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A COMPREHENSIVE STUDY ON THE BUSINESS FEASIBILITY, AND OPTIMIZATION MODEL FOR PADDY CULTIVATION ON MARGINAL AGRICULTURAL LAND IN PEKALONGAN DISTRICT

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ABSTRACT

Paddy cultivation on marginal land is the agribusiness activity. The aim of this research is to assess the feasibility status of paddy cultivation on marginal land and make efforts to optimize based on dynamic modeling system analysis. The research method used is descriptive quantitative with the dynamic modeling system analysis. The results show that the business profitability analysis shows a profit value of IDR 30,486,500, R/C Ratio 2.30, BEP unit 6,316 kg, BEP Sales IDR 15,477,220,-, and returnability 1.30%. This means this business is very profitable. The results of business financial analysis show an NPV IDR 2,536,754,052,-, profitability index 21.36%, IRR 14.21%, and payback period 14.4 years. This means this business is very worthy for development. The results of the dynamic modeling system analysis show that the paddy growth rate is influenced by using technology. Technology will influence rice growth of 3.5-7.0 cm. Nutrients influence the paddy biomass on marginal land. Using 10-20 kg/Ha of fertilizer will affect paddy biomass growth of 35-70 kg/Ha. The results of the dynamic model analysis show that the maximum paddy harvest production on marginal land is 25-50 kg/Ha/month with fertilizer use of 45-90 kg/Ha/month. This research concludes that the level of paddy

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cultivation feasibility on critical land is still quite feasible and profitable to develop. model analysis results show that of using agricultural technology and administering appropriate fertilizer doses will greatly determine the level of rice productivity on marginal agricultural land.

Keyword: *business, fertilizer, modelling, nutrients, paddy*

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INTRODUCTION

Paddy cultivation is the livelihood of most people in rural areas (Hatta et al, 2023). As an agricultural country, Indonesia has a large amount of paddy cultivation land (Ariadi, 2023). Data from the Department of Agriculture shows that Indonesia's rice farmland has reached 5,699 ha (Dinas Ketahanan Pangan dan Pertanian, 2022). Agricultural land in Indonesia, on average, has different characteristics depending on the surrounding environmental conditions (Han et al, 2023). Based on these conditions, the harvest productivity in each agricultural area in Indonesia varies. The planting production pattern will also influence the level of agricultural land productivity in Indonesia. Additionally, the diverse biodiversity of land in Indonesia also affects the soil fertility and nutrient levels when used as a planting medium (Liu et al, 2022). The differences in land characteristics also introduce unique dynamics when cultivating specific patterns (Han et al, 2023). Farmers in Indonesia tend to follow their own patterns in cultivation to prevent harvest failures caused by technical issues.

The land type in Indonesia is not productive for agricultural activities. Several regional zones have low levels of crop productivity (Cerbule et al, 2023). This condition is caused by the very carrying capacity of nutrients and water (Ariadi et al, 2022). Non-productive agricultural land is also marginal (Liu et al, 2022). Marginal land is extreme agricultural land that is very difficult to use as a zone for cultivation activities (Ariadi et al, 2022). Developing agricultural cultivation patterns on marginal land is a challenge if using conventional paddy cultivation concepts. There is a need for innovation or breakthroughs to form new cultivation models that are adaptive and can be developed sustainably on marginal lands (Hatta et al, 2023). This is important considering the low level of agricultural land in Indonesia which is able to stay within the specified level of carrying capacity for paddy production. One essensial problem in the agricultural sector related to implementing adaptive cultivation are the lack of

uniform cultivation patterns. This also happened in the highland area of Pekalongan, Central Java. Paddy cultivation in Indonesia uses various models depending on factors such as climatic conditions, soil type, topography, and available technology. Common rice cultivation models in Indonesia include traditional irrigation systems, rain-fed rice fields, rain-fed rice fields, technical irrigation systems, and modern or organic rice farming models (Han et al., 2023). In several agricultural areas in Pekalongan Regency there are also few innovative agricultural models, which greatly influences the region's agricultural productivity level. Support from governments, agricultural institutions, and the provision of technical information can help farmers implement agricultural practices that are appropriate to local conditions (Sinha, 2022).

