FOOD SELF-SUFFICIENCY AT THE LOCAL LEVEL: A CASE STUDY IN PEATLANDS OF SOUTH SUMATRA

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Received: 11 July 2023, Revised: 21 October 2023, Accepted: 30 October 2023

FOOD SELF-SUFFICIENCY AT THE LOCAL LEVEL: A CASE STUDY IN PEATLANDS OF SOUTH SUMATRA.The COVID-19 pandemic has brought attention to the need for Indonesia to prepare for future food challenges. The government is focusing on developing underdeveloped areas, including peatlands, which have great potential for integrated farming systems. Bangsal is a village with peat swamp lands that serve as a source of food in OKI Regency, South Sumatera. During the dry season, the land is used for agriculture, while during the rainy season, it is used for fisheries. This paper analyzes (a) the village-based farming patterns in peatland areas, (b) the institutional framework of peatland farmer groups in Bangsal, and (c) the strategy for sustainable peatland utilization for food security. The study used both qualitative and quantitative data analysis methods. The research showed that the role of the Ulak Kuto Mandiri effectively and efficiently increased community income and food self-sufficiency. Integrated farming systems, including swamp buffalo farming, swamp fish farming, and swamp agriculture, optimally and sustainably increased the potential of peatlands. Sustainable peatland utilization through integrated farming systems technically preserves the peatland ecosystem from land conversion, is economically feasible, increases the income of farmers, livestock breeders, and local cultural traditions, and empowers women in farming activities. It also reduces forest fire risks, chemical fertilizer and pesticide use, and increases peatland productivity.

Keywords: Integrated farming system, food security, swamp buffalo farming, swamp fish farming, sustainable peatland utilization

KEMANDIRIAN PANGAN DI TINGKAT LOKAL: STUDI KASUS DI LAHAN GAMBUT SUMATERA SELATAN. Pandemi COVID-19 telah menyoroti perlunya Indonesia untuk mempersiapkan tantangan pangan di masa depan. Pemerintah sedang fokus mengembangkan lahan yang belum berkembang, termasuk lahan gambut yang memiliki potensi besar untuk sistem pertanian terintegrasi. Desa Bangsal adalah sebuah desa dengan lahan rawa gambut yang menjadi sumber pangan di Kabupaten OKI, Sumatera Selatan. Selama musim kemarau, lahan tersebut digunakan untuk pertanian, sedangkan selama musim hujan, digunakan untuk kegiatan perikanan. Makalah ini menganalisis (a) pola pertanian berbasis desa di lahan rawa gambut, (b) kelembagaan kelompok petani gambut di Desa Bangsal, dan (c) strategi pemanfaatan gambut yang berkelanjutan untuk ketahanan pangan. Penelitian ini menggunakan metode analisis data kualitatif dan kuantitatif. Penelitian ini menunjukkan bahwa peran Pokmas Ulak Kuto Mandiri secara efektif dan efisien meningkatkan pendapatan masyarakat dan kemandirian pangan. Sistem pertanian terintegrasi, termasuk peternakan kerbau rawa, budidaya ikan rawa, dan pertanian rawa di lahan gambut, secara optimal dan berkelanjutan meningkatkan potensi lahan gambut. Pemanfaatan lahan gambut yang berkelanjutan melalui sistem pertanian terintegrasi secara teknis menjaga ekosistem lahan gambut dari konversi lahan, secara ekonomis layak, meningkatkan pendapatan petani, peternak,

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 doi:10.59465/ijfr.2023.10.2.207-219

dan tradisi budaya lokal, serta memberdayakan perempuan dalam kegiatan pertanian. Hal ini juga mengurangi risiko kebakaran hutan, penggunaan pupuk kimia dan pestisida, serta meningkatkan produktivitas lahan gambut.

