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Research Paper

Feasibility of Local Commodities on Peatlands

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Abstract

Indonesian peat ecosystem, generally managed for protection and cultivation functions, contributes to providing economic benefits to the local community through agricultural practices. This study aims to evaluate the feasibility of local commodity agriculture (coffee, areca, coconut, and pineapple) on peatland from social, ecological, and economic perspectives using descriptive and quantitative approaches in Mendahara-Batanghari, Jambi. Data was collected from interviews of 60 farmers in two villages with three types of farms, including monoculture and polyculture of commodities. The results of this study showed that socially, farmers still have difficulty with access and infrastructures. Coconut, areca, and coffee are popular among the smallholders because of land suitability, low maintenance, and high selling price. From an ecological perspective, intercropping on polyculture farms is able to store more carbon with a high density of biomass than on monoculture farms. Generally, the carbon emissions of local commodity farms are lower than other types of plantations, such as oil palm and rubber plantations. Lastly, from an economic perspective, local commodity farming in the study area is feasible based on analyses of net present value, benefit cost ratio, and internal rate of return. Polyculture farms provide higher benefits compared to monoculture land. The income is considered sufficient for standard living needs, and there is potential to increase the revenue by developing and optimising processing product industries.

Keywords

Economy Feasibility, Local Commodity, Peatland, Restorations

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1. INTRODUCTION

Indonesia peatlands provide multiple types of important ecosystem services such as carbon storage, water regulation, biodiversity, ecotourism and other cultural services which are valuable for local communities. In case of supporting regional economy, peatland is widely used for agricultural purposes. However, most activities related to land cover changes of peat forests led to a decrease in ecosystem quality. Peat oxidation, biologically, emits around 4.5 tC/ha/yr from burnt peatland and about 7.9 tC/ha/yr from drainage (Hirano et al., 2014). Moreover, drained peatland generates continuous carbon emissions through an oxidation process and affects the lowering groundwater level, implicating land subsidence. Peat fires also produce harmful smoke for health and regularly restrain social and economic activities. Hansson and Dargusch (2018) estimated that 2-million ha peat restoration would cost US$4.6 billion.

The commodities cultivated on peatland vary, and some could lead to ecosystem degradation. Besides economic benefits from agriculture practices, the effects on the environment and social perspective are also essential to be considered. Some agricultural commodities are considered suitable for the peat ecosystem, known as the paludiculture system, which includes the cultivation of fish and livestock on peatlands known as silvofishery and silvopasture (Tata and Susmianto, 2019). This system is introduced in order to support the development of the local economy along with maintaining the ecological function of peatlands. Local commodities are able to grow on degraded land or shallow peat areas without drainage. According to Uda et al. (2020) some local commodities can promote sustainable agricultural activities which have positive values in sustainability, profitability, and scalability aspects, especially sago, banana, and pineapple, followed by kangkong, tengkawang, dragon fruit, mangosteen, and melon. Yanarita et al. (2020) also recommended sago as an alternative for forest restoration economically and socially.

The economic, social, and environmental contributions of developing local commodities on peatland are essential to analyze (Gunawan and Afriyanti, 2019). According to Bagio et al. (2021) low social awareness (knowledge) on peatland management contributed to drought, potentially leading to economic loss. Many local communities utilize peatland for agricultural purposes in Tanjung Jabung Timur district, Jambi. They cultivate local commodities such as coconut, areca, coffee, and pineapple. Budiman et al. (2020) stated that local commodities help restore the peat ecosystem. This study intends to identify the feasibility of local commodities business on peatland. This aims to initially understand the agricultural practices in the study area from sustainable perspectives, i.e. from social, environmental, and economical perspectives. Two villages in the Peat Hydrological Unit (PHU) of Mendahara-Batanghari, Jambi, Indonesia, were selected as study areas.

2. EXPERIMENTAL SECTION

2.1 Study Area

This study was conducted in two villages, Mendahara Tengah and Merbau. Those regions are part of the Mendahara-Batanghari PHU located in sub district Mendahara, district of Tanjung Jabung Timur, Jambi Province (Figure 1). There are several local commodities cultivated by the farmers. This study examined both monoculture and polyculture farming systems of the most popular commodities, including coconut, areca, coffee, and pineapple, by smallholders. This study differentiated the commodities into three groups of farming composition: a monoculture land of pineapple and two polyculture land, coconut areca and coconut areca coffee. Detailed information regarding the area, commodities, and farming system of each study case can be seen in Table 1. Interviews were conducted in both villages with three groups of farmers.

