

Productivity and Feasibility Analysis of Rice Farming in Tidal Swamps Land Jambi Province

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Abstract. Jambi Province, rice productivity in tidal swamp areas is still low, ranging from 3.00 – 4.50 tons/ha. This production can be increased through quality seeds and superior variety's introduction. The aim of the research is to determine productivity and feasibility analysis rice farming varieties Inpara 3, Inpari 34 and local tidal swamp land in Jambi Province. The research was conducted in Lumahan Village, Senyerang District, West Tanjung Jabung Regency, Jambi Province with tidal swamp agroecosystems in the 2020 dry season. The research used superior varieties Inpara 3 and Inpari 34 while the comparison was local rice varieties. The results showed that growth of Inpara 3 was very significantly different from Inpari 34 and local varieties. The productivity of the Inpara 3 (4.72 tons/ha) and Inpari 34 (5.77 tons/ha) varieties were very significantly different from the local varieties (2.99 tons/ha). The income obtained by Inpara 3 and Inpari 34 rice was IDR 9,575,000 with R/C 2.38 and IDR 12,800,000 with R/C 2.73 respectively, while local rice was IDR 5,560,000 with R/C 2.13.

1 Introduction

Tidal swamp land in Indonesia has potential and a strategic role in supporting food security and sustainability. The total area of swamp land is 20.13 million ha, spread across Sumatra, Kalimantan, Sulawesi and Papua which is suitable for agricultural land around 9.53 million ha [1]. Along with a high population growth rate, the need for rice is increasing and decreasing paddy fields [2], meaning that with Indonesia's population of 210 million people and rice production reaching 51.4 million tons of dry milled grain, the population growth rate is an average of 1.7% per year and the per capita need is 134 kg, then Indonesia must be able to produce 78 million tonnes of rice to meet national rice needs.

The increase in rice production continues to be carried out Indonesian government through the Ministry of Agriculture is in line with the increase human population and domestic needs [3]. However, In Indonesia, rice production to be flat, so several efforts are needed to increase productivity. The application of technology needs to be carried out in agricultural development, including to overcome the decline in rice production [4].

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Agricultural development without technology will slow down so that people's needs are also delayed [5]

Jambi Province has an estimated 684,000 ha of swamp land, the area that has been cleared and reclaimed is 252,983 ha. Tidal swamp land in Jambi Province is found in Muaro Jambi district with 10,700 ha, West Tanjung Jabung 52,052 and East Tanjung Jabung 149,210 ha, while lowland swamp land is Kerinci, Merangin, Muaro Jambi, Tebo, Bungo and Batanghari districts. West Tanjung Jabung Regency, the average rice productivity in Jambi province is 4.31 t/ha [6]

Rice farming in tidal swamp land generally has low productivity, because the cultivation techniques applied are still simple, using local varieties and unlabeled superior varieties and incomplete fertilization at low rates, besides that the level of land fertility is low, contains pyrite compounds, acid, sea water intrusion and blast disease become obstacles of rice plants. Soil salinity was still an obstacle on agricultural land located on or adjacent to coastal land such as tidal swamp land, which has great potential to be exposed to salinity stress due to sea water intrusion [7] [8]. Next [9][10], that the problems that often occur in swamp land are that it is acidic with a pH of 3.5-4.5, macro and several micro nutrients (Cu, Zn, Mo, B) are less available or low, has high levels of Al, Fe, Mn, so it is toxic to plants and reduces productivity. Water management needs to be carried out to reduce the solubility of toxic elements through leaching, nutrient management by providing balanced fertilizer, amelioration, and tidal swamp rice cultivation technology [11]. Rice productivity can be increased by implementing rice cultivation technology using to planting system of jajar legowo and other technological components [12]. The planting system of jajar legowo to increasing plant population and rice production [13] [14]. The use of quality seeds and new superior varieties are the technological components that have a real role in increasing the production and quality of agricultural commodities [15].

