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Monitoring Behaviour Change of Farmers to Support Ecologically Friendly Agricultural Management Program in Peatland Ecosystems

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Abstract. Conserving peatland areas requires the commitment and the capacities of all stakeholders, including farmers living within the areas. Two business models, agro-silvo-fishery and Trigona apiculture, have been established in a demonstration plot in the peatland ecosystem of Baru Village, Banyuasin, South Sumatra, as new options for farmers to improve livelihoods while also managing peatland sustainably. Trainings on sustainable production, post-harvest, and markets were provided to the rice-based farmers to help them manage new livelihood options. Monitoring the behavioural transformation of farmers engaged in the two business model pilots is a crucial aspect of the program. This is accomplished using the ADKAR approach, which posits that attaining long-term behavioural change involves progressing through stages of Awareness, Desire, Knowledge, Ability, and Reinforcement. A survey instrument was created to monitor farmers behaviour changes in (i) collective action, and (ii) managing agroecosystems sustainably, reflecting collaborative effort required to conserve peatland. Prior to the intervention program, a baseline survey (n=43) was conducted to record farmers' current knowledge. The findings revealed that most farmers (60%) never joined a group but motivated to actively participate, whereas 25% of farmers had actively participated in groups and were eager to urge other farmers to join. Most farmers (52%) acknowledge the significance of safeguarding peatland areas but lack the knowledge to do so, whereas 25% have implemented ecologically friendly agricultural management in peatland areas. When the program began, none of the farmers were involved in agro-silvo-fishery or Trigona apiculture. According to a mid-program assessment aimed at recording the performance of the business models, 3 farmers have adopted apiculture with a total of 101 beehives. While none of the farmers adopt agro-silvo-fishery individually, 5 farmers produced organic fertilizer individually using the training program's new competence. However, producing organic fertilizer as collective action was halted, suggesting farmers partiality to work individually rather than collectively. A final survey to assess behavioural changes is planned towards the end of the program next year. The ADKAR approach for monitoring farmers' behavior change is useful for evaluating the performance of intervention programs and seek solutions to ensure it is aligned with the landscape level NRM goals.

Keywords: ADKAR approach, behaviour change, monitoring and evaluation, peatland ecosystems, South Sumatra

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1. Introduction

Indonesia has approximately 15 million hectares of peat soil, accounting for 50% of the world's total tropical peatland area [1]. When peatland hydrology is intact, peatlands provide multiple environmental benefits of water regulation, carbon storage, and biodiversity maintenance. However, activities that exposed peatland to air, can easily degrade peatland causing massive greenhouse gas (GHG) emissions. In 2010, emissions from peat decomposition and burning accounted for 44 percent of Indonesia's total GHG emissions [1] and the air pollution from peatland fires is estimated to cause, on average, around 33,100 adults and 2900 infants to die prematurely each year [2]. In response, the Government of Indonesia has adopted policies and initiatives to reduce peat degradation and fire as part of the country's Climate Change Mitigation Framework that also includes committing to emission reduction goals and setting domestic sectoral targets [3].

There are two regulations that have significant impact on farmers who manage agricultural systems in peatland areas. First, a permanent moratorium on peatland exploitation and prohibited its burning (PP 57/2016). Second, the mandatory development of Peat Ecosystem Protection and Management Plan (RPPEG) document that map out the current state of the peat ecosystems and classified its areas into two functions: protected and cultivation zones (PERMEN LHK 60/2019). The document also describes the potential consequences and challenges that can affect peat ecosystem utilisation by various sectors, regions and communities [4]. Both regulations require farmers to be informed of the permitted and prohibited practices in their agricultural land.

Many programs and interventions have been launched by the public and private sectors, as well as development agencies with the goal to equip farmers in petland areas with the knowledge and technology they need to manage their land sustainably. For effective program management, a well-designed monitoring and evaluation (M&E) system is essential. M&E can assist in demonstrating impact by providing public and internal accountability, answering questions about how well a project or strategy is performing, and identifying the conditions under which an intervention activity is likely to succeed or fail [5]. Moreover, M&E can serve as an early warning system for potential problems and lead to ideas for potential remedial actions [6]. M&E systems have recently begun to also pay attention to how beneficiaries of the program behave as they implement the suggested interventions. The underlying assumption is that for an impact to be sustained, the intended beneficiaries must successfully adopt and implement, or modify their behavior [7].