Kata kunci: Sistem pertanian terintegrasi, ketahanan pangan, peternakan kerbau rawa, budidaya ikan rawa, pemanfaatan lahan gambut berkelanjutan

I. INTRODUCTION

The issue of food for the world's population in the future will increasingly escalate due to factors such as changes in climate and the impact of global economic recession, affecting production levels and distribution. The world will also experience a doubling of the risk of food insecurity, both before (135 million people in 53 countries) and after the COVID-19 pandemic (345 million people in 82 countries), as reported by the World Food Programme (2023).

Several Asian countries have made efforts to address the food crisis, particularly rice, in their respective countries. These include Malaysia, which has increased paddy productivity through modern technology; the Philippines, which has increased investment in the agricultural sector, including the sub-sector of rice; Thailand, which has implemented sustainable agricultural systems and increased rice production; Myanmar, which continues to increase its rice exports; Vietnam, the second-largest rice exporter in the world after Thailand; and Laos, which has increased rice farming productivity through expanded cultivation areas (Research and Markets, 2023). Indonesia is also striving to increase rice production by implementing modern technologies such as the System of Rice Intensification (SRI) and the use of superior varieties (Research and Markets, 2023). According to the FAO, rice is a staple food in Asian countries and parts of the Pacific, where approximately 90% of the world's rice is produced and consumed. In 2020, India and China were the largest rice producers, known for their production volumes of 177.6 million metric tons and 211.4 million metric tons, respectively (Research and Markets, 2023).

Indonesia, as an agrarian country, once achieved rice self-sufficiency in the 1980s (Ministry of Agriculture, 2023). However, in the past five years, food imports have been increasing. This indicates the need for improvements in food production and its resilience. Food security becomes relevant when there are approximately 26.16 million people living in poverty (Central Agency on Statistics, 2022) who are the main consumers of national food. This is in line with the opinion of Bukari et al. (2022) that poor families are highly vulnerable to food insecurity because the largest portion of their household expenditure is allocated to meet food supply. Therefore, it is crucial for the Indonesian government to ensure sufficient food supply and affordable prices in order to maintain food stability and meet the needs of Indonesia's 267 million population.

The Indonesian government has implemented various programs to achieve food security, such as intensification and expansion of paddy fields, targeting both mineral soil and wetlands. Wetlands are targeted for food production due to their extensive coverage, with a total area of 24.67 million hectares, including 14.9 million hectares of peatlands and 9.7 million hectares of non-peatlands (Ministry of Environment and Forestry, 2018). Wetlands have significant potential as agricultural land, despite being located in remote areas far from public transportation (Qurani et al., 2022; Waluyo et al., 2012).

National peatlands are distributed across four major islands: Sumatra, Kalimantan, Sulawesi, and Papua (Ministry of Environment and Forestry, 2018). Peatlands are characterized by their dominance of peat soil and possess

important hydrological functions (Hooijer et al., 2010), high carbon reserves (Murdiyarso et al., 2017), and rich biodiversity (Kalima et al., 2020). Therefore, they need to be protected and preserved.

In general, there are several issues associated with peatland areas, including the humid environmental conditions (Hooijer et al., 2006) and the coarse texture of the soil (Dommain et al., 2014), which makes it difficult to cultivate the land and results in losses for crops. Additionally, peatland soil often has low nutrient content and is influenced by tidal effects, causing waterlogging during the rainy season and dryness during the dry season (Fahmid et al., 2022). According to Herawati et al. (2021), the potential for tidal effects, especially in peatland areas, has a negative impact as it leads to nutrient leaching from the soil, which is harmful to plants.

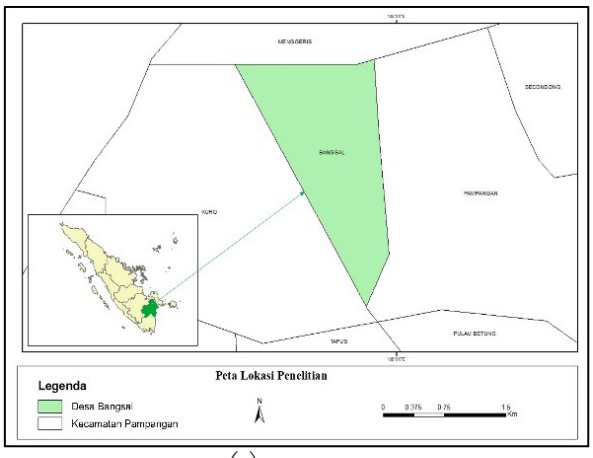
Publications related to the utilization of peatlands for agricultural or food sources have been conducted in various regions, including Kalimantan (Prayoga, 2016), West Kalimantan (Tampubolon et al., 2020), Central Kalimantan (Wahyuningsih et al., 2020), and Riau (Fasla, 2020).

