Implementation of government policy in integrated mangrove-shrimp farming and pond farmers' satisfaction to the policy in the Mahakam Delta, Indonesia

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Abstract. The implementation of government policy on integrated mangrove-shrimp farming through a mangrove planting program has driven the increase in mangrove covering. However, there was a gap between pond farmers' knowledge and skill about managing mangroves in the pond area, and implementation of government policy about mangrove rehabilitation rate. Secondary and primary data were employed. A qualitative approach to analysis was measuring 272 samples from Sepatin village that was selected because of the biggest pond areas in the Mahakam Delta. The aims of the study were to explore the government policies associated with integrated mangrove-shrimp farming, and to analyze pond farmers' satisfaction with the implementation of the integrated mangrove-shrimp farming policies. The results showed the implementation of the integrated mangrove-shrimp farming policy was found to be defective on the basis of not achieving optimally mangrove planting in ponds (silvofishery) and green belt area (between pond dike and river or sub canal). Those failures were encouraged by un-satisfaction of pond farmers toward mangrove planting performance, maintenance, and monitoring/evaluation of the program. Pond farmers were not really satisfied by the implementation of government policy in integrated mangrove-shrimp farming. Nevertheless, comparing the two groups, the satisfaction level of the latter group (group of planting mangroves in pond) is higher than the former group (group of planting mangroves outside pond). Therefore, the government needs to tighten policy through a proper and evaluated program and might improve the knowledge and skill of pond farmers through more training, workshops and seminars for the sustainability-enhancing of mangrove-shrimp farming management.

Key Words: management, mangrove covering, shrimp farming.

Introduction. Mangroves are crucial for humans, and among the benefits are providing livelihoods for societies living near coastlines and deltas. Despite their importance, mangrove forests are in decline across the world. The decline is driven by a multitude of factors ranging from shrimp farming, agricultural land, and palm plantations to tropical cyclones and global warming (ADB 2013; Duncan et al 2016; Ilman et al 2016). Due to very serious degradation of mangrove areas, the Indonesian government has been taking the initiative and action to save mangrove areas through regulations. In Indonesia, mangroves are protected by 22 laws and regulated by at least 18 institutions, where mangrove improvement policies such as mangrove rehabilitation are more seriously discussed (Susilo et al 2023).

The government, through Ministry of Marine Affairs and Fisheries decree no. 75 of 2016 (KKP 2016) regulated that the construction of new ponds on mangrove land and the core zone of conservation areas is not permitted or by placing the aquaculture zone

behind the intertidal zone, or another alternative, ponds with traditional technology, can be done through intercropping in mangrove forest locations (silvofishery) (Lusiana & Triana 2019). Integrated management of mangroves and ponds certainly has a positive impact on improving the surrounding ecological environment (Nasrudin et al 2020).

There, the rate of loss of mangrove forests is starting to decline, a sign that there are efforts to protect mangrove forests, and public awareness is starting to grow regarding the importance of the existence of mangrove forests. Law no. 41 of 1999 (President of the Republic of Indonesia 1999) (concerning forestry article 40 and 41) mentioned that forest and land rehabilitation is intended to restore, maintain and improve the function of forests and land so that their carrying capacity, productivity and role in supporting life support systems are maintained. Forest and land rehabilitation is carried out through reforestation, afforestation, maintenance, plant enrichment, or the application of vegetative soil conservation techniques and civil engineering, on critical and unproductive land in all forest areas except nature reserves and core zones of national parks. Also, the Ministry of Marine Affairs and Fisheries decree no. 28 of 2004 (KKP 2004) regulated that shrimp farming locations are not built on critical mangrove land, and do not damage or eliminate the function of mangrove forests.

Policy is deemed to fail if it achieves undesirable results or causes more problems. Even worse if the use of the term "regulation" is still limited to statutory regulations, whereas the regulation is under the law, and the regulation is considered as a tool to achieve social and economic goals. Hutabarat et al (2022) mentioned law enforcement must be carried out in accordance with applicable laws and regulations that have been mutually agreed upon so as not to cause new, prolonged problems. Hence, pro-farmer development of fisheries cultivation requires the support of all elements of the nation, particularly policymakers to place shrimp farming as a sector that requires real support, and Tezera (2019) also disclosed that the individuals and organizations' involvement was essential for successful and appropriate policies.

Fewer studies focus on the implementation of government policy in the integrated mangrove-shrimp farming in the Mahakam Delta, and how pond farmers' satisfaction with this policy particularly related to mangrove planting performance and its maintenance and monitoring/evaluation. Moreover, since the mid-2010s, aquaculture productivity in the Mahakam Delta has been declining and many pond farmers decided to leave their ponds (Fawzi & Husna 2021). Therefore, we needed to explore the government policies associated with integrated mangrove-shrimp farming, and to analyze pond farmers' satisfaction with implementation of government policy in the integrated mangrove-shrimp farming for sustainability-enhancing of mangrove-shrimp farming management. The framework of study is as shown in Figure 1.

