



A Model of Freshwater Fisheries Development Strategy in the Context of Economic Resilience and Environmental Sustainability - evidence in Indonesia

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Abstract. The fisheries sector in Magelang Regency, Indonesia has not yet developed optimally. Even though the potential of Magelang Regency to develop this sector is quite large. In this regard, further studies are needed which aim to 1) identify the factors that influence freshwater fisheries business in Magelang Regency and 2) determine the right strategy to optimize freshwater fishery businesses in Magelang Regency. Based on the SWOT analysis, there are factors that affect freshwater fisheries business in Magelang Regency, namely the quantity and quality of seeds are not optimal, businesses in fish processing are still small, limited funding for fishery business actors, appropriate technology implemented is still medium scale, and limited extension workers fishery. Therefore, there are 6 strategies to optimize the fisheries sector in Magelang Regency, namely 1) increasing the quality and quantity of fish seeds, 2) empowering the community through fish processing businesses, 3) facilitating the availability of capital, 4) implementing appropriate technology, 5) implementing rain technology harvesting, and 6) addition of fishery extension workers at least 1 sub-district 1 person.

Keywords: Fisheries, Freshwater Fisheries, Magelang Regency, Fish.

1 Introduction

The Master Plan for the Development of Fisheries Areas in Magelang Regency for 2019-2028 states that the potential for fishery business land in Magelang Regency is 56,679.20 hectares, but only 5.59% has been utilized. The fishery business that has been developed in Magelang Regency is seeding. The BPS data update dated April 13, 2021 shows that Magelang Regency occupies third place in Central Java Province after Banjarnegara and Rembang Regencies for freshwater fish hatchery, while fish growing business ranks eighth. The role of Pokdakan is very important for the development of freshwater fisheries agribusiness [1]. Specifically for growing fish, one of the obstacles is the high price of feed, so the selling price is high and unable to compete with the price of fish from other districts. Besides that, it is also caused by the low consumption of fish in the community, which causes stunting. Based on Susenas 2000 data, the level of fish consumption in Indonesia is 22 kg per capita per year, then in 2010 it increased

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to 30.5 kg/capita/year, and finally in 2020 it was 56 kg/capita/year [2]. The fish consumption rate in Indonesia is even relatively lower compared to ASEAN countries and Indonesia is ranked 6th out of 8 countries [3]. The causes of the low level of fish consumption include the low level of people's income, so that the purchasing power of consumed fish and its processed products is also low [4]. This condition is a good opportunity to optimize the fisheries business in Magelang Regency. Apart from preventing and reducing stunting rates, it can also be a solution for the poor as additional income. The results of research related to fisheries are presented in Table 1.

Table 1. Research related to fisheries

| No. | Fishery Sector | Research result |
|-----|------------------------|--|
| 1. | Cultivation | The situation of consumption fish and ornamental fish cultivation in the Poskandu Partners group has the potential to develop with the support of good facilities and infrastructure, local government support, good communication between members, and has a strategic location, which is in the minapolitan area [5]. |
| 2. | Business Process | The existence of a fishing business has gone through several phases so that it can survive with the impact of the inland fishing business, namely the birth of several local entrepreneurs, community economic improvement, and regional income [6]. |
| 3. | Appropriate technology | The use of appropriate technology can increase production capacity by at least 15% and improve the quality of processed marine fishery-based products that are produced which include texture, shape and color as well as the availability of product display space that is safe, attractive and adequate [7]. |
| 4. | Leading Sector | The average results of the Statistical Location Quotient (SLQ) for the fisheries sub-sector in Central Java from 2015-2019 show the number 0.41, which means that fisheries is not a leading sector in Central Java. This result is supported by the Dynamic Location Quotient (DLQ) in Central Java of 0.18, which means that fisheries is a sector that is lagging behind compared to other sectors [8]. |
| 5. | Fishery services | The necessary services for freshwater fish farming and fishing in Mina Tumbreb Village, Tersangede Village, Salam District, Magelang are buying and selling of fresh fish, fishing services, educating services and dining services [9]. |

Based on this, freshwater fisheries have very good prospects because until now consumption fish, both in the form of fresh fish and processed forms, are still not sufficient

for consumer needs. This research is focused on five sub-districts that produce the largest products both from fish hatcheries and rearing [10]. The five sub-districts include Mungkid, Muntilan, Sawangan and Dukun sub-districts for fish hatchery businesses. For fish enlargement business covers Muntilan, Mungkid, Sawangan, and Srumbung Districts.

