Management strategy of freshwater eels (*Anguilla* spp.) based on socio-economic influence in Cimandiri River

M D Putra¹,²,³*, H Effendi¹,²,³, M M Kamal² and Taryono²

¹Department of Natural Resources Environmental Management Science, IPB University, Indonesia
²Department of Aquatic Resources Management, IPB University, Indonesia
³Environmental Research Center (PPLH), IPB University, Indonesia

*Corresponding author: marfian_94@apps.ipb.ac.id

**Abstract.** Cimandiri River is highly potential for freshwater eel resources in Sukabumi Regency. The high exploitation rate on this eel combined with anthropogenic impacts cause a considerable threat to the sustainability of eel fisheries in the river. This study aims to analyze the socio-economic impact of the freshwater eel fisheries and its implementation in managing this fishery in Cimandiri River. Research data was based on in depth interview conducted in July 2020 and largely supported by secondary data for determine environmental quality. Data analysis was performed using scoring and swot methods. The results that environmental quality in the river remains in good quality for the growth of eels. Freshwater eel fishing is based on several motives, including being the main catch of fishermen, supporting the economy of the community around the river, and as a hobby for fishermen upstream. Eel main fishermen only depend on the economic chain of eel fishery resources, so that skills training is needed to increase their capacity. Stakeholders have the strength and opportunity in making policies and developing human resources for support the sustainability of eel fisheries in the Cimandiri River.

**Keywords:** Cimandiri River; eel resources; environmental quality; stakeholders

1. **Introduction**

The Cimandiri River is one of the rivers that became the habitat for eels to grow from the estuary to the upstream of the river. Cimandiri River is also a river that has a very high potential for the utilization of eel resources in Sukabumi [1]. There are three types of eels found in the Cimandiri River, including *Anguilla bicolor*, *Anguilla marmorata*, and *Anguilla nebulose* [2]. Eel fishery in Cimandiri River has a major impact to the economy for people around the Cimandiri River, especially around the estuary area. Eel fishermen's income comes from the catch glass eel from the estuary has a significant effect. The income from fishing eels is generally greater than farming and gardening. The high price of eel fish is due to limited technology or the absence of technology that can help eels in spawning, so that the source of the caught seed comes from river estuaries [3]. Therefore, the higher the demand for eel will increase the fishing effort of eel in rivers [4]. The fishing effort of eel which is very high in the eel estuary can threaten the sustainability of eel in the Cimandiri River.

In addition to the high effort to catch eel for industrial needs, another threat to the sustainability of eel includes the use of river bodies as rafting tourism activities, power generation, sand mining,
agricultural activities, plantations, and others [5]. These threats are motivated by the condition of the Cimandiri watershed, which has the potential to use the river very well to support the economy for the people around the river. Therefore, the management of the Cimandiri watershed area must pay attention to biological, ecological and social aspects [6].

It is different from catching eel in the upstream area. The catch that occurs in upstream area of the river is generally carried out by anglers. The motive for catching adult eels by anglers is generally due to hobbies and different ways of fishing compared to fishing for other fish. Eel caught by anglers upstream of the river is generally only consumed by the anglers or sold locally with an agreement price between the angler and the buyer. The difference though in the use of eel fisheries in each part of the river (downstream, middle, and upstream), needs the role of stakeholders in managing eel fishery resources, including the participation of DKP Sukabumi Regency which has a role as a determinant of policies and other stakeholders [7]. This study aims to analyze the socio-economic impact of eel fisheries and its implementation in the management of eel fisheries in the Cimandiri River.

2. Methodology

Research activities were carried out from May to August 2020 at the Cimandiri River eels catching site, Teluk Palabuhan Ratu, Sukabumi Regency, West Java. Data collection was carried out using primary and secondary data collection. Environmental parameters use secondary data from the results of research on the Cimandiri River in the last 5 years. This is done to support the management of environmental quality in the Cimandiri River. Primary data obtained through determining the location of the eel fishing site based on information from key respondents and carried out location marking in the downstream and upstream areas of the Cimandiri River. The key respondents referred to are the Sukabumi Marine and Fisheries Service, local eel collectors, eel fishermen and regular fishermen. In-depth interviews with relevant stakeholders or key respondents to find out the policy and management of eels in the Cimandiri River.