2.2 Methods

2.2.1 Social Acceptance

This indicator represents the social preferences of agriculture activity of local commodities. This indicator was elaborated using a descriptive-qualitative analysis based on interviews with the farmers and related stakeholders on the following parameters: a) access and infrastructure facilities; b) agricultural preferences; c) the influence and interests of stakeholders; and d) perceptions and acceptance of sustainable agricultural practices.

2.2.2 Environmental Impact

This indicator explains the potential environmental impacts of local commodities farming on peatland. The analysis focused on particular aspects including the condition of existing agricultural land, carbon storage, carbon emission, and fertilizer use. The information was collected through interviews with farmers and literature reviews.

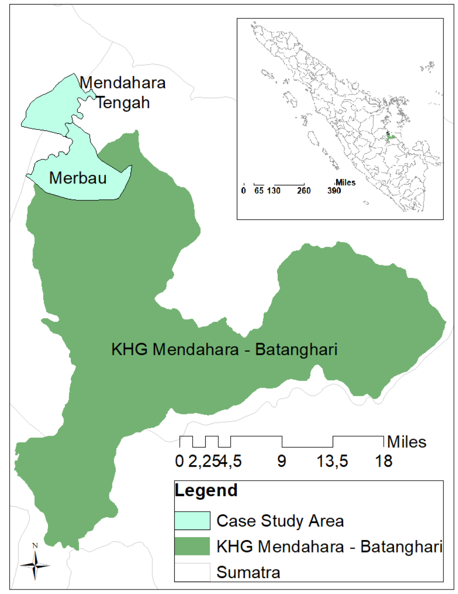

Figure 1. Area of Case Study of Feasibility Assessment of Local Commodities in Mendahara-Batanghari, Jambi (Badan Restorasi Gambut, 2020)

2.2.3 Financial Feasibility

The farming activities are conducted to support the welfare of farmers. In order to analyze the profitability of the farming, this study a) estimated the economic feasibility using NPV, BCR, and IRR approaches using the Equation 1, 2, 3; b) calculated the annual incomes and expenditures comparison; c) analyze the stability of market and price; and d) analysed the potential of added value applied by society in the study area based on Equation 4.

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

Note: NPV = net present value, Bt = benefits in t year, Ct = costs in t year, i = interest rate, t = farming year.

$$\mathrm{Net}\frac{B}{C} = \frac{\sum \mathrm{P.V.Net\ Benefit}(+)}{\sum \mathrm{P.V.Net\ Benefit}(-)} \quad (2)$$

Note: *net BC* = benefit and costs ratio, *net benefit (+)* = total benefits in profitable year, *net benefit (+)* = total benefit in non-profitable year.

$$\mathrm{IRR} = \left[i' + \frac{\mathrm{NPV}'}{\mathrm{NPV}' - \mathrm{NPV}''}(i'' - i') \right] \quad (3)$$

Note: *IRRC* = internal rate of return, *NPV'* = NPV at the interest rate i', *i'* = interest rates that produce positive

Table 1. Agricultural Practices of Case Study in KHG Mendahara-Batanghari, Jambi

Case Study	Village	
	Mendahara Tengah	Merbau
Area (km^2)*	67.3	87.5
Inhabitant (in 2018)*	3,926	2,852
Commodities	Coconut areca coffee	Coconut areca, pineapple
Cropping System	Polyculture: coconut (120-160/ha), areca (1,000-1,300/ha), and coffee: (1,100-1,300/ha)	Polyculture (coconut-areca): coconut (140-160/ha), and areca (1,200-1,600/ha), monoculture (pineapple) (36,000-51,000/ha)

(Badan Pusat Statistika, 2019)

NPV, $NPV"$ = NPV at the interest rate i", $i"$ = interest rates that produce negative NPV.

$$I = B - C \quad (4)$$

Note: I = average income during the farming year (IDR/ha/year), B = average annual benefit (IDR/ha/year), C = average annual costs (IDR/ha/year).

3. RESULTS AND DISCUSSION

3.1 Social Acceptance

3.1.1 Access and Infrastructure Facilities

Mendahara Tengah and Merbau villages are only accessible by boat and motorcycle. The distance from the capital city of Jambi Province to Mendahara Tengah and Merbau is approximately 113 and 80 kilometers, respectively. The distance between the agricultural land and settlement area in Mendahara Tengah is within a kilometer radius, and in Merbau is within 1-5 km, even more than 5 km for most coconut areca farmers (65% of respondents).