Paddy is an adaptive plants that is used as an agricultural cultivation commodity on agricultural land (Huang et al, 2023). This fact is also starting to be developed by some farmers on marginal land to cultivate paddy and horticulture as one of their livelihoods. Horticulture plant can survive if there is a balance between nutrients and water availability (Sinha, 2022). Water is an important parameter in agriculture (Ariadi et al, 2023). The choice of rice as a commodity is also influenced by the cultural preferences of Indonesian people toward rice consumption (Cerbule et al, 2023). On marginal land, many models of adaptive paddy cultivation are found. The productivity level of rice cultivation on marginal land still needs to be studied further to determine the feasibility and appropriate cultivation development model (Hatta et al, 2023). Rice cultivation on critical land requires special attention because this land tends to have less than optimal physical, chemical and biological soil conditions. Critical land generally shows high levels of erosion, nutrient deficiencies, poor drainage, or other problems that can affect plant growth (Liu et al, 2022). It is important to note that each critical land has unique characteristics, and effective approaches may vary depending on the specific conditions (Ariadi, 2023). Therefore, consultation with agricultural experts or local agricultural institutions can provide more specific guidance for certain land conditions.

Paddy cultivation on marginal land has been widely developed in the Pekalongan Regency area. Paddy cultivation on marginal land focuses more on nutrient balance and appropriate planting periods (Cerbule et al, 2023). Therefore, many paddy farmers on marginal lands rely on the season to carry out cultivation activities (Sawatraksa et al, 2023). This minimises losses due to nutrient and water imbalances on marginal agricultural land (Zhang et al, 2021). Paddy cultivation on marginal lands poses its own challenges as these lands typically exhibit suboptimal physical and chemical soil conditions. However, with the right approach, suitable technology, and effective management, rice cultivation on marginal lands can remain effective (Hatta et al, 2023). Marginal lands have distinctive characteristics, and the effectiveness of approaches can vary. Seeking guidance from local agricultural experts or agricultural institutions

can provide more specific advice tailored to the local conditions (Liu et al, 2022). Government support and agricultural institutions are also crucial for enhancing the effectiveness of rice cultivation on marginal lands.

In light of background above, the objective of this study is to evaluate the feasibility of paddy cultivation on challenging terrain and to optimize such cultivation through the utilization of dynamic modeling system analysis results. This study serves as a reference material pertaining to initiatives aimed at advancing paddy cultivation on marginal lands, and it seeks to analyze the potential improvement of similar programs in the future. Moreover, it is anticipated that the study will contribute to the development of a rice cultivation model that is more adaptable and can be applied across diverse regional patterns displaying varying soil characteristics.

RESEARCH METHOD

This research was conducted in Wonopringgo Village, Pekalongan Regency, from October to December 2023. The location was chosen due to the concept of paddy cultivation on marginal land practised for many years. The research method used was descriptive quantitative with purposive sampling. The data observed during the study included the average area of cultivated land, paddy seed needs, fertilizer needs, pesticide needs, electricity/water usage costs, average paddy production yields and average rice prices per harvest cycle.

The research data were then collected and analyzed for business feasibility with business assessment indicators such as business profit value, R/C Ratio, profitability, Net Present Value (NPV), IRR, Payback Period, Break Event Point (BEP), and Profitability Index. Based on the analysis of business feasibility, then we will know the feasibility status of paddy cultivation on marginal land. For the paddy cultivation production optimization model, dynamic modelling system analysis can be used with the help of Stella ver 9.02 software.