The number of papers related to the study of peatland utilization for village-based food security is still limited, highlighting the need for conducting research within the framework of discovering peatland utilization technologies with an integrated village-based agricultural system in Ogan Komering Ilir (OKI) District, South Sumatra. It is expected that this research will provide valuable insights for areas with similar site characteristics to adopt these new technologies. The objectives of this paper are: (1) to analyze the village-based farming patterns in peatland areas in OKI Regency, (2) to assess the institutional framework of peatland farmer groups in OKI, and (3) to develop strategies for sustainable peatland utilization for food security.

II. MATERIAL AND METHOD

A. Study Site

This research was conducted in Bangsal Village, Pampangan Subdistrict, Ogan Komering Ilir District, South Sumatra Province, from June to July 2022 (Figure 1). Bangsal Village was chosen because it is one of the villages that has a large expanse of peat swamp land with two land functions as a food source. During the dry season, it is utilized as agricultural land, while during the rainy/flood season, it can be used for fisheries. The residential settlements in Bangsal Village are concentrated in the mainland area, directly adjacent to the peat swamp ecosystem (Figure 1.



(a)

(b)

Figure 1. (a) Map of Bangsal village; (b) The landscape of Bangsal Village consists of both land and tidal peat swamp

Geographically, the area of Bangsal Village is approximately 3.20 km^2 or around 0.66 percent of the total area of the Pampangan Subdistrict (Central Agency on Statistics, 2021). Bangsal Village is the village with the smallest area in the Pampangan Sub-district. Administratively, Bangsal Village consists of one orchard which is divided into two hamlets and five neighbourhoods. When viewed from the regional prospects, Bangsal Village is one of the areas in OKI District. This district is one of three districts in South Sumatra with the highest potential for rice production in early 2023 (Central Agency on Statistics, 2023). With optimal utilization of agricultural land in Bangsal Village, Bangsal Village will certainly contribute to rice production in OKI District.

B. Collecting Data

The types of data collected include primary and secondary data. Primary data includes information gathered through interviews, discussions, and direct observations at the research location. Direct observations were conducted by observing and directly observing integrated farming practices at the research site. Interviews and observations were carried out with village community leaders, such as the village head, community group leaders, pesantren (Islamic boarding school) administrators, and farmer activists. Meanwhile, secondary data obtained from formal and informal institutional sources, including the Central Agency on Statistics of the regency and the village government, were also collected as references and to support the primary data. By collecting comprehensive primary and secondary data, it is expected to generate more accurate analyses.

C. Data Analysis

The analysis methods used to address the objectives of this research are qualitative and quantitative analysis. First, to analyze the village-based agricultural patterns in the peatland area, a descriptive analysis of common agricultural practices is conducted to provide a comprehensive overview of the village-based agricultural patterns in the research location. Second, to assess the institutions of the peatland farmer community, data from interviews and literature studies are used to gain a better understanding of the community groups (local farmer groups), their roles, and the factors influencing the success of the community groups/farmers in the research location. Third, to develop strategies for sustainable peatland utilization, a financial analysis of the agricultural endeavors undertaken by the community groups is carried out. This analysis can identify optimal economic development strategies for peatland utilization.

