Feasibility of rice farming jajar legowo planting system in Dramaga, Ciomas, and Tamansari Sub-District, Bogor Regency

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Abstract. The area of land that applies the Jajar Legowo planting system is still little, it indicates there were only fewer farmers who applied this technology. Even though the implementation of that system is efficient to increase rice production and farmers' income in the Sub-District Dramaga, Ciomas, and Taman Sari. This study aims are to determine the application of rice farming with the Jajar Legowo planting system and to analyze the feasibility of farming in Dramaga, Ciomas and Tamansari Districts, Bogor Regency. The data obtained were processed quantitatively and qualitatively. Farming feasibility analysis used R/C and B/C ratios. The Jajar Legowo planting system applied by farmers was a 2:1 type, the area of the Jajar Legowo planting area was between 200 m^2 – 1,500 m^2 with an average yield of 1,214 kg per 1,000 m^2. The results of the feasibility analysis of farming obtained an acceptance value of IDR 6,678,571 the total cost is IDR 3,226,190 therefore; farmers get income of IDR 3,452,381 in one growing season within an area of 1,000 m^2. Obtaining an R/C value of 2.07 and a B/C value of 1.07, rice farming with the Jajar Legowo system is feasible and able to increase the farmer's income.

1 Introduction

One of the absolute requirements for agricultural development is always a change in farming technology [1]. Using technology in lowland rice cultivation is expected to increase productivity, farm efficiency, and product-added value and ultimately increase farmers' income. In addition, to increase farmers' income, it is necessary to diversify to avoid dependence on one agricultural commodity [2] and be influenced by the behavior and motivation of farmers [3].

Rice can be grown almost in all parts of Indonesia, but most rice farming is traditionally done from generation to generation. As the main farming person, farmers still need to implement good cultivation technology in their farming fully. The lack of knowledge about cultivation technology and limited capital are some causes of the delay in adopting agriculture technology innovations. Therefore, efforts are needed to change the farmers' mental mindset by increasing their knowledge and skills and capital assistance to help

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farmers adopt technology and provide motivation to increase their production [4]. Rice is the primary commodity and staple food for most of the population in Indonesia. As an essential commodity, the development of rice (paddy) remains a top priority in food crop agriculture [5]. Managing the rice ecosystem is a necessary key in developing rice commodities, and its activity is to conduct a comprehensive evaluation of the sustainability of the rice ecosystem [6].

Food sufficiency (especially rice) at affordable prices for consumers is the primary goal of agricultural development policies. Food scarcity can cause social, economic, and political issues destabilising national stability. On the other hand, paddy fields experience conversion to non-agricultural land continuously, and it also occurs in irrigated rice fields with high productivity. Self-reliance and food security must be built through programs to increase rice production. The Ministry of Agriculture launched the National Rice Production Improvement Program (P2BN) through the Development and Research Agency, which made various innovative efforts to increase rice production by issuing recommendations to be applied by farmers. The Jajar Legowo planting system is more allocative efficient than the traditional planting system because the inputs using ability is more optimal to the price if compared to the conventional planting system [7].

Jajar Legowo system uses rice planting technology by adjusting the spacing with a pattern of several rows of plants interspersed with one empty row. The plants that should be in the blank row are inserted in the other rows. The Jajar Legowo system is technologically engineered to get a plant population of more than 160,000 per hectare [8]. In addition to increasing the crop population, the Jajar Legowo planting system improved paddy photosynthesis. With the legowo planting system, the production was 12-29% higher than the tile planting system. The clump production was increased due to the open space that gave an entire row of rice plants sufficient sunlight for the photosynthetic process [9].

The Jajar Legowo planting system is the effort to manipulate the planting location to have a higher number of periphery plants by creating empty rows. Rice plants in the periphery grow and develop better than plants in the middle, and the yield and quality of grain obtained were higher. It is because the plants on edge get more sunlight intensity. Applying the row Jajar Legowo planting system for farmers will provide maximum results while still paying attention to the direction of the sun's rays and the order of the rows of plants [10].