2 Method

The sample in this study were 5 sub-districts in Magelang Regency including Mungkid, Muntilan, Sawangan, Dukun, and Srumbung, because these five sub-districts are centers or centers for empowering freshwater fish in Magelang Regency. The strategy for optimizing the freshwater fishery business in Magelang Regency is determined using a SWOT analysis. Rangkuti stated that SWOT analysis is a useful analytical method for obtaining the right strategy formulation, adapted to the conditions and potential of the region [11].

Decision making for the formulation of strategies to optimize freshwater fisheries business in Magelang Regency using the IFAS and EFAS matrices, these matrices produce four sets of possible alternative strategies as shown in Table 2.

Table 2. SWOT Matrix Diagram

| EFAS \ IFAS | <i>Strengths (S)</i> | <i>Weakness (W)</i> |
|--------------------------|---|--|
| <i>Opportunities (O)</i> | Creating strategies that use strengths to take advantage of opportunities. | Creating strategies that minimize weaknesses to take advantage of opportunities. |
| <i>Threats (T)</i> | Create a strategy that uses strengths to overcome threats and opportunities | Creating strategies that minimize weaknesses to avoid threats |

Source: [11]

3 Result and Discussion

The five sub-districts in Magelang Regency which have the largest land for fish farming are Muntilan, Mungkid, Sawangan, Salam, and Dukun. Fig 1 shows a diagram of the area of fish farming land in Magelang Regency in 2021.

Weighting in SWOT is carried out by calculating the point factors which are carried out in an interdependence manner. That is, the assessment of one factor point is through a comparison of the level of importance with other factors, so that the value obtained (the range of values is equal to the number of factor points divided by the number of factor points).

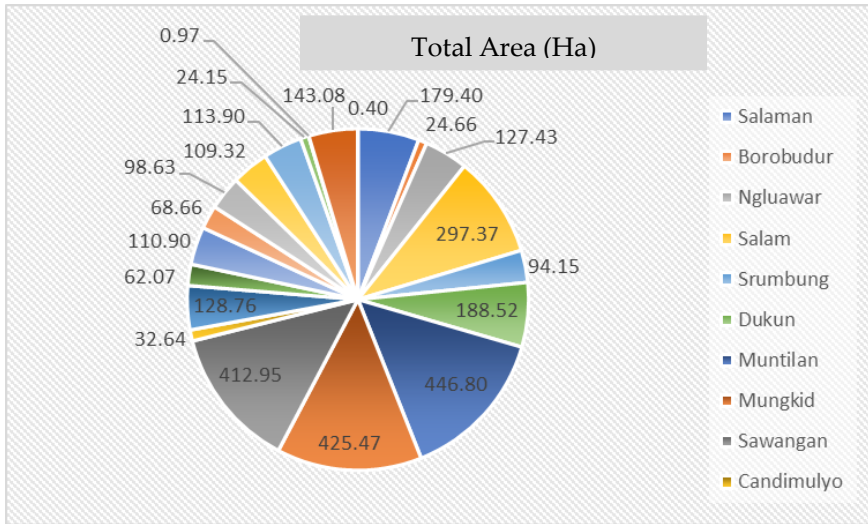


Fig. 1. The area of fish farming land in Magelang Regency in 2021 (Source: Farm and fishery Department, 2021)

Based on the factors that determine the freshwater aquaculture business in Magelang Regency, a strategy has been developed to optimize the freshwater fishery business in Magelang Regency which is listed in Table 3.

Table 3. Strategy Formulation with SWOT analysis

| IFAS | Strength (S) Internal strength factor | Weaknesses (W) Internal weakness factor |
|------|---|---|
| EFAS | <ol style="list-style-type: none"> 1. Availability of abundant water (during the rainy season) 2. Does not require a lot of land 3. Fish seeds are easy to obtain 4. The cultivation process is easy and does not require a long time | <ol style="list-style-type: none"> 1. Limited human resources in the Department of Education 2. Limited capital for business 3. The use of appropriate technology is still low 4. There are not many businesses related to fisheries, especially fish processing 5. Types of fish cultivated are limited (tilapia and catfish) 6. Limited production capacity 7. Joint Business Groups in the fisheries sector have not developed optimally 8. Business actors' knowledge of CPIB and CBIB is low 9. Programs related to fisheries implemented by the government are not sustainable |

