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The Performance of Existing Rice Farming on Peatlands in Central Kalimantan Food Estate Area

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Abstract

Peatland is tidal wetland that has the potential to be utilized for rice farming. This study aims to identify the characteristics of farmers and rice farming performance, and analyze the feasibility of rice farming on peatlands in the Food Estate area, Central Kalimantan. The research was conducted in Kapuas and Pulang Pisau districts, Central Kalimantan, in 2020. Primary data were obtained through interviews with 180 farmers purposively selected as research respondents. Farmers' characteristics and rice farming performance were analyzed using descriprive qualitative and quantitative approaches. The feasibility of rice farming was analyzed using RC ratio. The results showed that in general, the farmers were productive with a long experience of rice farming despite low education. Land ownership is quite extensive with self-owned status. Farmers in Kapuas district used hybrid and labeled rice seeds (85.87%), while in Pulang Pisau district the seeds used were inbred and only 42.86% were labeled. The farmers also used inorganic fertilizer, organic fertilizer, lime, herbicides and pesticides. Rice farming on peatlands in the Food Estate area of Central Kalimantan is feasible with RC > 1. Rice farming on peatlands should be widely developed to support the increase in national rice production, in line with the increasing demand for rice.

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INTRODUCTION

The Food Estate Program in Central Kalimantan, starting in 2020, focuses on rice as the main commodity. This program aims to increase the national rice production to meet the increasing demand. For example, in West Java in 2018, the demand for rice exceeded its production (Isnaini et al., 2021). The policy of the Ministry of Agriculture is directed to increase the production of staple foods, including rice (Hidayah et al., 2021). In line with such an aim, the efforts to increase food production, especially rice, can be carried out on sub-optimal lands such as peatlands which are tidal wetlands. According to Susanti and Mamat (2017), sub-optimal lands, such as peatland have the potential to be optimized as rice farming lands that can contribute to national food production. Surahman et al.'s (2018b) research demonstrated that agricultural development through rice farming on 0.16 million ha of degraded peatland in Central Kalimantan can contribute 0.59 million tons/year to the national rice production.

The land area of the food estate program was previously the land for the "one million hectare rice field" program or the Central Kalimantan Peatland Development - *Pengembangan Lahan Gambut* (PLG) which is mostly peatlands. Peatlands in the Central Kalimantan food estate area are categorized as tidal swamps. According to Januar et al. (2021), Central Kalimantan has 2.7 million ha of peatlands, while Indonesia has 14.9 million ha. Indonesia has the 4th largest peatland area in the world and the largest in Southeast Asia, which is 20.70 million ha (87.5%). The remaining 2.97 million ha (12.5%) are spread across Malaysia, Myanmar, Brunei, the Philippines, Thailand, and Vietnam. (Dohong et al., 2017).

Constraints and challenges in the utilization of peatlands are diverse, and inappropriate management will cause environmental damage and land degradation, which in turn affects land productivity (Susanti & Mamat, 2017). According to Utami et al. (2009), peatland management is multifaceted as the problems are related to physical, chemical, biological, and hydrological aspects. In line with that, Ritung and Sukarman (2014) and Daryono (2009) describe that peatlands are fragile, infertile (poor in mineral nutrients), irreversibly drying, flammable in dry conditions, and have high acidity.

The food estate is located in Kapuas and Pulang Pisau districts, Central Kalimantan. These two districts have the largest contribution to rice production of Central Kalimantan. In 2019, the contribution of the two districts reached 59.17% or 262,469.37 tons of milled dry grain (MDG), while Central Kalimantan's rice production was 443,561.33 tons of MDG. (BPS Central Kalimantan, 2020). Rice productivity of Kapuas District is 3.28 tons/ha, while the productivity of Pulang Pisau District is 3.06 tons/ha. This productivity is above the average Central Kalimantan rice productivity of 3.04 tons/ha. The rice harvest areas in Kapuas and Pulang Pisau districts reached 81,288.64 ha or 55.62% of the rice harvest area in Central Kalimantan which reached 146,144.51 ha.

Based on the research problem, it is important to study the existing condition of rice farming on peatlands in the food estate area. The results of this study are expected to provide up-to-date information on the existing conditions of rice farming in the food estate area to support the success of the program, which has an impact on the national rice production. This study aims to: 1. identify the characteristics of farmers in the food estate area, 2. identify the performance of rice farming in the food

estate area, and 3. analyze the feasibility of rice farming on peatlands in the food estate area.