Records from the Food Crops, Horticulture, and Plantation Service show that the Jajar Legowo type 2:1 rice cropping system increased the rice population to 213,333 clumps per hectare, while the conventional cropping system (tile) only produced 160,000 clumps per hectare [11]. Several sub-districts in Bogor Regency have implemented the Jajar Legowo planting system, specifically in the working area of the Class an Agricultural Integrated Service Unit Region I Dramaga, including Dramaga, Ciomas, and Taman Sari sub-districts, there are several farmers who have implemented the Jajar Legowo planting system. Based on observations in the field, only some farmers want to apply the Jajar Legowo planting system because the land needs to be optimally utilized, and they think this system has empty rows. Based on data from UPT Region I Dramaga, the area of rice production that applies Jajar Legowo and the villages' names are presented in the following Table 1.

Based on Table 1, nine villages from three sub-districts within the working area of UPT Dramaga apply Jajar Legowo rice cultivation with a total land area of 16 hectares. Details of the land area in each sub-district are Dramaga Sub-district with an area of 3.5 hectares, Taman Sari District covers an area of 4 hectares, and the most extensive is Ciomas District, covering an area of 8.5 hectares. Based on the Bogor Regency statistical data in figures for 2021, the rice field data was unavailable. While the data of harvested areas in the three districts, like Dramaga 268 hectares, Ciomas 366 hectares, and Tamansari 658 hectares [12]. With the assumption that rice fields are planted twice a year, and the rice fields area in the three sub-districts is 646 hectares, the location of land that applies Jajar Legowo planting is only 16 hectares or 2.47% of the total paddy field area.

Table 1. Realization Tanam Jajar Legowo Area 2020 Integrated Service Unit Agriculture Class-A Fifth Region Dramaga

Districts	Village	Area (Ha)
Dramaga	Purwasari	2
	Cikarawang	1
	Ciherang	0.5
Total		3.5
Ciomas	Sukaharja	4
	Ciomas	1
	Parakan	2
	Mekarjaya	1.5
Total		8.5
Taman Sari	Sukaresmi	3
	Pasir Eurih	1
Total		4

The area of land that applies the Jajar Legowo planting system still needs to be bigger; it indicates that fewer farmers use this technology. Even though implementing that system is an evasion to increase rice production and farmers' income in the District Dramaga, Ciomas, and Taman Sari. Therefore, it is necessary to analyze the feasibility of farming rice farmers who apply the Jajar Legowo planting system in the three sub-districts.

Based on those existing problems, the purpose of this study is to obtain an overview of the application of the Jajar Legowo planting system of rice farming and to analyze the feasibility level of agriculture in Dramaga, Ciomas and Taman Sari Districts, Bogor Regency.

2 Research methods

The research was conducted in the Districts of Dramaga, Ciomas and Taman Sari, Bogor Regency. The location of the research was deliberately because the three areas are rice production centers that apply the Jajar Legowo system in the working area of Integrated Service Unit Agriculture Class-A Fifth Region Dramaga. The population of farmers who apply the Jajar Legowo rice planting system is 60 people and 30 people are determined to be respondents who were chosen intentionally (purposive sampling) on the grounds that they routinely plant rice using the Jajar Legowo system and have experience in Jajar Legowo rice farming.

The research was conducted from August to October 2021. The data was collected consisted of primary data obtained from direct interviews with farmers and the secondary data from BPS, Distanhorbun (Department of Food Crops, Horticulture and Plantation), other relevant agencies, and several scientific literatures.

The data obtained were processed quantitatively and qualitatively, and presented in a descriptive way, while the quantitative data was processed using a computer tool and processed using Microsoft Excel software. Furthermore, made a description using economic formulas based on the research objectives to provide an overview of the reality found in this research. Data analysis was using the Income Calculation formula to calculate the income of the Jajar Legowo rice farming system as follows: = TR – TC and Feasibility Analysis of Farming Revenue-Cost Ratio: R/C = TR/TC and Benefit-Cost Ratio: B/C= π/TC [13].