| | | |
|---|--|---|
| <p>Opportunities (O)</p> <p>External opportunity factors</p> <ol style="list-style-type: none"> 1. High market demand 2. The selling price of fresh fish is high 3. Generate high profits 4. High stunting rate 5. The level of community fish consumption is low | <ol style="list-style-type: none"> 1. Growing and improving the entrepreneurial spirit of the community in agriculture, especially youth. 2. Facilitating people who are interested in pursuing business in the fisheries sector, both physical and non-physical | <ol style="list-style-type: none"> 1. Increase the quantity and quality of human resources at the local government level 2. Facilitate capital loans with low interest 3. TTG innovation in the field of fisheries 4. Diversify the cultivation of local fish species (kotes, nilem, tawes). 5. Growth and development of fish-based food processing industries 6. Institutional strengthening of business actors in the sector fishery 7. Optimizing the level of knowledge of business actors 8. Implementation of sustainable programs |
| <p>Threats (T)</p> <p>External threat factor</p> <ol style="list-style-type: none"> 1. The market price from outside is low 2. Raw materials for fish processing are limited 3. Factory feed prices are still expensive 4. There are diseases/pests that have not been resolved 5. Non-standard seed quality 6. Fluctuating weather 7. Limited water during the dry season 8. The role of the government is still low <p>Processed fish production costs are high</p> | <ol style="list-style-type: none"> 1. Increasing the quantity and quality of fish farming 2. Increasing the role of government | <ol style="list-style-type: none"> 1. Increasing the quantity and quality of human resources, both business actors, government and non-government in fisheries business 2. Growing the natural fish feed industry at an affordable price 3. Implementation of technology to deal with problems faced by business actors |

The four strategies that have been formulated are reviewed to determine the most appropriate strategy for optimizing freshwater fisheries business in Magelang Regency based on SWOT and presented in Table 4.

Table 4. SWOT with Weighting and Rating

| Defining factor | Weight | Rating | Value |
|---|-----------|-----------|-----------|
| Internal factors | | | |
| Strengths (S) | | | |
| 1. Availability of abundant water (during the rainy season) | 5 | 4 | 20 |
| 2. Does not require a lot of land | 3 | 3 | 9 |
| 3. Fish seeds are easy to obtain | 5 | 4 | 20 |
| 4. The cultivation process is easy and does not require a long time | 4 | 2 | 8 |
| TOTAL | 17 | 13 | 57 |
| Weaknesses (W) | | | |
| 1. Limited human resources in the Department of Education | 5 | 1 | 5 |
| 2. Limited capital for business | 5 | 1 | 5 |
| 3. The use of appropriate technology is still low | 4 | 2 | 8 |
| 4. There are not many businesses related to fisheries, especially fish processing | 4 | 2 | 8 |
| 5. Types of fish cultivated are limited (tilapia and catfish) | 3 | 3 | 9 |
| 6. Limited production capacity | 4 | 2 | 8 |
| 7. Joint Business Group in the field | | | |
| 8. fisheries have not developed optimally | 3 | 2 | 6 |
| 9. Business actors' knowledge of CPIB and CBIB is low | 5 | 2 | 10 |
| 10. Programs related to fisheries implemented by the government are not sustainable | 4 | 2 | 8 |
| TOTAL | 37 | 17 | 67 |
| External Factors | | | |
| Opportunities (O) | | | |
| 1. High market demand | 5 | 4 | 20 |
| 2. The selling price of fresh fish is high | 4 | 3 | 12 |
| 3. Generate high profits | 4 | 3 | 12 |
| 4. High stunting rate | 5 | 4 | 20 |
| 5. The level of community fish consumption is low | 5 | 4 | 20 |
| TOTAL | 23 | 18 | 84 |
| Threats (T) | | | |
| 1. The market price from outside is low | 3 | 3 | 9 |
| 2. Raw materials for fish processing are limited | 4 | 2 | 8 |
| 3. Factory feed prices are still expensive | 5 | 1 | 5 |
| 4. There are diseases/pests that have not been resolved | 4 | 3 | 12 |
| 5. The quality of the seeds is not standard | 4 | 2 | 8 |

| | | | | |
|-------|--|----|----|----|
| 6. | Fluctuating weather | 4 | 3 | 12 |
| 7. | Limited water during the dry season | 4 | 2 | 8 |
| 8. | The role of the government is still low | 3 | 2 | 6 |
| 9. | Processed fish production costs are high | 5 | 2 | 10 |
| TOTAL | | 36 | 20 | 78 |

Source: Primary data processed, 2022

Information:

- SWOT factor weighting: 1-2-3-4-5, indicating Very Not Important - Somewhat Important-Most Important- Important-Very Important
- Rating: The SWOT factor rating is on a scale of 1-2-3-4, each indicating a role that is: Very Small-Medium-High-Very Big.