For the analysis of the financial feasibility of the business can be calculated based on the equation formula used by Ariadi et al. (2019) as follows:

1. Business Profits

Business profit is the net revenue obtained from reducing the cost of revenue (TR) with the operational cost of production (TC).

$$\Pi = TR - TC$$

2. R/C Ratio

R/C Ratio is the difference in the ratio of the value of the cost of revenue (TR) to the operational cost of production (TC) in a unit of business activity formulated using the formula:

$$R/C = \frac{TR}{TC}$$

3. *Rentability*

Rentability is the percentage of the estimated value of profit (L) divided by capital (M) during the business production cycle described by the equation:

$$\text{Rentability} = \frac{L}{M} \times 100\%$$

4. *Net Present Value*

Net Present Value (NPV) is a presentation of the value of business feasibility obtained from the difference between the gross revenue amount and the expenditure costs, which is then divided by the discount factor value of the business unit's running cycle.

$$\text{NPV} = \sum_{i=1}^{n} \frac{(Bt-Ct)}{(1+i)t} Ko$$

5. *Internal Rate of Return (IRR)*

Internal Rate of Return is an analysis used to determine the rate of return on investment costs based on the estimated Net Present Value value and discount factor percentage as outlined in the following formula:

$$\text{IRR} = i' + \frac{NPV}{NPV'-NPV"} (i'' - i')$$

6. *Payback Period (PP)*

The payback period is an analysis used to determine the rate of return on investment capital issued in a business operational unit that runs constantly or inconstantly. The payback period value is calculated using the following formula:

$$PP = \frac{investment}{net\ cash / year} x\ 1 year$$

7. *Profitability Index (PI)*

The profitability index is the estimated value of the percentage comparison between the percentage of current revenue assets against the expenditure value of investment results. Profitability Index is calculated using the following equation:

$$PI = \frac{\sum PV\ net\ cash}{\sum PV\ investment} \times 100\%$$

Next, the data resulting from the business feasibility analysis are tested using dynamic modeling system analysis. In the dynamic modeling system analysis, a *causal loop* model will be created to explain the causal relationship between parameters. In the Stella software ver 9.02, a causal model will be created which is taken from indicators of the financial feasibility of the business and the level of feasibility of agricultural land productivity for paddy cultivation.

RESULT AND DISCUSSION

Respondent Profile

The respondents used in this research were productive farmers in Wonopringgo Village, Pekalongan, totaling 20 farmers. Most farmers who acted as respondents were productive farmers with marginal agricultural land for paddy cultivation activities. The reason they still persist in cultivating agriculture using paddy commodities is because they have a planting pattern that they have memorized. Apart from that, rice is an adaptive plant that is most suitable to be developed as an agricultural cultivation commodity on non-productive land.

From the results of the interviews, it was also obtained that they tend to be able to accept paddy cultivation activities even though the level of profit is low. This statement can be used as a reference that agricultural activities at this research location are still stagnant. Apart from that, traditional planting patterns also greatly influence why the level of paddy harvest productivity in Wonopringgo Village, Pekalongan is still very minimal.

Aspects of Financial Analysis of Paddy Cultivation Business

In a business activity unit, it cannot be separated from the existence of capital as a driving element of the business. In productive business activities, capital is divided into two types, namely fixed capital and working capital (Ariadi et al, 2021). Fixed capital is capital used for an extended period while working capital is used as business operational capital during one operating cycle of paddy cultivation.

Fixed capital in paddy cultivation activities includes paddy fields, water pumps, pipes, and long-term boreholes (Ahmadian et al, 2021). The total value of fixed capital is IDR 415,750.00 with an average technical life of 23%. Cost items for working capital in paddy cultivation activities include paddy seeds, fertilizers, pesticides, electricity, labor, harvesting costs, equipment maintenance costs, and depreciation (Table 1.). The total cost value required for working capital is IDR 23,513,500. The stability of production units in the agricultural sector is strongly influenced by the strengthening of fixed models and working capital in a detailed and regular manner (Ariadi et al, 2023).

