Jurnal Pengelolaan Perikanan Tropis (*Journal of Tropical Fisheries Management*)

Website: http://journal.ipb.ac.id/index.php/jurnalppt
e-ISSN: 2721-1525
Vol. 8 No. 2: 68-75 (2024) https://doi.org/10.29244/p13b2243

Optimization Of Vaname Shrimp (*Litopenaeus vannamei*) Ponds Using A Social Ecological System (SES) In Jatimalang Village, Purworejo Regency.

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Received: Jan 2024 / Accepted: 09 12 2024

ABSTRACT
Many vannamei shrimp (*Litopenaeus vannamei*) ponds in Jatimalang Village are not producing, despite the fact that the potential for success in the pond industry is quite strong, as evidenced by high market demand and the suitability of the area for pond construction. As a result, this research was carried out in order to identify the source of the problem and offer remedies that can be implemented using the Social Ecological System (SES) approach and the method DPSIR (Driving Forces, Pressures, State, Impacts, and Responses). According to the research, the less than optimal pond land in Jatimalang Village was caused by a variety of factors, so it was necessary to have microfinance, infrastructure provision, farmers' ability and knowledge in pond management, the formation of farmer groups, a policy of converting land into ponds, the application of WWTP, changes in farmers' lifestyles, routine monitoring of water quality, the application of pond biosecurity, and business.

Keywords: Jatilawang, Pond, SES, Shrimp, Vaname.

INTRODUCTION

Jatimalang Village, Purwodadi District, Purworejo Regency, Central Java Province, is an ideal location for pond cultivation due to its proximity to sea and river water supplies. Based on the potential of aquaculture, the community is very interested in starting aquaculture pond businesses, as evidenced by the large number of ponds found along the road near the coast of Jatimalang Village, with the main commodity being reared, namely vaname shrimp (*Litopenaeus vannamei*).

However, some of the ponds in Jatimalang Village are underoptimized and are not producing, despite the fact that the potential for aquaculture is very high, implying that ecological, social, and economic issues such as the frequency of cultivated shrimp contracting disease or the high cost of pond operational equipment influence pond potential optimization. As a result, it is vital to understand the causes of less-than-optimal pond use in Jatimalang Village using a Social Ecological System (SES) approach in order to determine the best solution to the problems that exist. This study aims to identify the root cause of the problem of suboptimal pond land in Jatimalang Village using a Social Ecological System (SES) approach, then provide solution recommendations based on the results of the problem analysis, so that it can be used as a reference for pond farmers in Jatimalang Village in re-optimizing shrimp pond land.

MATERIAL AND METHOD

This study was carried out between March and May 2023 in Jatimalang Village, Purwodadi District, Purworejo Regency, Central Java Province. Figure 1 depicts the primary data collection for ecological parameters, which involved obtaining samples at three station sites. This study utilized the Horiba Water Quality Monitoring System, GPS, ammonia kit, camera, printer, and stationery. The materials used include water, pond soil samples, pond water samples, HVS paper, CmapTools software, Google Earth, ArcGIS (ArcGIS Pro and ArcMap), and Ina Geoportal.

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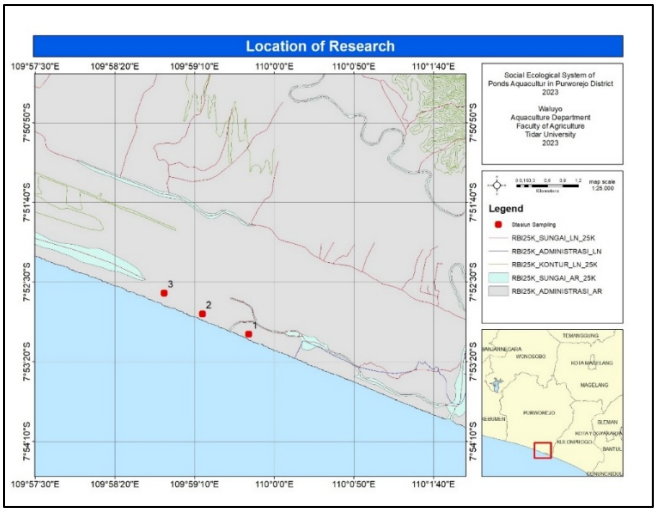