Furthermore, a strategic plan is prepared which will become a guide in implementing activities that are more effective, efficient, and sustainable. Table 5 presents the ranking of alternative strategies for developing fisheries product processing in Magelang district in 2022

Table 5. Ranking of Alternative Development Strategies for Processing Fishery Products in Magelang Regency in 2022

| | SWOT element | Attachment | Score | Ranking |
|------------|--|------------------------------------|---------------------------|---------|
| Strategy 1 | Implementation rain harvesting technology | S1, S2, T6, T7 | 20+12+8+9 =49 | 4 |
| Strategy 2 | Enhancement seed quality and quantity fish | S1, S3, S4, O1, O2, O3, T5, T8 | 20+20+8+20+12+12+8+6=106 | 1 |
| Strategy 3 | Empowerment society through business fish processing | S3, S4, O4, O5, T2, T8, T9 | 20+8+20+20+8+6+10 =92 | 2 |
| Strategy 4 | Addition number of fishery instructors (one district one extension worker) | W1, T1, T2, T4, T5, T8 | 5+9+8+12+8+6 =48 | 5 |
| Strategy 5 | Facilitation availability of capital selective | W2, W5, W6, W7, W8, T2, T3, T5, T8 | 5+9+8+6+10+8+5+8+6 =65 | 3 |
| Strategy 6 | Implementation appropriate technology in the field fishery | W3, W4, W6, W9, T3, T4, T8, T9 | 8+8+8+8+5+12+6+10 =65 | 3 |

Sumber: Data primer yang diolah, 2022

Six strategies were obtained for fisheries development in Magelang Regency based on SWOT analysis.

Strategi 1- Enhancement seed quality and quantity fish.

The quantity and quality of fish in Magelang Regency is not yet optimal. This, among other things, resulted in the fish processing business in Magelang Regency not being carried out so much by the community because of the difficulty of raw materials. The application of CPIB as the main strategy to improve the quality of fish seeds. The management application of Good Fish Hatchery Practices (CPIB) has a very good effect on shrimp seed production [12]. The implementation of CPIB has a positive influence on the performance of shrimp hatcheries in Barru Regency, with the most influencing factors being food safety and the environment [13]. The use of round ponds in gouramy cultivation can increase the quality and quantity of production, because water quality can be controlled using a pH meter, fish stocking density is higher, feeding and fish growth are also maximized [14]. Compounds of natural ingredients affect the reproductive processes of aquatic animals [15]. Natural compounds added to fish feed (pellets) in the form of turmeric can increase the pass rate of catfish seeds up to 100% and have high durability, so that productivity increases. One of the factors that affect the growth of gouramy is water quality [16]. In order to obtain good water quality, one way is to manage the recirculation system [17]. The aquaculture recirculation system or Recirculating Aquaculture System (RAS) is a fish farming maintenance system that uses a system with water circulation from the rearing container which then flows into the filter container, and then flows back to the rearing container assisted by a pump [18][19]. The recirculation system was developed so that water quality is maintained and optimal by increasing the dissolved oxygen content in the water, and reducing the levels of ammonia and organic waste produced by fish. [20]. In principle, the basic principle of the RAS mechanism is that the ammonium content is converted into nitrites and into low-toxic nitrates so that the water can be reused for aquaculture activities. [21]. Usman concluded that with the RAS system, cultivated gourami produced a specific growth rate [19].

Strategy 2 – Empowerment society through business fish processing.

