

Collective actions to support sustainable aquaculture: evidence from brackish water ponds area in Aceh Tamiang

Armen Zulham ^{1*}, Nensyana Shafitri ², Budi Wardono ¹, Radytio Pramoda ³, Cristina Yuliati ², and Agus Heri Purnomo ⁴

¹Research Center for Cooperative, Corporation, and People's Economy – National Research Innovation Agency Jakarta- Indonesia

²Research Center for Marine and Fisheries Socio Economics. Jakarta Indonesia

³Research Center for Behavioural and Circular Economics – National Research & Innovation Agency Jakarta- Indonesia

⁴Research Center for Society and Culture – National Research & Innovation Agency. Jakarta- Indonesia

Abstract. Our research focuses on establishing and improving farmers' organization in areas with brackish water aquaculture. This research aims to promote sustainable aquaculture enterprises in Aceh Tamiang by engaging fish farmer organizations and promoting collective action. Managing a brackish water region covering a total land area of 3,624.5 hectares requires collective action measures. There is no local governing body that manages water resources or the environment and surroundings of the ponds. Farmers who require knowledge about pond waste and sediment management in the context of fish farming can better understand pond season planting techniques. We selected two villages from the four sub-districts of Aceh Tamiang to gather relevant data from April to May 2021. We comprehensively investigated the brackish aquaculture in Sungai Kuruk III, located in the Seruway sub-district. Our study recommends the formation of a collective entity called Gapokkan, where groups of brackish water fish producers from various villages in Aceh Tamiang can collaborate and unite. Gapokkan can effectively address various difficulties associated with brackish water pond areas to achieve sustainable aquaculture in Aceh Tamiang.

1 Introduction

Community groups engaging voluntarily to establish a sustainable aquaculture enterprise is collective action. In Aceh Tamiang, this study aimed to improve the managerial and commercial frameworks in the 3,624.5 hectares of brackish pond regions across four sub-districts [1]: Seruway (652.5 ha), Banyak Payet (1,317.0 ha), Banda Mulia (1,403.1 ha), and Bendahara (251.9 ha). Unfortunately, from 2008 to 2017, a lack of collective action led to a

* Corresponding author: keude_bing@yahoo.co.id

decrease in the area of these ponds from 5,605.9 hectares to 2,828.9 hectares, at an annual reduction rate of 0.35%. The Seruway sub-district had the highest rate at 0.57%, while Banda Mulia had the lowest rate at 0.15%. The empirical evidence obtained from field observations showed that the implementation of local government initiatives to restore coconut palm plantations, along with financial assistance provided by the central government, contributed to the reduction in the size of brackish ponds. The reduction was mainly due to the establishment of coconut palm plantations, which significantly contributed to the region's economy by accounting for over 25% of the Gross Regional Domestic Product (GRDP) in Aceh Tamiang [2, 3]. The fisheries sector contributed to around 3.5% of the agricultural sector and 40.5% of the GRDP.

The cultivation of vanamei shrimp (*Litopaneaus vannamei*) in Aceh Taming increased by 0.3% per year between 2017 and 2019, as evidenced by the expansion of brackish pond areas. The legalization of brackish ponds built by locals in mangrove forest-protected zones has aided this progress. The Tanah Objek Reformasi Agraria (TORA) was responsible for the legalization. Farmers were allowed to use the company's abandoned brackish water ponds, which were left due to conflict in Aceh. Changes in the number of brackish water ponds in Aceh Tamiang do not have the same consequences as those described in references [4, 5, 6]. The municipal government's policies should have encouraged brackish water pond farmers to collaborate and take collective action. Collective actions are critical in achieving consolidation, specialization, organization building, and organizational structure change to exploit fishery resources and access markets successfully. The policies of local governments have created new challenges, including changes in ownership structures of brackish water ponds, establishing an organization for managing the business, creating a local institution to manage water and the environment, and coordinating production activities. Community action is necessary for brackish water pond production to increase from 1,616 to 6,000 kilograms per hectare per year and gain market access [7]. Small-scale fishermen have successfully managed fisheries and gained access to export markets through collective actions in hybrid and network arrangements with other parties. [7, 8].

