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Ecotourism: Another Benefit of Agro-Silvo-Fishery and Trigona Apiculture in Peatland Ecosystem of Baru Village, Banyuasin, South Sumatra

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Abstract. Agro-silvo-fishery and Trigona apiculture are two business models developed in the peatland ecosystem in Baru Village, Banyuasin District, South Sumatra. Since the beginning of 2022, two demo plots have been built in the same village landscape as part of the business model implementation. The system's agro-silvo-fishery was established by constructing a pond around a paddy field and planting betelnut, vegetables, and fruit trees. Local fish that had acclimated to the acidic peatland habitat were captured during the flooding and raised in the ponds. In the constrained biophysical and chemical conditions of swampy terrain, this method is thought to be the greatest way to provide a variety of revenue. Individual farmers cannot afford the costs associated with setting up this system, especially when it comes to constructing the pond and dykes. Individual farmers cannot afford the costs associated with establishing this system, especially when it comes to constructing the pond and dykes. Hence, support from the district and village government and program partners is valuable. The farmer group harvested corn and vegetables from the dykes and rice from the paddy fields in the first year, and fish were not ready for harvest. However, the local BUMDes saved the day by creating weekly regular fishing activities and competition events, generating revenue from tickets. Moreover, the Trigona apiculture became a popular place for those outside the village to learn free of charge. Based on profitability analysis, the NPV of establishing agro-silvo-fishery is Rp103.036.769 per 0.8 ha for 30 years, with additional income from ecotourism is estimated to reach Rp21.600.000 per year. The established demonstration plot has the potential to become an ecotourism destination, and the key is to maintain the surrounding flowers and plants as the source of food for bees and the water condition for the fish.

Keywords: ecotourism, agroforestry business model, apiculture, peatland ecosystems, South Sumatra

1. Introduction

Peatland is a natural resource that has the potential to be used for human welfare. Indonesia is the fourth country after Canada, the Soviet Union and the United States to have extensive peatlands. The area of peatlands in Indonesia is estimated to have an area of 15 million hectares spread over the islands of Sumatra, Kalimantan and

Papua, as well as a small part in Sulawesi [1]. Indonesia's peatlands have the potential to be utilized for the supply of food. The more massive utilization of peatlands to supply food is triggered by (1) the rate of conversion of agricultural land, (2) population growth, and (3) the desire to make Indonesia a world food barn. Based on the thickness of the peat, peat soil with a thickness of 50-100 cm is categorized as shallow/thin peat. The thicker the peat, the lower its potential for cultivating food crops and horticulture [2].

Peatland in South Sumatra covered area of 1.3 million ha in Banyuasin, Ogan Komering Ilir (OKI) district and Musi Rawas. Fire in peatland of South Sumatra. Limited livelihood options in peatland area become constraint for community. Physical condition in peatland area such as flooding, tidal effect, low pH of water, low soil fertility, limited commodities adapted to peatland, fire et.

Baru Village, in Rambutan Sub-district, Banyuasin Regency, which is included in the Saleh-Sugihan peat hydrological unit is relatively isolated village due to limited access. This village is surrounded by protected forest of Padang Sugihan wildlife reserve and oil palm plantation.

Peatlands in Baru Village are categorized as shallow peatlands that are used for agriculture, livestock, and plantation activities, which are the livelihoods of the people who live around them. The impact of climate change that has occurred in recent years has had an impact on the survival of the community, especially farmers. Erratic rainfall, prolonged heat and flooding are among the biggest obstacles to cultivation and livestock activities that greatly affect their welfare. Declining crop yields, declining production prices and the high cost of agricultural inputs have also become problems that further complicate the community.

The impact of climate change has also influenced government policies, in which regulations have been issued for peatland conservation and production maps, prohibiting burning for land clearing. The burning ban has really impacted the livelihood options of farmers, as they are now experiencing difficulties in managing their land. Bare land with swamp species of grass occupied the land during rainy season and potential as materials fuel during dry season.

Communities around peatlands now need the best solutions to overcome problems in cultivating, increasing income and preserving sustainable peat ecosystems. Agro-silvo-fishery and *Trigona* beekeeping are options that the community can implement as a form of adaptation and mitigation in dealing with climate change by implementing good agricultural practices, diversifying agricultural products, and utilizing local potential to become ecotourism.

2. Study site and Methods

2.1. Study Site

Baru Village is located in Rambutan District, Banyuasin , South Sumatra where is part of Saleh-Sugihan Peat Hydrological Unit (Figure 1). Farmers in this village are rice-based farmers that, in the past used fire to clear land and start their rice systems.

