

Swamp land optimization in supporting food security and enhancing farmers welfare in South Sumatra Indonesia

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Abstract: Swamp land in Indonesia spread in Sumatra, Kalimantan and West Papua. In Sumatra the largest swamp land area is located in South Sumatera Province. Unfortunately only few of the areas have been utilized due to its fragility, in which farmers could only cultivate rice on it once a year. The purpose of this paper is to develop a feasible farming pattern in swamp land to help farmers and practitioners in optimizing it by managing its water level. Shallow and mid swamp land can be cultivated using rotation model of crops (rice, corn, cassava), horticulture (cucumber, long beans, watermelon etc), fish farming (catfish, snake head fish, tilapia), and duck farming, whereas submergence tolerant rice varieties can be cultivated alternating with fish farming in deep swamp land. This study shows that such swamp land management is financially feasible showing by its positive NPV value, BCR value is above 1.00, and IRR value is greater than the interest rate. Therefore, implementation of this farming pattern is expected to increase farmers' income and household food supply as well as village food supply.

1. Introduction

Land, as mention in the first strategy of the Indonesian Ministry of Agriculture to strengthen agricultural development [1] is important is necessary to properly utilize effectively and efficiently. Due to its limited resources, land conservation, protection and expansion through land reclamation and optimization of marginal land and or low productive land are applied [2].

Swamp land as marginal land can be utilized for agriculture since it is quite large in Indonesia. It reaches 13.3 million hectares spreads in Sumatra, Kalimantan and West Papua [3]. In Sumatera, the largest swamp land area is located in South Sumatera Province (2.98 million ha). Unfortunately only 368,690 hectares have been utilized for rice which is divided into 70,908 hectares of shallow swamp land, 129,103 hectares of mid swamp land and 168,670 hectares of deep swamp land [4]. Low optimization of swamp land is happened due to its physical condition which considered as a fragile land. According to Djamhari [5], obstacles found in swamp land were physic-chemical condition with high acidity, low soil fertility, as well as sudden and erratic water logging and flooding in rainy season but drought in dry season. Moreover, biological problem of high weeds, pests and disease also occurs. All these problems lead to low productivity in swamp land.

Several projects and studies have been done to increase productivity in swamp land as well as to increase farmers' welfare. A study conducted by Djamhari [5] revealed with proper technology and proper water management system, swamp land can be cultivated three times a year using rice-rice-



crops pattern which can increase productivity up to 7.00 tons of dry grain harvest. The weakness of this study was lower farmers' level of adoption due to higher technology intake which leads to higher cost. However, Galib [6] shows using relatively low input along with integrated crop management approach, corn cultivation in swamp land still yield 4.5 tons per hectares and even more.

In line with agriculture development strategic plan by Ministry of Agriculture to optimize and increase the use of land, this study is design to visualize utilization of swamp land optimally based on its natural characteristics. This feasibility study is different from existing studies and projects because it emphasize on optimal land utilization throughout the year using propose farming pattern based on swamp land characteristics. Moreover, simple technology is used in order to be easily adopted by farmers. Hence, the specific objectives of the study are: 1) to develop a feasible farming pattern for swamp land; and 2) to give an overview of the feasibility of the project. The expected result may provide greater insight for the farmers and government regarding the effort of swamp land optimization.

2. Methods

This study uses both primary and secondary data. Primary data was gathered from interview with existing rice farmers in Kota Daro II Village, Rantau Panjang Sub-district, Ogan Ilir in mid swamp land during April 2017. The random sample consisted of 15 farmers from Harapan Maju II farmer group (managers and members). Due to the study purpose to learn the farming feasibility through financial analysis, the interviews were not conducted individually but in groups to obtain an actual and valid data of input and output items so that this method is expected to represent the farming business in swamp area. However, since the farming pattern of rice-corn-fish has not yet found in this location, the benefit cost analysis of corn and fish are derived from the secondary data which is financial analysis of corn and fish farming in other swamp area outside the study location that compiled and analyzed for the purpose of this study.