Farmers agreed that the general condition of the infrastructures in their villages is considerably poor (Table 2). The roads connecting the villages to the capital city of district are not well constructed. Moreover, there is no paved roadway within the villages. During the wet season, the road made of clay and grass becomes slippery, making transportation limited. Motorcycles that the farmers commonly use to reach the buyers are hardly operated during the rainy days. In contrast, during the dry season, the obstacle is encountered by the buyers who transport the product to the main road using boats. These situations become a burden for farmers due to the higher expense needed for transportation. The communication infrastructure is also hardly found in the villages. Internet access is limited in the area close to the river. Therefore, the farmers often complain that there is a lack of information regarding the market condition.

3.1.2 Agricultural Preferences

The number of residents who farm coconut, areca, and coffee has increased in the last decades due to the popularity of the commodities (Table 3). This is supported by the higher prices of the products compared to the prices of others. The farmers also favour these commodities because of the lower maintenance costs and even zero fertilizer costs. They only use herbicide to clear the weeds. The main difficulties are the high production costs (additional labour cost for extensive land) and the transportation costs, usually higher during the wet season.

For monoculture farming of pineapple, the farmers received the nurseries from governmental aid. There is no extra cost for fertilizers and pesticides (organic). However, the maintenance of pineapple land is considerably hard. Because the gap between the plant lane is quite close and the plant is relatively small, farmers cannot use herbicide and have to clear the land manually. There are also pests and wild pigs that often eat the plants. Moreover, the price of pineapple is lower than othes. Some farmers are willing to shift their pineapple farm to coffee and areca.

3.1.3 The Influence and Interests of Stakeholders

Agricultural development in the study area involves several stakeholders, i.e., farmers, farmer groups, buyers (customers and collectors), local and central governments, and NGOs (Table 4). Farmers have been cultivating local commodities as their main livelihood for decades. There are farmer groups in each village. Farmers use the organization as a forum for discussions about agriculture. However, the continuity of farming depends strongly on the influence of collectors (toke). Toke is the primary buyer for the harvested products. Toke usually give loan to the farmers by taking the potential yields that will be harvested shortly. This purchasing system has been established for decades, and it seems unchangeable.

In recent years, other parties, including local government, governmental peat restoration agency (BRG), and an NGO (WARSI), have run several programs related to the development of sustainable agriculture on peatlands. All parties are interested in introducing more sustainable practices of agriculture on peatlands. The local government has been supplying nurseries of pineapples and supporting entrepreneurship for farmers. BRG and WARSI also provide support in the form of giving processing equipment to add product values, conducting studies and training, and providing assistance to enhance the skills of farmers and

Table 2. Satisfying Level of Supporting Infrastructure Conditions in The Study Area Mendahara-Batanghari

Response	Supporting Infrastructures		
	Roads	Transportation	Communication
Strongly dissatisfied	0%	0%	0%
Somewhat dissatisfied	79%	95%	100%
Somewhat satisfied	21%	5%	0%
Strongly satisfied	0%	0%	0%

Table 3. Constraints and Predominant Factors of Local Commodity Cultivation According to Smallholders The Study Area Mendahara-Batanghari

Indicator	Coconut Areca Coffee	Coconut Areca	Pineapple
Constraints	High cost (100%)	High cost (90%)	High maintenance (100%)
	Transportation (100%)	Transportation (100%)	Low price (100%)
Benefits	Low maintenance (100%)	Low maintenance (85%)	Low cost (100%)
	Land suitability (100%)	Land suitability (100%)	Land suitability (100%)
	Popularity among farmers (100%)	Popularity among farmers (100%)	

other residents.

3.1.4 Perceptions and Acceptance Toward Local Commodity Development

Generally, the farmers have agreed that they have contributed to peatland preservation for several reasons. First, the farmers actively expand the cultivation of local commodities. The governments support the development of areca, coffee, and pineapple farming because they require relatively low drainage levels. Secondly, for years, the farmers have started developing awareness about the damages of land fires. In the past, burning was the best, cheapest and fastest procedure to clear the land. They were convinced that the produced ash enhances the fertility of their land. Currently, locals join the government in preventing forest and land fires. The impact of forest fires in 2015 brought trauma for them. Fires have spread and damaged their agricultural land. In addition, the smoke affected their health, resulting in a higher number of Acute Respiratory Infections (ARI) cases, particularly among children patients.