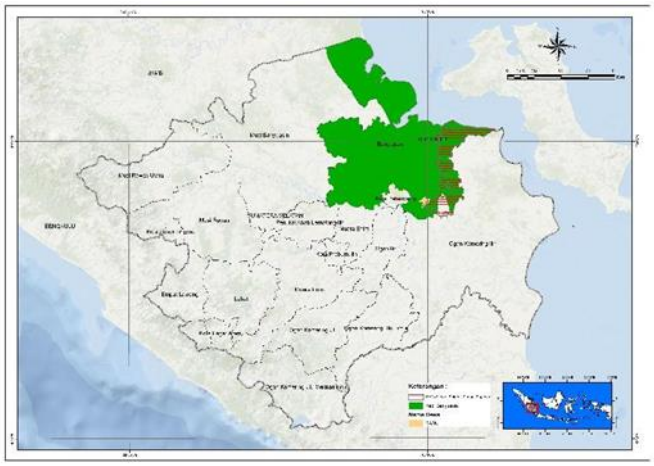

Figure 1. Map of Baru Village, Rambutan District, Banyuasin Regency, South Sumatra

2.2. Methods

Integrated business model had been developed to improve livelihood while improving peatland management. Five livelihood capitals (natural resources, human resources, socials, financials and physical capitals) at village levels were assessed through focus group discussions. The basic data of five livelihood capitals used to develop

business models. In determining the farming model, a participatory approach was used involving various stakeholders such as the local government, private sector, village government and community working together on developing business model and planning.

After several process of discussion between local community who joined in farmers working group, local government, private sectors and experts, agro-silvo-fishery and Trigona apiculture choose as integrated model business that potential developed in Baru Village. The business model includes farming systems' main activities, marketing, supporting functions, enabling factors and involved stakeholders (Figure 2).

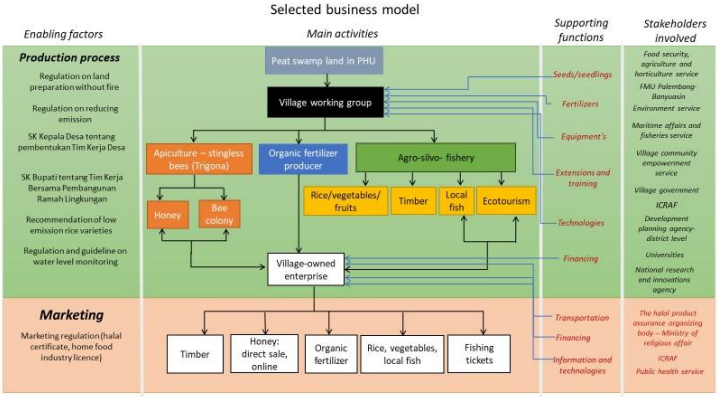

Figure 2. Business models of agro-silvo-fishery and Trigona apiculture implemented in Baru Village

The business models are running three activities, are: (1) agro-silvo-fishery for producing rice, vegetables, local fish species, fruits, and timbers, (2) organic fertilizer producers and (2) apiculture (stingless bees of *Trigona*) for producing honey and bee colonies. Producing process of products in this business model was done by farmers group that formally registered in the systems that connected to operation unit at local government. Village-owned enterprise run the marketing process of the products as business unit of village government.

The action research in Baru Village began with the establishment of the working group at the village level that involved various stakeholders to identify problems and find the best solutions for running the business model. Village working group consisting of farmer groups and village government in charge of carrying out activities at the site level. Demoplot of agro-silvo-fishery and *Trigona* apiculture was built in the area of 2 ha (Figure 3). The construction of the Agro-silvo-fishery farming model and Trigona bee cultivation was carried out together with the village work team at the designated demo plot location.

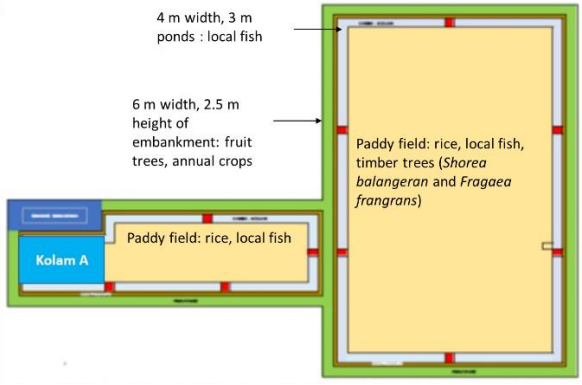

Figure 3. Agro-Silvo-Fishery demoplot design

The construction of the demoplot was carried out on an area of 2 ha. The demoplot construction consisted of rice fields, caren, and embankment. The embankment is made with a height of 2.5 m and a width of 6 m consisting of a 3-meter-wide main embankment and a 2-m-wide foot embankment for fruit and horticultural crop cultivation areas, while the caren is made with a depth of 3 m and a caren width of 4 meters for aquaculture, the embankment is made around the rice cultivation area to prevent flooding and confine fish when rainfall is high.