3 Results and discussion

Respondent farmers who applied the Jajar Legowo planting system had an average age of under 40 years (73.33%), in the counselling they are classify as early adopters [14]. They are more adapted to new system than the old respondents. Productivity increases with age, peaks at mid-life and then decreases by age [15]. The respondents' education mostly taken for 9-12 years (43.33%), graduated from middle to high school. The farmers who had higher education were easier to understand and learn the Jajar Legowo planting system, such as in fertilization, maintenance, pests' control, and harvesting. The experience of farming along with the length of farming, respondents who have cultivated rice for more than 10 years (46.67%), tend to have more experience to consider and compare the yields from several cropping systems that they have implemented before. They applied the Jajar Legowo planting system at first because of government recommendations. In addition to education, psychological variables also influence a person to want to innovate or accept innovation [16].

The land area owned by most respondents (43.33%) is under 500 m^2, and only one participant has 1,500 m^2. The performance of food crop farming is generally characterized by the ownership of a small planting area of less than 1 ha and the use of labour entirely from the farmer's family [17]. Narrower the area of land managed by farmers, the higher the opportunity for applying the Jajar Legowo planting system technology because the management of this planting system is more intensive than the tile system usually used by farmers [18]. The farm-specific variables that explain farm inefficiency show that small farmers are more efficient than the other categories of farmers [19]. As time and population growth progressed in the region, residential and additional development pressure increased. The robust and nonlinear relationship between land price and parcel size signifies that residential demand significantly impacts the rural land market [20].

Implementing this cropping system is complicated for some farmers because it requires time, and skilled labour is difficult to obtain. Meanwhile, some farmers feel it is more accessible to implement the Jajar Legowo planting system than the conventional system, especially in maintenance activities such as fertilizing, weeding, and spraying as well as assistance from extension workers in the application of this technology.

If farmers do not apply the Jajar Legowo system due to difficult labour, the Jajar Legowo rice planting system tends to be more tenuous. It seems less than the conventional rice system, which is denser and looks more numerous. Generally, there are several types of planting methods in the Jajar Legowo system, such as legowo types (2:1), (3:1), (4:1), (5:1), (6:1) and other styles that already exist and have been applied by some farming communities in Indonesia. The best type of Jajar Legowo planting system to provide high grain production is the Jajar Legowo type (4:1), while the Jajar Legowo type (2:1) can be applied to obtain quality grain seeds. This is supported by the results of research in Pinrang Regency area in 2017, which showed the jarwo planting system increased rice production by 33.07% compared to the tile system [21]. In addition, the success of farmers in implementing the jajar legowo system is supported by the dynamics of farmer groups. The higher the dynamics of farmer groups, the better the performance of farmers, especially in Jajar Legowo rice farming [22].

The farming analysis is done by calculating the income and the level of payment at the expense of rice farmers with the Jajar Legowo planting system. In calculating farm income, the cost components are divided into fixed costs and variable costs. Farming income is obtained from the yield of dry-milled grain (GKG) for one season multiplied by the current price level. As for the income ratio, the R/C and B/C ratios are calculated.

The calculation of farming analysis is the average land area of 30 respondents obtained by an area of 700 m^2, then to facilitate the calculation it is converted to 1,000 m^2 square because the area of land cultivated is not more than 1,500 m^2. Estimating costs and revenues are calculated based on the planting period (seasonal). Fixed costs incurred consist of equipment such as a hoe, tick, rice weeder, sickle/machete, and tarpaulin, which is

calculated in depreciation expense of IDR 26,333 and property tax fee of IDR 33,333 per season. The calculation of equipment depreciation costs is presented in Table 2 below.

Table 2. Cost of Depreciation Jajar Legowo System Paddy in 2021.

No	Tools Name	Amount	Price (IDR)	Total Cost (IDR)	Economic Age	Annual Cost (IDR)	Seasonal Cost (IDR)
1.	Hoe	2	90,000	180,000	5	36,000	12,000
2.	Tick	1	50,000	50,000	5	10,000	3,333
3.	Rice weeder	1	35,000	35,000	5	7,000	2,333
4.	Sickle/Machete	1	50,000	50,000	5	10,000	3,333
5.	Tent	4	12,000	48,000	3	16,000	5,333
Total				363,000		79,000	26,333

Variable costs consist of the cost of production facilities and labour costs. Details of the costs of production facilities and labour incurred are presented in Table 3 as follows.

