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Increasing Index of Paddy Plantation on Lebak Swamp with Polder System

Dian Yulistarini[1], Edward Saleh[2], Riswani[3]

University of Sriwijaya, Agribusiness Program, Indonesia

Abstract: ***Utilization of lebak swamp as an effort to expand the planting area is carried out by seeking an increase in the Planting Index (IP) through optimizing water and land resources and utilizing appropriate technology. To make lebak swamp is suitable for use as paddy fields, the method that can be done is by improving water management to meet the needs of plants. Improvements to water management are carried out by controlling the water level of the land using a closed polder system, which is irrigation when the plants of lack water and drainage when the water is over. It is necessary to regulate water equilibrium so that land does not experience flooding and drought, it is necessary to calculate water balance on the land through the water balance. A suitable cropping pattern to be applied with a polder system can be carried out into several patterns such as fallow - rice - rice and so on. After knowing cropping patterns and crop productivity levels, financial feasibility analysis was carried out. Based on the financial feasibility analysis, this polder system meets the value requirements for the parameters of financial feasibility.***

Keywords: lebak swamp, polder system, water balance, cropping pattern, financial feasibility

1. Introduction

Rice as the main priority for consumption of the Indonesian people whose production must always be improved requires improvement efforts in all fields. In addition to improvements in terms of cultivation, efforts to expand the harvest area and efforts to increase the Planting Index (IP) must also be done. With the decreasing planting area, this can be overcome by utilizing a fairly extensive agroecological land in Indonesia, namely inland swamp. This land use can be done by combining existing technology so that the increase in rice production is done by striving to increase IP through optimizing water and land resources and utilizing appropriate technology. Inland swamp is waterlogged land for a long period of time.

The water is not just an accumulation of tide, but originates from surface runoff in the region and the surrounding area because of its lower topography than other regions. In normal conditions of dry season in general, this area still has puddles. The method that can be done to meet the water needs of plants on inland swamp is by improving water management. Improvements to water management are carried out by controlling the water level of the land using a closed polder system, which is irrigation when the plants lack water and drainage when the water is over. This polder system is a system for controlling ground water levels by utilizing dikes around the land and assisted by pumps as a supplier of water and removing excess water on the land. With a polder system, the flood-prone location will be clearly limited, so that the water level, discharge and volume of water that must be removed from the system can be controlled. Therefore, a polder system is also called a controlled drainage system.

According to Ibrahim (2003), to analyze the financial feasibility of this business can be done through several methods. There are three methods (measurement criteria) that are different but interconnected to regulate the value of the financial feasibility of an investment, namely the Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (B / C Ratio). To determine the extent of the success of the drainage irrigation system using this polder system, it is necessary to study the technical feasibility and investment of this business. By utilizing this system, it is expected to increase crop production from 1 time to 2

or more times in one year. With the vast potential of swamp in the vast South Sumatra region, the utilization of the polder drainage irrigation system is expected to produce harvests at least twice a year and significantly increase rice production without being affected by the season. For this reason, an in-depth study of the use of this polder system is needed both technically and financially. By analyzing the adequacy of available water in inland swamps to support rice plants IP 200, analyzing the management used so that inland swamps could be planted with rice IP 200, analyzing the financial feasibility of the polder system in swamp, and analyzing what factors were constraints on the application of IP 200 rice cultivation on swampy swamp. So that the results made can be the basis for consideration and recommendations in making decisions to invest in this polder system.

Purpose
From the formulation of the problem, the objectives of this study are determined: 1) Analyzing the availability of water in inland swamps to support rice plants IP 200 2) Determine water management that can make swampy land capable of planting rice with 200 IP 3) Analyzing the financial feasibility of a polder system on inland swamp.

2. Research Method

This research conducted at Ogan Ilir Regency, South Sumatera Indonesia from December 2017 to February 2018. Sources of data obtained are surveys and observations taken from interviews with farmers. Data collected in the field are processed qualitatively and quantitatively. The technical analysis includes hydrological analysis carried out by analyzing the availability of water in the swamp swamp so that it can support rice plants IP 200, then an analysis is carried out to determine water management that can make swamp swamps capable of planting IP 200 rice.