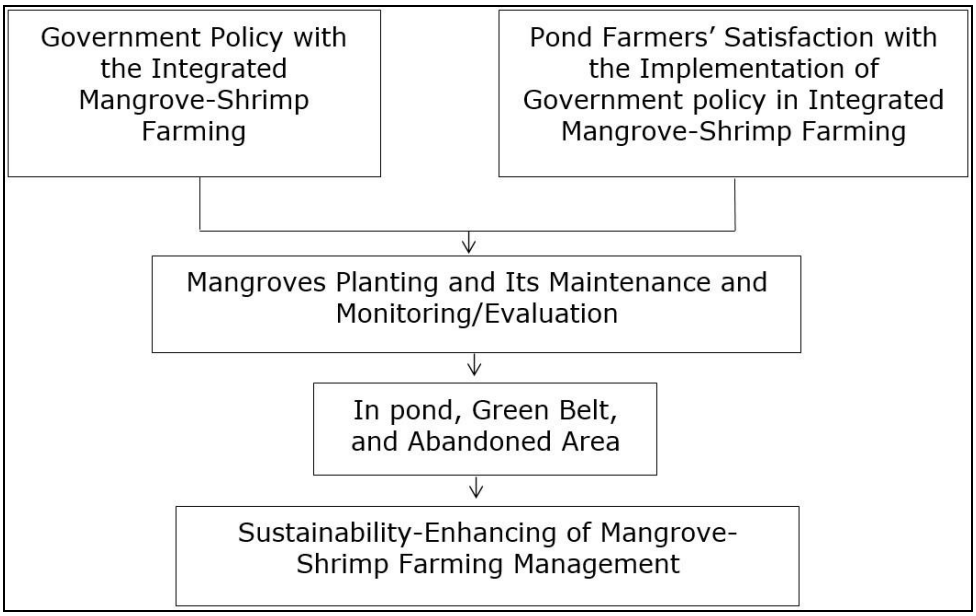

Figure 1. The framework of the study.

Material and Method

Study site and time. The study site was in the Sepatin village, Anggana sub-district, East Kalimantan, Indonesia. Sepatin Village is an area where many shrimp ponds have been built compared to other villages in the Mahakam Delta (BPS 2022; MFO 2022). Data was gathered in 2022 and 2023.

Sampling technique. The selected sample of pond farmers was taken using a purposive random-sampling method, and the sample size estimation of pond farmers was performed using the Taro Yamane formula at a 95 % confidence level for each stratum. Thus, 231 persons were from the group planting mangroves outside pond, and 41 persons from group planting mangroves in pond.

Data collection method. The data collection method consisted of primary and secondary data. The primary data was directly collected from pond farmers and gathered through a questionnaire. The secondary data was collected from recent research, project reports from government and private institutions, datasets, and books. Also, this study included a literature review and semi-structured reviews.

Statistical analysis. Descriptive analysis was employed to measure pond farmers' satisfaction with the implementation of the integrated mangrove-shrimp farming policy. As for scoring on the Likert scale, it consisted of 5 points, i.e., 1 meaning strongly dissatisfied (SD), 2 meaning dissatisfied (D), 3 meaning Neutral (N_t), 4 meaning satisfied (S), and 5 meaning strongly satisfied (SS). A reason for using the Likert scale is due to social sciences research with a number of descriptive anchors or points (Alhassn et al 2022; Tanujaya et al 2023). The range of mean scale and category for 5 classes, are lowest (1.00-1.79), low (1.80-2.59), moderate (2.60-3.39), high (3.40-4.19), and highest (4.20-5.00) (Onuoha & Ibe 2020), and several definitions of the study are described in Table 1.

Table 1

Operational definition of the study

Items	*Description/illustration*
The integrated mangrove-shrimp farming	A model cultivation that combines mangroves into ponds in the middle (called yard or background) or planted outside of main cultivation canal that is separated by dike and watergate (silvofishery).
The policy of integrated mangrove-shrimp farming	Government wisdom in the management of the integrated mangrove-shrimp farming (regulatory policy).
Planting mangroves	Implementation of mangroves planting inside the ponds and/or outside the ponds.
Maintenance	Implementation of mangroves maintenance after planting stage.
Monitoring and evaluation	Implementation of mangroves monitoring and evaluation during mangrove planting and maintenance.
Green belt	A physical separation that stretches between a river or river channel and a pond building in the form of a green open space with mangrove trees growing in it. Or, based on Ministry of Public Works Regulation No.5/PRT/M/2008 (Ministry of Public Works Regulation of the Republic of Indonesia 2008), green belt areas are spaces in cities or wider areas, either in the form of areas or in the form of lanes/longitudes whose use is more open and basically without buildings.
Abandoned areas	Barren areas and inactive ponds (Duncan et al 2016) (including green belt area).

