	0.0	0.0	0.0	0.0	1.967.0	20.0	1,947.0
14	Gunung Mas	0.0	0.0	0.0	0.0	0.0	1.195.0	1,195.0	0.0

Source: *Balai Rawa Provinsi Kalimantan Tengah* (2012)

Table 2. Raw land area, potential, functional and non functional irrigated land in Central Kalimantan.

District	Irrigation	Land area (ha)	Potential land area (ha)	Fungtional land area (ha)	Non fungtional land area (ha)
Gunung Mas	Sakata Juri	400	205	150	250
	Sakata Tewah	410	400	100	310
	Gohong Rawei	710	710	40	670
Barito Utara	Trinsing	687	687	100	587
	Trahean	400	400	150	250
Barito Timur	Pematang Karau	3,794	1,794	587	3,207
	Tampa	259	259	200	59
Kotim	Mantaya Hulu	400	400	100	300
	Antang Kalang	100	100	0	100
Lamandau	Bayak	250	250	50	200
	Sumber Cahaya	150	150	30	120
Kobar	Barambai Makmur	250	250	250	0
	Kumpai Batu Atas	1,500	1,500	1,500	0
	Pangkalan Satu	100	100	100	0
	Palih Baru	300	300	300	0
	Sagu Saka Mulya	200	200	200	0
Total		9,910	9,705	3,857	6,053

No	Description	Planted with rice			Not planted with rice*)	while not cultivated	Total
		Three times	Two times	One times			
1	Technical irrigation	1	929	3,056	915	2,083	6,984
	Semi technical irrigation	-	2,304	10,441	2,003	1,670	16,418
3	Simple irrigation	5	4,672	19,795	9,176	14,611	48,259
	Rural irrigation/Non Public Works	-	4,663	12,995	4,308	9,080	31,046
	Total	6	12,568	46,287	16,402	27,444	102,707

Table 3. Area of irrigated land that is used for rice crops with different planting pattern

II. RICE CROP DEVELOPMENT CHALLENGES IN TIDAL SWAMP LAND OF CENTRAL KALIMANTAN

Constraints rice development in Central Kalimantan covers several aspects, that are land, cultivation, agriculture infrastructure, pests attack, socio- economic and non-functional. The most aspects of the constraints are land and infrastructure which still inadequate. The description of each aspect of the constraints in the development of rice is as follows.

Land

Considering the land in Central Kalimantan province are predominantly swampy lands, both lebak, or tidal, then that becomes the main obstacle is puddles that are currently difficult to predict. The existence of global climate change causing water levels difficult to estimate. This makes the farmer is not easy to determine the time of planting. Besides that drought often hit the tidal land, and seawater intrusion. Such soil characteristics necessarily cause to high abiotic stresses like high soil acidity due to the high content of (Al^{3+}), (Fe^{3+}), and (SO_{4-}), mainly on the type of tidal land. Critical limits Fe toxicity in plants by

Yoshida (1981) was 300 ppm. Excessive iron content can form ferric oxide layer on the surface of the root, thus inhibiting the absorption of nutrients, decrease of oxidation and Fe prevention by roots (Todano and Yoshida 1978 in Suhartini, 2004). Suhartini (1992) also mentions that rice yields declined by 90% in paddy fields containing high Fe on a Red Yellow Podzolic soil type. Sudana (2005) suggested that the amelioration and fertilization is an important component in solving soil acidity, especially on acid sulfate and peat soil. By providing 1-3 tonnes/ha of lime/dolomite or ash as ameliorant will be able to increase yields significantly in acid sulfate soil.

Cultivation

Most of sub-optimal land in Central Kalimantan used for rice farming of local rice variety which have long maturity. In general, local farmers grow rice once a year. Tidal land areas of type B and C as well as a shallow lebak area can basically be planted with rice twice a year. This can be done if the rice varieties planted is short or moderate maturity. Currently, the IAARD has released varieties Inpara 1 to Inpara 9 suitable for cultivation in swampy land with a shorter maturity (Jamil et al. 2015). These varieties can be implemented in swampy land, so that rice production increased. Busyra et al (2014) reported that the planting Inpara 3 on tidal land can increase cropping intensity from IP 100 to IP 200 with a profit of Rp. 4.4 -7.5 million at the frist cropping season (DS I) and Rp. 6.5 - 8.8 million on second cropping season (WS).

Infrastructure

Most of water canals and drainage is not equipped with doors regulator. Thus the water can not be controlled. Water regulation in lebak area is actually very necessary in order to achieve harvest index 200 in shallow lebak area. Farm roads and transportation facilities are limited, and most of them use the water transport. In addition, the arrangement of land to diversify commodity that can be cultivated (surjan system/intercropping) is still expensive.

Pest attack

Rat attacks become the main obstacle in tidal and lebak land. This is due to the amount of undeveloped land that eventually became the nest of rat. In addition, other pests that were encountered are bird and rice bug. Anggraeni et al. (2014) reported that the rice bug is one of the groups of bugs which most common in the swampy area. Attacked of this rice bug can reduce rice yields of up to 50%.