Table 1. Capital Details On Paddy Cultivation In Marginal Farmland Of Wonopringgo Village

Description	Amount	Price (IDR)	Technical Life	Total (IDR)
Fixed Capital				
Land 10.000 m^2	4	95,000,000	25	380,000,000
Water pump	1	20,000,000	20	20,000,000
Pipe	10	75,000	20	750,000
Drill Well	1	15,000,000	25	15,000,000
Total Fixed Capital				415,750,000
Working Capital				
I. Fixed Cost				
Depreciation				10,248,500
Maintenance Cost				2,000,000
TOTAL				12,248,500
II. Non-Fixed Cost				
Paddy Seeds	30	18,000		540,000
Fertilizer	3	350,000		1,050,000
Pesticides	1	250,000		250,000
Electricity	5	125,000		625,000
Labor	80	100,000		8,000,000
Harvest Cost	8	100,000		800,000
TOTAL				11,265,000
Total Working Capital				23,513,500

Source : Primary Data Research, 2023

Production and Revenue of One Harvest Cycle

The production value of paddy cultivation on marginal land in Wonopringgo Village can be seen in Table 2. The average paddy harvest production per hectare is 7,200 kg. The total revenue value is IDR 54,000,000, with the price of rice IDR 7,500 / kg, then obtained the revenue value of IDR 54,000,000. The results of the calculation of revenue costs and operational costs in agro-complex cultivation activity units will greatly affect the value of business profits (Ariadi et al, 2022).

The price of rice in the market and in each region varies depending on the existence of rice stocks in the area (Sulistyanto et al, 2013). The productivity level of the rice harvest in Wonopringgo Village tends to be low at only 7,200 kg/Ha. This low level of harvest productivity also dramatically determines the selling price of rice in that place (Oktania et al, 2021). From the results of the ratio of the difference in the value of revenue costs and production costs, which

reached IDR 30,486,500 still needs to be more productive for the size of 1 ha of paddy fields.

Table 2. The Level Of Paddy Production On Marginal Land And Money Turnover In Wonopringgo Village

No.	Data	Value
1.	Rice price (IDR/Kg)	7,500
2.	Harvest production (Kg)	7,200
3.	Total Revenue (RIDR)	54,000,000
4.	Total Cost (IDR)	23,513,500

Source : Primary Data Research, 2023

Business Profitability Analysis

Analysis of the level of business profitability is used to determine the level of business profit when run over a long period (Ariadi dan Puspitasari, 2021). The business unit will continue to grow along with the massive operational cycle (Song et al, 2023). This study's business profitability analysis variables are the value of business profits, the value of the R / C Ratio, BEP units, BEP sales, and business profitability. The value of business profits reached IDR 30,486,500 per cultivation cycle with a land area of 1 Ha. The value of business profits in paddy cultivation is still quite profitable because the cost of business revenue is greater than that of business operations (TR> TC). The value of business profits reflects the level of business feasibility seen from the value of incoming revenue costs (Jing & Zhang, 2023).

Table 3. Results Of Profitability Analysis Of Paddy Cultivation On Marginal Land

No.	Analisys	Value	Results	Criteria
1.	Profit (IDR)	30,486,500	TR > TC	Profit
2.	R/C Ratio	2.30	R/C > 1	Profit
3.	BEP Unit (Kg)	6,316	BEPu < Q	Profit
4.	BEP Sales (IDR)	15,477,220	BEPs < TR	Profit
5.	Rentability (%)	1.30	R > i	Worth

Source : Primary Data Research, (2023)

The R/C Ratio in this business reached a score of 2.30, meaning it is quite profitable because the R/C Ratio value> 1. The R/C ratio is an analysis that compares business expenses and revenues during one business operational cycle (Li et al, 2023). The revenue and business operating cost ratio has ideal

assessment results and potential to be developed again. For the profitability parameter, the value is 1.30%, which is feasible and profitable in the future. The profitability value is an elemental assessment of a business unit based on the ratio of investment and business profits during the operational period (Gao et al, 2022).

The Break Event Point value obtained from the BEP unit value on a unit basis is 6,316 kg. This means that farmers know the standard break-even point of the automatic irrigation channel unit. Furthermore, for BEP sales, the value of IDR 15,477,220 was obtained. This means that this paddy cultivation business unit will reach the break-even point of production at a value of 6,316 kg or obtain a revenue of IDR 15,477,220,.BEP value can be used as a basis for an entrepreneur to assess the feasibility level of a business unit (Hosseinpour et al, 2022). BEP value is also widely used as an indicator to assess the minimum production limit that can be managed by a business unit (Akinyi et al, 2022).