Results and Discussion

Sample profile. As mentioned above, 85% of pond farmers planted mangrove outside the pond, and 15% applied mangrove planting in their ponds. Pond farmers employed mangrove trees that consisted of natural and planted tree species. Most of them were male, pond owners, and married. In the former group, most pond farmers (53.3%) were in the 46-55 age group, and the 56-65 age group (28.6%), the rest of them represented 16%, 1.7%, and 0.4% in the 36-45, 26-35 and 16-25 age categories, respectively. So, most pond farmers were in the productive age range, as well as the latter group ranged in productive ages (26-65 years). When comparing those four educational levels, the majority of them have primary education (92.2%), no school (3.5%), junior high school (3%), and only 1.3% of them have senior high school. In the group of pond farmers planting mangroves in ponds, 31.7% of pond farmers had senior high school, 19.5% had junior high school, 24.4% had primary school, and the rest had no school. The size of the household family, length of residency, and experience of those two groups were dominated by >4 persons, >5 years, and >1 year, respectively (Table 2).

Table 2

Description of the sample profile

Variable	*Category*	*Group of pond farmer*	
		Planting mangroves outside pond (n=231)	*Planting mangroves in pond (n=41)*
Mean age of both groups = 50.2 years	16-25	0.4%	0%
	26-35	1.7%	7.3%
	36-45	16.0%	26.8%
	46-55	53.3%	56.1%
	56-65	28.6%	9.8%
		Avg. age = 50.8 years	Avg. age = 46.7 years
		Max. age = 65 years	Max. age = 60 years
		Min. age = 25 years	Min. age = 33 years
Education level	No school	3.5%	24.4%
	Primary school	92.2%	24.4%
	Junior high school	3.0%	19.5%
	Senior high school	1.3%	31.7%
Number of household family members	<4 persons	0%	2.4%
	>4 person	100%	97.6%
Length of residency	<5 years	19.5%	7.3%
	>5 years	80.5%	92.7%
Experience	<1 years	1.3%	4.9%
	>1 years	98.7%	95.1%

When comparing the pond farmers group, their profile was almost similar except the educational level of pond farmers in the latter group (the group of pond farmers that plant mangroves in ponds) was better because half of them had junior and senior high school, while the former group was dominated by primary school level. A lot of research mentioned that education can drive knowledge and skill development, collaboration/connection, and experience (Wekke & Cahaya 2015; Tang 2023; Wood 2023; Courish et al 2024; Sharma & Singh 2023; König et al 2024; Lundell Rudberg et al 2024). Therefore, a challenge of pond farmers was how to improve their good performance in shrimp farming with their knowledge and skill.

Government policies on integrated mangrove-shrimp farming and its implementation. We consider it necessary to review several government policies and show its fact related implementation in the integrated mangrove-shrimp farming in the Mahakam Delta. Government involvement and its dedicated policies for the integrated mangrove-shrimp farming played a crucial role for sustainable enterprise and the environment (Harkes et al 2015; Reis-Neto et al 2019; Lukman et al 2021; Osmundsen et al 2022; Sidik et al 2023), besides involvement of stakeholders, officials, educators

and students (Tezera 2019). Based on Presidential Regulation no. 120 of 2020 (President of the Republic of Indonesia 2020) concerning location target of the Peat and Mangrove Restoration Agency (BRGM) for mangrove rehabilitation and peat restoration, East Kalimantan was one of thirteen provinces that focused on the increase of mangrove rehabilitation (Table 3). Data collected by BRGM showed the total damage to mangroves in East Kalimantan was 17,879 hectares, thus it needed acceleration of mangrove rehabilitation. Critical land of 9,084 hectares was within the mangrove area, and the remaining 8,795 hectares was outside the mangrove area. This critical area was caused by illegal logging, cutting down mangroves for ponds, people's agriculture, gardens and a number of other reasons. Since 2021, the government has begun restoring 5,000 ha of mangrove areas which have changed their function (Sucipto 2021). In 2022, mangrove rehabilitation in East Kalimantan planted 1.045 ha or equal with 28.7% of total rehabilitation in Indonesia by the program of the Peat and Mangrove Restoration Agency (Badan Restorasi Gambut dan Mangrove – BRGM) (BRGM 2022).

Table 3

Mangrove rehabilitation and restoration in Indonesia in 2020

No	*Province*	*Concerning*
1	North Sumatera	Mangrove rehabilitation
2	Riau	Peat restoration and mangrove rehabilitation
3	Riau Islands	Mangrove rehabilitation
4	Jambi	Peat restoration
5	Bangka-Belitung	Mangrove rehabilitation
6	South Sumatera	Peat restoration
7	West Kalimantan	Peat restoration and mangrove rehabilitation
8	Central Kalimantan	Peat restoration
9	North Kalimantan	Mangrove rehabilitation
10	East Kalimantan	Mangrove rehabilitation
11	South Kalimantan	Peat restoration
12	West Papua	Mangrove rehabilitation
13	Papua	Peat restoration and mangrove rehabilitation

Source: President of the Republic of Indonesia 2020.