Figure 1. Research Location

This study's data was acquired utilizing the Social Ecological System (SES) approach and consisted of both primary and secondary data. The basic data in this study is comprised of ecological and social parameter data. Ecological characteristics measured include water quality in vaname shrimp ponds (temperature, pH, DO, salinity, ammonia, and pond water depth), pond area, beach distance, river distance, land slope, terrain, area use, production amount, pond system, cultivation technology, and commodities. Leadership, institutional data, land ownership, security level, income, revenue sources, regeneration, fixed and variable costs are examples of primary data for social factors. Secondary data was gathered through literature searches of numerous sources, including journals, theses, conferences, and so on, all of which were relevant to the research issue.

Ecological data was analyzed using a scoring method that modified the score with three suitability categories: a score of three categories is very suitable, a score of two categories is suitable, and a score of one category is not suitable (Kusuma *et al*., 2017; Akbarurrasyid & Kristiana, 2020). The gathered ecological and social parameter data was then evaluated in accordance with (Bradley, 2015), utilizing the DPSIR (Drivers-Pressures-States-Impacts-Responses) Eco-Health technique, as shown in Figure 2. The DPSIR approach can determine the relationship between factors that cause pressure on ecosystems, which can then be used to assess the intensity of human resource use and activities in coastal areas, as well as the relationship between ecological and social systems, or what is commonly referred to as the social ecological system (SES). CmapTools is a software tool for creating concept maps (Bradley, 2015).

The examination of the data obtained is organized according to the description of the DPSIR framework chart. After the group is created, the data is entered into the CmapTools software application in a sequential order, identifying driving forces, pressures, states, impacts, and responses. These reactions are studied sequentially using four other components: driving force-based responses, pressure-based responses, state-based responses, and impact-based responses, with subsequent replies appearing on each chart of the other four components. During the identification process, each chart is strengthened by questions and answers or discussions with respondents who can represent the two components of each framework, namely social, community, and ecological, in order to obtain accurate information about the relationship between social, economic, and environmental factors, which is then entered into the template. The DPSIR framework chart in CmapTools has the following color scheme: Driving Forces in grey, Pressures in light green, State in orange, Impacts in yellow, and Responses in purple. The DPSIR framework can be viewed as follows: each chart contains the results of the analysis. Each chart has its own color that represents each DPSIR component, allowing problems and impacts to be identified by reading the chart and following the flow of each arrow shown along with its description in accordance with the framework order, namely driving forces, pressures, states, and impacts, before returning to the driving chart. Forces are used to build a complete cycle, and the response chart is placed in each framework sequence so that it can be read concurrently with the chart in the framework being read.

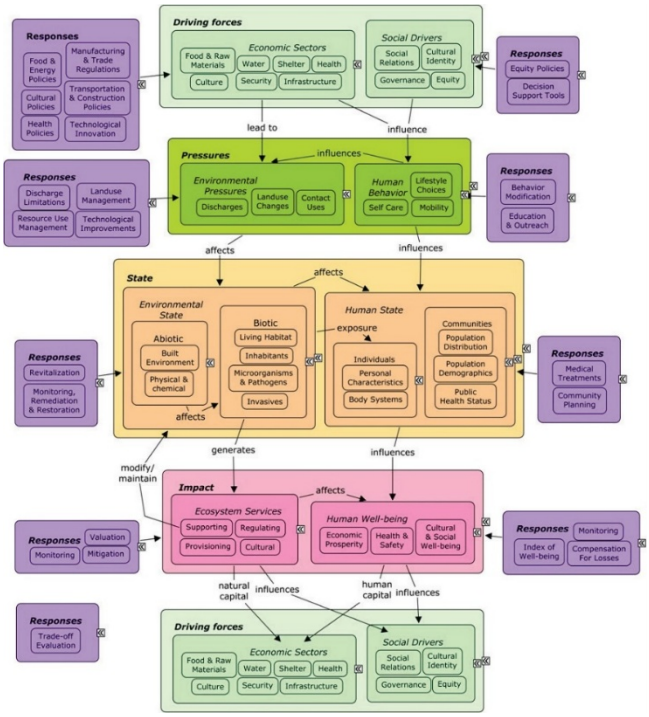

Figure 2. DPSIR Eco-Health
Sources: (Bradley, 2015)