However, awareness of residents to protect peat ecosystems is still limited. Other essential ecosystem functions of peatlands, such as water and climate regulations and biodiversity protection, are less taken into account. This might be due to a lack of understanding among locals. The respondents mentioned that few have participated in training (15% of coconut-areca farmers). Interviewed farmers in the studied areas are primarily elementary, and junior high school graduates; only 5% of them (coconut-areca farmers) hold a university degree.

3.2 Environmental Impact

3.2.1 Land and Drainage

Most agricultural land owned by the respondents was converted from the forest. The rest was already cultivated hereditary. The land was converted in several ways in the past, including by manual clearing, forest firing, and indirect firing called peat peeling. Peat peeling is a land clearing procedure that takes out the upper layer of peat (around 20 cm) to be burned in another place blocked by canals to prevent widespread fire. However, the use of fire in land preparation still potentially increases the risk of forest and peat fires. In general, Indonesian forest and peat fires can be strongly linked to human activities (Medrilzam et al., 2014; Sumarga, 2017).

After clearing, the land area requires canals and ditches (smaller ones) for drainage (Table 5). The canals are constructed in the agricultural land by the farmers voluntarily. The width of the canal is approximately 50-100 cm. Most canals are blocked during tide periods to prevent flooding and are opened during the dry season. According to the farmers, the land is becoming drier as an impact of canal construction.

3.2.2 Carbon Emissions

Drainage on peatlands reduces the level of groundwater which leads to greenhouse gas production. Drained peatlands decrease the soil capacity to retain water and accelerate the peat decomposition rate (Agus and Subiksa, 2008). Hence, the lower the groundwater level, the higher the carbon emissions. Table 6 presents the average groundwater level and the estimated carbon emissions from agriculture on peatlands. For comparison, the information of other peatland uses (plantation (sago, oil palm, rubber), primary forests and secondary forests) are also provided. The emis-

Table 4. Stakeholders Analysis in Terms of The Development of Local Commodity Cultivation in Study Area KHG Mendahara-Batanghari

Stakeholder	Power	Main Interest
Smallholders	Cultivating on their (peat) land	Increasing their welfare
Community of farmers	Conducting meeting and discussions	Sharing and implementing knowledge Business activity
Toke (buyers)	Purchasing agricultural products Giving loan	Making profit Market monopolism
Consumers	Purchasing agricultural products	Consumption
Village government	Arranging regulation regarding peatland uses at village level	Preserving peat ecosystem
Regional government	Sharing information and knowledge Supplying aids	Regional economic development Human resources development Preserving peat ecosystem
NGO and national institution	Sharing information and knowledge Providing consultation and assistance Supplying aids	Regional economic development Human resources development Preserving peat ecosystem

Table 5. The Use of Canals in Local Commodity Plantations in Study Area Mendahara-Batanghari

Criteria	Coconut Areca Coffee	Coconut Areca	Pineapple
Have no canal	0%	0%	0%
Have canals	100%	100%	100%

sions from local commodity farming on peatlands are around 17-39 tCO_2/ha/yr. This number is higher than emissions from sago plantation, primary and secondary forests, but lower than emissions from the well-known plantation, such as oil palm and rubber which could reach 178 tCO_2/ha/yr. It is noted that among the local commodities, the groundwater level for coconut and coffee farms is relatively high, reaching 57 cm. The water level on peatlands needs to be kept below 40–50 cm to slow down land subsidence (Noor, 2001).

3.2.3 Carbon Storage

The conversion of peat forest to agricultural land implicates the change in carbon storage. The variability of carbon stored as dry matter biomass (dmt) above land in various land covers is displayed in Table 7. It shows that the carbon stored on a monoculture farm is lower than the one on peat forests due to less biomass and vegetation density. However, an agroforestry system that cultivates several commodities increase the capacity of carbon stored. The intercropping system of polyculture increases the density of vegetation and the capability of carbon absorption. Coffee is a commodity which is recommended for agroforestry/intercropping system. Based on Saidi and Suryani (2021) around 54% of peatlands in Tanjung Jabung Timur are marginal suitable for coffee plantations.

3.2.4 The Use of Fertilizers

Exaggeration use of fertilizers on agricultural land would bring negative effects to the ecosystem. According to a study by Landry and Rochefort (2012) the fertilizers for agriculture on peatland are only required on drained poor land. Based on surveys and interviews in this study, most farmers hardly fertilize the land. There are only some minor cases when fertilizers are needed on considered-poor land. As a result, the farming of local commodities in the study area is considered organic.