According to Boslaugh [7], secondary data analysis research can be done by collecting secondary data, then examines it to look at the variables (aspects) of what is in the data to then raised the research question (problem formulation) by connecting various aspects (variables). Using Amirin [8] steps of secondary research methods, the main secondary data used in this study is derived from Statistics Indonesia and journals. In terms of data analyzing, production-consumption analysis is done by comparing data from 2010 to 2015 to see the pattern of production and consumption development and use the gap in projecting surplus or scarcity of each commodities in the future. Furthermore, to determine business feasibility, some of methods are used which are Net Present Value (NPV) where C_t are net cash inflow during the period t , C_0 are the total initial investment costs, r is a discount rate, and t is the number of time periods; Benefit Cost Ratio (BCR); Internal Rate of Return (IRR) where r_1 is the lower discount rate, r_2 is the higher discount rate, NPV_1 is the NPV at r_1 , and NPV_2 is the NPV at r_2 ; and Payback Period (PP) where I_0 is the initial investment amount, and R is the amount of return on investment [9].

$$NPV = \sum_{t=1}^T \frac{C_t}{(1+r)^t} - C_0 \quad (1)$$

$$BCR = \frac{\text{Discounted Value of Benefit}}{\text{Discounted Value of Cost}} \quad (2)$$

$$IRR = r_1 + \frac{NPV_1}{NPV_1 - NPV_2} (r_2 - r_1) \quad (3)$$

$$PP = \frac{I_0}{R} \quad (4)$$

3. Results and discussion

This study proposes a feasible farming pattern in swamp area in South Sumatra Province. Ogan Ilir Regency is chosen as the study case location because it is the largest swamp area in South Sumatra

where 55.2 percent (266,607 ha) of swamp land in South Sumatra is located in this regency [10]. This regency has shallow, mid, and deep swamp area which currently used for farming that makes it a suitable location for this study. Ogan Ilir has tropical wet climate (Type B) with dry season on May until October and rainy season from November to April [13].

In terms of planting time, the water logged in the land which affected by rainfall intense and river rise may cause differs in crops planting time. Most of the field is cultivated once a year and only small part of land is utilized for vegetables and crops grown in the bunds. Using climate data and planting time of the area above, thus the proposed farming pattern is formulated as shown in Table 1.

Table 1. The Proposed farming pattern in swamp land

Swamp Land	Commodities	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Agst	Sep	Oct	Nov	Dec
Shallow	Rice												
	Crops												
	Crops												
Mid	Rice												
	Corn												
	Fish												
Deep	Rice												
	Fish												

In shallow swamp land when the water recede begins, farmers start to cultivate rice in March to June and plant crops such as corn from June/July to October followed by another crops in November to February. Mid swamp land can be cultivated started in April followed by corn in August and fish farming during rainy season in December to March. Furthermore in deep swamp land, where most of the times are flooded by high tide, cultivation can only be done once in June to September for rice while the rest of the year can be utilize for fish raising. Thus this study propose a throughout year optimization. However, mid swamp land is the only agro ecosystem that estimated for this feasibility study since it is the largest swamp area compare to shallow and deep swamp land. Furthermore, the mid swamp land has greater chance to be planted twice a year due to its water availability.

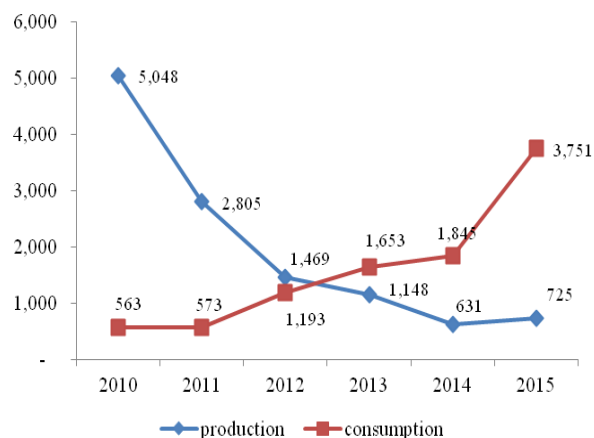
Rice is planted in April to July using early maturing submergence rice variety because it has higher level of resistance considering more problems occur in swamp land with expected yield per hectare per year is 5 tons rice. The leftover straw from rice production will be rotten and become organic media for the next crops. Corn is cultivated after the rice production in August to October. Sweet corn variety is used considering it short day plant period compare to other corn variety which has 75 days plant to harvest period so it may harvest in October with expected yield as much as 20,000 corncobs.