Hydrological analysis is done by analyzing Rainfall Frequency using the formula:

$$R_e = 0.7 \times \frac{1}{15} R_{75}$$

Where :
Re = effective rainfall, mm / day
R75 = minimum monthly rainfall with a 75% chance of being fulfilled
Next, calculate the evapotranspiration value with modified Penman :

ETo = c [w.Rn + (1-w) x f(u) x (ea – ed)]

Where :
ETo = Evapotranspiration
c = correction factor
w = temperature and elevation factors
Rn = Long wave net radiation
F (u) = function of wind speed
ea = saturated vapor pressure
ed = actual vapor pressure

and analyze the water balance using steps of the Mock method

In = water surplus x I
Vn = k.V(n-1) + 0,5 (1+k) In
DVn = Vn – V(n-1)

Where :
In = Infiltration of the volume of water entering the soil
Vn = Volume of groundwater
V (n-1) = n-1 month groundwater volume
I = Infiltration coefficient
DVn = Change in the coefficient of groundwater volume

The final stage that will be carried out is inventorying the costs needed in cultivating the polder system so that IP 200 rice cultivation can be carried out on swampy swamp land. Financial analysis carried out includes the analysis of NVP, IRR, and B / C ratio.

According to Kasmir (2014), the NPV method is used to calculate the difference between the present value of the investment and the present value of net cash receipts, both operating costs and cash flows in the future.

$$NPV = \sum_{i=1}^{n} \frac{NB_i}{(1+i)^n}$$

Where :
NB = Net benefit = Benefit - Cost
i = factor discount
n = year (time)
If the present value of net cash receipts is smaller than cash receipts in the future, then the project is said to be profitable so that it can be continued for execution.

Furthermore, the IRR is calculated to determine the interest rate of the present value of investment with the present value of net cash receipts in the future. The formula used in calculating the IRR is as follows :

$$IRR = i_1 + \frac{NPV_1}{(NPV_1 - NPV_2)} x\,(i_2 - i_1)$$

If the interest rate is greater than the required level of profit, then the investment is profitable, and vice versa is said to be harmful.

After knowing the value of profits, the calculation of B / C ratio is a comparison between the value of benefits that have been discounted positively with the value of benefits that have been at negative discounts. The calculation formula for B / C Ratio is as follows :

$$B/C_{Ratio} = \frac{the\ amount\ of\ income}{Total\ production\ costs}$$

The feasibility of such a project can be carried out when the B/C > 1 is obtained, and is said to be ineligible when the B/C < 1 is obtained.

3. Result and Discussion

The value of recapitulation of decade rainfall (10 years) with an opportunity of 75% per month experiencing varying values. It was found that the average monthly rainfall ranged from 8.35 - 284.45 mm. The highest effective rainfall occurred in April, which amounted to 284.45 mm and subsequently decreased in May and continued to September, which was 8.35 mm. Thus if the falling rainfall has a low or high intensity, then the amount of water that is insufficient or excessive will disrupt plant growth.

To calculate the availability of water using the Mock method, it is necessary to analyze evapotranspiration first. The calculation of evapotranspiration in this study used the modified Penman method. The use of evapotranspiration data is as input data for calculating water availability. Measured data used to determine evapotranspiration values is by processing data derived from regional climatology data. From the calculation of evapotranspiration using the Penman method, it can be concluded that evapotranspiration in January was 5.84 mm / day and in June it was 4.16 mm / day which means that water availability in June decreased. So that this month the land needs water supply that can meet the growth so that the plants can grow optimally.

The results of the water balance analysis obtained using the Mock method illustrate that there is a surplus of water in March - April and October - December. While in May - October there is a water deficit on the land. It can be seen that in May - October the groundwater level is below the surface of the ground, so that if it is planted at this time, what is used by plants for water needs of plants is the use of groundwater deposits. In deficit conditions, the groundwater content also decreases with decreasing rainfall. Groundwater is then used for evapotranspiration (ETA) so that if groundwater is not supplied by rain the ground water will be deficit.