RESULT AND DISCUSSION

Socioeconomics of the Jatimalang Village Community

The socioeconomic results, in the form of questionnaire scores, can be found in the table attached on pages 119-123. The population of Jatimalang Village is 427 heads of families (KK), including 117 families in Krajan I Hamlet, 119 families in Krajan II Hamlet, 87 families in Patalan Hamlet, and 102 families in Patuk. Jatimalang Village has a population of 1,253 people, with 582 men (46.4%) and 671 women (53.6%) ranging in age from 0 to 3 years, 58 people 4-6 years, 67 people 7-12 104 years old, 85 people 13-15 years, 91 people 16-81 years, and 848 people 19 years and above (BPS Purworejo, 2023).

Coastal communities are people who live and engage in socioeconomic activities that are inextricably linked to coastal and marine resources, resulting in a significant reliance on the potential and circumstances of these resources. People live together in coastal locations, forming and maintaining a distinct culture based on their reliance on coastal resources. As a result, the majority of Jatimalang Village residents work as fishermen, including those who catch fish in rivers, sled net fishermen, and those who catch fish using outboard motor boats. Aside from fishing, many inhabitants in Jatimalang hamlet make a living from shrimp ponds, particularly vaname shrimp, and some work as agricultural laborers (Waluyo *et al*., 2021)

DPSIR Ponds of Jatimalang Village

Based on the numerous components in preparing the analysis utilizing the DPSIR approach, a framework in the form of DPSIR for ponds in Jatimalang Village was obtained as follows:

Driving Force

Driving force is a component that drives community activities in Jatimalang Village, allowing them to regularly meet their basic needs and live a decent life. Driving forces are classified into two categories: economic driving factors and social driving forces. In Jatimalang Village, especially for shrimp growers, the driving forces that arise are:

Economic Driving Forces

1. The substantial capital required for a shrimp farming firm includes both variable and fixed costs, with white shrimp being the primary commodity. Farmers in Jatimalang Village require more than $50 million each year to operate a pond business.
2. Because there are no middle and high schools in Jatimalang Village, many economically disadvantaged youngsters are unable to continue their education. This occurs because there are no expenditures associated with returning home and traveling to school, which is located outside of Jatimalang Village.
3. In Jatimalang Village, there is no infrastructure to assist the advancement, development, and sustainability of pond agriculture, such as varying road construction between ponds. At station 1, the road between the ponds is paved, however at stations 2–3, the existing road construction is primarily made of sand. Sandy roads make it difficult to access or reach ponds, and farmers' motorized vehicles frequently become stuck or unable to move because they are too deep in the sand, making driving through the sand difficult. There are variable and fixed costs, with white shrimp being the primary commodity. Farmers in Jatimalang Village require more than $50 million each year to operate a pond business.

Social driving forces

1. The inhabitants of Jatimalang Village are coastal communities who use the natural resources of the sea and beaches for various activities and revenue, one of which is as fish farmers. However, there is no shrimp farmer group in Jatimalang Village, despite the fact that many farmers understand the need of joining one.
2. The low level of education of fish farmers, caused by a lack of awareness of the importance of education, causes fish farm management to be less structured and efficient, resulting in high costs, even to the point of losing money and eventually going out of business.
3. The government provides no policy or support to fish growers in Jatimalang Village, such as capital loans or fry facilities.

Pressure

Pressures are activities carried out by Jatimalang Village residents in response to economic and social factors that seek to influence environmental or human behavior. forces are classified into two categories: environmental forces and human actions, like happened in Jatimalang Village.

Environmental Pressures

1. Waste products from vaname shrimp agriculture are returned to the shore from ponds closer to the beach, whilst garbage from ponds closer to the river is discharged into the river known as Kali Pasir. Farmers understand that rivers and beaches are the primary sources of water for their ponds, yet they continue to dump agricultural waste into beaches and rivers due to limited ways and a lack of information about waste water treatment plants.
2. Many unoccupied or agricultural sites near the coast have been transformed into ponds.
3. Farmers are more likely to get skin disorders as a result of continuous exposure to sunshine when managing their pond. Aside from that, managing the pond ecosystem requires a lot of energy, which can cause substantial exhaustion and even death if you aren't physically strong.