3.3 Economic Feasibility

3.3.1 Financial Analysis

The costs of smallholders in cultivating commodities vary in different regions enormously depending on the social and economic conditions. Farming costs carried out by the smallholders in the study area consist of costs for land preparation, equipment, nurseries, herbicides, planting, harvesting, and transportation. Meanwhile, costs of land, labor, and infrastructure (canals) are not taken into account because they are voluntary works. The polyculture system has a planting interval between commodities. Generally, coconut is the first commodity to be planted, followed by areca after 4-7 years, and coffee in the next 4 years. Coconut commodities are able to be harvested after 6-8 years, while areca and coffee are harvested after 3-4 years and pineapple after 18 months.

The results of financial analysis of local commodity farm-

Table 6. Estimation of Carbon Emissions Based on Water Levels in Various Peatland Covers

Commodity	Average Groundwater Level (m)	Estimated Carbon Emission (tCO_2/ha/year)*
Sago	-0.09 to -0.73[a]	6 to 60
Coconut, coffee	-0.3 to -0.5[c]	21 to 34
Areca	-0.25 to -0.57[g]	17 to 39
Pineapple	-0.3 to -0.4[d]	21 to 27
Oil palm	-0.5 to -0.8[c,f]	45 to 73
Rubber	-0.83 to -1.96[e]	75 to 178
Primary swamp forest	-0.13 to +0.1[b]	0 to 3
Secondary swamp forest	-0.3 to -0.56[f]	3 to 7

Source: a. (Watanabe et al., 2009); b. (Hergoualc'h and Verchot, 2012); c. (Agus and Subiksa, 2008); d. (Situmorang et al., 2019); e. (Wakhid and Nurzakiah, 2021); f. (Adhi et al., 2020); g. (Andesmora, 2021); *Estimated based on Hooijer et al. (2010) with assumption of drained area: 25% for swamp forest, 75% sago, coconut, coffee, pineapple, and 100% for oil palm and rubber plantations.

Table 7. Estimation of Carbon Storage Based on Land Cover Types on Peatlands

Commodity	Carbon Storage (dm ton C/ha)
Sago	53[a]
Coconut	51[b]
Coffee	82 (shade), 52 (sun)[c] 62-79[h]
Agroforestry land	144[d]
Oil palm	2-60[e]
Rubber	32-67[f]
Primary swamp forest	157[g]
Secondary swamp forest	140[g]

Sources: a. (Tata and Susmianto, 2019); b. (Bhagya and Maheswarappa, 2017); c. (Van Noordwijk et al., 2002); d. (Novita et al., 2021); e. (Kho and Jepsen, 2015); f. (Corpuz and Abas, 2014); g. (Krisnawati, 2014); h. (Yunianti et al., 2021).

ing in the study area are presented in Table 8. All of the local commodity farming has a positive NPV, which shows that these activities are financially feasible. Three types of farming are also categorized as feasible from the estimated BCR and IRR values. The IRR of the three types of farm is greater than the discount rate (12%), with a BCR of more than one. Therefore, it can be concluded that the development of local commodities, both monoculture pineapple and coconut-areca and coconut areca coffee (polyculture) farming, can be a financially feasible option for smallholders.

3.3.2 Incomes and Expenditures Comparison

The farming area owned by farmers varied from 1 ha to 13 ha. The agricultural activities are carried out by themselves or with families. Meanwhile, the pineapple farmers use a land-sharing system where a group of farmers, namely Sumber Usaha, co-cultivates the land owned by four members. The average area of pineapple farms is 1.6 Ha per farmer, smaller than the area of the other commodities. Table 9 displays the information on income contribution from agricultural activities. The polyculture farms provide higher profit than the monoculture (pineapple) farms. If the production of each type of commodity is compared, the two-commodity land of coconut and areca provide the highest production. After all, the three-commodity farms provide higher income because of higher harvesting frequency and less production cost.

Additional labor costs for areca peeler apply in Merbau, while there is no cost in Mendahara Tengah. The farmers or their family members carry out the peeling process in this village. The income from one-hectare polyculture land surpasses the monthly minimum needs per person (UMP) in Jambi. Meanwhile, sharing profit system from pineapple farms only contributes to less than half of UMP Jambi. The sufficiency level of the income depends on the total area owned by each farmer, the number of family members, personal lifestyles, and other sources of income. This study found that all respondents agreed that their income from agricultural activities fulfilled their basic needs, even excessed according to the farmers with extensive land (>10 ha).