After the construction of the demoplot was completed, various trainings were given to the village work team and the community to increase their capacity including training on land clearing without burning, training on making organic fertilizer, making independent fish feed, training on fish farming

and training on plant disease pest control. After increasing their capacity, the research process was carried out, starting with rice planting, preparing fish farming and planting tree and horticultural crops.

The Agro-silvo-fishery farming model focuses on rice cultivation, fish rearing and cultivation of tree crops and horticulture. For the first season, March – June 2022, Inpari 32, Impara 8 and Arumba varieties were planted with 2 planting methods namely "tegel" and "jajar" legowo with 3 replications. Rice planting was carried out by applying Good Agricultural Practices (GAP) by preparing land without burning, using organic fertilizers and biopesticides.

In the trigona bee farming model, the same thing is done, namely capacity building through training including training in trigona bee cultivation, training in planting bee food plants and post-harvest care and handling. After capacity building is carried out, research activities begin by preparing trigona bee feed plants such as Antigonon leptopus,Turnera sublata and other types of tree plants that contain pollens and saps.

These two business models have been analyzed using profitability analysis to see whether this research will generate profits for the community if they adopt some or all of the research activities in the future. Land-Use Profitability Assessment (LUPA) developed by World Agroforestry (ICRAF) Indonesia is a tool to analysis profitability of the systems. Performance economic indicators used in the analysis are: (a) Net Present Value (NPV) or return to land is the difference between the present value of cash inflows and the present value of cash outflows over a period of time, (2) equal annual equivalent (EAE), (3) Internal Rate of Return (IRR), a metric used in capital budgeting to estimate the return of potential investments and (4) establishment cost and (5) payback period.

Along with the research activities, from the institutional side, capacity building was also carried out by conducting administrative and financial training, marketing training, packaging training and also BUMDes assistance to support the downstreaming of products produced from this research activity .

To ensure that this research activity in the future can have a good impact on farmers and the community, as well as to see the development of activities, a monitoring and evaluation process is carried out through the Awareness, Desire, Knowledge, Ability and Reinforcement (ADKAR) approach, which is carried out in a participatory manner together with the joint work team and the village work team that has been formed.

3. Results and Discussion

3.1. Agro-Silvo-Fishery

From the results of the discussion, it was found that the main problem of the community in carrying out cultivation practices was that the best scheme for sustainable agricultural cultivation had not been found and was in compliance with existing regulations. The solution that was finally agreed upon was to build two farming business models, namely agro-silvo-fishery and Trigona apiculture, which could be one of the community's adaptation and mitigation options to climate change and existing regulations. From the results of rice research conducted, the best results were obtained in the Inpari 32 variety using the "tegel" planting method with a productivity of 6.9 tons/ha (Figure 4). This result is better when compared to community land outside the demoplot, called business as usual/BAU, with a productivity of 3.2 tons/ha.

The difference in productivity between the demoplot and community farming practices is influenced by several factors, one of which is land cultivation and the use of organic fertilizers. Cultivation practices carried out by the community so far are sonor practices that do not do land cultivation and apply organic fertilizers. Based on previous research the addition of solid and liquid organic fertilizers to organic farming system rice crops can increase dry grain yields by 4.4% -17.4% [3].

Meanwhile, fruit trees such as avocado, jengkol and rambutan were planted in the embankment area. In contrast, local fish such as betook, sepat and tembakang were raised in the pond area. Tree planting and conservation-based fish rearing have been carried out, but it takes a long time to know the results, to overcome this period, a profitability analysis is made as shown in the Table 1.

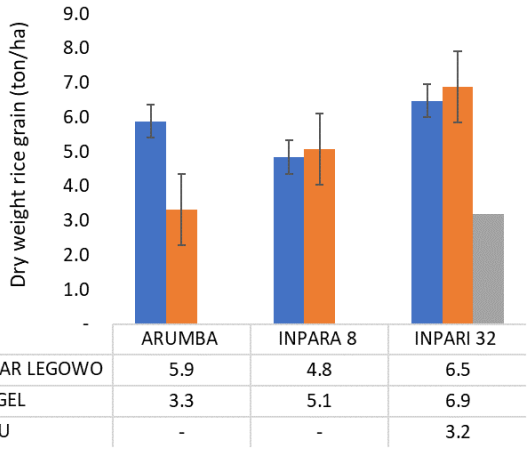

Figure 4. harvest chart first planting season

Table 1. Performance economic indicator for agro-silvo-fishery

Performanc economic indicator	Unit	Value
Net Present Value	IDR/ha	26,875,220
Equal Annual Equivalent	IDR/ha/year	2,189,758
Internal Rate Ratio	%	10.57
Establishment cost	IDR/ha	100,295,054
Payback period	Year	4.17

This analysis used the cycle of plantation 30 years, since the timber species that need about 30 years for harvesting is part of component in agro-silvo-fishery systems. Table 1 indicate that the annual benefit from the farming system is IDR2,189,758. High establishment cost occurred due to the construction.