Business Financial Feasibility Analysis

Business financial feasibility analysis is used to determine the level of business profit based on financial variables (Ariadi dan Puspitasari, 2021). Business financial feasibility analysis is used to estimate a business unit's financial suitability over a long period (Ariadi dan Abidin, 2019). The business financial feasibility analysis indicators include Net Present Value, profitability index, Internal Rate Return, and business payback periods. The business financial feasibility analysis results can be used as an essential reference for business development and increased business investment in the future (Wafi et al, 2020). The results of paddy cultivation activities in Wonopringgo Village obtained a profit value of IDR 30,486,500, - so that the analysis of the results of business financial feasibility was obtained as follows (Table 4.):

Table 4. Results Of The Analysis Of The Financial Feasibility Level Of Paddy Cultivation On Marginal Land

No	Analysis	Value	Results	Criteria
1.	NPV (IDR)	2,536,754,052	NPV > 0	Worth
2.	Profitability Index (%)	21.36	PI > 1	Worth
3.	IRR (%)	14.21	IRR > interest rate (10%)	Worth
4.	Payback Period (years)	14.4	PP < technical life (25 years)	Worth

Source : Primary Data Research, (2023)

The NPV value was obtained at IDR 2,536,754,052, - or NPV> 0, meaning that the paddy cultivation business is very feasible to develop based on the current economic use value. The deal is a measure of the ratio of the difference in the current company's revenue and expenditure level that will affect the

presentation value of project feasibility (Hsu, 2022). The NPV value is feasible if it has a value of more than 0. The current cash flow strongly influences the NPV value in business activities (Waha et al, 2022). In agribusiness business units, the NPV value tends to fluctuate following the level of harvest production and changes in market prices for these commodities (Permatasari dan Ariadi, 2021). The NPV value > 0 indicates that business activities are feasible and have high profit prospects (Ariadi et al, 2022).

The profitability index is the percentage of the estimated index between the value of the current revenue level and the level of revenue from investment (Zou et al, 2021). The profitability index value is feasible if> 1. In this paddy cultivation business activity in Wonopringgo Village, the profitability index value is 21.36, meaning that this business activity is very profitable and feasible to run. The profitability index value is also strongly influenced by discount factors in market operations (Ariadi et al, 2019). The discount factor value acts as a control indicator to determine the level of profitability index of a business unit during the production period (Tolinggi et al, 2018). For developing countries such as Indonesia, the average discount factor value ranges from 8-15% (Ariadi et al, 2019). In addition to the discount factor value, the profitability index value is also strongly influenced by price fluctuations of related commodities and the capital turnover index (Akinyi et al, 2022).

Internal Rate Return (IRR) is a method used to assess the rate of return on investment capital from a productive business (Muqsith et al, 2020). The IRR value from the results of this analysis was found to be 14.21% or higher than the average bank interest rate of 10%. The IRR value is said to be feasible if it is >% of the bank interest rate (Wafi et al, 2020). The percentage level of IRR higher than the average interest rate value indicates that this paddy cultivation business is more profitable than if we make short-term deposits in the bank. In addition, the high IRR value also implies that the rate of return on this business capital is compelling (Permatasari dan Ariadi, 2021). From the IRR value analysis results, an entrepreneur can determine the best scenario for conducting business investment options (Edwards, 2017).

The payback period is an estimate of the rate of return on capital in a business investment activity (Ariadi et al, 2021). The payback period calculation results in several 14.4, meaning that the payback period for this paddy cultivation takes 14.4 years. The payback period value is feasible if it is less than the average technical life of the equipment used for production (Patiung, 2021); (Ahmadian et al, 2021). The payback period value in the results of this study is quite good because it is 57.6% faster than the age of business investment. The results of the payback period value in this study are slightly slower than the results of Patiung's research (2021), which resulted in a return on cultivation capital for nine years. The value of the payback period analysis results can be

used as a mirror to determine business development options in the middle of the business investment period (Gandhi et al, 2023).