Table 3. Cost of Production Facilities and Labors.

No	Production Facilities	Seed Requirements	Units Price (IDR)	Total Cost (IDR)
1	Seeds (Kg)	13.21	19,600	259,000
2	UREA (Kg)	21.19	12,000	254,285
3	NPK (Kg)	42.86	12,000	514,285
4	Sp36 (Kg)	42.86	12,000	514,285
5	Diesel fuel (L)	11.38	7,000	79,666
6	Manure (Kg)	200	2,000	400,000
Total				2,021,524
No	**Laboring Activities**	**Working People's Day Amount**	**Wages (IDR)**	**Labo Cost**
1	Hoeing	3	75,000	225,000
2	Planting	3	90,000	270,000
3	Spraying	3	90,000	270,000
4	Weeding	3	40,000	120,000
5	Harvesting	3	40,000	120,000
6	Sheding	1	40,000	40,000
7	Lifting	1	100,000	100,000
Total				1,145,000

The total costs incurred by respondents in the Jajar Legowo rice farming activities was IDR 3,226,190. The rice production obtained was 1,214.29 Kg in the form of milled dry grain with a price level of IDR 5,500/kg, then the farmer's income from one planting season with a land area of 1,000 m^2 was IDR 6,678,571 and the income for the costs obtained is IDR 3,452,381.

Feasibility analysis is carried out to assess the business unit's financial viability by using the R/C ratio and the B/C ratio. The results of the feasibility analysis on rice farming using the Jajar Legowo system in the working area of the Integrated Service Unit Agriculture Class-A Fifth Region Dramaga, Bogor Regency, are presented in Table 4 below.

Table 4. Jajar Legowo Paddy Appropriateness Farming Analysis in 2021.

No	Investation Criteria	Value
1.	R/C Ratio	2.07
2.	Benefit-Cost Ratio	1.07

The results of the feasibility analysis of farming are a description of business activities carried out during one planting season with a land area of 1,000 m^2. Overall, the R/C value of Jajar Legowo rice farming by respondent farmers has a value of 2.07 which means each IDR 1 cost will get IDR 2.07 of income, so it can be said that this farm meets the criteria of an R/C ratio > 1. While the Benefit-Cost value of the farm has a value of 1.07 which means that from each cost incurred, IDR 1 will get a benefit of IDR 1.07 it can be said that the implementation of Jajar Legowo rice farming meets the criteria benefit-cost ratio > 0. The results of the calculation of the feasibility of Jajar Legowo rice farming systems can provide adequate income and remuneration for farmers.

4 Conclusion

Characteristics of respondents who apply the Jajar Legowo farming system in the working area of the UPT Agriculture Class a Region V (fifth) Dramaga, Bogor Regency has an average age of under 40 years (73.33%). The length of education is 9-12 years (43, 33%), the rice farming duration is over ten years, as much as 46.67%, the land area is under 500 m^2, as much as 43.33%, and the most extensive is 1,500 m^2. If farmers do not apply the Jajar Legowo system, due to the difficulties in labour, the Jajar Legowo rice planting system tends to be more tenuous and looks less than the conventional rice system, which is denser and looks more numerous.

The analysis results of Jajar Legowo rice farming obtained an acceptance value of IDR 6,678,571 and a total cost of IDR 3,226,190, so an IDR income of 3,452,381 in 1 growing season with an area of 1,000 m^2. The feasibility of farming based on the calculation results obtained an R/C value of 2.07 and a B/C value of 1.07; it predicted that the Jajar Legowo farming system applied by farmers is feasible and can increase farmers' income.

More intensive counselling and assistance to farmers have been carried out to provide the understanding and benefits obtained by implementing the Jajar Legowo planting system, especially in increasing production yields and farmers' income.

The need for skilled labour and more than the tile system can be tackled by applying cultivation technology and using machines that are suitable for a narrow land area.

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