RESEARCH METHOD

The research was conducted in two districts, Kapuas and Pulang Pisau, Central Kalimantan. In Kapuas district, the research was conducted in Terusan Karya and Terusan Mulya villages in Bataguh sub-district. Meanwhile, in Pulang Pisau district, the research was conducted in Belanti Siam village in Pandih Batu sub-district. The research locations were purposively selected because the food estate development program was implemented by the Ministry of Agriculture in the districts. This research was conducted in October 2020. The food estate development program was launched by the government in early 2020.

The data used in this study are primary data, including the characteristics of farmers as the respondents, such as age, education, number of family members, experience in rice farming, and the status and size of agricultural land ownership; data on the performance of rice farming, which include the use of agricultural resources such as rice seeds, fertilizers, lime, and pesticides, as well as the involvement of labor both from within and outside the family; data on the cost of rice farming, including the cost of production inputs (seeds, fertilizers, lime pesticides), labor costs, and other costs (land rent, water pump rent, land tax, cash contributions, *zakat*, and so on).

Primary data were obtained through interviews using a structured questionnaire involving farmers as the respondents. Secondary data were obtained through reviews of reports and publications, such as data on harvest areas, production and productivity of rice in Kapuas and Pulang Pisau districts in 2019, the area of peatland in Central Kalimantan, and so on. The number of respondents in this study was 180 farmers, consisting of 90 farmers in Kapuas District and 90 farmers in Pulang Pisau District. The respondents purposively selected were farmers who were directly involved in the food estate development program.

The methods of analysis used to answer objective 1, which is to identify the characteristics of farmers in the food estate area, are descriptive qualitative and quantitative approach, as well as data tabulation. To answer objective 2, the descriptive qualitative and quantitative approach were also employed. The method used to answer objective 3, which is to analyze the feasibility of rice farming on peatland in the food estate area, is the Revenue and Cost Ratio (R/C) approach.

RESULTS AND DISCUSSION

Characteristics of Farmers in Food Estate Areas

The application of technology in farming depends on the characteristics of farmers. According to Takahashi and Barrett (2013), technology adoption is significantly influenced by farmers' characteristics. Farmers in Kapuas Regency have an average age of 49 years, while the average age of farmers in Pulang Pisau is 43 years. The farmers are in their productive age. According to Agwu et al. (2008), technology adoption by farmers is influenced by their age. The education of farmers in the research location is quite low, which is about 7-8 years or at the level of junior secondary education. Baumgart-Getz et al. (2012) argue that farmers' characteristics such as education do not affect the level of technology adoption by farmers, although

according to Abebaw and Haile (2013) and Sumarno et al. (2015), the higher the farmers' education, the higher the application of technology is.

From the aspect of farming experience, farmers in the research location have quite a long farming experience, around 20-23 years. This shows that farmers are very familiar with rice farming. Mariano et al. (2012) and Baumgart-Getz et al. (2012) concluded that the level of technology adoption by farmers is not influenced by this factor. On the other hand, as Nazeb et al. (2019) has shown in their research on the peatlands of Pelalawan Regency, Riau, the longer the farming experience, the more skillful the farmers will be.

The farmers have an average of 4 family members, and these family members constitute labor in the family supporting rice farming, thus reducing labor costs. Land ownership by farmers is quite extensive, with an average of 2.2-2.8 ha/farmer and the status is self-owned. For farmers with narrow land ownership of less than 1 ha, the average is 0.6-0.75 ha/farmer with non-owned status. According to Mulyono et al. (2016), one indicator of farmer welfare is land ownership as the main asset. Farmers with extensive agricultural land ownership have greater opportunities to apply new technologies and innovations. According to Mariano et al. (2012) and Ghimire et al. (2015), the larger the area of cultivated land, the higher the chances of adoption.