There are not many fish processing businesses in Magelang Regency. Existing businesses also use more raw materials from outside the region. Therefore, strong efforts are needed to encourage people to be willing to open businesses in the field of fish-based food processing. Empowerment of the community through the processing of fishery products is one way of alleviating poverty [22]. Community empowerment through fish processing business is supported by the existence of fish seeds that are easy to obtain, the cultivation process is easy, and it doesn't take a long time for several types of fish. Catfish is a type of fish that is quite easy to cultivate and serve as raw material for processing [23]. One of the reasons for the high stunting rate is the low level of fish consumption. Efforts to increase fish consumption are carried out especially for low-income communities [4]. Communities can make their own various processed fish both

for their own consumption and to be developed as a productive business [24]. At the same time, this can support efforts to reduce stunting rates in Magelang City [25].

Dahlia et al., (2019) also empowering fishing communities through fish processing training to support the Majene Regency Government's MP3 program [26]. Tuna fish is processed into nuggets and crackers, then packed in attractive packaging. In addition, training was also given to prepare simple financial reports. Furthermore, Suharman & Syarifah, (2021) conducting community empowerment through catfish chip processing training in improving the creative economy during the new normal period in Potorono Village [27]. Feed costs, which can reach 70% of the total cost, can be replaced by using homemade pellets made from local raw materials which are easily available in the surrounding environment, thereby reducing feed costs by up to 25% [28].

Strategy 3- Facilitation availability of capital selective.

In the fishing business, limited capital is the most serious obstacle to expanding the business being run. Fish cultivators in Magelang, especially nurseries, complain of a lack of capital to expand their business, while the demand for fish seeds has increased sharply over a period. Fish cultivators in the Magelang area already understand and master the science of hatchery. Of course, this cannot be denied, because several years ago Magelang became a reference for other regions in fish hatchery. However, one of the main problems that arise is limited capital for business expansion [29]. Capital limitations can be resolved by 1.) The government should conduct an initial screening of potential businesses and make selections to determine businesses that can be given additional capital. 2.) Maximizing revolving funds with a mentoring system for MSMEs in the marine and fisheries sector with relatively easy conditions through the BLU LPMUKP (Public Service Agency for Marine and Fishery Business Capital Management Institutions) which provides two service rates, namely conventional and Sharia [30]. 3.) Introduction of fintech lending technology as a capital solution for Micro, Small and Medium Enterprises (MSMEs) [31]. Fintech is an innovation in the field of financial services, derived from the words "financial" and "technology"[32]. Fintech can simplify payment systems and transactions to be more effective, efficient and economical [33].

Strategy 4-Implementation appropriate technology in the field fishery.

The development of the fisheries business in Magelang Regency has not been optimal. One reason is the implementation of appropriate technology in the fisheries sector is still low. As stated Nugraheni et al., 2021 that the use of appropriate technology as a solution to encourage the interests of fish cultivators has not been widely implemented in Magelang Regency [7]. With the biofloc method, there was an increase in catfish yield weight of 50% in a harvest period of about 9 weeks. In addition, it also saves commercial feed costs and reduces the mortality rate of catfish by 40% [34]. Harnawan, et.al., 2016 implementing an automatic fish feeder called Ading Pintar which can save 150 minutes or 1 hour 30 minutes for each feeding in one day and can measure fish feed automatically, so as to avoid the possibility of overfeeding, shortage of feed, and inadequate feed. scattered when done manually [35]. Hendrawan et.al., has designed an

Arduino-based automatic catfish seed counting system, because so far the calculation of catfish seeds has been done manually so it takes a long time and the results are inaccurate [36]. A system for monitoring the quality of catfish farming water using Internet of Things (IoT) technology has been created [37]. The sensors used are a Waterproof DSB180 temperature sensor and a pH meter sensor. The results of measuring the temperature and pH of catfish water will be displayed via websites and smartphones, making it easier for catfish farmers to control pH and water temperature.

Strategy 5-Implementation rain harvesting technology.

Water is the main component of the fishery business. To overcome the problem of lack of water, especially during the dry season, rain harvesting technology can be used as an alternative source of water, especially in areas that lack water, such as Grabag, Tegalrejo, Borobudur, Salaman, Tempuran and Bandongan sub-districts. Mariono et al. has implemented Gama Rain Filter Technology with the UTAUT method to harvest rainwater in 5 districts, Yogyakarta Province [38]. The harvested rainwater has better physical, chemical, and biological qualities than well water. Efforts to harvest rainwater to overcome water shortages based on water resource conservation technology have also been carried out in Rote Ndarö Regency, East Nusa Tenggara [39]. Rainwater harvesting techniques or also known as rainwater harvesting are defined as a method of collecting or collecting rainwater or surface runoff during high rainfall for further use during low rainfall. [40]. According to El Khobar, rain water harvesting is the process of capturing, diverting and storing rainwater for various purposes, irrigation, drinking water sources, household needs and aquifer recharge [41].