Social Economy

Some socio-economic aspects of a constraint in rice development in

Central Kalimantan include:

1. The level of education of farmers is still low.
2. Application of innovation has not been realized, especially for farmers in dry land, whereas in tidal land, most farmers have adopted a variety of innovations.
3. The number of labor is very limited, so that the production cost becomes expensive.
4. Youth farmer is not interested in farming and more interested in working in services and industry in urban areas.
5. Limitations of farm capital caused many farmers who farm based on existing ability, without providing inputs production.
6. Many of the cases in the provision of fertilizers subsidized, evidently farmers who entitled to receive can not relish that subsidized.

Infra Structure

Some non-functional aspects are often an obstacle in the development of rice, among others:

1. The physical facilities or irrigation canal have damage such as door controller broken.
2. The canals are made do not reach the main location of the farm.
3. Suctions of water for non-agricultural purposes, such as fish ponds.
4. The amount of water flow is insufficient for the region

III. THE OPPORTUNITIES OF SUB-OPTIMAL LAND DEVELOPMENT

Geographical, climate and topography conditions

Central Kalimantan is located in the path of the equator that is at 00° 44' 54" North Latitude - 03° 47' 07" South latitude and 110° 43' 19"- 115° 47' 36" East Longitude. Schmidt and Ferguson stated that Central Kalimantan including climate type A is characterized by the number of months more wet than dry months and pattern of rainfall spread almost evenly in all regions. Agroclimate consists of 4 classes, namely Class A in the North, in the Central Part of Class B1, Class C1 and C2 in the Southern part. The air temperature is relatively constant, reaching 23°C at night and 33°C during the day. Solar radiation reaching 60% per year. An average rainfall of 200 mm/month or 2,732 mm/ year with an average of 120 days of rainy day. In the hilly hinterland, rainfall from 2.000 to 4000 mm per year. The rainy season is usually from September to May, and a peak in November and April. The climate is relatively dry starting in June-August. The average wind speed of 4 knots/Km.

Institutional Support

Central Kalimantan has institutions that can support an increase in rice production include:

1. Agency for Food Security and Coordination Extension in Provincial Level in Central Kalimantan.
2. Agency for Implementing Counseling or Extension Office and Food Security in 14 Districts/Cities.

3. Center for Agricultural Extension (BPP) in 356 sub-districts, and there is a new BPP model BPP in 6 districts and is equipped with a tool of Cyber Extension from Agency for Human Resources and APBD II.
4. More than 2,000 field officers have to follow field training II and III (PL II dan III) and understand the technology of rice cultivation.

IV. INNOVATION APPLICATION IN RICE FARMING AT SUB OPTIMAL LAND

Tillage traditionally which called Tajak-Puntal-Urai, aims to improve soil organic matter and nutrients in-situ. The rest of the straw left on the land by piling into clumps until rotten, then flatten back in paddy fields. Water management by making anjir-anjir as the primary canal and handil-handil as the secondary canal.

The use of local rice varieties specific location which long maturity and tolerant of acidic environmental conditions. Physiologically local varieties that long maturity is able to perform grain filling optimally, pest and environmental stress resistant, so that farmers are very rarely experienced of harvest failure, except flooded long enough. Local rice flavored very highly favored and has a high sales value, but low productivity.

Technology of Sawit-Dupa or once weeding twice harvest, is the technology accelerates to plant local rice crops, leaving little area around the high yielding rice crops, for placing local rice before moving to the main land.

Ratun technology that allow plants that have been harvested to produce grain again, by setting the cutting height at harvest, N fertilizer management, and the provision of water.

The last few years AIAT have mentoring introduced new technologies in rice farming systems in South Kalimantan. By doing these activities proved to improve farmers' knowledge about the management of rice farming and environmentally friendly farming. Besides, local farmers are skilled in determining the soil and crop nutrient requirements with PUTR. This technology assistance also enhances the ability to utilize organic waste from the surrounding environment to improve the quality of soil and plants.

Until now in AIAT Central Kalimantan have available technologies to swampy land area, are: (1) water management technology, (2) technology land arrangement, (3) nutrient management and ameliorant, (4) rice varieties that are adaptive, and (5) improvement of cultivation and farming systems.

AIAT of Central Kalimantan also activates the pest control and the introduction of ecological engineering, such as: (1) the use of plastic fence to rat; (2) ecological engineering through the planting of flowering plants in the dike which is believed to increase the abundance of parasitoids and enhance the role of natural enemies in the field. The observation by using light trap, there are several kinds of natural enemies were able parasitized rice pests.

CLOSING

1. Sub-optimal land has the potential to be developed as agricultural land, especially rice plants.
2. Constraints faced are land productivity level, farmer education, cropping index is still low, the infrastructure is still inadequate, pest attack is high, etc.
3. Implementation of innovation and the quality of human resources and institutional support is an opportunity in the development of sub-optimal land.

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