Based on the profitability and financial feasibility analysis, this paddy cultivation business is profitable and feasible to develop. Paddy cultivation is one of agriculture's productive agribusiness activities (Pueyo-Ros et al, 2024). This paddy cultivation activity unit is widely developed in upland areas that are fertile in nutrients and the availability of sufficient water sources (Birthal et al, 2022). The results of the feasibility analysis of paddy cultivation on marginal land can be new information related to the development pattern of adaptive agriculture on non-productive land (Wang et al, 2022).

Dynamic Modeling Analysis of Paddy Cultivation on Marginal Land

In preparing the concept of causal loop dynamic modeling analysis, it is necessary to map the parameters that make up the model (Wafi et al, 2021). Furthermore, a multi-parameter relationship correlation is carried out. The causal loop model that has been formed is then run with data to assess the model's validity (Ariadi et al, 2022). The conceptual dynamic model can be seen in Figure 1.

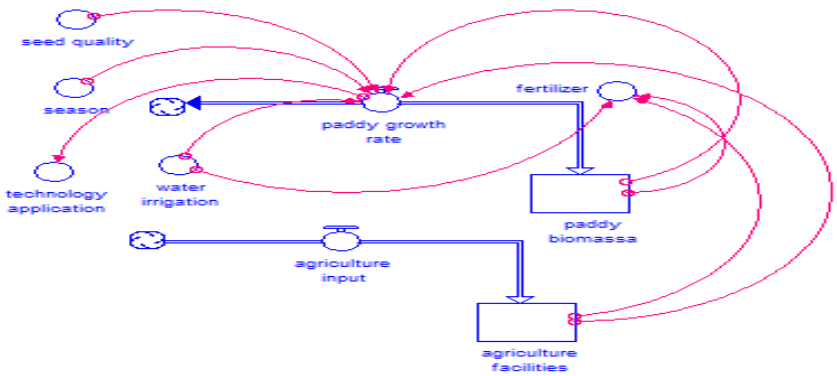

Figure 1.
Causal Loop Optimization Model Of Paddy Cultivation
Source : Primary Data Research, 2023

The parameters that were analyzed included seed quality, season, technology, irrigation, fertilizer, production facilities, and biomass harvest (Outram et al, 2016). These parameters were obtained based on the analysis of research objectives. The correlative results of these parameters will then be used to analyze the cultivation's productivity level. Data from seed quality parameters, season, technology, irrigation, fertilizer, production facilities and harvest biomass were then analyzed using the causal loop model in Stella software ver 9.02. Data from the results of modeling analysis can be used to

justify research results. The causal loop model described in Figure 1 is one of the analytical methods used to identify the feasibility level of cultivation productivity seen from various parameter points of view.

Paddy Growth Rate

The growth rate of rice paddy from the results of dynamic modeling analysis can be seen in Figure 2. Based on the results of dynamic modeling, it can be described that the growth rate of rice paddy correlates with the use of technology. This means that if technology is increased, it will connect to the growth rate of paddy. In addition, the growth rate of paddy also has a range of fluctuations with harvested paddy biomass. The use of technology impacts technological engineering efforts for the biological growth of paddy (Chaudhary & Kumar, 2022). Paddy growth will decline in the tenth week, and this condition is correlated with the results of the use of technology. Technology is essential in increasing the biological development of paddy (Pandya et al, 2022).