This research proposes collaborative measures among fish farmers in Aceh Tamiang to establish a sustainable brackish water aquaculture business. The paper is divided into two sections: materials and methods, results and discussion, with the ultimate goal of improving the region's economy and people's well-being through collective action to address the previously mentioned problems. The study results and subsequent discussion highlight the collaborative efforts required to manage brackish water businesses. Additionally, the paper identifies crucial factors necessary for collective action in the brackish water ponds of Aceh Tamiang.

2 Material and methods

2.1. Survey period and location

This study was conducted in Aceh Province, specifically in selected villages in four sub-districts of Aceh Tamiang, between April and May of 2021. The villages include Alue Sentang and Ujung Tanjung, which are part of Mayak Payed Sub-District; Alur Nunang and Matang Seuping, part of Banda Mulia Sub-District; Bandar Khalifah and Seunebok Aceh, part of Bendahara Sub-District; as well as Sungai Kuruk III and Kampung Baru, part of Seruway Sub-District—the research locations presented in Figure 1.



Fig. 1. Research locations in Aceh Tamiang District, 2021.

2.2 Data collection

This research involves the use of both secondary and primary data. The Aceh Tamiang Marine Fisheries and Food Agency provided secondary data, while 160 respondents in 8 villages provided primary data.

2.3 Data analysis

The table presents a statistical analysis of total number, average, and percentage, followed by an explanation of the results using descriptive techniques.

3 Results

3.1 Managing brackish water pond areas by fish farmer organization

Collective action among brackish water fish farmers can maximize long-term benefits, address dangers posed by poorly managed pond regions, reduce livelihood insecurity [9, 10], and access prospective markets. According to [11], institutional entities such as fish farmer groups, producers/fish farmer associations, farmer firms, and cooperatives [18] can potentially improve the management of brackish water pond regions and the shrimp industry.

Table 1 presents the findings of an investigation conducted in the brackish water pond regions of Aceh Tamiang in 2021. The table shows 30 fish farmer organizations operating in the area. Matang Seuping and Sungai Kuruk III have seven groups each, while Seunebok Aceh and Ujong Tanjung have one. Additionally, there are six fish farmer groups in Banda Khalifah, three in Kampung Baru, and five in Alur Sentang. The government established these groups to support the brackish water pond business and alleviate administrative problems. The ownership of brackish water ponds varies; 13% are privately owned, 67.7% are rented or leased, and unmanaged ponds occupy 19.4%.

Table 1. The number of brackish water fish farmer organizations in Aceh Tamiang, 2021

| Villages | Brackish water pond ownership status (%) | | | Number of fish farmer groups |
|------------------|--|---------------|----------------------|------------------------------|
| | Private owned | Rent or lease | Occupy unmanage pond | |
| Kampung Baru | 19.0 | 38.1 | 42.9 | 3 |
| Sungai Kuruk III | 16.6 | 66.8 | 16.6 | 7 |
| Alur Nunang | 0.0 | 94.4 | 5.6 | 0 |
| Matang Seuping | 5.6 | 77.2 | 17.2 | 7 |
| Seunebok Aceh | 15.0 | 70.0 | 15.0 | 1 |
| Bandar Khalifah | 26.3 | 68.4 | 5.3 | 6 |
| Alue Sentang | 0.0 | 89.5 | 10.5 | 5 |
| Ujung Tanjung | 21.1 | 36.8 | 42.1 | 1 |
| Average / Total | 13.0 | 67.7 | 19.4 | 30 |

In 2021, a fish farmer group called Gapokkan Sepakat was established in Sungai Kuruk III village, Seruway sub-district. The organization was formed by seven fish farmer groups, namely Pokdakan Berkah, Pokdakan Tamiang Lestari, Pokdakan Mekar Jaya, Pokdakan Raja Ulak, Pokdakan Purna Abadi, Pokdakan Bina Paya Rambe, and Pokdakan Harapan Baru. This collaboration of fish farmer groups aims to enhance their productivity and improve their livelihoods. It was officially recognized by issuing a Decree of the Head of Marine Fisheries and Food Agency of Aceh Taming District Number 523/387 in 2021. Each farmer group in Sungai Kuruk III Village consisted of 7 to 9 members with a simple organizational structure. On the other hand, Gapokkan Sepakat consisted of 79 members, necessitating a better organizational structure and strategies to address challenges in brackish water pond regions. Gapokkan Sepakat pledged to support production and access to modern markets as a potential vehicle for brackish water fish producers' economic and social growth [5, 11, 12, 13].