Sourced from a database for the development of standardized ecological coastal units (Sayre et al 2018) and supporting dataset of Global Mangrove Extent Change 1996–2020: Global Mangrove Watch Version 3.0 (Bunting et al 2022), the area of mangrove habitat in Indonesia in 2020 was 2,953,398 ha. Then, in the Mahakam Delta, the area was only 519.66 km^2 or 51,966 ha (84.72% of the 1,621.25 km of the coastline) with the mean maximum canopy height of 9.14 meters (Figure 2). Thus, these results were recorded as very encouraging when compared to mangrove coverage condition for the last 5 years (2016-2020) in good and moderate condition. Recorded severe damage was in 2017 and 2018, around 123 and 125.1 thousand hectares respectively, but damage decreased gradually to 81 thousand hectares in 2019 and 2020 (Table 4). It means that involvement of all parties, including these government policies, has driven mangrove habitat to increase.

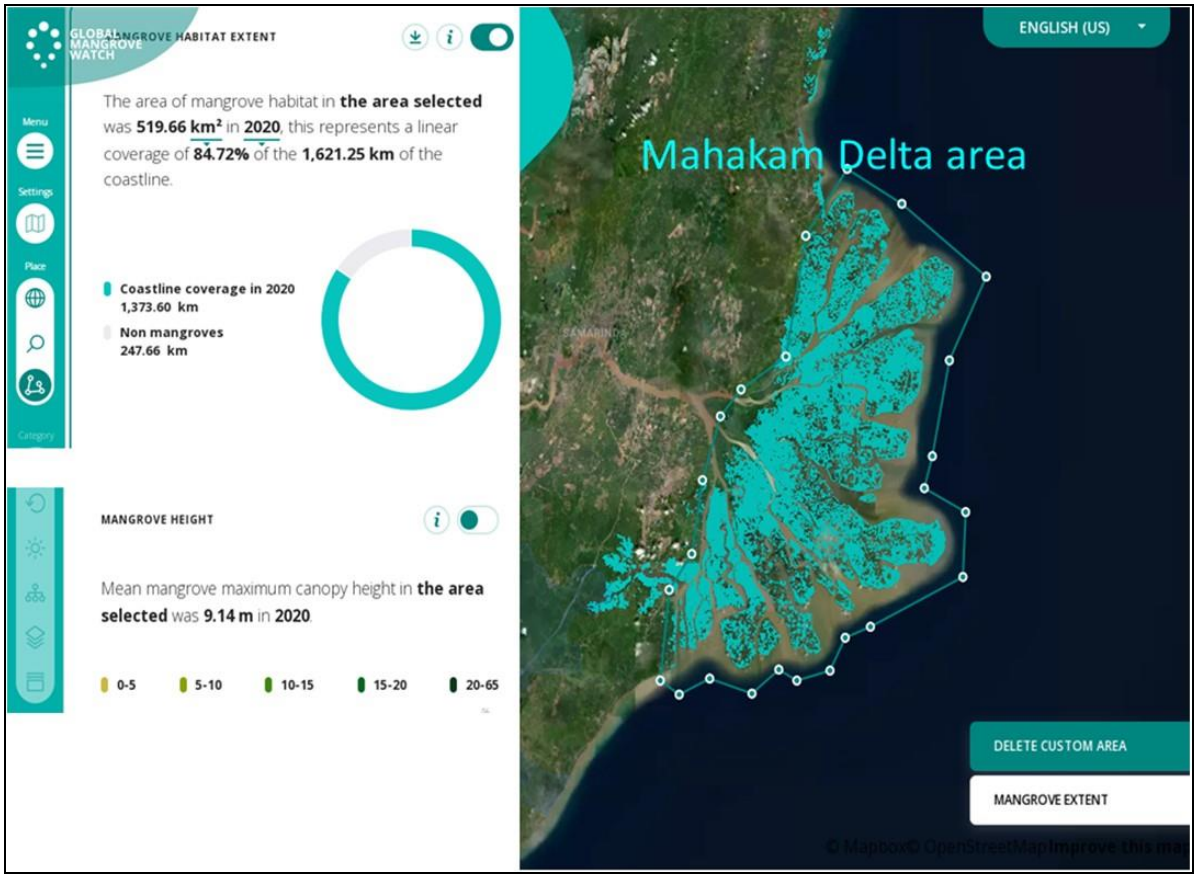

Figure 2. Mangrove extent and height in the Mahakam Delta (Dataset from www.globalmangrovewatch.org).

Table 4

Mangrove covering growth during 2016-2020 period

Mangrove covering condition	*Year and ha*				
	2016	*2017*	*2018*	*2019*	*2020*
Good	225.00	31,462.58	29,168.46	33,925.00	33,925.00
Moderate	328.00	139,085.12	134,345.81	0.00	0.00
Defective	329.00	123,013.31	125,114.56	81,150.00	81,150.00

Reference: BAPPENAS (2024).