For fish farming, tilapia or catfish species is used since it has higher level of resistance to high acidity water and its relative easier to be raised. Fish farming is conducted in 48m³ ponds considering farmers' ability both capital and labor. It started to culture in December and harvested in May.

As mention above, rice is the existing commodity in swamp area. Based on literature, swamp land optimization is possible to be done either by a second rice production or other commodities. Corn and fish are chosen as additional commodities to optimize swamp land in this study because it is relatively easier to conduct. Production-consumption analysis of corn and fish is done in order to predict its market share in the future. The gap between the two will indicate whether a particular commodity is on its surplus or scarcity. It is important because by analyzing the production-consumption, the product that are needed and desired by consumers will be known to fill the expected target market share.

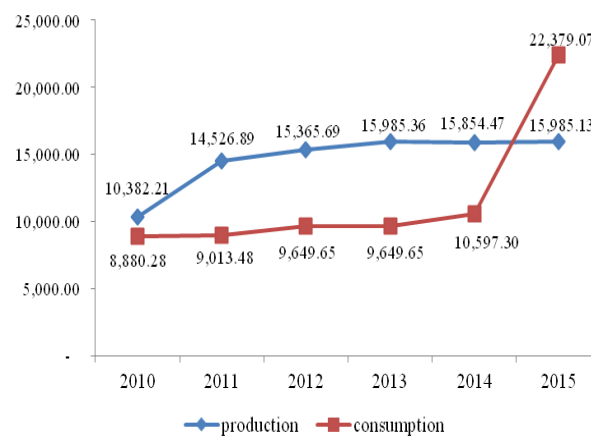
Corn is a major commodity crop after rice which contributes as feed. Corn production was obtained from corn production in Ogan Ilir Regency from 2010 to 2015 while corn consumption was compiled from livestock and poultry corn feed consumption which shown in Figure 1. The average increase of corn consumption was 49.47% per year during 2010-2013 while corn supply has decrease in average

of 37.79% per year. It can be seen that corn production is not sufficient to cover corn feed consumption in the future.



Source: Compiled from Statistics Ogan Ilir, 2011-2016

Figure 1. Production-Consumption of Corn in Ogan Ilir Regency (in tons)



Source: Compiled from Statistics Ogan Ilir, 2011-2016

Figure 2. Production-Consumption Analysis of Fish in Ogan Ilir District (in tons)

Like other South Sumatrans, the people in Ogan Ilir also fond of fish compare to meat. The Ogan Ilir fish supply is coming from river catch and fish farming. The fish supply demand analysis in Ogan Ilir District is shown in Figure 2. During 2010 to 2015, fish supply has the highest increased in 2011 while slightly increase shown during 2012 to 2015. Contrary, fish consumption has tremendous increased in 2015 that has doubled its number. Therefore, any efforts to increase fish production to increase fish supply are necessary to meet the increasing demand of fish.

Table 2. The Proposed farming pattern in swamp land (in IDR)

Item			Year – 1	Year – 2
1.	Investment Costs	a. Land (1 ha)	60,000,000	0
2.	Operating/Maintenance Costs			
	• Materials	a. Rice	1,650,000	1,701,150
		b. Corn	12,300,000	12,681,300
		c. Fish	9,312,500	9,601,188
	• Tools	a. Rice	247,150	247,150
		b. Corn	265,900	265,900
		c. Fish	1,803,000	1,803,000
	• Labors	a. Rice	9,803,929	10,294,125
		b. Corn	5,883,750	6,177,938
		c. Fish	5,750,000	6,037,500
	Total Costs		107,016,229	48,809,250

Several assumptions were used to provide a proper projection of the project feasibility. The assumptions used are increase in material costs as much as 3.1 percent per year and increase in labor

cost as much as 5 percent per year while tools depreciation is assumed similar. With regards to the revenue, assumption used is increase in output price as much as 5 percent. These were based on inflation rate “year on year” (January 2015 to January 2016) [11]. Production cost of the project is shown in Table 2 while revenue of the project per hectare is shown in Table 3.