This paper showcases the implementation of a monitoring systems in a rice-based village (Baru village) in Banyuasin, South Sumatra that currently receiving a program to strengthen its farmers capacity to improve their livelihoods through establishing Trigona apiculture and agro-silvo-fishery. We examine the lesson learnt by the program as a result of monitoring systems to date, as well as the next steps that can be made to ensure the program's aim is reached.

2. Data and Methods

2.1. The M&E approach

The program implemented in Baru village aims to raise awareness and develop capacities in managing paludiculture or agroforestry as a sustainable agriculture in peatland, through the piloting of two business models: Trigona apiculture and agro-silvo-fishery. The business models established are integrated business model that when fully implemented represent business model of circular economy (Appendix 1). The business models established and consequently its capacity strengthening program encompass the topics of sustainable commodity production, sustainable value chain and sustainable financing, an enabling condition for establishing the previous two phases. Hutasuhut (2023, this issue) provide more detail on the design of the business model. The business model's concept is covered in further detail in Hutasuhut (2023, this issue). As a result of the objectives, the M&E systems put in place in Baru village have two goals: (i) monitoring the behavior change of farmers taking part in the capacity strengthening program and (ii) assessing the effectiveness of the two business models

2.1.1. Monitoring behaviour change

There are several methods to monitor behaviour change. Michie [8] proposed a framework called behaviour-change-wheel as a tool to design interventions based on the assumption that behaviour change requires opportunity and *capability* that will inspire *motivation* to change. Bell [9] used the framework AID (Awareness, Interest and Doable/Actionable) as the key prerequisites factors to assess the influence of the use of information communication technology (ICT) in agricultural extension to induce behaviour change in farmers. Another framework that is often used in marketing and advertising is AIDA (Awareness, Interest, Desire, and Action) that track consumers' cognitive stages during the buying process for a product or service [10]. We used the ADKAR framework that posits to attain long-term behavioural change involves progressing through stages of Awareness, Desire, Knowledge, Ability, and Reinforcement (Awareness, Desire, Knowledge, Ability and Reinforcement). The similarity in the methods of monitoring behaviour change is that to take action, an individual must go through phases of awareness and interest. The difference is that in ADKAR, there is an additional phase following action to ensure the sustainability of change, which is Reinforcement. This phase refers to enabling conditions that must exist to sustain the behaviour change. Initially intended to assist organizational structure transformation, ADKAR has more recently been used in a variety of areas where behaviour change is required, such as education [11], biosecurity in veterinary medicine [12], digital transformation in industry [13].

The target behaviour change of the farmers is a sustained ability to (i) manage the business models as a group, (ii) protect the forest/peatland and carry out ecologically friendly agricultural management in peatland areas. To better understand the farmers' current behaviour, we created questionnaires that could gather data on (i) farmer's current behaviour, (ii) the challenges they face in achieving sustained behaviour change, and (iii) the institutions or people who can help them change their behaviour. The findings may indicate the additional capacity building that is necessary to enable long-lasting behaviour change.

The ADKAR survey will be carried out twice: once at the beginning of the program (before the capacity strengthening activities began) to gather baseline data, and once after the conclusion of the capacity strengthening program (training and facilitation). In 2022, 43 people participated in the first survey.

2.1.2. Monitoring and evaluating the business performance

Key Performance Indicators (KPI) are the most popular method to measure the effectiveness a project or program towards the achievement a set of key objectives. In general, indicators (and more specifically, KPI) should express as precisely as possible to what extent an aim, a goal or a benchmark has been attained or exceeded [14]. In our study, we developed the KPI as the project's performance metrics using the Principles, Criteria, and Indicators (PCI) approach. *Principles* are typically normative statements normally developed from program goals which are idealistic and immeasurable. At the level below principles, *criteria* serve as benchmarks that show adherence to program goals. They are categories of conditions or processes that contribute to the principles and are intended to ease analysing the principle. If they are consistently met, they provide reliable evidence that the ideal is the principle is being achieved or upheld. Although criteria are typically not immediately measurable, they are developed so that the level of conformity can be assessed. *Indicators* are parameters that represent the level of conformity with the relevant criteria and can be measured qualitatively or statistically [15].