Tabel 1. Characteristics of farmers in the research location, 2020

Description	Terusan Karya & Terusan Mulya Village	Belanti Siam Village
Age (year)	49,26	42.92
Education (years)	7.04	8.05
Number of Family Members	3.57	3.77
(people)	23.11	20.13
Rice Farming Experience (years)		
• Status and size of land tenure	2.23	2.85
• (ha)	0.6	0.75

Source: Primary Data (processed), 2020

Performance of Food Estate Rice Farming

Peatlands can potentially be developed into agricultural land for rice cultivation by taking into account several characteristics such as typology, soil type, and inundation type to maintain sustainability and environmental sustainability. In the Central Kalimantan food estate area, the existing cropping pattern is rice-rice-bera with a Cropping Index (IP) of 200.

In Kapuas district, farmers use hybrid rice seeds with an average of 11.5 kg/ha. Farmers using labeled seeds are 85.87% of the total farmers, while those using unlabeled seeds are 14.13%. In Pulang Pisau District, farmers use inbred rice seeds with an average of 28 kg/ha. Farmers who use labeled seeds are 42.86% while those who use unlabeled seeds are 57.14%. Farmers commonly use the varieties of Suppadi, Sertani 14, Sl-88 Hybrid, and Sembada (hybrids) and IR (32 and 64), Inpari (32, 40, and 42) which are inbred varieties. Farmers do not use labeled seeds because

they are more expensive and rarely available, their self-prepared seeds are good, and they do not easily trust labeled seeds.

The fertilization dose with urea fertilizer averaged 105.5 kg/ha. SP-36 fertilizer used was no more than 33 kg/ha, even only 3 kg/ha (Belanti Siam Village). The fertilizer dose with NPK fertilizer averaged 196.5 kg/ha (Terusan Karya and Terusan Mulya villages), while in Belanti Siam village, it was higher at 201 kg/ha. The farmers also use organic fertilizer, namely manure, although very little, between 25.5-37 kg/ha. According to Sholikah and Kadarmanto (2020), fertilizer application affects the production of inbred and hybrid rice.

The use of lime aims to neutralize the acidity and toxicity of the land. The use of lime in Terusan Karya and Terusan Mulya villages was 27 kg/ha, less than that in Belanti Siam village, which was 349.5 kg/ha. This is due to the lack of lime availability in the field and lack of capital among farmers. According to Susanti and Mamat (2017), the use of lime is only done by some farmers due to lack of capital.

In general, farmers use herbicides and pesticides to eradicate and control weeds, pests and diseases; only a few farmers do it manually. In Terusan Karya and Terusan Mulya villages, 93.0% of farmers use herbicides, 4.7% do it manually, and 2.3% use a combination of manual and herbicides. In contrast to farmers in Belanti Siam Village, 100% of farmers controlled weeds by spraying herbicides. To control pests and diseases in rice, farmers usually spray for prevention (preventive) and this is incidental only if an attack occurs. Farmers who took preventive action reached 92.20% in Terusan Karya and Terusan Mulya Villages, while other farmers (7.80%) only sprayed if there was an attack of pests and diseases on rice plants. In Belanti Siam Village, 75% of farmers took preventive action, while the other 25% of farmers sprayed if their paddy plants were attacked by pests and diseases. The following are some of the pests and diseases of rice that become the main problems for farmers, namely blast, *walang sangit* (grasshopper), stem borer, broken neck, leafhoppers, caterpillars and rats.

Rice production on tidal peatlands in the food estate area reached 3,550-3,693 kg/ha, lower than that in South Sumatra, South Kalimantan and Riau (5,420-6,150 kg/ha). In contrast, rice production on tidal patlands in East Tanjung Jabung Regency was lower at 2,500-3,000 kg/ha. (Adri et al., 2013). The difference in yield or production is due to the application of different technologies in each location or region by farmers, such as the use of varieties, fertilizers, lime, pest and disease control, and so on.

As previously explained, the low rice production in the Central Kalimantan food estate area is due to the fact that not all farmers use labeled seeds; also, the use of manure and lime is not optimal. This is different from the low rice production in East Tanjung Jabung District, where the low production is due to farmers still using local varieties; the plants are often attacked by pests and diseases such as *sundep*, groundhogs, and birds.

In contrast, rice production on tidal land in Banyuasin Regency, South Sumatra was higher than that in the food estate and Jambi, at 5,420 kg/ha. (Agustiani & Ruskandar, 2019). This is because the farmers have applied RAISA (*Rawa Pasang Surut, Intensif, Super,* and *Aktual*) technology. This technology applies the Integrated Crop Management (ICM) technology for tidal swamp paddy to increase yields by

considering sustainability. The 'intensive' aspect refers to the effort to increase the cropping index, while super and actual refer to the use of the latest innovations.