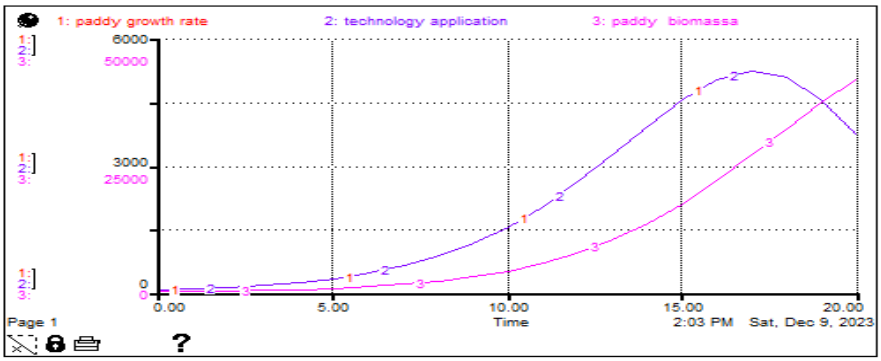

Figure 2.
Results Of Dynamic Model Analysis Of Paddy Growth Rate
Source: Primary Data Research, 2023

From the results of the dynamic modeling analysis, it is stated that each use of 1 unit of technology will affect the growth rate of paddy by 3.5-7.0 cm (Figure 2.). Paddy growth influenced by technology suggests efforts are needed to modernize the agricultural system to increase crop productivity (Li et al, 2022). The provision of treatments in paddy cultivation is still too insufficient to increase the productivity of cultivation per unit of production (Wang et al, 2022).

Use of Means of Production in Paddy Cultivation

Means of production have the same trend towards fluctuation as paddy harvest biomass and fertilizer. Paddy harvest biomass is correlated with fertilizer (Figure 3.). The addition of fertilizer on farmland will correlate to the addition of cultivated paddy biomass (Maomao et al, 2023). The use of 10-20 kg/Ha of

fertilizer will affect the growth of paddy biomass by 35-70 kg/Ha, while the rest is influenced by other factors (Figure 3). The high content of nutrients and minerals in fertilizers will impact paddy growth in paddy fields (Agegnehu et al, 2023).

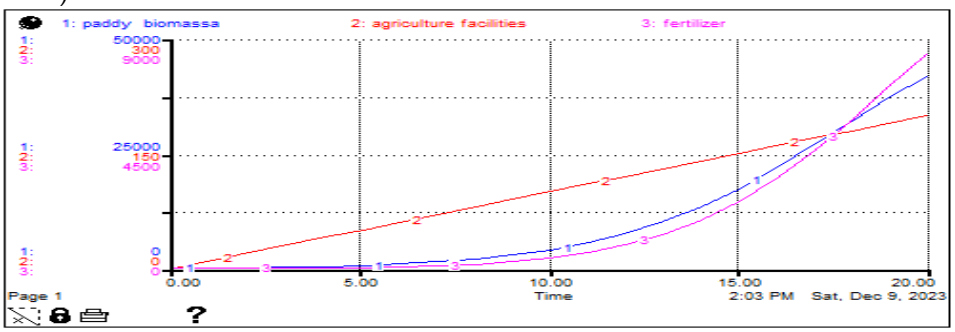

Figure 3.
Results Of Dynamic Model Analysis On The Level Of Technology Use
Source: Primary Data Research, 2023

The most dominant means of production in the paddy fields of Wonopringgo Village is water pump irrigation. The lack of production facilities is due to the traditional cultivation system. Production facilities are an essential factor for increasing land productivity (Wang et al, 2022). The use of production facilities is also relative or depends on the model and location conditions of paddy cultivation (Des et al, 2020).

Optimization of Paddy Cultivation

Based on the results of the dynamic modeling system analysis assessment, using technology and applying fertilizers with the correct dosage are the main factors determining the growth rate and increase in biomass of cultivated paddy plants. Critical marginal land conditions require nutrient intake and applicable technology to increase soil fertility (Desta et al, 2021). These two factors are the main points for optimizing the development of paddy cultivation on marginal land. An optimal development pattern is needed to support the paddy cultivation cycle on land (Naseri et al, 2021). The results of the optimization analysis of paddy cultivation are shown in Figure 4.

The modeling analysis results show that the maximum paddy harvest biomass production on marginal land is 25-50 kg/Ha/month with fertilizer doses of 45-90 kg/Ha/month (Figure 4.). This means that a ratio of 1:1.8 is required for paddy biomass growth and fertilizer use. The growth rate of paddy biomass is significant in determining the growth performance of paddy per unit of land with a specific duration. The types of fertilizers suitable for marginal land are compost and NPK fertilizers balanced with the provision of sufficient mineral elements (Maomao et al, 2023).