To support the mangrove management, there are government regulations by Government Regulation of the Republic of Indonesia no. 23 of 2021 (BPK 2021) concerning forestry implementation, and the other regulation regarding mangrove management, East Kalimantan Governor Decree no. 522/K.269/2018 (DDPI 2018) concerning the establishment of a roadmap of the forest management unit (KPH) of East Kalimantan province for 2018-2028, has mentioned the roadmap of KPH. It is a guideline in development of mangroves and its steps towards target, including monitoring, supervising and coaching in East Kalimantan.

Presidential Regulation of the Republic of Indonesia no. 51 of 2016 (President of the Republic of Indonesia 2016) concerning coastal borders. This regulation mentioned that 100 meters is about the length of coastal border between the highest and lowest tides. As well as the forestry government decree Forest Department No. 507/IV-BPHH/1990 (Forestry Government of the Republic of Indonesia 1990) states that each utilization would need 50 meters for the riverside and 200 meters for the coastal line as the suggestion. However, the zone in the green belt did not comply with the distance stated by the government. In the field, the buffer zone between the riverbank and pond dike in the Mahakam Delta was only around 5-10 meters. The distance between the pond

and the river/canal was less than the distance, which was the provision of a forestry government decree about 50 meters, or presidential decree about 100 meters.

Minister of Marine and Fisheries of Republic of Indonesia decree No. 75 /Permen-Kp/2016 (KKP 2016) concerning the general guidelines for shrimp farming has mentioned silvofishery as a method for shrimp farming. Also, based on the long term strategic plan for 2017 to 2026, the KPHP Mahakam Delta has encouraged mangrove rehabilitation and the silvofishery program in the Mahakam Delta area to following several places in Indonesia which have successfully implemented it. So, based on two large institutions' presence (both forestry and fishery institutions), they have agreed that the integrated mangrove-shrimp farming is the result of a successful policy.

During implementing those policies, there was also a history of incidents and conflicts over land claims between pond farmers and related parties. Based on observation, since the 1970s, concessions had been granted to several companies, including Japex, Total E&P Indonesia, and Virginia Company (VICO) in the Mahakam Delta area. Because mining natural resources, both oil and gas and other minerals, were considered strategic, their position was higher than other interests such as shrimp farming. In the government of the new order era (orde baru), forest area permits were still limited, including oil and gas. Therefore, for the sake of law enforcement, particularly Law no. 41 of 1999 (President of the Republic of Indonesia 1999) concerning forest, oil and gas interests in this area, the permits had been accommodated. Tension and conflict usually arise when their pretension was arranged or reduced, and village people usually resisted these regulations. So far, compensation has been a solution for pond areas under which there were gas and oil pipelines.

Pond farmers' satisfaction with the implementation of government policy in the integrated mangrove-shrimp farming. To implement the integrated mangrove-shrimp farming on the site, all parties and related institutions need to work together to solve the problems and to face the challenges. According to this study, pond farmers evaluated that there were still many improvements that need attention to mangrove planting performance, maintenance, and monitoring/evaluation. Hence, those three indicators were highlighted by pond farmers, particularly areas of ponds, green belt, and abandoned lands.

The result showed that most pond farmers were not really satisfied by all the implementations. The means of pond farmers' satisfaction of the former group were 2.1 (low), 1.3 (lowest), and 1.5 (lowest) for mangrove planting performance, maintenance, and monitoring/evaluation, respectively, and the other group was approximately 3.4 (high), 2.2 (low), and 1.4 (lowest). Thus, comparing those two groups, the satisfaction level of the latter group is higher than that of the former group (Table 5).

Table 5

Pond farmers' satisfaction with the implementation of government policy in integrated mangrove-shrimp farming

No.	*Implementation of integrated mangrove-shrimp farming policy*	*Pond farmers group that planted mangroves outside pond (n=231)*		*Pond farmers group that planted mangroves in pond (n=41)*	
		Mean±SD	*Satisfaction level*	*Mean±SD*	*Satisfaction level*
1.	Mangrove planting performance	2.1±0.77	Low	3.4±1.09	High
	- in pond	-	-	3.3±0.08	
	- green belt	2.4±0.05		4.2±0.10	
	- abandoned areas	1.8±0.04		2.6±0.22	
2.	Maintenance	1.3±0.65	Lowest	2.2±1.21	Low
	- in pond	-	-	2.1±0.19	
	- green belt	1.1±0.03		2.0±0.17	
	- abandoned areas	1.5±0.04		2.5±0.19	
3.	Monitoring and evaluation	1.5±0.73	Lowest	1.4±0.84	Lowest
	- in pond	-	-	1.7±0.12	

- green belt	1.7±0.04	1.1±0.06
- abandoned areas	1.3±0.04	1.4±0.12

Note: SD - standard deviation.

In detail, the satisfaction percentage of the former group for mangrove planting in green belt and abandoned areas were 19% (strongly unsatisfied), 57% (unsatisfied), 18% (neutral), and 6% (satisfied). Next, for implementation of maintenance were 77% (strongly unsatisfied), 16% (unsatisfied), 5% (neutral), and 2% (satisfied), then 62%, 26%, 11%, and 1% for monitoring/evaluation respectively (Figure 3). Those realizations were really dominated by the unsatisfaction of this pond farmers group.