Human Behavior

1. Farmers' understanding of good and correct shrimp pond management is limited because they learn on their own without researching in depth or following applicable standards.
2. Farmers in Jatimalang Village lead an unhealthy lifestyle, which includes active smoking. Because of the risks that smoking poses to farmers' health and performance, this may limit their ability to carry out pond management measures. Farmers' garments do not protect their skin from sunshine, and some farmers prefer not to wear tops when managing the pond.

State

The state of the pond environment varies as a result of the stresses that occur. The state is separated into two categories: environmental state and human state. The situation in Tambak Jatimalang Village is as follows:

Environmental State

1. Farmers do not check water quality in their ponds, thus without recognizing it, the water quality of their ponds has deteriorated and is no longer appropriate for the survival of grown shrimp, and organisms that can cause disease and mass shrimp death have evolved.
2. White shrimp offer raw materials to the food industry, with the majority shipped to other regions and even nations, or consumed on a regular basis. However, vaname shrimp produced in Jatimalang Village sometimes die in large numbers due to disease and poor pond water quality, which does not match the shrimp's best capacity to survive and grow.
3. Egrets and blekok paddy birds are pests that cause problems for fish producers because they impair the pond's physical condition while also reducing pond productivity by feasting on germs. White Spot Disease (WDS), also known as Acute Hepatopancreatic Necrosis Disease (AHPND) and White Feces Disease (WFD), are two diseases that frequently affect vaname shrimp grown in ponds in Jatimalang Village.

Human State

1. Out of 30 responses, only one is female, while the remaining 29 are male. The harsh sun and the need for more energy when keeping ponds have led to the conclusion that only men are better suited to handle pond enterprises than women.
2. Because there is no security organization capable of guarding and anticipating all types of crime that occur in the pond region,

pond farmers must still deal with a number of losses.

3. Only two of the 30 respondents were under the age of 30, while the remaining 28 farmers ranged in age from 30 to 60 years. 45-60 years of age is no longer productive, which can impair business production in the ponds.

Impact

Impact merupakan perubahan kualitas dan fungsi ekositem yang berdampak pada kesejahteraan manusia. Impact terbagi menjadi Ecosystem Services dan Human Well-being. Impact yang berlangsung di Desa Jatimalang meliputi:

Ecosystem Services

1. The quality of the pond ecosystem is deteriorating, indicating that several conditions governing the suitability of the pond land are not being satisfied effectively.
2. If one of the vaname shrimp becomes affected, the potentially contaminated shrimp must be collected right as to prevent the disease from spreading to healthy shrimp.
3. Farmers have used electric and diesel water wheels to meet the dissolved oxygen needs of their vaname shrimp agriculture ponds. However, damage to the water wheel might result in the mass mortality of shrimp owing to a shortage of dissolved oxygen in the pond. Furthermore, the usage of probiotics and the growth of phytoplankton create competition for oxygen in the pond.

Human Well-being

Pond productivity has declined, with just approximately 77% of ponds still producing well. Pond productivity has declined, with just approximately 77% of ponds still producing well. 23% of ponds are no longer producing due to huge losses caused by shrimp mortality, leading farmers' income to fall and leaving them unable to afford the necessary capital costs. Furthermore, the price of shrimp on the market has plummeted dramatically.

Responses

1. Responses refer to components or activities that can be taken to fix problems that arise. Responses are classified into four types: driving force responses, pressure responses, state responses, and impact responses. The Implementation of microfinance for Jatimalang Village residents who want to start a pond company to help the community achieve its capital needs. Microfinance is an institution that provides funding or special financing for small, productive communities or MSMEs (micro, small, and medium enterprises) in order to achieve family prosperity (Andrean *et al*., 2023), or microfinance is a type of financial service that serves as a fund raiser and provides small loans and financial services to low-income people who do not qualify for bank loans. Microfinance is thought to be one of the most effective strategies to improve people's lives. These institutions may originate from the government, non-governmental groups, or the commercial sector.
2. The requirement for money for good and proper pond maintenance in order to maintain the quality of the waters and keep the shrimp being farmed in peak condition for both pond owners, technicians, and feeders. The larger the capital of the individual who maintains the shrimp pond directly, the better the outcomes; conversely, if the capital of the individual who manages the shrimp pond is poor, difficulties may occur in the pond, including devastating losses. Furthermore, feed children typically merely carry out orders from the pond owner without fully comprehending the situation, therefore it is critical to provide feed children with understanding, expertise, and experience so that they can manage the pond rather than just following orders. This is consistent with (Deswati *et al*., 2020), who state that human capital is critical in the vaname shrimp cultivation business and focuses on individuals who manage the pond directly or feed children because, in some cases, the pond owner does not directly participate in managing the pond business he owns. only employs and feeds children. This also happened in Jatimalang Village, where 15 out of 30 respondents were pond owners who used feeders to manage their pond.
3. It is critical that various parties, particularly the government, provide infrastructure to support the progress and development of vaname shrimp aquaculture ponds in Jatimalang Village. Problematic infrastructure, such as problematic road access, can impede the process of running shrimp farms in Jatimalang Village and lower the degree of income that could be obtained. This is consistent with