Qualitative data analysis describes the ongoing community group activities, including community group, village-owned enterprises, Family Income Improvement Program, and organic/natural farmers, in a descriptive manner. Data management focuses on the potential of the peat swamp ecosystem as the primary source of livelihood for the community. Quantitative analysis is used to determine financial aspects. From various data obtained, cash flows, investment costs, operational costs, selling prices, and buying prices are analyzed using investment feasibility criteria such as Net Present Value (NPV), Net B/C, Internal Rate of Return (IRR), and Payback Period (PP). Quantitative data is processed using Microsoft Excel software and presented in tabular and descriptive forms to facilitate the data analysis process.

Financial aspects analysis

The feasibility of a business can be analyzed using investment criteria, including NPV, Net B/C, IRR, and PP.

$$\text{NPV} = \sum_{t=0}^{n} \frac{Bt - Ct}{(1+i)^t} \quad (1)$$

Remarks:
Bt = Benefits in year t
Ct = Costs in year t
t = Year of business activities (t = 0, 1, 2, 3, ..., n), where the initial year can be year 0
i = Interest rate (%)

A business is considered feasible if the NPV is greater than 0 (NPV > 0), which means the business is profitable. Meanwhile, a business is considered not feasible if the NPV is less than 0 (NPV < 0).

Net Benefit-Cost Ratio (Net B/C)

$$\frac{\sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t} (B_t - C_t) > 0}{\sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t} (B_t - C_t) < 0} \quad (2)$$

Remarks:
Bt = Benefits in year t
Ct = Costs in year t
t = Year
i = Interest rate (%)

A business is considered feasible or profitable to implement if the Net B/C > 1 and is considered infeasible or unprofitable if the Net B/C < 1.

Internal Rate of Return (IRR)

$$\text{IRR} = i1 + \frac{NPV1}{NPV1 - NPV2} x\,(i2 - i1) \quad (3)$$

Remarks:
i1 = Discount rate that results in a positive NPV
i2 = Discount rate that results in a negative NPV

A business is considered feasible if its IRR is greater than its opportunity cost of capital (DR).

Payback Period (PP)

$$\textit{Payback Period} = \frac{I}{Ab} \quad (4)$$

Remarks:
I = Amount of investment required
Ab = Net benefits that can be obtained each year

A business that has a shorter payback period for the investment is relatively more likely to be chosen by investors.

III. RESULT AND DISCUSSION

A. Integrated Farming System in Peatland

The utilization of peat swamp land in the agricultural sector can be done in several ways, including through swamp agriculture. Peat swamp land can be used for agriculture, although its condition is moist and difficult to access. Some crops such as corn, rice, and legumes can thrive in peat swamp land if properly cultivated. Furthermore, another utilization is the cultivation of swamp fish such as freshwater fish and brackish water fish, which can also help meet the food demand of the surrounding communities (Wicaksana et al., 2015; Nurzannah, 2021). Another potential is the use of peat swamp land for livestock farming, such as buffalo, cattle, and chicken breeding. Mukhlis et al. (2018) stated that the implementation of integrated farming systems through integrated agriculture, livestock, and fishery systems can improve farmers' welfare and land productivity. Additionally, integrated farming can also minimize waste generation, as the waste produced in one sector can be utilized by another sector. For example, livestock waste can be used as fertilizer for agricultural crops, and crop residues from agriculture can be used as animal feed (Gunawan et al., 2022).

An integrated farming system can be considered as an organic farming system. Organic farming is an agricultural production system that optimizes the health and productivity of agroecosystems naturally through a holistic and integrated approach. This system aims to produce food and fiber that meet quality standards and sustainability requirements to fulfill the needs of society (Trewavas, 2004; Reganold, 2016).

Despite the significant benefits it offers for agricultural progress and economy, integrated farming methods are still rarely practiced by farmers in Indonesia. Given the numerous benefits derived from integrated farming practices, it becomes an interesting topic to study, especially in relation to the feasibility of such integrated farming enterprises considering the lack of interest from some farmers. Ulak Kuto Mandiri is a community group from Bangsal Village, Pampangan Sub District, OKI District. This group engages in integrated farming activities, including rice cultivation, freshwater fish farming, and swamp

buffalo livestock. In line with this, Ulak Kuto Mandiri aims to develop sustainable agriculture by utilizing available natural resources and organic waste without relying on synthetic fertilizers, making their farming efforts more environmentally friendly and prioritizing the principle of 'back to the nature.'