One effort to support increased rice productivity in tidal swamp areas is to plant new superior rice varieties that are adaptive, have the potential to produce higher yields and are more mature than local varieties. Inpara (Swamp rice inbred) is a variety that has been released and is adaptive in swamplands, including Inpara 3. This variety can adapt to tidal swamps and lowland swamps, is tolerant to Fe and Al poisoning and has a yield potential of 5-7 tonnes/ha, while Inpari 34 is a variety tolerant to salinity, resistant to blast disease and has a potential yield of 8.1 tonnes/ha [16]. Based on research results, superior rice varieties in swamp land can reach 5.0 -7.0 tons/ha, while local rice productivity is only 3.0 tons/ha. According to [17] [7] stated that the productivity of Inpara 3 variety reached 5.46 tonnes/ha and 6.69 tonnes/ha. The productivity of Inpari 34 rice can reach 8.60 tons/ha [18]. This research aims to determine the productivity and feasibility analysis rice farming varieties Inpara 3, Inpari 34 and local tidal swamp land in Jambi Province.

2 Methodology

The research was conducted in tidal swamp land, Lumahan Village, Senyerang District, West Tanjung Jabung Regency, Jambi Province during the dry season April 2020 - September 2020. The study location included tidal swamp land with potential acid sulphate land typology and waterlogging type B. This research used superior varieties Inpara 3 and Inpari 34 while the comparison was local rice varieties. The data collected in this research consisted of plant height at harvest, productive tillers, panicle length, smooth grains/panicles number, empty grains/panicles number and productivity. The data obtained was compiled tabulated and analyzed with T-test statistics (Independent samples T test) using the SPSS program.

This research data analysis tested financial feasibility farming using superior and local varieties by analyzing the balance of revenue and costs or R/C ratio and to measure the level of superiority of superior varieties compared to local varieties by Marginal B/C ratio or

MBCR analysis [19]. The components of rice cultivation technology are listed in Table 1.

Table 1. Technology of rice cultivation in tidal swamp land Lumahan Village, Senyerang-Tanjung Jabung Barat District - Jambi

No.	Technological components	Variety		
		Inpara 3	Inpari 34	Local
1.	Soil processing	Tillage	Tillage	Tillage
2.	Seed	Labeled	Labeled	Not Labeled
	(kg/ha)	30	30	50
3.	Rice seedbed	wet seedbed	wet seedbed	wet seedbed
4.	Age of seedlings	21 days	21 days	30 days
5.	Planting system	Legowo 4 : 1 (25 x 25) x 50 cm	Legowo 4 : 1 (25 x 25) x 50 cm	Tegel (25 x 25) cm
6.	Variety	Superior varieties	Superior varieties	Local varieties
7.	Inorganic fertilizer			
	- Urea (kg/ha)	150	150	50
	- SP 36 (kg/ha)	100	100	50
	- KCl (kg/ha)	50	50	0
8.	Pest control	Integrated pest management (IPM)	Integrated pest management (IPM)	Integrated pest management (IPM)
9.	Harvest/post-harvest	Sickle/Thresher	Sickle/Thresher	Sickle/Thresher

3 Results and discussion

3.1 Location Characteristics

Lumahan Village was included in Senyerang District. The potential for rice fields in Senyerang sub-district is around 3,800 ha, while Lumahan sub-district is 150 ha, and the height is 3 m above sea level with a pH of 4.5-5.0. The land typology includes potential acid sulfate, where the top layer (around 50 cm) is gray and has a clay texture, while the layer below 50 cm is brighter in color. Generally, in paddy fields the planting pattern is paddy-paddy or paddy-fallow. In the rainy season, namely October – March, the first rice planting is carried out. In the dry season, the second rice planting is carried out April – September.

3.2 Plant Performance and Productivity

The height growth of Inpara 3 plants shows that very significantly different from Inpari 34 and local, as well as Inpari 34 and local. Inpara 3 has a shorter plant height than Inpari 34 and local, namely 122.14 cm, while the local variety is taller than other varieties, namely 137.31 cm. The productive tillers of Inpara 3 are very significantly different from Inpari 34 and local, while Inpari 34 is significantly different from local. Inpara 3 has the highest number of productive tillers, while local has the lowest. Then the panicle length of Inpara 3 is very significantly different from Inpari 34 and local while Inpari 34 is not significantly different from local. The shortest panicle length was achieved by Inpara 3, namely 25.08 cm and the longest panicle length was achieved by Inpari 34 and local (Table 2). The diversity of rice plant growth is due to the variety of rice varieties planted which have different genotypic factors. Local varieties genetically have higher plant height and fewer tillers compared to superior varieties [20].