Efforts to provide land water developed with a polder system are one way to engineer extreme climate change. Determination of water management in this farm is intended to be able to increase food production without being hampered by climate change so that it is expected to be able to use more efficient time in terms of farming, overcome labor problems, and increase farmers' income in broad unity. The polder system in irrigation can be interpreted as an effort to take water using a pump, so that water can be distributed and used to irrigate the land according to crop needs. Whereas in its capacity as drainage, the polder system is useful as a drainage system from the ground to the outside of the embankment. In this drainage system also pay attention to the amount of tide contained outside the embankment. However, under certain conditions, the water in the polder cannot be discharged outside the dike because the tide height has exceeded the height of the embankment. In this condition, what can be done is to wait for the water outside the embankment until the water level does not match the height / surpass of the embankment and then it can only be carried out from the rice field to the outside of the rice field.

The ideal planting pattern is done in April 3 while in August - December and January - April the land is left unplanted so that fertility is maintained (fallow) until the land is not flooded again. For this reason the proposed cropping pattern is in accordance with the cropping pattern that is generally carried out by local farmers, namely paddy-fallow. However, by utilizing a polder system, the planting season can be increased from once to twice to three times a year. Through increasing production intensity, from IP 100 to IP 200, of course, it will increase rice production and means to support the food security program launched by the government, especially on the production aspect towards rice self-sufficiency.

After knowing cropping patterns and crop productivity levels, a financial feasibility analysis was carried out. This analysis is carried out to see the development of the business so that it can be seen whether this business is giving a profit or loss. It is assumed that the rice planting season can be done twice a year. The average yield of GKP production is 6000 kg / ha. The price of grain at the farm level is Rp. 5.646, - / Kg. The projection period in this analysis was carried out for 3 years following the age of using the polder. The applicable interest rate is assumed to be 14% per year. The assumption of the proportion of investment capital is 30% of its own and bank loans of 70%. The business scale in the research location in an area of 86 hectares to determine the feasibility of this polder system can be applied at the farmer level.

Table 1: Feasibility Projection of Rice Farming Using Polder

Feasibility Projection				Criteria
B/C	NPV	IRR	PBP	
1,58	Rp 832.516.899,-	46,36%	2,3	worthy

Source: Calculation Results (2018)

With the NPV value obtained, it means that in the period of feasibility analysis calculation, the business gives a profit of Rp. 832,516,899. Whereas if it is converted into land owned by farmers, a profit of IDR 9,680,429 per hectare is obtained. In the rice fields with this polder system the IRR value obtained is 46.36%, which means that this business is still feasible to run at an interest rate of 46.36% (above the current commercial interest of 14%). From the results of the analysis of calculations also obtained a Net B / C value greater than 1 or equal to 1.58 which means that this business is feasible to implement, with the meaning that every 1 rupiah of costs incurred will give a profit of 1.58 rupiah. Furthermore, to find out the length of the period in which we can repay the investment in a business that has been invested or in other words, how long the costs that have been spent can be returned again by PBP calculations. Obtained PBP value of 2.3 years, so it can be seen that, this business can restore initial costs for 2.3 years. This period is advantageous for large-scale businesses such as rice fields with this polder system. From the feasibility analysis, the rice fields using the polder system provide high profits. So that it is believed that it can increase production intensity from IP 100 to IP 200 which will increase rice production while supporting the food security program launched by the government.

4. Conclusion

1) The availability of sufficient water for the cultivation of rice in swamp land only occurs in April-July, and outside of these months the availability of water in terms of rainfall analysis, evapotranspiration and water balance is in a fluctuating condition, causing the land to become prone to flooding and drought, so that technically the polder system is a feasible solution to overcome the problem of the threat of inundated land and drought in the cultivation of paddy fields.
2) Polder system is water distribution management that can make swamp swamp land capable of being planted with rice IP 200 because it is able to drain excess water (drainage) using pumps from inside the land outside the land, and vice versa when the land is dry and water from the main channel unable to enter and irrigate the land, water distribution (irrigation) is carried out into the land using a pump so that the water needs of the plant will be fulfilled.
3) From the financial aspect, this polder system is feasible to be applied in swamp land because of all the elements of the financial feasibility criteria analyzed it shows that it is in the feasible category, including the NPV value of Rp 832,516,899, - IRR of 46.36%, Net B / C amounting to 1.58 and PBP 2.3 years.

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