One of the capacities of the farmers that the program seeks to develop is their capability to conduct M&E. Farmers must understand the value of monitoring their business, assess their progress, identifying any bottlenecks, and discuss potential solutions as a group. Hence, participating farmers will oversee and carry out the M&E of business performance.

The KPIs of the Trigona apiculture and agro-silvo-fishery are based on three main principles: (i) sustainable production, (ii) good post-harvest and sustainable marketing, and (iii) sustainable financing. The criteria and indicators were developed jointly with the farmers during the training on M&E. The key metrics, the feasibility to measure, which individuals will be responsible to collect the data and

when, were discussed. The jointly developed KPIs of Trigona apiculture and agro-silvo-fishery are depicted in Appendix 2.

3. Results and Discussion

3.1. Baseline of farmers behaviour

Most farmers participating in the business models never joined a group (60%) but motivated to actively participate, whereas 25% of farmers had actively participated in groups and eager to urge other farmers to join (Tabel 1 and Figure 1). The rest have become members of farmers group, although some are inactive.

Table 1. Definition of ADKAR phases

ADKAR Phase	A. Working as a group	B. Conserving peatland by practicing environmentally friendly agriculture
0	Unaware farmer groups exist	Unaware on the need to protect peatland areas
AD: Awareness Desire	Aware that farmer groups exist and eager to participate	Aware the significance of protecting peatlands, but lack the knowledge and skills to do so
K: Knowledge	Inactive member of a group	Have the knowledge to practice environmentally friendly agriculture but lack the skills to do so
Ab: Ability	Active member of a group	Have practiced environmentally friendly agriculture
R: Reinforcement	Active member of a group, have benefited from being in a group and encouraged others to join	Have practiced environmentally friendly agriculture and have gradually transferring the knowledge to other farmers

Only 12 % of respondents believe that there are active, progressive farmer groups in the village that are beneficial for their members. Most respondents do express a desire for a good farmers organization that can help its members and offer the most recent information and technology, including assistance with production inputs, agricultural equipment, and business know-how.

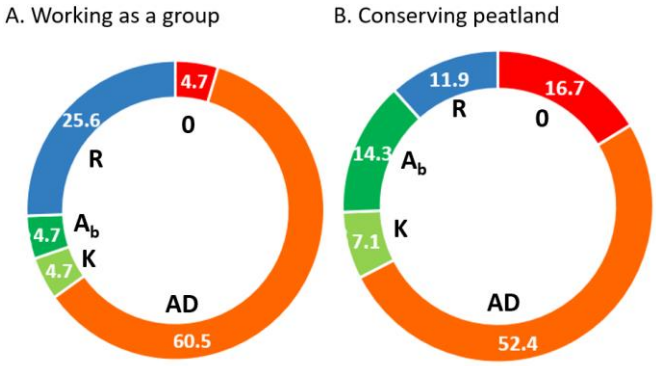

Figure 1. Percentage of farmers at different ADKAR phases. Definition in Table 1.

According to every respondent, inactive members are the biggest obstacle to the existence of a good farmers organization, and all respondents depend on village, community, or group leaders as well as the wealthy villagers. Other ideas include having the farmers organization engage in more productive activities like renting out agricultural equipment or offering help with land clearance, both of which may pique members' interest and require financial capital support.

Most respondents (52%) also acknowledge the significance of safeguarding peatland areas but lack the knowledge to do so, whereas 25% have implemented ecologically friendly agricultural management in peatland areas and some even started to teach their peer farmers. A total of 83.3% of respondents understood the importance of protecting peatland to prevent fires, degradation, and the loss of its ability to be used for other purposes. As a result, most respondents were aware of the ban on burning, growing oil palm, rubber, and timber, extracting forest goods (timber, deer, and pangolins), and purchasing and selling land. According to the respondents the number of respondents who farmland in peat areas is equal to that of those who do not. Farmers continue to cultivate in peatland areas out of habit and because the land is a gift from their elders. They would do this during the dry season when peatland areas have less water. Those who cultivate peatland believe that peatland is more fertile, but costs more because it is located far away from the settlement. Due to ban on use of fire, clearing land the biggest challenge to cultivate in the production area of peatland. The lack of resources, capital, and knowledge are challenges to overcome. Farmers look on the government, agricultural services, and extension personnel for assistance.