3.2 Key elements to perform collective action to promote sustainable aquaculture business

Gapokkan Sepakat is crucial in promoting sustainable aquaculture, managing water in pond farms, and handling waste and sediment [10, 14, 15, 16]. Kurien [17] suggests ten critical elements for fish farmer organizations to promote sustainable business. These elements include collective agreement and resolve, a vision for collective action, democracy and transparency in functioning and governance, trust in those elected to lead, resources and institutional arrangements, gender accounting, courage and conviction in the face of adversity, information on activities, achievements, and failures, education to build capacity, and alliance building with other organizations. In Costa Rica [7], Kurien's essential elements were condensed into seven critical elements.

We analyzed Kurien's six critical elements for promoting sustainable aquaculture business in Aceh's brackish water pond areas, including controlling environmental pollution, managing water through reservoirs, and waste and sediment management. Table 2 summarizes the significant findings for these aspects.

Table 2. Kurien's principal components analysis found in Aceh Tamiang in 2021

| Grouped of Kurien's key element | Finding from the field to support key element | Target |
|---|--|--|
| Collective agreement and collective action | <ul style="list-style-type: none"> - Gapokkan Sepakat is a newly formed organization that consists of seven fish farmer groups joining forces. - There are three collaborative actions: controlling environmental pollution, managing reservoir water supply, and handling waste and sediment. | Each village will have a group of fish farmers practicing Good Aquaculture Practices within five years. |
| Resources and institutional arrangements | <ul style="list-style-type: none"> - Access to the market at an affordable price - Allow access to trash and sediment management institutions or businesses. - Provide competitive pricing and access to numerous market venues or off-takers. | <ul style="list-style-type: none"> - Eliminate monopsony in the provision of input, waste, and sediment services. - Remove monopolies in the sale of production |
| Courage and conviction to face odds | To maintain the best environment and water management, promote and implement village regulation of brackish water pond areas. | Brackish water regulation in Aceh Tamiang for environmental and water management |
| Building alliances with other like-minded organizations. | Establish partnerships with the Aceh Taming District Marine Fisheries and Food Agency, the Ujung Batee Fish Aquaculture Installation, and the Farmer Irrigation Management Group (Poklina). | Develop a good brackish water pond governance system. |
| Education to build capacity | <ul style="list-style-type: none"> - Brackish water reservoir training for fish farmer groups. - IPAL training for fish farmer organizations. - Water management training and pond planting season for fish farmer groups | Good Aquaculture Practices Implementation |
| Processes to evaluate actions and envision changes for the future | Legal documents have been prepared for the village's brackish water fish farmer group, which has received support from the local government. | <ul style="list-style-type: none"> - Legal documents for all Aceh Tamiang brackish water fish farmer organizations - Provide legal documents to end monopsony and monopoly in the brackish water aquaculture business. |

4 Discussion

Gapokkan Sepakat's collective initiatives have been more effective than those of the fish farmer group. The organization collaborates with various parties and engages in four principal activities, as listed in Table 2.

The first task is to reduce pollution in the brackish water pond regions. Gapokkan Sepakat in Sungai Kuruk III village intervened in the charcoal and poultry businesses because they were polluting the area. Moreover, these operations were illegal and took place along the canal supplying water to the brackish water ponds. The charcoal-making industry was consuming mangrove forests, resulting in the degradation of fish nursery grounds. The poultry sector's manure has degraded the water quality for vanamei shrimp production. Gapokkan Sepakat is creating local legislation to safeguard the water ecology, which is expected to ensure the shrimp farming industry's long-term sustainability.

The cultivation of vanamei shrimps requires high-quality water. To address this, Gapokkan Sepakat partnered with the Installation of Fish Aquaculture Ujung Batee- Banda Aceh to introduce reservoir ponds for water management in brackish water. The purpose of a reservoir pond is to remove pollutants, such as chicken excrement and trash from the charcoal industry, from polluted rivers. Additionally, having a reservoir pond is a prerequisite for receiving the Certificate of Good Aquaculture Practice in brackish water pond regions. [14].