Rice production on tidal peatland in Siak District, Riau is also higher at 5,800 kg/ha (Masganti, 2021). This is because farmers apply the 2:1 *jarwo* planting technology, supported by the application of other technologies such as the use of the inpari 13 variety, 14-day-old seedlings, and fertilization based on the test results using the Leaf Color Chart (BWD). Rice production on tidal peatland in Barito Kuala District, South Kalimantan was also higher at 6,150 kg/ha (Darsani et al., 2021). This is because farmers apply *biotara* biofertilizer technology and the *jarwo* 2:1 planting system, supported by other technologies including the use of IR 42 and Inpara 2 varieties, inorganic fertilizers (NPK), lime, and agricultural tools and machinery. The application of 5 tons/ha of dolomite lime in swampland rice farming in South Bengkulu Regency can increase production by 10% (Kusnadi et al., 2022).

Table 2. Rice farming performance in research locations, 2020

Rice Farming Performance	Terusan Karya Village & Terusan Mulya Village, Kapuas Regency	Belanti Siam Village, Pulang Pisau Regency
Rice Seed		
- Type of rice seed	Hybrid	Inbred
- Rice varieties	Supaddi, Sertani 14, SL 88 Hybrid, Sembada	IR 32, IR 64, Inpari 32, Inpari 40, Inpari 42
- Quantity of seed (kg/ha)	11.50	28.00
- Seed quality		
• Labeled (%)	85.87	42.86
• Unlabeled (%)	14.13	57.14
Fertilizer		
- Urea (kg/ha)	105.50	105.50
- SP-36 (kg/ha)	33.00	3.00
- NPK (kg/ha)	196.50	201.00
- Manure/Organic fertilizer (kg/ha)	37.00	25.50
- Lime (kg/ha)	27.00	349.50
Percentage of Organic Fertilizer/Compost/Lime Usage (%)		
- Using Organic Fertilizer/Compost/Lime (%)	24.44	44.82
- Using Organic Fertilizer/Compost/Lime (%)	0	39.09
- Not Using Organic Fertilizer/Compost/Lime (%)	75.56	16.10
Weed Control		
- Herbicide (%)	93.0	100
- Manual (%)	4.7	0
- Combination (%)	2.3	0
Pest and Disease Control		
- Preventive (%)	92.20	75.00
- Incidental	7.80	25.00
Rice Production		

– Dry Grain Yield (GKP ton/ha)	3.69	3.55

Source: Primary Data (processed), 2020

The use of fertilizers contributes to the increased rice production (Purba et al., 2020). Meanwhile, the use of lime aims to improve land quality (Imanudin et al., 2021). The application of technology in rice farming on peatlands must consider land characteristics, suitability, efficiency, and synergy between specific technologies and environmental components to ensure production sustainability (Wardie & Sintha, 2018). According to Surahman et al. (2017) and Osaki et al. (2016), the utilization of peatlands for agriculture must be regulated proportionally and sustainably to obtain optimal results. Accoridng to Wardie and Sintha (2018) and Surahman et al. (2018a), rice farming in Central Kalimantan's tidal swamp peatlands has a high sustainability score.

Feasibility of Rice Farming in Peatland Food Estate Area

Rice farming costs borne by farmers in Kapuas District reached Rp. 8,378,629/ha, higher than that in Pulang Pisau District (Rp. 7,580,373/ha). This difference is due to the fact that farmers in Kapuas district use hybrid rice seeds, while those in Pulang Pisau district use inbred rice seeds. Hybrid rice seeds are more expensive than inbred seeds. The use of hybrid rice seeds has an impact on additional labor and work time, consequently increasing the costs incurred by farmers. Farmers must seed the rice and then transplant it using the transplanting system (*Tapin*). When using inbred rice seeds, farmers do not seed the rice. The seeds are planted directly (*Tabela*), so the costs incurred are lower and the time is shorter. Planting can be done manually (spread by hand) or with planting tools. In addition, land rent and zakat are more expensive in Kapuas district than in Pulang Pisau.