3.2. Monitoring the business performance

Based on the KPIs for both businesses, the Trigona apiculture farmers had undergone 3 periods of monitoring. The inclusive approach in developing the key metrics enable farmers to collect and measure data independently (Table 2). There had been a surge in number of beehives, from 0 to 101 beehives over 9 months , with relatively stable number of owners. However, the productivity of honey /beehives are still low as the population of feed (flowers) were not able to catch up with the increase of bee population.

To date, the farmers were only able to monitor the production phase, as the capacity strengthening on sustainable marketing and financing has yet to start. The farmers have started selling the produced honey to visitors from neighbouring villages who are interested to learn apiculture.

Table 2. The result of the 1st monitoring activity for Trigona Apiculture conducted forest farmer groups Bunga Desa after training and pilot establishment.

No	Indicators	Key metrics	Target	Data collection cycle	Period 1	Period 2	Period 3
1	Continuous honey production	# beehives	Increased over time	3 months	10	20	101
		Feed availability (number of plants/trees)	Increased over time	3 months	120	150	180
		Honey produced per harvest	0.5 litre/ beehive	3 months	0 litre	1 litre	5 litre
2	Active involvement of farmers	# farmers attending the meeting	100%	3 months	30	15	15
3	Protecting peatland	# farmers managing land in protected peat areas	0	6 months	1	0	-
4	Trigona apiculture is widely managed by Baru Village farmers	# farmers managing Trigona apiculture	Increased over time	3 months	0	3	2
5	Support from other institutes individuals	# supporting institutions/ individuals	At least 1 institute/individual	6 months	1	2	2
6	Farmers' honey and derivative products sent to BUMDes are sold	Percentage (%) of harvest sold	Increased over time	6 months	-	10%	100%
7	Marketing activities outside the village	Number of buyers from outside the village	Increased over time	6 months	-	1	10

(a) (b)

Figure 2. Harvesting Trigona honey(a) and Organic fertilizer production (b)

However, the agro-silvo-fishery farmers have yet to collect information of their business based on the developed KPIs. The agro-silvo-fishery business comprise of several business units: the organic fertilizer, the agro-fishery, and the timber production. The piloting experienced hiccups, as the fish initially was not able to survive the harsh acidity of peat water, thus unable to mature. The timber trees obviously are still in the growing phase. The farmers were also unable to replicate the business model in their own land, due to high establishment cost. The organic fertilizer as a collective business also did not survive, as there was dispute among the farmers over the source of organic materials. However,

individually there were 5 farmers who continue producing the organic fertilizer for their own use and market (Table 3).

Table 3. Individual organic fertilizer production

Farmers	Number of productions (in 6 months)	Average yield (kg)	Source of materials	Use
Farmer A	3	150	Surrounding landscape	Chili field & for sale
Farmer B	3	50	Surrounding landscape	For sale
Farmer C	3	500	Own land	Rice field
Farmer D	3	200	Own land	Rice field
Farmer E	2	300	Own land	Rice field

3.3. Lesson learned and the way ahead

The combined methods of monitoring, individual behaviour change using ADKAR approach and business performance using KPIs, provided integrated evaluation on the efficacy of farmers capacity strengthening program implemented in Baru village. The baseline farmers behaviour results and the periodic business performance provided feedback and lesson learnt needed to improve the on-going program. Although more integrated analysis is still needed, the list below provided key lessons learnt to date and areas for improvement.