Table 8. Financial Analysis of Local Commodity Farming in The Study Area Mendahara-Batanghari

Indicators	Coconut Areca Coffee	Coconut Areca	Pineapple
Total costs (million IDR)	513	1.786	137
Total revenue (million IDR)	3.16	3.758	375
Net benefit (million IDR)	2.804	1.972	237
NPV (million IDR)	447	333	68
IRR (%)	45.95	45.92	218.60
BCR	17.05	22.49	7.65

Note: estimated for one-hectare land with a discount rate of 12% and a 25-year planting period.

Table 9. Financial Conditions of Smallholders in The Study Area Mendahara-Batanghari

Criteria		Unit	a	b	c
Land ownership	Proprietary	%	100	100	100
Labour	Family member	%	100	100	-
	Group of farmers	%	-	-	100
Agricultural land	Min-max	Ha/farmer	2-7	1-13	1-4
	average	Ha/farmer	3.9	4.5	1.6
Basic needs	Family member	People	2-4	2-5	1-5
	Monthly needs*	Million IDR/family/month	5.3-10.6	5.3-13.2	2.6-13.2
	Average income	Million IDR/month/ha	9.3	6.5	0.96
Adequacy level (standard living)	Excessed	%	-	10	-
	Sufficient	%	100	90	100
	Less sufficient	%	-	-	-
	Insufficient	%	-	-	-

Note: a) coconut areca coffee; b) coconut areca; c) pineapple; *based on provincial standard minimum wage (UMP) Jambi 2020 (Badan Pusat Statistika, 2020).

Table 10. Market Condition of Local Commodity Business The Study Area Mendahara-Batanghari

Criteria		Coconut Areca Coffee	Coconut Areca	Pineapple
Nursery purchasing	Strongly easy	-	-	100%
	Somewhat easy	100%	90%	-
	Somewhat difficult	-	10%	-
	Strongly difficult	100%	-	-
Product selling	Strongly easy	-	-	-
	Somewhat easy	70%	15%	100%
	Somewhat difficult	30%	85%	-
	Strongly difficult	-	-	-
Price	Strongly stable	-	-	-
	Somewhat stable	100%	100%	100%
	Somewhat fluctuate	-	-	-
	Strongly fluctuate	-	-	-
Sales	Toke	100%	100%	-
	Market	-	-	100%

3.3.3 Stability of Market and Price

The market condition in the study area is presented in Table 10. Most farmers expressed that it is convenient to purchase the nursery. The sales process was also quite simple. Coconut, areca, and coffee are sold to toke, which offers a selling guarantee. The challenge is found in the transportation process, which is costlier during wet seasons. Looking at the price, it tends to be stable because toke monopolies the

Table 11. General Condition of The Processed-Product Business in The Study Area, Mendahara-Batanghari

Type of Business	Business Scale	Average Productivity	Market Price (IDR/kg)
Coffee processing	Medium Enterprise	6 ton/year	150,000-250,000
Pineapple dodol	Home industry	480-600 kg/year	40,000

market. The farmers of coconut, areca, and coffee concluded that they are satisfied with their commodity preference, and there is no planning on changing the commodity in the near future. On the other hand, most pineapple farms are willing to change their commodity to more profitable ones, such as areca or coffee.

3.3.4 Potential of Added Value

Most harvested products from the study area are sold to toke without post-harvest processing. Only a tiny part of coffee and pineapple is processed into roasted coffee and pineapple dodol (traditional food) by locals to add higher product value. The dodol home-processing industry is carried out by the Ketupat Farmer Group in collaboration with BUMDes (village-owned enterprises) in Merbau. The industry is able to produce 40-50 kg of dodol at once (Table 11). With the price at IDR 40,000/kg, the net profit can reach 30% of total revenue or about IDR 600,000 on average. However, production is occasionally carried out because it depends on demand. Marketing is still underdeveloped, and the market is limited due to management and permit issues. The Sustainable Peat Farmers Group developed a coffee processing industry in a neighboring village. Their products have been recognized with the brand Peatland Coffee Liberika Mendahara. The product has already reached the online market with a price range of IDR 150,000-250,000/kg, depending on the quality. In addition, farmers in Merbau also carry out a post-harvest drying process for areca. There is a place to store unsold peeled areca called 'areca house'. Drying the areca increases the price to IDR 19,000/kg instead selling it in logs at IDR 120,000-150,000/sack or as peeled areca at IDR 5,000-9,000/kg.