Table 2. The growth of Inpara 3, Inpara 34 and Local rice varieties in tidal swamp land Jambi Province

Parameters	Variety	Average	Inpara 3	Inpara 34
Height Plant (cm)	Inpara 3	122.14	-	
	Inpara 34	130.06	**	-
	Local	137.31	**	**
	Variety	Average	Inpara 3	Inpara 34
Number of productive tillers (stems/clumps)	Inpara 3	21.17	-	
	Inpara 34	17.23	**	-
	Local	15.07	**	*
	Variety	Average	Inpara 3	Inpara 34
Panicle length (cm)	Inpara 3	25.08	-	
	Inpara 34	30.13	**	-
	Local	30.18	**	tn

Note: ** = very significantly different (Probability < 0.01)
 * = significantly different (Probability < 0.05)
 tn = not significantly different (Probability > 0.05)

Filled grain/panicle of Inpara 3 is very significantly different from Inpara 34 and local varieties, while Inpara 34 is significantly different from local varieties. Inpara 3 has 221.27 and 180.17 grains/panicle in the local variety. The number of empty grains/panicles from Inpara 3 was very significantly different from Inpara 34 and local, while Inpara 34 (25.13 grains/panicle) and Local (25.30 grains/panicle).

Table 3. The yield components and results of Inpara 3, Inpara 34 and Local rice varieties in tidal swamps land Jambi Province

Parameters	Variety	Average	Inpara 3	Inpara 34
Number of filled grains/panicles (grains)	Inpara 3	221.27	-	
	Inpara 34	190.30	**	-
	Local	180.17	**	*
	Varietas	Average	Inpara 3	Inpara 34
Number of empty grains/panicles (grains)	Inpara 3	30.10	-	
	Inpara 34	25.13	**	-
	Local	25.30	**	tn
	Varietas	Average	Inpara 3	Inpara 34
Yield (tons/ha)	Inpara 3	4.72	-	
	Inpara 34	5.77	*	-
	Local	2.99	**	**

Note: ** = very significantly different (Probability < 0.01)
 * = significantly different (Probability < 0.05)
 tn = not significantly different (Probability > 0.05)

The yields of Inpara 3 and Inpara 34 are very significantly different from local varieties with yields of 4.72 tonnes/ha and 5.77 tonnes/ha, while Inpara 3 and Inpara 34 are significantly different (Table 3). This is due to the technological components that support the Inpara 3 and Inpara 34 varieties, using the row legowo planting system and balanced fertilization so that the results are higher than local varieties. Apart from that, the Inpara 34 variety can adapt to tidal swamp land. According to [21], the use of superior varieties and the jajar legowo planting system provides higher rice production, meaning there is an interaction of these technological components. The yield of Inpara 3 rice is lower than the Inpara 34 variety because the Inpara 3 variety is attacked by neck blast disease. Rotating varieties and

planting resistant rice varieties with appropriate planting patterns can suppress the growth of pathogens [22]. Furthermore [23], neck blast disease, especially in areas where blast disease is endemic, to reduce the attack of this disease needs to be done when rice plants flower not at the same time as high rainfall.

3.3 Feasibility Analysis of Rice Farming

The income obtained by Inpara 3 rice is IDR 16,520,000, and Inpari 34 rice is IDR 20,195,000, while local rice is IDR 10,465,000. Variety income obtained by farmers is due to the different results obtained from each variety. Factors that influence rice yields include of varieties, fertilization and planting system. The application of planting system, labeled superior varieties, the addition of SP 36 fertilizer and KCl gives higher results compared to the technology of farmers who use local varieties and do not use KCl fertilizer and the tile planting method. This is in accordance with the research results [24], that by implementing superior variety, planting system jajar legowo, and balanced fertilization can increase rice yields higher than the farmer's method.