(Akbarurrasyid & Kristiana, 2020), who state that road infrastructure to cultivation areas should be considered because unsupportive road infrastructure conditions will make it difficult for farmers to distribute their harvests, so the infrastructure must be in good condition to support the smooth operation of their fish farming business.

4. Shrimp growers in Jatimalang Village should join a group to boost the carrying capacity of their pond operations. According to (Rahma & Nuryaman, 2020), farmer groups will promote company growth and boost farmers' profitability. This group can be formed with the help of the government that collects it or community activities in order to get the best results in the pond company they operate, with physical and emotional assistance from fellow group members.

Recommended response for ponds in Jatimalang Village is as follows.

Driving Forces-based Responses

Pressure-based Responses

1. Disposing of waste on beaches and rivers, particularly without first managing it, has the potential to harm the environment and impair the quality of shrimp farming water since it is thrown into the pond's water source. Therefore, it is necessary to build an IPAL in ponds in Jatimalang Village, which is in accordance with (Fatimah *et al*., 2018.), who state that Waste Water Treatment Plants (IPAL) are one of the important efforts in processing waste in order to minimize the negative impacts arising from pond liquid waste containing. High quantities of organic compounds, such as phosphate and ammonia, can cause algae blooms.
2. The necessity for understanding of good and proper pond management in order to maintain the quality of the pond and surrounding waters and ensure that the shrimp being cultivated are constantly in peak condition for both pond owners, technicians, and feeders. The more knowledge and experience the individual who directly manages the shrimp pond has, the better the results will be, and vice versa. If the person in charge of the shrimp pond lacks knowledge, issues and even fatalities can occur. (Deswati *et al*., 2020) also claimed that solid human knowledge can serve as the foundation for running a good business management system, giving it advantages.
3. The government should establish a policy for pond design when changing existing land so that it complies with applicable guidelines by paying attention to aspects of land suitability, such as waste disposal, in conjunction with the implementation of IPAL to prevent other or new pond businesses from dumping waste into rivers and beaches, thereby harming the environment.
4. Changes in behavior or lifestyle to become healthier are necessary, given that fish farming demands a lot of energy to carry out the process every day since it must always be monitored, one of which is a healthy lifestyle that does not include smoking. Aside from that, the use of field clothes that can limit the intensity of sunlight exposure while carrying out pond business is critical since pond activities, which are frequently carried out during the day when the sun is very hot, can cause skin diseases.

State-based Responses

1. A severe reduction in water quality, even to the point where it is not suitable for vaname shrimp growth, is extremely dangerous, resulting in mass mortality and disease epidemics. As a result, water quality must be constantly checked and monitored to ensure that your shrimp pond is always in the best possible environmental circumstances for shrimp production. This is consistent with (Hertika *et al*., 2021), who state that optimal water conditions in vaname shrimp ponds will encourage shrimp survival in good conditions so that they are not easily attacked by disease, as diseases in shrimp are typically caused by a decrease in the water quality of cultivation ponds.
2. Biosecurity measures must be implemented in vaname shrimp agriculture ponds in Jatimalang Village due to frequent pest invasions, specifically egrets and blekok paddy birds, but there is no guard system in place to anticipate these pests. This is consistent with the findings of (Azmi *et al*.,2017), who indicate that a guard mechanism is required to prevent disease-causing viruses from being easily transferred from one pond to another by predators such as birds, otters, and other animals acting as vectors.