3.2. Trigona Apiculture

The planting of bee food has been done around the demoplot, including bride's tears, 8 o'clock flower (Turnera sublata), passion fruit, hibiscus, mango, durian and jackfruit. Amount of 180 plants (trees and shrubs have been planted in the first year and will continue to grow in the following year. This planting of bee food creates a good living space for Trigona bees. Amount of 15 colonies of Trigona set up in the demoplot area (Figure 5) and keeping by farmer group.

Figure 5. Trigona bees' colonies in demoplot

Women in farmer groups participate actively in apiculture activities. Twice a month, they carry out maintenance of nest, cleaning the grass around the demoplot, fertilizing plants as source of nectar. Hovey can be harvested after about six years set up and continue harvesting for twice a week (Figure 6).

Profitability analysis of apiculture in Baru Village using economic indicators indicate provide benefit to community (Table 2).

Figure 6. Trigona bee honey harvesting process

Table 2. Performance economic indicators for apiculture

Performance economic indicator	Unit	Value
Net Present Value	IDR/ha	5,585,630
Equal Annual Equivalent	IDR/ha/year	1,366,298
Internal Rate Ratio	%	29
Payback Period	year	3.26
Gross BCR		1.14
Return to Labour	IDR	189,970
Establishment cost	IDR/ha	22,086,170

On the other hand, they began to realize that the cultivation of trigona bees helped increase their agricultural yields, the fruit, rice, horticulture and flower crops they planted were more productive than before they did trigona bee cultivation. According to research conducted by Wahyuni (2019) Trigona laeviceps beekeeping is effective in helping pollinate cucumber plants. The number of flowers that succeeded in becoming fruit on cucumber plants was 81%[4].

Other research shows that the Trigona leaviceps bee as a pollinator causes an increase in fruit weight of the plantation by 20.43% and an increase in yield per ha of 9.17% compared to the help of wind (Dewirman and Bustari 2018) [5].

The success of trigona bee cultivation has attracted the interest of the community and members of forest farmer groups in Baru village. Three members of the group have started to adopt this cultivation practice, cumulatively, these three people already have 101 stups which produce 5 liters of kelulut honey each harvest within 1 week. This happened because they began to realize the huge potential of this kelulut cultivation to become an alternative alternative livelihood. They sell kelulut honey at a price of 400,000 per liter.

3.3. Ecoturism

Ecotourism is another advantage derived from the construction of the agro-silvo-fishery demo plot and Trigona beekeeping. The types of fish kept in pond are local fish such as betok, sepat, and tembakang. Once the water is neutral and the fish can live, pond filled with protective plants as a medium to stay, shelter and forage.

In the second planting season rice clearing fish in caren have been harvested using nets and nets. The fish that were successfully harvested amounted to 60 kg consisting of betok and sepat fish in rice field area of 0.25 ha, while in the pond estimated about 200 kg of fish that will be harvested in conjunction with the second planting season rice harvesting.

Many fish in pond are used as fishing tours managed by the village government. Maintenance is carried out by making care during the construction of the demo plot, then neutralizing the water using

manure and dolomite. At the beginning of making pond, the pH of the water is at 3-4. This condition is not ideal for fish development; after fertilization and calcification, the pH of the water is at 5-6.5.

In 2023 the kelulut cultivation demonstration plot was visited by the Jambi Province River Basin Forum (Figure 7). They learn the cultivation techniques with local champion farmers. Until now, the development and promotion of ecotourism for Trigona beekeeping and agro-silvo-fishery continues to be developed to support the expansion of the learning process from the two farming models that have been carried out towards eco-friendly tourist villages.

Figure 7. visit of Forum DAS Jambi in the trigona cultivation

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References

[1] Wahyunto k, Nugroho S and Sulaiman Y 2014 Indonesian peatland map: method, certainly, and uses pp.**81-96**

[2] Masganti, Anwar K and Susanti M 2017 Reference utilization of shallow peatlands for agriculture **11** 1907-0799

[3] Wijana G, Suparta I and Adnyana G 2012 Application types of organic fertilizer for rice (oryza sativa l.) in organic farming system **2** 2301-6515

[4] Elfis, Wahyuni 2019 The Effectiveness of the Trigona laeviceps Polinator on the Production of Cucumber (Cucumis sativus L.)

[5] Putra D and Badal B 2018 Effectiveness of pollination apis cerana fabr. and trigona laeviceps in increasing red pepper yield (Capsicum annuum L) **2** 2579-7766