Table 4. Costs of rice farming in Lumahan Village, Senyerang District, Regency West Tanjung Jabung - Jambi

No.	Description	Inpara 3		Inpari 34		Local	
		Physical	Value (IDR)	Physical	Value (IDR)	Physical	Value (IDR)
I.	Production Facilities (IDR)						
	- Seed (kg)	30	300,000	30	300,000	50	250,000
	- Urea (kg)	150	330,000	150	330,000	50	110,000
	- SP 36 (kg)	100	240,000	100	240,000	50	120,000
	- KCl (kg)	50	300,000	50	300,000	0	0
	- Pesticides	-	500,000	-	500,000	-	200,000
	Amount		1,670,000		1,670,000		680,000
II.	Labor (IDR)						
	- Spray the grass/dust (WD)	4	400,000	4	400,000	4	400,000
	-Tillage (wholesale)	-	1,000,000		1,000,000	-	1,000,000
	- Plant (wholesale)	-	1,000,000		1,000,000	-	1,000,000
	- Fertilization (WD)	3	225,000	3	225,000	1	75,000
	-Weeding (WD)	4	300,000	4	300,000	4	300,000
	- Pest and disease Control (WD)	4	300,000	4	300,000	2	150,000
	Harvesting/ Processing (Profit sharing)	-	2,050,000	-	2,500,000	-	1,300,000
	Amount		5,275,000		5,725,000		4,225,000
	Total (I + II)		6,945,000		7,395,000		4,905,000

The labor costs for superior rice are IDR 5,275,000 (Inpara 3) and IDR 5,725,000 (Inpari 34), respectively, while for local rice it is IDR 4,225,000 (Table 4). The use of superior rice production is the same amounting to IDR 1,670,000 and local rice amounting to IDR 680,000. The total costs incurred for superior rice and local rice are respectively IDR 6,945,000 (Inpara

3), IDR 7,395,000 (Inpari 34) and IDR 4,905,000 (Local). The income obtained by Inpara 3 and Inpari 34 rice was IDR 9,575,000 (R/C 2.38) and IDR 12,800,000 (R/C 2.73) respectively, while the income obtained by local rice was IDR 5,560,000 (R/C 2.13) (Table 5). This shows that the income from superior varieties of rice (Inpara 3 and Inpari 34) is greater than local rice. According to [25], that planting system jajar legowo and supported by other technological components such as superior varieties and balanced fertilization can increase rice productivity and farmer income compared to the tegel. Inpari 34 of revenue and cost is better than other varieties. The feasibility of rice farming Inpari 34 is better than other varieties. MBCR (Inpara 3 vs Local) 1.97 MBCR (marginal benefit cost ratio) is 1.97, which means that every additional input in farming of IDR 1000, - will increase income by IDR 1,970 and MBCR (Inpari 34 vs Local) 2.91 MBCR (marginal benefit cost ratio) is 2.91, which means that every additional input in the farming of IDR 1,000- will increase income by IDR 2,910.

Table 5. Analysis of rice farming in Lumahan Village, Senyerang District, Regency West Tanjung Jabung - Jambi

No	Description	Inpara 3		Inpari 34		Local		
		Physical	Value (IDR)	Physical	Value (IDR)	Physical	Value (IDR)	
I.	Revenue (IDR)							
	a. Yield (kg/ha)	4720	-	5770	-	2990	-	
	b. Price (IDR/kg)	-	3500	-	3500	-	3500	
	Total (axb)		16,520,000		20,195,000		10,465,000	
II.	Income (IDR)		9,575,000		12,800,000		5,560,000	
	R/C		2.38		2.73		2.13	
	B/C							
	MBCR (Inpara 3 vs Local)							1.97
	MBCR (Inpari 34 vs Local)							2.91

4 Conclusion and recommendation

Inpari 34 rice productivity is 5.77 t/ha, higher than Inpara 3 and local varieties with 4.72 t/ha and 2.99 t/ha respectively. This means that there is an increase in productivity of 1.73 tons/ha (Inpara 3) and 2.78 tons/ha (Local). Revenue from Inpari 34 rice was IDR 12,800,000 (R/C 2.73), higher than Inpara 3 and local varieties, respectively IDR 9,575,000 (R/C 2.38) and IDR 5,560,000 (R/C 2.13). Inpari 34 of revenue and cost is better than other varieties, meaning that Inpari 34 rice farming is economically feasible, and feasibility is better than other varieties. Inpari 34 rice variety is adaptable and can be applied in tidal swamp land in Jambi Province.

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