Waste and sediment management is essential in the brackish water pond business. Different types of waste are generated in this business, such as fish food waste, solid waste from the fish, bacteria colonies, ammonia, urea, carbon dioxide, phosphorus, and hydrogen sulfide [15]. Gapokkan Sepakat and the Ujung Batee Fish Aquaculture facility in Banda Aceh have installed a liquid waste processing facility (IPAL) in conventional brackish water ponds to address this issue. Various wastes from brackish water ponds are not directly channeled into canals or rivers because the liquid waste, high in nitrogen and phosphorus, can create algae blooms and catastrophic fish mortality. An extremely low amount of oxygen dissolved in water can cause mass fish death [16]. Companies must have an IPAL in their brackish water pond to obtain a Good Aquaculture Practice certificate, indicating eco-friendly fish farming [14].

In Aceh Tamiang, shrimp farmers may need to become more familiar with the growing season, but the final step is pond planting. Fish farmers, on the other hand, continuously perform fingerling, growing, and harvesting throughout the year. Unfortunately, shrimp are prone to diseases that can lead to harvest failure. A rotation system must be implemented where shrimp and fish are sowed alternately. Alternating cultivation of shrimp and milkfish using a rotation method is recommended. Shrimp are cultivated for eight months and milkfish for the remaining four. The harvest ratio is 2:1, with one fish harvest after every two shrimp harvests. For instance, shrimp cultivation commences in February, and it takes three months for them to mature and be harvested, which happens in May. After the first harvest, the shrimp seeds are dispersed for the second planting season in June, and the harvest for this cycle occurs in September. Fish farming, on the other hand, occurs before the second shrimp planting season. Fish seeds are sown in September, and the harvest occurs in January.

5 Conclusion

Gapokkan Sepakat promotes sustainable aquaculture in Aceh Tamiang by regulating pollution, managing water for cultivation, and waste and sediment disposal. These organizations work together towards sustainable aquaculture in brackish water, following Kurien's six fundamental principles. Participating groups include the Marine Fisheries and

Food Agency, the Ujung Batee Fish Aquaculture Installation, and the Farmer Irrigation Management Group (Poklina). The goals are establishing a fish farmer organization in each village, implementing Good Aquaculture Practices, eliminating monopoly in the brackish water business, issuing environmental and water management regulations, and establishing good management of brackish water ponds.

Acknowledgement

This project received support from APBN-BBRSEKP funding in 2021. We express our gratitude to the Head of the Center for Socioeconomic Research of Marine and Fisheries for their support, and to the Aceh Tamiang Fisheries Extension officials who assisted us in collecting data from eight Aceh Tamiang villages.

References

1. Aceh Tamiang Food and Fisheries Offices Brackish water pond statistic (2020)
2. Aceh Tamiang in Figures BPS Aceh Tamiang (2010)
3. Aceh Tamiang in Figures BPS Aceh Tamiang (2021)
4. Maspaitella M, Garnevska E, Siddique M I, Shadbolt N, The International Food and Agribusiness Management Review **21** (2018)
5. Narrod C, Roy D, Okello J, Avendano B, Rich K, Thorat, Food Policy **34** (2009)
6. Reardon T, Barrett C B, Berdegue J A, Swinnen J F, World Development **37** (2009)
7. Rivera V S, Patricia M C, David C R, Brian O, Maritime Studies **16** (2017)
8. Rasmussen L N, Meinzen-Dick R S (1995)
9. Béné C, G Macfadyen, E H Allison, FAO Fisheries Technical Paper **481** (2007)
10. Kalikoski D, N Franz, *Strengthening organizations and collective action in fisheries* FAO Fisheries and Aquaculture Proceedings **32** (2014)
11. Markelova H, Meinzen-Dick R, Hellin J, Dohrn S, Food Policy **34** (2009)
12. IFAD *Promoting market access for the rural poor in order to achieve the millennium development goals* (2003)
13. Rao E J O, Qaim M, World Development **39** (2011)
14. Zainal A, N Prayitno, Budi S, Soedarsono & Prijadi *JU* **1**(2), 1-11(2011)
15. Nur A, *Manajemen Pemeliharaan Udang Vannamei*, BBPBAP, Jepara (2011)
16. Somamiharja A, *Bijak mengelola limbah tambak udang* (2020)
17. Kurien J, *Collective action and organisations in small-scale fisheries*, FAO Fisheries and Aquaculture Proceedings **32** (2014)
18. Masoud S, Heshmatollah S, Masoud A, Khalil M, Elham A, Esmail A, Ateieh S, J. the Saudi Society of Agricultural Sciences **16** (2017)