The collected data, then is analyzed by SWOT (Strength, Weakness, Opportunities, and Treats) method. SWOT analysis is carried out as a form of problem solving and decision making process [8]. This is done to identify internal factors (strengths and weaknesses) and external factors (opportunities and threats), to create a policy strategy from a combination of the four factors that influence each other. The stages of the SWOT analysis carried out by interview and direct observation [9]. The SWOT matrix analysis scheme is described in table 1 [10].

Table 1. SWOT analysis.

| Categories                         | Strength | Weakness                     |
|------------------------------------|----------|------------------------------|
|                                    | Identify internal strength factors. | Identify internal weakness factors |
| Opportunities                      | SO Strategy | WO Strategy                  |
| Identify the external opportunity factors | Combining strategies based on strong use advantage opportunities | Combine the strategies to minimize weakness to take advantage of opportunities |
| Threat                             | ST Strategy | WT Strategy                  |
| Identification of threat factors using external forces | Combining the strategy that use to tackle threats. | Combining strategies that will minimalize and avoid the threats. |
3. Results and discussion

3.1. Aquatic quality

The survival of eel is influenced by the quality of the river environment for its growth. Based on the results of research in previous years, in the Cimandiri River, the value of water quality downstream of the Cimandiri River was obtained in table 2.

Based on the results of research that has been carried out in previous years downstream of the Cimandiri River. It is known that the abundance of eel rising into the river is decreasing. The eel catches in 2018 amounting to 710.21 kg, in 2019 it decreased to 512 kg and at the beginning of 2020 only 13.05 kg was caught. Based on the results of interviews with local eel fishermen and collectors in the Cimandiri River, eel fish did not go up into the river from March to September 2020. There were very few eels caught, so that it is impossible to sell eel by fishermen.

The results of the observation of temperature parameters downstream of the Cimandiri River fall into a good category for the growth of eels, namely with a range of 26-32°C at observations in different years. Good water temperature in the Cimandiri River is thought to be due to the large amount of vegetation along the river so that the river surface temperature is stable. According to Fekri et al. [11] temperature affects the physiological function of fish, at optimal temperature conditions it can have an impact on optimal growth whereas if the temperature is extreme the fish will avoid this environment.

The DO values from research from 2009 to 2018 are known to be above 5 mg l⁻¹, namely 5.8 mg l⁻¹ to 7.8 mg l⁻¹. Fekri et al. [11] states that the water quality needed by eels includes dissolved oxygen in the waters> 5 ppm. Also supported by the Environmental Agency [12] states that in eel migration, good water quality conditions are needed, including oxygen solubility> 2 mg l⁻¹ at 15 °C. This shows that every year the DO value downstream of the Cimandiri River is good oxygen solubility for the growth of eels.

The pH value of the research from 2009 to 2018 is known to range from 6.5 to 7.5. This value is included in the value which is a good water quality for eel migration, eels can migrate well at a pH of 5.0 to 8.0 [12]. Tesch [13] also stated that pH influences other parameters to support the growth of eels in waters.

Ammonia, nitrite, and nitrate are parameters that are interrelated in the nitrification process. Ammonia values were taken from the Cimandiri River in 2009 and 2010 with values of 0.23 and 0.0575 mg / l. This value is below the optimum value, which is <0.03 mg l⁻¹ [14]. According to Tesch [13], a good ammonia value for eel growth is in the range <0.05 to 0.1 mg l⁻¹. Nitrite can be one of the parameters that indicates toxicity in the water. Tesch [13] states that a good nitrite value for eel growth is <30 mg l⁻¹. The nitrite value in research on the Cimandiri River in 2009 was 0.054 mg l⁻¹. The nitrate values in the 2009, 2013, and 2015 studies were 20.32 mg l⁻¹, 0.85 mg l⁻¹, and 0.82 mg l⁻¹, respectively.

The depth and flow velocity of the river estuary was observed by Triyanto [15] to determine the characteristics of the river and to describe the area of the observation location. Meanwhile, for the upstream area, the value of water quality parameters cannot be identified due to the lack of research and the difficulty of access in the upstream area.