The production input costs including seeds, fertilizers, lime, fertilizers, herbicides, pesticides reached Rp. 2,503,560.00/ha (29.88%), while labor costs reached Rp. 3,640,982.00/ha (43.46%), and other costs were Rp. 2,234,088.00/ha or 26.66% (Kapuas District). Meanwhile, in Pulang Pisau District, production input costs including seeds, fertilizers, lime, herbicides, and pesticides reached Rp. 2,327,132/ha (32.18%), labor costs reached Rp. 3,024,508/ha (41.00%), and other costs reached Rp. 1,978,518/ha (26.82%). The largest portion of costs in both locations was used for labor costs, which was around 41%-43%. The results of research by Agustiani and Ruskandar (2019) in South Sumatra show that the labor cost component was the largest component in rice farming (66%-69%), and the input cost was 31%-34%.

According to Susilawati et al. (2016), rice productivity on tidal swamp peatlands is 2-3 tons/ha. In Kapuas District, the average production of harvested dry grain (GKP) was 3,693 kg/ha, with a grain price of Rp. 4,221.00/kg. So, farmers earned Rp. 15,584,196.00/ha. Farmers' income from rice farming amounted to Rp. 7,205,568/ha, with an RC ratio of 1.86. In Pulang Pisau District, the average GKP production reached 3,550 kg/ha, with a grain price of Rp. 4,214/kg. So, farmers earned Rp. 14,957,593/ha. Farmers' income from rice farming amounted to Rp. 7,580,373.00/ha, with an RC ratio of 2.03. With an RC ratio of more than one, rice farming on peatlands in the Central Kalimantan Food Estate area is feasible.

Table 3. Composition of rice farming costs/ha at the research location, 2020.

Uraian	Terusan Karya & Terusan Mulya Villages, Kapuas District			Belanti Siam Village, Pulang Pisau District		
	Volume (Unit)	Price (Rp/Unit)	Value (Rp)	Volume (Unit)	Price (Rp/Unit)	Value (Rp)
I. Production Input			2,503,560			2,374,195
Seed (Kg/Ha)	11.5	75,492	868,158	28	22,135	619,780
Urea (Kg/Ha)	105.5	2,193	231,362	105.5	2,097	221,234
SP-36 (Kg/Ha)	33	2,364	78,012	3	2,417	7,250
NPK (Kg/Ha)	196.5	2,588	508,542	201	2,600	522,600
Organic Fertilizer (Kg/Ha)	37	953	35,261	25.5	1,204	30,689
Lime (Kg/Ha)	27	983	25,313	349.5	983	343,384
Other Supplements (Rp/Ha)			21,818			15,182
Pesticides (Rp/Ha)			644,670			381,347
Herbicides (Rp/Ha)			90,425			232,730
II. Labor			3,640,982			3,024,508
Labor for land preparation and post-harvest activities			3,640,982			3,024,508
III. Other Expenses			2,234,088			1,978,518
Land Rent (Rp/Ha)			1,565,000			1,375,000
Water Pump Rent (Rp/Ha)			83,334			186,386
Land Tax (Rp/Ha)			4,751			6,267
Membership Fee (Rp/Ha)			7,536			6,539
Zakat (Rp/Ha)			465,134			88,632
Other (Rp/Ha)			108,334			315,965
Total Cost (I + II + III) (Rp/Ha)			8,378,629			7,377,221
IV. Production (Kg/Ha)	3.693	4,221	15,584,196	3.550	4,214	14,957,593
Income (Rp/Ha)			7.205.568			7.580.373
R/C			1,86			2,03

Source: Primary Data (processed), 2020

CONCLUSIONS

The farmers in the food estate area in Central Kalimantan are in their productive age with a long experience in rice farming although their education level is low. Farmers' land ownership is quite extensive and it is self-owned. In conducting rice farming, most farmers in Kapuas district have used labeled hybrid rice seeds. In Pulang Pisau District, farmers use inbred rice seeds and most farmers use unlabeled seeds. In general, farmers have applied organic and inorganic fertilizers, herbicides and pesticides, as well as lime to increase rice production and productivity. Rice

farming on peatlands in the food estate area of Central Kalimantan is feasible and profitable. So, it needs to be widely developed to support the national rice production.

RECOMMENDATION

Based on the results of this study, it is necessary to improve the assistance and extension by field extension workers (PPL) in other locations through the application of technology, because rice farming on peatlands is feasible and profitable. It can contribute to the national rice production.

AUTHOR CONTRIBUTIONS

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