Strategy 6-Addition number of fishery instructors (one district one extension worker)

Fisheries Extension is a position that has the scope of duties, responsibilities and authority for fisheries extension occupied by civil servants with full rights and obligations given by the authorized official [42]. Fisheries extension activities aim to increase the knowledge, skills and attitudes of extension targets, identify problems, exchange information between extension agents and the main actors in running their business [43]. The addition of extension agents can be carried out in stages, starting with data collection on sub-districts that need more counseling based on the potential of the area and aquatic ecosystems. The results of this data collection can be used to determine the division of tasks for extension agents, so that the workload of extension agents can be evenly distributed, and fish cultivators get optimal benefits. In addition, it is also necessary to map extension agents based on their competence and experience [44].

If these six strategies are implemented optimally, it is hoped that fisheries will become one of the mainstays in Magelang Regency. Of course, in its implementation it requires synergy from various parties, not only being the responsibility of the Dispensary and business actors in the fisheries sector.

Based on the discussion of the problems faced by the Regional Government in developing the fisheries sector in Magelang Regency along with the recommended solutions, it is concluded that the involvement of various parties, both the Regional Government, Educational Institutions, the private sector, and the community is urgently needed. However, this involvement is not partial or individual, but must be synergized and integrated, so as to form a pattern or model for fisheries development in Magelang Regency. The concept of good governance can be an alternative for fisheries development in Magelang Regency. This concept involves three pillars that synergize with each other, namely the Government, the private sector, and the community [45]. The concept of good governance, as desired by the World Bank, is a construction of good governance, which involves the concept of administering clean, democratic, and effective governance that regulates patterns of synergistic and constructive relationships between the government, the private sector (business), and community. The role of the three pillars in the concept of good governance is presented in Fig 2.

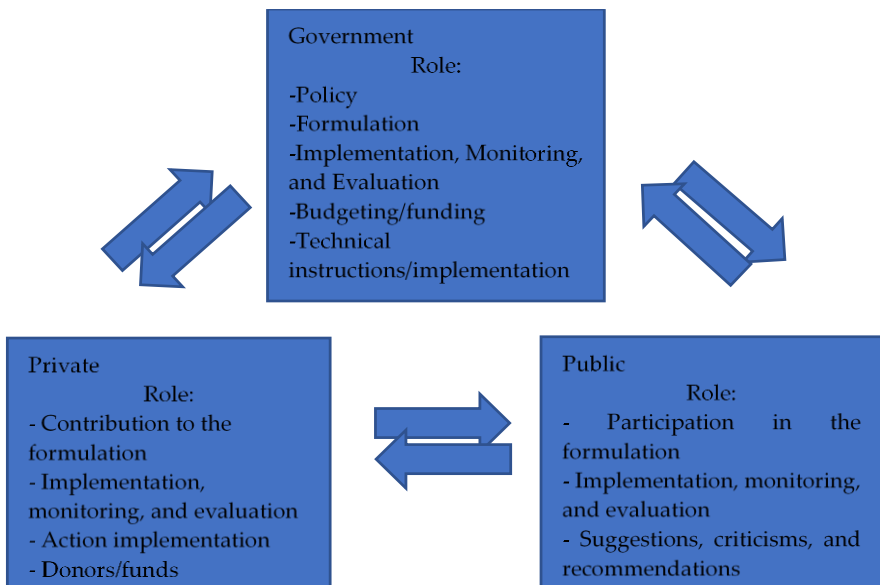


Fig. 2. The role of the three pillars in the concept of Good Governance

4 Conclusion

The current condition of the freshwater fisheries business in Magelang Regency has not yet developed optimally, because there are still many obstacles to be faced, such as the quantity and quality of seeds that are not maximized, there are not many businesses in the fish processing sector, limited funding for actors to develop fishery businesses, appropriate technology the benefits that are implemented are still medium scale, and the limitations of fishery extension workers. The six strategies can be implemented based

on the concept of Good Governance which involves 3 pillars namely Government, Private and Society. The model for the involvement of the three pillars can be in the form of a Partnership Model or Community-Based Management or commonly called Community-Based Management (CBM).

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