4. CONCLUSIONS

Socially, the local commodities cultivated in the study areas are favored by the stallholders despite the limitation in access and infrastructures and price differences between commodities. All studied farming types are feasible options from an economic perspective, and they generate incomes that are sufficient for basic living costs, from the polyculture farming system in particular. This study is an initial analysis of peat friendly local commodity-based business development. In order to improve the local economy, further research is required, including to assess and implementation strategies in facilities and infrastructure development, application of related sustainable agricultural practices, the development of multiple income based strategy through the application of post harvest technology, processed agro industries, and agro silvofishery, as well as the development of farmer partnerships between villages, local enterprises, and partnerships with the private sector.

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REFERENCES

Agus, F. and I. M. Subiksa (2008). Lahan Gambut: Potensi untuk Pertanian dan Aspek Lingkungan. Technical Report (in Indonesia)

Adhi, Y. A., S. Anwar, S. D. Tarigan, and B. Sahari (2020). Relationship between Groundwater Level and Water Content in Oil Palm Plantation on Drained Peatland in Siak, Riau Province, Indonesia. *Pertanika Journal of Tropical Agricultural Science*, **43**(3); 1–14

Andesmora, E. V. (2021). Potensi Budidaya Tanaman Pinang (*Areca catechu L.*) di Lahan Gambut: Studi Kasus di Khg Mendahara Kabupaten Tanjung Jabung Timur, Jambi. *Jurnal Ilmu Pertanian Tirtayasa*, **3**(1); 1–9 (in Indonesia)

Badan Pusat Statistika(2019). Kecamatan Mendahara dalam Angka 2019. Technical Report (in Indonesia)

Badan Pusat Statistika (2020). Kebutuhan Hidup Minimum/Layak (Khm/Khl) Selama Sebulan (Rupiah) Menurut Provinsi (Rupiah). Technical Report (in Indonesia)

Badan Restorasi Gambut (2020). Peta Kesatuan Hidrologis Gambut Mendahara-Batanghari. Technical Report (in Indonesia)

Bagio, B., Y. Abubakar, A. Anhar, and A. Baihaqi (2021). Identifkasi Komoditas Pertanian untuk Peningkatan Pendapatan Masyarakat pada Lahan Gambut di Desa Cot Mee Kecamatan Tadu Raya Kabupaten Nagan Raya. *Jurnal Pengabdian Agro and Marine Industry*, **1**(1); 24–29 (in Indonesia)

Bhagya, H. and H. Maheswarappa (2017). Carbon Sequestration Potential in Coconut Based Cropping Systems. *Horticulture Society of India*, **74**(1); 1–5

Budiman, I., E. N. Sari, E. E. Hadi, H. Siahaan, R. Januar,

R. D. Hapsari (2020). Progress of Paludiculture Projects in Supporting Peatland Ecosystem Restoration in Indonesia. *Global Ecology and Conservation*, **23**; e01084

Corpuz, O. S. and E. L. Abas (2014). Potential Carbon Storage of Rubber Plantations. *Indian Journal of Pharmaceutical and Biological Research*, **2**(2); 73

Gunawan, H. and D. Afriyanti (2019). Potensi Perhutanan Sosial dalam Meningkatkan Partisipasi Masyarakat dalam Restorasi Gambut. *Jurnal Ilmu Kehutanan*, **13**(2); 227–236 (in Indonesia)

Hansson, A. and P. Dargusch (2018). An Estimate of The Financial Cost of Peatland Restoration in Indonesia. *Case Studies in The Environment*, **2**(1); 1–8

Hergoualc'h, K. A. and L. V. Verchot (2012). Changes in Soil CH_4 Fluxes from The Conversion of Tropical Peat Swamp Forests: a Meta Analysis. *Journal of Integrative Environmental Sciences*, **9**(2); 93–101

Hirano, T., K. Kusin, S. Limin, and M. Osaki (2014). Carbon Dioxide Emissions Through Oxidative Peat Decomposition on a Burnt Tropical Peatland. *Global Change Biology*, **20**(2); 555–565

Hooijer, A., S. Page, J. Canadell, M. Silvius, J. Kwadijk, H. Wösten, and J. Jauhiainen (2010). Current and Future CO_2 Emissions from Drained Peatlands in Southeast Asia. *Biogeosciences*, **7**(5); 1505–1514