B. Institutional of Ulak Kuto Mandiri

Bangsal Village in Pampangan Subdistrict, OKI District, is known as a remote and hard-to-reach area. However, its residents have shown initiative and awareness to independently develop their village through strong social capital, ideological alignment, and long-established emotional bonds. This initiative is reflected in the formation of Ulak Kuto Mandiri in 2019, a community group that emerged organically and demonstrated a spirit of self-reliance and collaboration in building their village.

Before the establishment of Ulak Kuto Mandiri, organized community groups based on specific economic activities already existed in Kuro - Bangsal Village, such as the village farming group, swamp buffalo herding group, and swamp fishing group. Each group had specific activities related to their respective economic activities, and they supported each other in the preparation and implementation of these activities. The presence of these groups has been recognized by various stakeholders, including academics, NGOs, and the government, because they possess substantial social capital.

Support from external parties is crucial in complementing the existing social capital in Kuro - Bangsal Village. The initiative to merge these three groups into Ulak Kuto Mandiri arose when Bangsal Village became part of the Peatland and Mangrove Restoration Agency of Republic of Indonesia revitalization program. This program not only provided assistance to individual economic activity groups but also integrated them together. For example, Peatland and Mangrove Restoration Agency of Republic of Indonesia provided technology to convert swamp buffalo waste into liquid organic fertilizer, which could be utilized by the farming group. Integrated programs like this can deliver greater and sustainable benefits to the community, as well as help improve economic and social well-being in Kuro - Bangsal Village.

Meanwhile, research has shown that the development of strong social capital can contribute to the sustainability of economic and social development in rural areas (Pretty et al., 2003). In this context, social capital can be defined as the interrelated and reinforcing values, norms, and social networks that can be utilized to achieve common goals. Furthermore, evidence also suggests that cooperation among economic groups in rural areas can enhance production efficiency and effectiveness, as well as help reduce economic inequality (Miskiah et al., 2022).

In practice, the Ulak Kuto Mandiri in Bangsal Village consists of three activity groups: the wetland agriculture group, the wetland livestock group, and the wetland fish cultivation group. Each group conducts activities collectively with the aim of advancing and developing ongoing programs to achieve maximum benefits. Some of the activities carried out by the Ulak Kuto Mandiri include participating in agricultural training, processing buffalo manure into compost or liquid organic fertilizer to enhance livestock production and product marketing, as well as developing local fish seeds. This aligns with the findings of Thirtle et al. (2003), which demonstrate that the development of human resources and technology can improve the efficiency and effectiveness of livestock and agricultural endeavors. Furthermore, the fish cultivation group collaborates with the management of the Islamic boarding school to collect food waste as feed for maggots, propagate black soldier flies (BSF) as fish feed, which are then processed into crackers and kemplang. These products are coordinated with UP2K (Family Income Enhancement Program) and marketed by Village-Owned Enterprises "Teratai Indah", a village-owned enterprise.

Overall, the integration of these economic activity groups into the Ulak Kuto Mandiri in Bangsal Village proves to be an effective and efficient strategy to enhance the welfare and prosperity of the community. This is supported by research that shows collaboration, human resources, and technological development, along with cooperation with microfinance institutions, can improve the efficiency and effectiveness of business operations and product marketing (Guimarães et al., 2021). Through this integration, the village can utilize available resources more efficiently and reap greater benefits from the collaboration between different economic activities (Ito, 2012).

C. Strategies for Utilizing Peatland for Sustainable Food Production

The strategy for utilizing peatland for sustainable food production can be achieved by considering three technical, economic, and ecological aspects. These three aspects will support the management of sustainable peatlands.

C.1. Technical aspect

For the technical aspect of agriculture on peatland, three practices within the integrated farming system will be discussed, namely swamp buffalo farming, fish cultivation, and organic farming.