- Farmers are motivated and able to conduct M&E independently with simple key metrics that were developed inclusively. For more complicated business, and hence complicated KPIs, such as agro-silvo-fishery business, specific and repeated training may be required.
- Farmers in Baru Village prefer to work individually, as elicited in the ADKAR survey result, and demonstrated by the organic fertilizer production in agro-silvo-fishery business. This behaviour is typical of farmers in general and frequently contributes to the failure of programs that rely on collective action. The solution that is frequently suggested—to involve local stakeholders (business and public actors, and village leaders) as enablers—is challenging to put into practice, as this program also has discovered. The most practical and efficient strategy to date is to strengthen farmer-to-farmer extension by identifying and equipping key champions that is motivated to teach and inspire peers by examples and foster innovation through experimentation.
- The KPIs created must also be flexible enough to be changed throughout the piloting phase. The emergence of individual organic fertilizer production demonstrated the program's success in encouraging individual entrepreneurship rather than group effort. In order to take advantage of this opportunity and build the business collectively at an institutional level, it is vital that the business/financing institutions at the village level (cooperatives, BUMDes) be strengthened.

Acknowledgements

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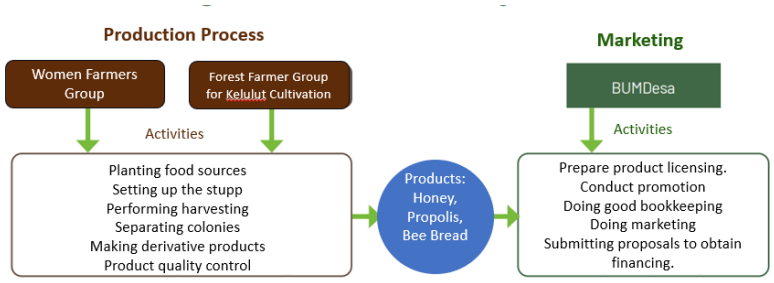
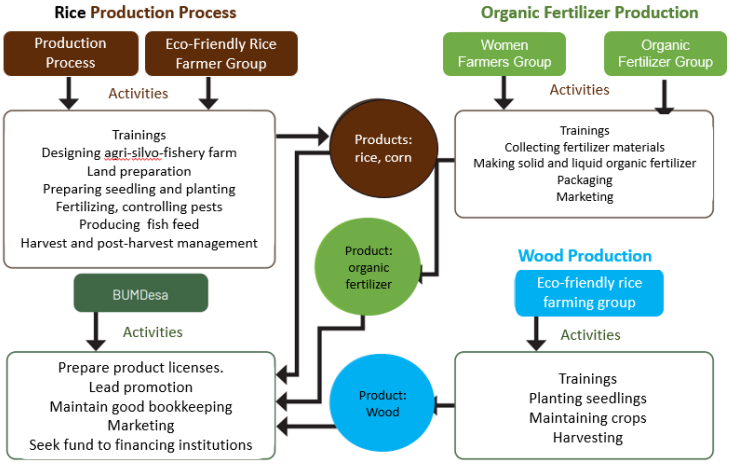
Appendix

Appendix 1. Diagram of the business models implemented in Baru Village

A. Trigona Apiculture



B. Agri-Sylvo-Fishery



Appendix 2. The Principles, Criteria and Indicators of sustainable business models piloted in Baru Village, Banyuasin, jointly developed with the farmers'group

A. Trigona Apiculture

Principle: Sustainable production

Criteria	Indicators	Key metrics	Data collection period
Guaranteed production continuity	Honey products are available continuously	Number of stups / kelulut houses	3 months
		Feed availability	3 months
		Honey yield per harvest	every harvest
	Active involvement of kelulut farmers	Number of farmers in the group who attended the meeting	every meeting
Safeguarding forests and peat protected areas	Managing/utilizing agricultural land in other use areas (land designated for agriculture)	Number of kelulut farmers who still manage land in forest areas or peat protected areas	6 months
Apiculture is adopted by the community	Apiculture is widespread among the people of Baru Village	Number of farmers who have stups other than demonstration plots	3 months
Multi-stakeholder support	Support from parties outside the kelulut group for kelulut cultivation	Number of institutions or individuals that support the production process	6 months