3. The notion that shrimp farming is only for men must be dispelled because efficient pond management can also be organized by a woman in her own way. Despite the fact that the procedure differs, the farmed shrimp are of greater quality.
4. Aging can cause a decline in an individual farmer's condition or physical strength, so appropriate methods are required for farmers who are no longer productive in the United States to be able to run their fish farming business, such as regenerating their descendants or closest family members who are still there.

Impact-based Responses

1. Providing water quality monitoring equipment, as well as counseling and assistance in their use, is one option that can be implemented to help farmers understand the condition of their pond waters. This is consistent with (Hertika *et al*., 2021) observation that the lack of comprehensive water quality measuring instruments resulted in erratic water control in shrimp cultivation ponds. Well-monitored water quality will simplify and accelerate the mitigation procedure or actions that must be made if the water quality conditions in your vaname shrimp growing ponds have deteriorated.
2. Fisheries education on good pond management, which includes maintaining the components in the pond from production to harvest, is required to increase the success of the pond cultivation business so that optimal efforts can be made in managing the ponds owned and improving the welfare of the pond farmers. This is consistent with (Aprilia *et al*., 2021) conclusion that fisheries education can influence fish farmers' behavior by encouraging the implementation of innovations ranging from pond construction to harvesting. The extension approaches and strategies presented are intended to be alternate answers to various problems encountered and are advocated through extension programs.

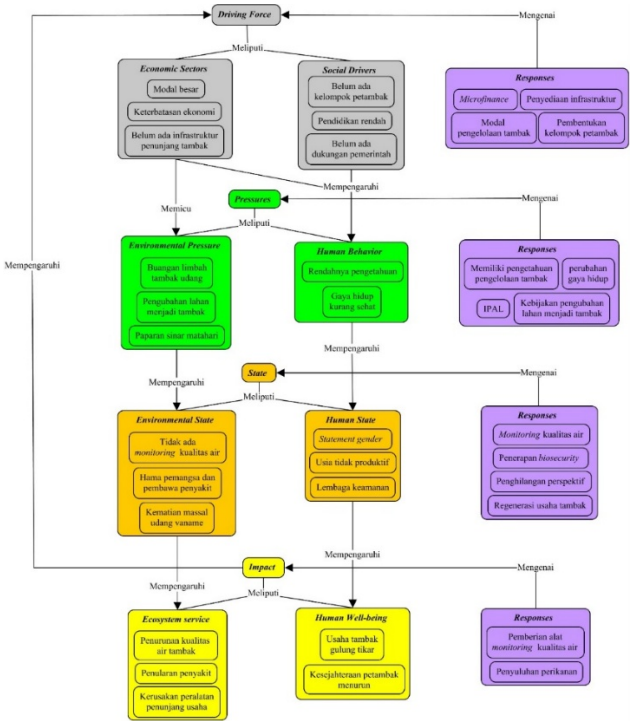

Figure 3. DPSIR Pond in Jatimalang Village

CONCLUSION

According to the findings of the research conducted using the Social Ecological System approach, the suboptimal pond land in Jatimalang Village is caused by a number of issues, ranging from the social to the ecological aspects of ponds that are deteriorating. As a result, these numerous issues must be solved immediately in order to re-optimise the pond property in Jatimalang Village. Based on the results of the DPSIR analysis, some recommended solutions that can be carried out are: providing microfinance; providing infrastructure; forming groups of farmers; implementing policies on converting land into ponds; changing farmer lifestyles; monitoring routine water quality; implementing pond biosecurity; business regeneration; and providing monitoring tools, and offering fisheries instruction for pond enterprises.

RECOMMENDATIONS

Further research into pathogens in ponds in Jatimalang Village is required to determine the types of pathogens that attack vaname shrimp cultivation ponds in Jatimalang Village, to find the most appropriate solution as a handling effort, and to reduce the risk of losses that farmers will incur. Aside from that, it is hoped that the author's recommended remedies can be adopted to Jatimalang Village ponds to ensure optimal and sustained production.

ACKNOWLEDGEMENT

We would like to thank the Dean of the Faculty of Agriculture at Tidar University, as well as the entire research team and Aquaculture study program students who participated actively in this research. Hopefully, the findings of this research will be valuable to all of us, particularly the government, in developing policies for managing protected fish resources in Indonesia.

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