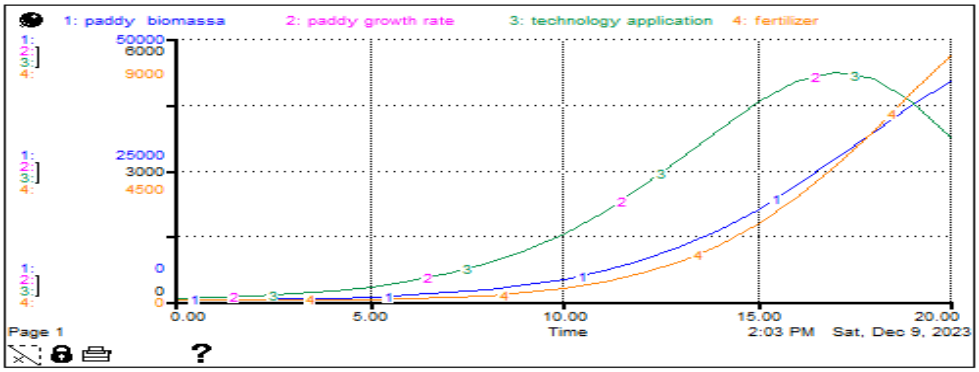

Figure 4.
Results Of The Analysis Of The Optimization Level Of Paddy Cultivation On Marginal Land (Source: Primary data research, 2023)

The results of the optimization model analysis also showed a clear correlation between the use of technology and paddy growth. Each use of 1 unit of technology impacts a paddy growth rate of 3.0-7.0 cm (Figure 4.). If the amount of technology used is increased, the growth rate of paddy will increase. The land mechanization system will significantly affect the growth rate of plants planted on the land (Yadav et al, 2021). Marginal land is a type of land area that requires an intense level of soil management engineering (Pueyo-Ros et al, 2024). The lack of nutrients, irregular cropping patterns, and unsuitable paddy types causes the low growth rate of paddy in this analysis. The paddy cultivation model on marginal land requires a particular cropping strategy to obtain the expected cropping production pattern (Desta et al, 2021).

Overall, the feasibility analysis of paddy cultivation on marginal land is still classified as profitable and feasible. However, this contradicts the level of productivity of paddy cultivation on marginal land. Marginal land is non-productive and challenging to use as a paddy-growing medium (Shi dan Huang, 2021). Nutrient factors and the availability of mineral elements are the causes of paddy cultivation on marginal land (Ariadi et al, 2019). Therefore, fertilizing with the correct dose and using applied technology for paddy cultivation on marginal land is needed. Fertilizers and technology are essential for increasing paddy cultivation production on marginal land (Chen et al, 2023). An increase in rice production will affect the profit and profit feasibility of the rice business on marginal land correlatively (Kanthilanka, 2023).

CONCLUSION AND SUGGESTION

Conclusion

The feasibility level of paddy cultivation business on critical land based on profitability analysis and financial feasibility of the business is declared feasible

and profitable to develop. This means that in terms of business, paddy cultivation on marginal land is still very feasible to develop by farmer. Furthermore, based on the results of the dynamic modeling system analysis it is described that in order to optimize paddy cultivation on marginal land based on the results of the *causal loop* model analysis it is necessary to apply the use of agricultural technology and appropriate fertilizer dose techniques to support the paddy growth rate and increase of acumulative paddy biomass per unit of time. This means that if the amount of paddy biomass increases it will impact the amount of paddy production per cycle and the level of receipt of greater profits for each cultivation cycle by farmer.

Suggestion

1. Agricultural rehabilitation is needed for marginal lands that can no longer be planted by applying organic fertilizer or compost and improving water irrigation.
2. The need for mentoring activities related to the use of modern equipment for farmer groups in Pekalongan.
3. Paddy cultivation activities on critical land are still economically feasible and appropriate to be developed in the future

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