The largest production cost of this project is investment expenditure which is buying the land in the first year or the beginning of the project that reach IDR 60 millions. The purchase of land is chosen because this study wants to see the feasibility of the project with all the expected costs to see its breakeven point.

Operating and maintenance cost of the project are divided into three part namely materials, tools and labors. The highest material cost is found in corn production because of higher seed price that reach IDR 9 million for 12 kg sweet corn seeds for one hectare farm. Fish farming also has higher material cost due to high feed consumption which takes more than 80 percent of its total material cost. Moreover, it also has the highest tools cost compare to rice and corn production. In terms of labors, rice production has the highest labor input since it has more differ work activities from land processing to post harvesting compare to corn and fish farming so that requires higher labor intake.

Rice production yields 5 tons with a selling price of IDR 4,300 per kilograms. It also has side product in form of bran at a price of 5 percent of rice selling price. The corn yields 20,000 corncobs at IDR 1,500 selling price per cobs while fish farming yields 1.5 tons of fish at IDR 16,000 selling price per kilogram. Thus, the total revenue in the first year of the project reaches IDR 79,800,000. In the second year, the revenue increase using 5 percent increase in price output assumption, so that the expected total revenue is IDR 83,790,000 (Table. 3).

Table 3. Revenue of the project per hectare in mid swamp land (in IDR)

Item	Year – 1	Year - 2
Rice	25,800,000	27,090,000
Corn	30,000,000	31,500,000
Fish	24,000,000	25,200,000
Total Revenue	79,800,000	83,790,000

3.1 Financial statement and analysis

Financial statement and analysis will show the feasibility of project in term of financial approach. BCR, NPV, IRR and payback period were used to see the project feasibility.

Table 4. Profitability of the project (in IDR)

	Year – 1	Year - 2
Total Cost	107,016,229	48,809,250
Total Revenue	79,800,000	83,790,000
Benefit	(27,216,229)	34,980,750
Discount Factor (25%)	0.800	0.640
PV of 1 (25%)	(21,772,983)	22,387,680
Discount Factor (30%)	0.769	0.592
PV of 1 (30%)	(20,929,280)	20,708,604
<i>Financial statement:</i>		
NPV	614,697	
BCR	1,01	
IRR	28.68 %	
Payback Period	1 year 9 months	

Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of a projected investment or project. The discount factor used in this analysis is 25 percent per year and 30

percent to obtain both positive and negative NPV value. Based on table 4, the NPV value is IDR 614,697 which shows that this project is feasible since NPV value is greater than zero.

Benefit-Cost Ratio (BCR) is used in cost-benefit analysis as an indicator to summarize the value for money of a project by determining the relationship between cost and benefit. The decision rule is to accept investment projects with B/C ratio greater than 1. The BCR value of this project is 1.01 or greater than 1 so that it is feasible.

The Internal Rate of Return (IRR) method is a method that calculates the interest rate equalizing the value of the initial investment. If the IRR is greater than interest rate, then investment can be considered feasible and if the IRR is smaller, then the investment is not feasible. Based on the latest data released by The Bank Indonesia [12] in The Basic Interest Rate of Credit applied in all operated Banks in Indonesia, the average interest rate is 12.03 which used in this study. Table 4 shows that IRR value is greater than interest rate ($28.68\% > 12.03\%$) meaning this project is feasible.

The last financial statement to see project feasibility is Payback Period. Payback Period is the number of years it takes to recover all the capital invested. Payback Period computation shows that this project needs 1 year and 9 months to be able to recover all costs. Therefore, based on financial analysis and all financial statement above, this project is feasible.

4. Conclusion

Swamp land is potential as one of alternative production land to support food security. Unfortunately swamp land has not optimally utilized since farmers only cultivate once a year. Research studies show that using appropriate treatment and integrated farming system, swamp land can be utilized thorough out the year. This study shows that swamp land can be cultivated twice a year with additional fish farming during wet season. Using actual input and low projected output, this project is financially feasible with the NPV value is IDR 614,697; BCR value is 1.01; IRR value is 28.68 percent; and Payback Period of 1 year 9 months. Since farming is very crucial for this community, government fully support is needed in protecting the input prices and regulate commodity prices particularly rice, corn, and fish to maintain the feasibility of this project.

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