C.1.1) Swamp Buffalo Farming

Swamp buffalo farming activities can provide income through the sale of gulo puan, a derivative product of swamp buffalo milk. The selling price of gulo puan managed by the Village-Owned Enterprises directly from the producer to the consumer is IDR100,000 per kilogram, which is higher than selling directly to consumers at IDR90,000 per kilogram. However, Village-Owned Enterprises does not pursue profit, and the packaged gulo puan sold by Village-Owned Enterprises is priced at IDR170,000 per kilogram to improve the welfare of the community. In the first year, the production of swamp buffalo milk was hindered by the initial stage of barn management, resulting in only 3,570 liters of milk produced with seven lactating buffaloes. Therefore, the total income in the first year amounted to IDR128,520,000 from the sale of 1,428 kg of gulo puan at a price of IDR90,000 per kilogram.

Liquid organic fertilizer derived from swamp buffalo dung, EM4, and rice washing water has become a by-product sought after by farmers around the livestock farm. Liquid organic fertilizer has advantages over other fertilizers, particularly its more affordable price. As stated in the research by Kakar et al. (2020) and Hatibie et al. (2022), the use of liquid organic fertilizer in rice cultivation can significantly enhance plant growth and rice production. This aligns with the experience of farmers around the swamp buffalo farm who have utilized liquid organic fertilizer for their crop cultivation efforts.

In addition, the successful sale of liquid organic fertilizer generated by the swamp buffalo farm also has a positive impact on the local economy. According to the research conducted by Gelgo et al. (2016), the utilization of liquid organic fertilizer in rural areas can increase farmers' income and reduce expenses for purchasing chemical fertilizers, making the affordable price of liquid organic fertilizer beneficial for farmers in multiple ways.

From a production perspective, the use of animal manure as raw material for liquid organic fertilizer is also an environmentally friendly and sustainable alternative. In a study by Zubair et al. (2020), the use of liquid organic fertilizer derived from animal manure not only resulted in low energy consumption and low emissions but also reduced the presence of chemicals that can harm the soil. In this context, the successful sale of liquid organic fertilizer generated by the swamp buffalo farm not only provides economic benefits but also contributes to the implementation of sustainable and environmentally friendly agricultural practices.

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C.1.2) Freshwater fish farming

Freshwater fish farming is a promising industry in Indonesia. Besides fulfilling food needs, fish farming also offers significant economic potential. In this research, the production value is calculated based on the sales of catfish and tilapia cultivated in Ulak Kuto. The sales of catfish and tilapia are obtained from selling prices to middlemen and the local community. The selling prices of catfish and tilapia are influenced by factors such as fish size, season, and supply availability.

Furthermore, this study also explores the potential for product diversification derived from processed fish, namely kemplang crackers. Kemplang crackers are made using sago and fish as the main raw materials. The sales of kemplang crackers contribute to the revenue of freshwater fish farming in Ulak Kuto. According to Rahmi & Sudarmiatin (2022), derivative products from processed fish, such as fish crackers, have a wide and promising market potential in Indonesia.

In this regard, the use of product diversification derived from processed fish as an additional source of income in freshwater fish farming in Ulak Kuto can enhance the generated economic value. Moreover, it can assist farmers in tackling market competition issues with rising prices and improve their skills in processing fish into high-value derivative products. Therefore, diversification of derivative products from processed fish can be considered as a strategy to enhance the economic value of freshwater fish farming in Ulak Kuto.

C.1.3) Organic farming

In organic rice farming, farmers generate income from the sale of dried paddy and natural rice. Peat swamp agriculture can yield 3-5 tons of dried paddy per hectare per harvest season. The selling price of dried paddy to collectors is Rp5,000/kg. Assuming a harvest success rate of 85% and half of the dried paddy produced is sold while the other half is diversified into natural rice, each hectare of paddy field will yield a gross income from dried paddy of IDR6,375,000 (producing 1,275 kg) per harvest season. The diversification of dried paddy into natural rice amounts to 799.93 kg or equivalent to 50 cans (1 can = 16 kg) with a selling price of IDR150,000 per can. Therefore, farmers receive an income of IDR7,500,000 from the sale of natural rice. Thus, organic rice farming in peat swamp areas can provide promising income for farmers.