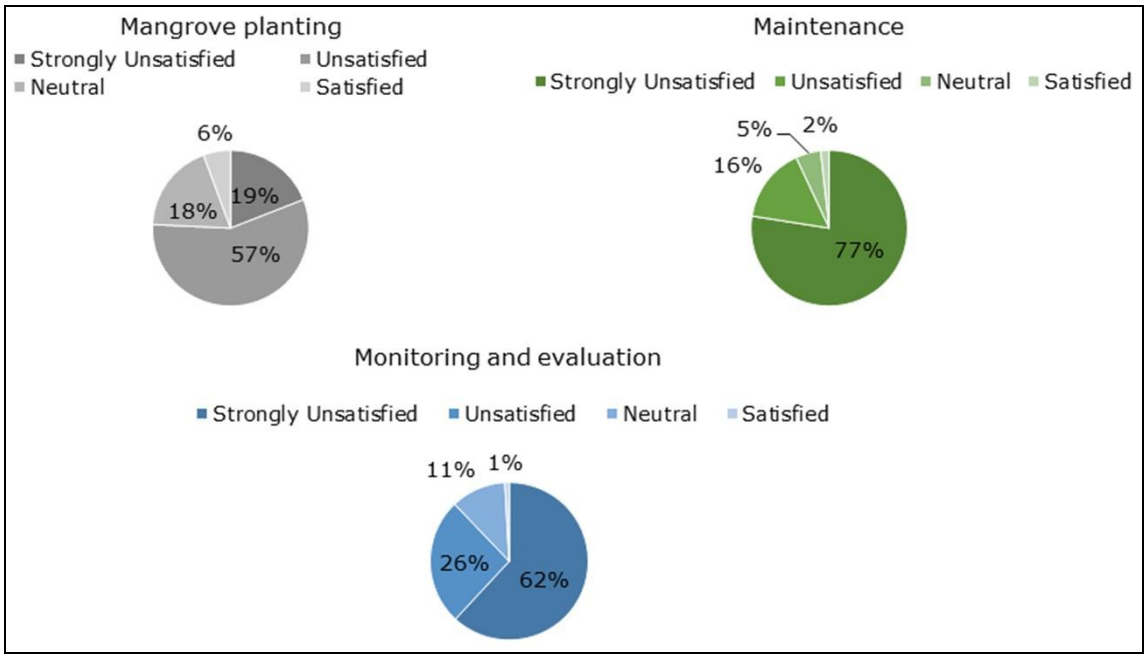

Figure 3. Satisfaction of pond farmers' group who planted mangroves outside pond for mangrove planting area, maintenance, monitoring/evaluation.

Otherwise, although unsatisfaction looks prominent, the latter group was still satisfied by the implementation of the integrated mangrove-shrimp farming policy in ponds, green belts and abandoned areas. The satisfaction percentage for planting mangroves were 27% (unsatisfied), 24% (satisfied), 29% (neutral), and 20% (strongly satisfied), following 39% (strongly unsatisfied), 19% (unsatisfied), 27% (neutral), 10% (satisfied), and 5% (strongly satisfied) for implementation of maintenance. Then, for monitoring/evaluation, it covered strongly unsatisfied (76%), unsatisfied (12%), neutral (7%), and satisfied (5%) (Figure 4).

In the mangrove planting stage, the chance of failure was high enough, because the low growth of mangrove seedlings was influenced by the pond condition which was always in a state of flooding, such as *Avicennia* spp. that grew only 2.4% from 2000 seedlings (Basyuni et al 2022), as well as, determined by onsite/species selection, propagule sources, nursery protocols, outplanting techniques, and biological/physical/anthropogenic threats (Primavera et al 2011). The other failure was due to species of shrubs or herbs (*Acanthus ilicifolius* and *Derris heterophylla*) that colonize and dominate the mangrove forest floor. Hence, it prevented the mangrove tree propagules from growing, such as the case in Segara Anakan, Cilacap (Djohan 2015).