Kho, L. K. and M. R. Jepsen (2015). Carbon Stock of Oil Palm Plantations and Tropical Forests in Malaysia: a Review. *Singapore Journal of Tropical Geography*, **36**(2); 249–266

Krisnawati, H. (2014). *Estimation of Forest Biomass for Quantifying CO_2 Emissions in Central Kalimantan: a Comprehensive Approach in Determining Forest Carbon Emission Factors*. Research and Development Center for Conservation and Rehabilitation

Landry, J. and L. Rochefort (2012). The Drainage of Peatlands: Impacts and Rewetting Techniques. Technical Report

Medrilzam, M., P. Dargusch, J. Herbohn, and C. Smith (2014). The Socio Ecological Drivers of Forest Degradation in Part of The Tropical Peatlands of Central Kalimantan, Indonesia. *Forestry*, **87**(2); 335–345

Noor, M. (2001). *Pertanian Lahan Gambut, Potensi dan Kendala*. Yogyakarta: Kanisius (in Indonesia)

Novita, E., M. N. Huda, and H. A. Pradana (2021). Analisis Potensi Simpanan Karbon Agroforestri Perkebunan Kopi Robusta (*Coffea canephora*) di Pegunungan Argopuro, Kabupaten Bondowoso. *Jurnal Ilmu Lingkungan*, **15**(2); 165–175 (in Indonesia)

Saidi, B. B. and E. Suryani (2021). Evaluasi Kesesuaian Lahan untuk Pengembangan Kopi Liberika di Kabupaten Tanjung Jabung Timur Jambi. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, **5**(1); 1–15 (in Indonesia)

Situmorang, M. E., D. Astiani, and W. Ekyastuti (2019). Pengaruh Tinggi Muka Air Tanah pada Populasi Serangga di Lahan Rawa Gambut Desa Kuala Dua Kabupaten Kubu Raya. *Jurnal Hutan Lesari*, **7**(1); 1–8 (in Indonesia)

Sumarga, E. (2017). Spatial Indicators for Human Activities May Explain The 2015 Fire Hotspot Distribution in Central Kalimantan Indonesia. *Tropical Conservation Science*, **10**; 1–9

Tata, H. L. and A. Susmianto (2019). *Prospek Paludikultur Ekosistem Gambut Indonesia*. Bogor: Froda Press (in Indonesia)

Uda, S. K., L. Hein, and A. Adventa (2020). Towards Better Use of Indonesian Peatlands with Paludiculture and Low-Drainage Food Crops. *Wetlands Ecology and Management*, **28**(3); 509–526

Van Noordwijk, M., S. Rahayu, K. Hairiah, Y. Wulan, A. Farida, and B. Verbist (2002). Carbon Stock Assessment for a Forest to Coffee Conversion Landscape in Sumber Jaya (Lampung, Indonesia): from Allometric Equations to Land Use Change Analysis. *Science in China Series C Life Sciences-English Edition*, **45**; 75–86

Wakhid, N. and S. Nurzakiah (2021). Soil CO_2 Emissions from a Rubber Plantation on Tropical Peat During a Strong El Niño Year. *In IOP Conference Series: Earth and Environmental Science*, **648**(1); 012098

Watanabe, A., B. H. Purwanto, H. Ando, K. I. Kakuda, and F. S. Jong (2009). Methane and CO_2 Fluxes from an Indonesian Peatland Used for Sago Palm (*Metroxylon sagu rottb.*) Cultivation: Effects of Fertilizer and Groundwater Level Management. *Agriculture, Ecosystems & Environment*, **134**(1-2); 14–18

Yanarita, Afentina, Sosilawaty, C. Birawa, and S. Monika (2020). Analisis Sosial dan Ekonomi Agroforestri Berbasis Tanaman Sagu (*Metroxylon sagu*): Alternatif Rehabilitasi Hutan dan Lahan Gambut. *Jurnal Hutan Tropis*, **8**(3); 306–314 (in Indonesia)

Yunianti, I. F., I. Aprianthina, R. Kartikawati, and E. Yulianingsih (2021). Emisi Gas Rumah Kaca dan Cadangan Karbon pada Perkebunan Kopi Organik dan Konvensional di Kabupaten Badung, Bali. *Pusat Penelitian dan Pengembangan Perkebunan*, **8**(1); 1–10 (in Indonesia)