The following are the revenues received by Ulak Kuto Mandiri Community Group from swamp buffalo farming, freshwater fisheries, and organic rice cultivation activities, as shown in Table 1.

C.2. Economy aspect

Investment feasibility criteria are used to determine the feasibility of a business based on its financial aspects. Investment feasibility criteria used in the financial analysis of integrated farming practices of Ulak Kuto Mandiri for raising swamp buffaloes, freshwater fish farming, and organic rice farming are Net Present Value (NPV), Net Benefit Cost Ratio (Net B/C), Internal Rate of Return (IRR), and Payback Period (PP). The business is considered

Table 1. Revenues of Ulak Kuto Mandiri from swamp buffalo farming, freshwater fisheries, and organic rice cultivation activities

No	Activities	Capacity	Unit	Price (IDR)	Income (IDR)
1	Swamp buffalo farming				
	*Gulo puan	1428	kg	90,000	128,520,000
	*Liquid organic fertilizer	1200	liter	25,000	30,000,000
	Total				158,520,000
2	Freshwater fisheries				
	*Catfish	650	kg	18,000	11,700,000
	*Tilapia/Nila	200	kg	30,000	6,000,000
	*Kemplang crackers kemplang	850	kg	50,000	42,500,000
	Total				60,200,000
3	Food crops: Rice				
	*Dried paddy	1275	kg	5,000	6,375,000
	*Natural rice	50	can	150,000	7,500,000
	Total				13,875,000
	Total				232,595,000

Source: processed data

Table 2. Criteria for the feasibility of the Ulak Kuto Mandiri business investment

No.	Investment feasibility criteria	Feasibility requirements	Business unit			Feasibility
			Swamp buffalo farming	Freshwater Fish Farming	Organic farming	
1	NPV (IDR)	≥ 0	551,373,473	151,584,587	15,779,949	Feasible
2	Net B/C	≥ 1.00	3.33	3.72	2.33	Feasible
3	IRR (%)	≥ 10	22.77	26.06	16.44	Feasible
4	PP (year)	< 5	2.34	2.01	3	Feasible

Source: Processed data

feasible if the NPV is greater than 0, Net B/C is greater than 1, IRR is greater than the discount rate, which is 10 percent, and PP is less than the business life, which is 10 years. The values of investment feasibility criteria for each business activity can be seen in Table 2.

Table 2 shows that all three types of business activities are feasible investment options based on the criteria used for investment feasibility analysis. Rawa buffalo farming has the highest NPV at IDR 551,373,473, Net B/C of 3.33, IRR of 22.77%, and PP of 2 years and 3 months. These results indicate that the rawa buffalo farming business has a positive present value and is profitable. Meanwhile, freshwater fish farming has an NPV of IDR 151,584,587, Net B/C of 3.72, IRR of 26.06%, and PP of 2 years. This indicates that freshwater fish farming has a large profit potential and a quick return on investment. Organic rice cultivation is also a feasible investment with NPV of IDR15,779,949, Net B/C of 2.33, an IRR of 16.44%, and PP of 3 years. Although the NPV and IRR values for organic rice are

lower compared to rawa buffalo farming and freshwater fish farming, this business is still profitable and can provide long-term benefits.

These results are in line with previous research showing that agricultural businesses such as rawa buffalo farming, freshwater fish farming, and organic rice cultivation have significant profit potential. For example, research by Hilmawan et al. (2020) showed that rawa buffalo farming can provide substantial profits and has good prospects for development in Indonesia. Meanwhile, research by Hendrik (2020) showed that freshwater fish farming, such as catfish farming, can generate high profits and contribute to improving the welfare of communities in the cultivation areas. Other research by Karnasuta & Laoanantana (2021); Rahmaniah et al. (2020) also shows that organic farming businesses, such as organic rice cultivation, have significant profit potential (by saving production costs and daily consumption expenses and being sustainable) and can improve the quality of life for farmers while balancing ecology.