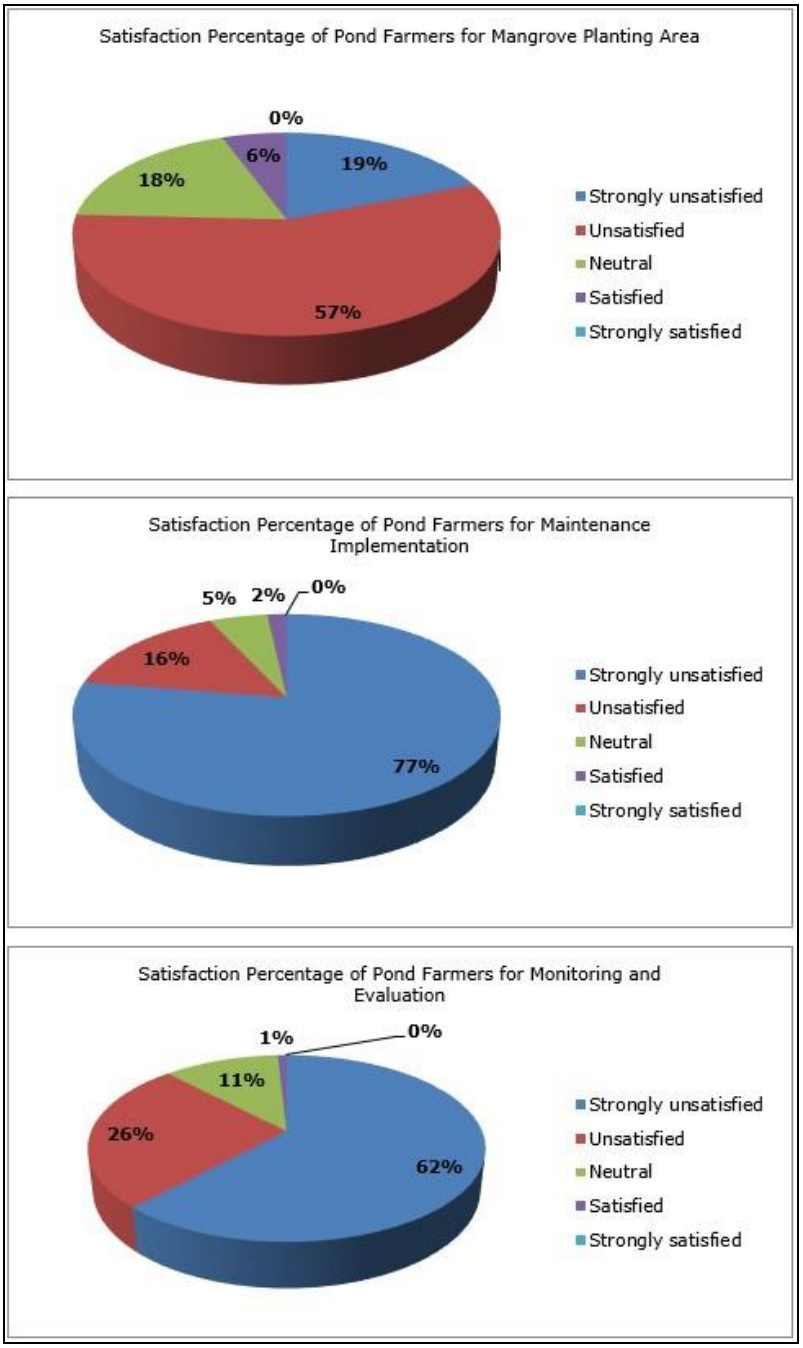

Figure 4. Satisfaction of pond farmers' group who planted mangroves in ponds for mangrove planting area, maintenance, monitoring/evaluation.

Moreover, the pond management used by the latter group in the field was selectively pruned by some branches and tree trunks of 5 to 7-year-old mangroves to decrease density volume. However, Trang et al (2022) recommended that the highest profit margin was at 9–12 years from planting for pond environment and shrimp productivity. Also, the upgraded thinning and selective harvesting of mangrove tress did not contribute to the loss of mangrove forests and negative effects on vegetation cover (Phong & Nuong 2023). The other method of shrimp farming recognized as an alternative model of shrimp farming, is the separated pond. In Indonesia, this model was called komplangan. Komplangan pond was a pond model developed where this concept of environmentally friendly ponds combines fish/shrimp cultivation activities with efforts to plant, maintain, manage and conserve mangroves, where mangroves were planted outside of main cultivation canal that was separated by dike and watergate (Lusiana & Triana 2019). This pond model was also recognized in Vietnam (Johnston et al 2000).

While applying the government policy, there was a telling response from pond farmers that rehabilitation might be permitted but required attention to the community's ponds and their skills. The lack of government attention was seen in the management of integrated mangrove ponds in the field as not optimal, including the knowledge and expertise of farmers in managing the ponds which were still lacking. Some of the problems of mangrove ponds that were still often faced by farmers include: 1) lack of mangrove maintenance in the ponds resulting in mangrove leaf litter falling and rotting in the water, 2) there are shrimp, crabs and fish trapped under the mangrove roots in the ponds resulting in hampered harvesting, and 3) damage to pond embankments due to the growth of large mangrove tree roots around the pond embankments. A similar result was reported by Alam et al (2021), Alam et al (2022a) and Alam et al (2022b), that the long term use of mangrove leaf litter might degrade the water quality and impact shrimp production decline in the pond. Also, when mangrove trees grow to be more than 20 years old, high wind loads on the mangrove canopy can cause the trees to fall during hurricanes (Mancheño et al 2023). That was why proper maintenance, monitoring and evaluation in ponds, green belts, and abandoned areas are important to be noticed.