Principle: Good post-harvest and sustainable marketing

Criteria	Indicators	Key metrics	Data collection period
The quality of kelulut honey and its derivative products (if any) is	Have a minimum certification of Home Industry Food Production Certificate (SPP-IRT)	Number of certified products and derivative products	6 months

guaranteed by standards and certificates.	Honey product quality meets good quality standards	Products that meet SNI quality standards (water content)	6 months
Marketing runs smoothly	Honey products and farmer-derived products sent to BUMDes are sold	Percentage (%) of harvest sold	6 months
Better product price	Farmer's honey products are valued higher than other buyers	Price of products purchased by BUMDesa	6 months
Product marketing reach	There are marketing activities outside the village (e.g. inter-village, district, provincial, or national sales)	Number of buyers from outside the village	6 months
	Variation in buyer type (individual or corporate)	Type of buyer	6 months
Clear marketing plan	There is a long-term marketing plan	Marketing plan	6 months
Orderly administration	Every sales transaction and inventory is well recorded	Simple bookkeeping to record sales and inventory transactions	6 months
Multi-stakeholder support	Support from outside the group for the post-harvest process and marketing of kelulut cultivation products	Number of institutions and individuals supporting post-harvest and marketing processes	6 months

Principle: Sound and sustainable financing

Criteria	Indicators	Key metrics	Data collection period
Stable cash flow	Product sales provide benefits to BUMDes	Profits earned by BUMDesa	Once a year
Addition of equity participation	Product sales profits can be used for business capital in the next period	Business capital from profits	Once a year
	Financing/additional capital from other parties	Number of other parties providing financing/capital	Once a year
Healthy debt	Payables paid per period	Debt payment (instalment) per period	Once a year

B. Agri-Sylvo-Fishery

Principle: Sustainable production

Criteria	Indicators	Key metrics	Data collection period
Continuity of production	Fish products are available continuously in sufficient quantities	Fish yield after each harvest	every harvest
	Rice products are available continuously in sufficient quantities	Wet grain yield per harvest	every harvest
	Vegetable products are available continuously	Yield of fresh vegetables per harvest	every harvest
	Sufficiency of inputs	Fertilization dose	every harvest
		Frequency of weed control/weeding	every harvest
Continuity of production	Number of farmers in the group who attended the meeting	person	100%
Maintain forests and peat protected areas	Conducting rice mina cultivation in other use areas (land designated for agriculture)	Number of farmers from minapadi farmer groups who still manage land in forest and peat areas	6 months
Rice mina cultivation is adopted by the community	Minapadi cultivation is widespread among the people of Baru village	Number of farmers who have stups outside of demonstration plots	6 months
Demonstration plots are well maintained	Good rice growth	Number of rice tillers per clump	1 month
	Local fish species and populations on the land increase	*per species (fish species observed for half an hour in a boxed area)*	3 months
Multi-stakeholder support	External support for environmentally friendly agricultural production processes	Number of institutions that support the production process	6 months

Principle: Good post-harvest and sustainable marketing

Criteria	Indicators	Key metrics	Data collection period
Product quality is guaranteed with standards and certificates	Product quality meets good quality standards and has a minimum certification of Home Industry Food Production Certificate (SPP-IRT)	Number/percentage of standardized and certified products	every harvest

	Packaging	Availability of packaging	Every time a new product is packaged
Better product price	grain	Price of products purchased by BUMDesa	6 months
Smooth marketing	Farmers' rice products sold through BUMDes	Percentage (%) of harvest sold	6 months
Product marketing reach	There are marketing activities outside the village (e.g., inter-village, district, provincial, or national sales)	Number of buyers from outside the village	6 months
	Variation in buyer type (individual or corporate)	Type of buyer	6 months
Clear marketing plan	There is a long-term marketing plan	Marketing plan	6 months
Orderly administration	Every sales transaction and inventory are well recorded	Simple bookkeeping to record sales and inventory transactions	6 months
Multi-stakeholder support	Support from outside the group for post-harvest processing and marketing of environmentally friendly rice cultivation products	Number of institutions and individuals supporting post-harvest and marketing processes	6 months

Principle: Sound and sustainable /financing

Criteria	Indicators	Key metrics	Data collection period
Stable cash flow	Product sales provide benefits to BUMDes	Profits earned by BUMDesa	Once a year
Addition of equity participation	Product sales profits can be used for business capital in the next period	Business capital from profits	Once a year
	Financing/additional capital from other parties	Number of other parties providing financing/capital	Once a year
Healthy debt	Payables paid per period	Debt payment (installment) per period	Once a year