The analysis results also show that all three types of business activities are viable investments based on the investment feasibility criteria used. This indicates that the potential profits that can be obtained from these business activities are greater than the initial capital invested. Although they differ in NPV, Net B/C, IRR, and PP values, all three types of businesses have great profit potential and can benefit farmers as well as improve the welfare of the community in the surrounding cultivation areas. With the increasing human population and growing demand for food, agricultural activities such as swamp buffalo farming, freshwater fish cultivation, and organic rice farming are becoming more attractive as investments.

Previous studies also show that investments in the agricultural sector can provide promising returns. For example, research conducted by Putra et al. (2023) shows that investments in the agricultural sector can provide relatively high profits with positive NPV values. Other research by Mpaing et al. (2022) indicates that organic vegetable farming is profitable and feasible with a B/C Ratio of more than 1. Meanwhile, research by Mardiyanto (2014) states that the landscape of integrated agricultural systems in home gardens is feasible with positive NPV and IRR above a 20% interest rate, and a B/C ratio of more than one. However, to ensure the success of investments in the agricultural sector, factors such as the availability of land, skilled human resources, the use of appropriate technology, and support from the government and financial institutions to access wider markets and capital should be taken into consideration.

In the context of Indonesia, the agricultural sector plays an important role in the national economy by significantly contributing to GDP and employment (Kurniawati, 2020; Sayifullah & Emmalian, 2018; Isbah & Iyan, 2016). Therefore, investments in the agricultural sector are increasingly important in improving the welfare of farmers and strengthening national food security.

C.3. Ecological aspect

To achieve food self-sufficiency, the optimization of peatland utilization can be done by implementing the concept of natural farming. Natural farming utilizes home gardens to meet food needs in an environmentally friendly manner, without relying on manufactured products. In Bangsal Village, the practice of natural farming has been carried out since before the green revolution. This has become the identity of the Ibnu Falaah farmer children's school, which includes extracurricular activities on environmental resource management and natural farming every Saturday and Sunday. The main principle of natural farming is to break free from dependence on manufactured products, from agricultural inputs to healthy products that are shared with scientific knowledge. Natural farming also emphasizes soil fertility by maintaining healthy soil nutrients and reducing the use of chemical fertilizers and pesticides that can harm the environment and human

health. Additionally, raising swamp buffaloes and cultivating freshwater fish can increase the productivity of peatland and improve water quality in the area. By implementing natural farming strategies, communities can utilize abundant local resources that were previously considered useless, reduce the risk of forest fires, and improve the balance of the peatland ecosystem.

IV. CONCLUSION

Integrated farming systems can provide many benefits, including increasing land productivity and financial profits, reducing pressure on natural resources, and improving food security and farmers' livelihoods.

An integrated farming system that combines swamp buffalo rearing, freshwater fish farming, and organic/natural farming offers several benefits, such as:

- Swamp buffalo rearing can help cultivate agricultural land and produce organic fertilizer that is useful for organic/natural farming.
- Freshwater fish farming produces high-value fish products and provides nutrition for farmers and the surrounding community.
- Organic/natural farming can produce healthier and high-quality agricultural products while helping to reduce the use of pesticides and other harmful chemicals that damage the environment.

The integrated farming activities by Ulak Kuto Mandiri are financially feasible to be developed as a community agricultural pilot project in Bangsal Village, with the longest payback period being three years for organic rice farming, and two years each for freshwater fish farming and Swamp buffalo farming.

The application of integrated farming systems can increase productivity and efficiency in agricultural businesses, while reducing production costs and business risks. Moreover, it can also improve the welfare of farmers and help maintain environmental sustainability. Therefore, it is recommended to adopt the principles of integrated farming systems in agricultural development, especially in integrating livestock, fish farming, and organic farming activities to increase productivity and efficiency in agriculture while maintaining environmental sustainability.

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