The green belt was a positive natural capital asset capable of providing multifunctional benefits to people (Kirby & Scott 2023), but targeted abandoned ponds reversion to being an area of mangroves, more favorable due to large size and appropriate site conditions (Duncan et al 2016) for bringing back fishes' diversity (Ikejima et al 2006). As in Andhra Pradesh, India, efforts to return abandoned ponds to mangroves can reduce conversion of agricultural land to shrimp ponds, while preserving agricultural land (Jayanthi et al 2019).

A strategy through training, workshops and seminars must be provided more. According to Slavković and Slavković (2019), training improves the career of employees, makes them more successful at work, and makes their community more profitable. Training to select mature mangrove seedlings and monitoring skills at mangrove replanting sites increases the willingness of people to participate (Abdullah et al 2014). Further, in the Riau Islands, the government and related institutions have implemented the strategy of the principle of common heritage of mankind for raising the public awareness of the negative impacts of mangrove logging (Daulay et al 2023). Figure 5 shows pond farmers' presence in trainings/workshops/seminars for each group in the field. The former group participated as much as 82%, and 18% did not attend, while the latter group attended as much as 100%.

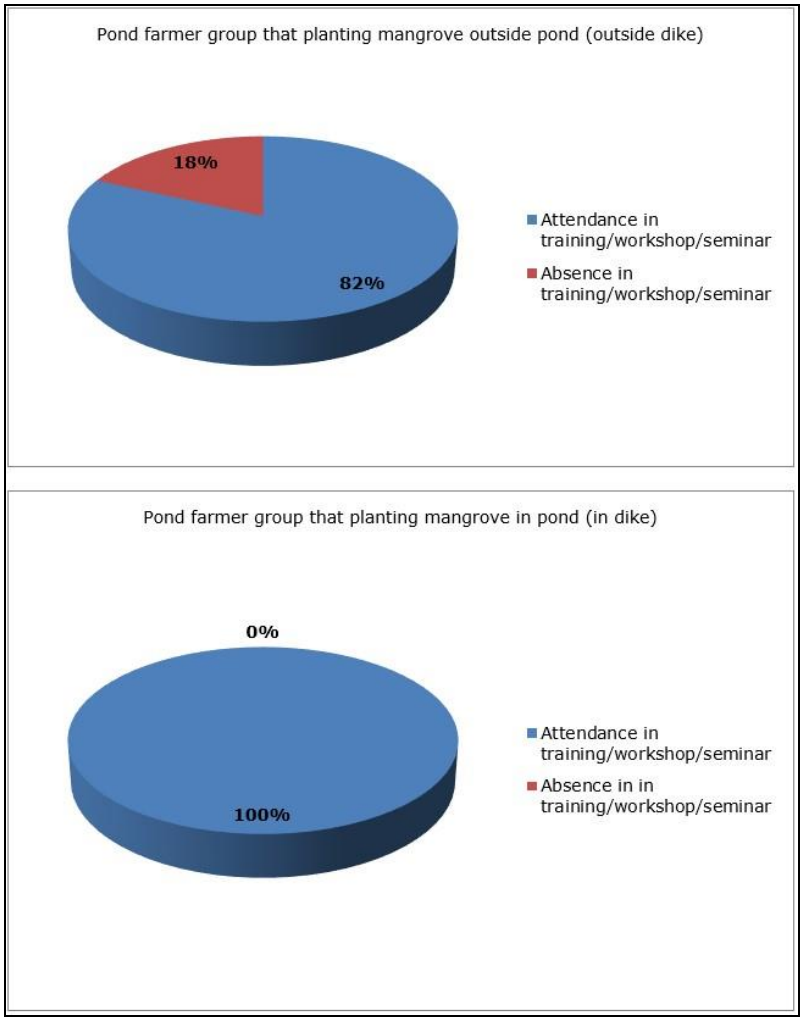

Figure 5. Pond farmers participation in trainings/workshops/seminars.

Conclusions. The implementation of government policy in the integrated mangrove-shrimp farming was found to be defective based on not achieving optimally mangrove planting in ponds (silvofishery) and green belt area (between pond dike and river or sub canal) in the field even with the increase of mangrove covering since 2019. The failure was encouraged by unsatisfaction of pond farmers toward mangrove planting performance, maintenance, and monitoring/evaluation of the program. In analysis, pond farmers were not really satisfied by the implementation of government policy in the integrated mangrove-shrimp farming, however comparing the two groups, the satisfaction level of the latter group (group that planted mangroves in ponds) is higher than the former group (group that planted mangroves outside pond). The means of those pond farmers' satisfaction of the former group were 2.1 (low), 1.3 (lowest), and 1.5 (lowest) for mangrove planting performance, maintenance, and monitoring/evaluation, respectively, and for the other group was approximately 3.4 (high), 2.2 (low), and 1.4 (lowest).

Recommendation. The pond farmers' satisfaction in the Mahakam Delta can be considered in developing a strategy for the sustainability-enhancing of mangrove-shrimp farming management. The government needs to tighten policy through a proper and evaluated program and might improve knowledge and skill of pond farmers through more training, workshops and seminars.

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Conflict of interest. The authors declare that there is no conflict of interest.

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