3.2. Eel catching site

The area which is used as an eel catching area by fishermen is located at the mouth of a river which also has a power plant and sand mining activities. In general, adult eel fishermen determine the catchment area based on locations that have the potential for a lot of fish. Because grown eels are generally not the main target for fishing. However, fishing for eels has a different method compared to fishing for other types of fish. The following are the eel catching sites in the downstream, middle and upstream rivers as figure 1.
| No | Parameter                  | Optimum Value | Reference               | Observation year | Observation value | Unit | Source                                      |
|----|----------------------------|---------------|-------------------------|------------------|-------------------|------|---------------------------------------------|
| 1  | Abundance eels             | -             | DKP Data*               | 2018             | 710.21            | kg   |                                            |
|    |                            | -             | DKP Data*               | 2019             | 512               | kg   |                                            |
|    |                            | -             | DKP Data*               | 2020             | 13.05*            | kg   |                                            |
| 2  | Temperature                | 28-30         | Fekri et al. [11]       | 2009             | 26.8              | °C   |                                            |
|    |                            | 28-30         | Fekri et al. [11]       | 2010             | 28                | °C   | Haryono and Wahyudewantoro [16]            |
|    |                            | 28-30         | Fekri et al. [11]       | 2013-2014        | 27                | °C   | Murtini [17]                               |
|    |                            | 28-30         | Fekri et al. [11]       | 2014             | 32                | °C   | Vamellia [18]                              |
|    |                            | 28-30         | Fekri et al. [11]       | 2015             | 26                | °C   | Hakim et al. [7]                           |
|    |                            | 28-30         | Fekri et al. [11]       | 2017-2018        | 27.6              | °C   | Triyanto [15]                              |
| 3  | DO                         | >2            | Environment Agency [12] | 2009             | 6.9               | mg/l |                                            |
|    |                            | >2            | Environment Agency [12] | 2010             | 7.8               | mg/l | Haryono and Wahyudewantoro [16]            |
|    |                            | >2            | Environment Agency [12] | 2014             | 6.3               | mg/l | Vamellia [18]                              |
|    |                            | >2            | Environment Agency [12] | 2013-2014        | 5.8               | mg/l | Murtini [17]                               |
|    |                            | >2            | Environment Agency [12] | 2017-2018        | 6.82              | mg/l | Triyanto [15]                              |
| 4  | pH                         | 7.0 - 8.0     | Tesch [13]              | 2009             | 7.34              |      | Fahmi [2]                                  |
|    |                            | 7.0 - 8.0     | Tesch [13]              | 2010             | 7.1               |      | Haryono and Wahyudewantoro [16]            |
|    |                            | 7.0 - 8.0     | Tesch [13]              | 2014             | 6.5               |      | Vamellia [18]                              |
|    |                            | 7.0 - 8.0     | Tesch [13]              | 2013-2014        | 6.5               |      | Murtini [17]                               |
|    |                            | 7.0 - 8.0     | Tesch [13]              | 2015             | 7                 |      | Hakim et al. [7]                           |
|    |                            | 7.0 - 8.0     | Tesch [13]              | 2017-2018        | 7.73              |      | Triyanto [15]                              |
| 5  | Nitrite                    | <0.5          | Knosche [19]            | 2009             | 0.054             | mg/l | Fahmi [2]                                  |
| 6  | Ammonia                    | <0.03         | Wahyudi [14]            | 2009             | 0.23              | mg/l | Fahmi [2]                                  |
|    |                            | <0.03         | Wahyudi [14]            | 2010             | 0.0575            | mg/l | Haryono and Wahyudewantoro [16]            |
| 7  | Nitrate                    | <1.0          | Wedemeyer [20]          | 2009             | 20.32             | mg/l | Fahmi [2]                                  |
|    |                            | <1.0          | Wedemeyer [20]          | 2013             | 0.85              | mg/l | Afrianto [21]                              |
|    |                            | <1.0          | Wedemeyer [20]          | 2015             | 0.8207            | mg/l | Hakim et al. [7]                           |
| 8  | Water Depth                | -             |                         | 2017-2018        | 0.51              | meter| Triyanto [15]                              |
| 9  | Current Speed              | -             |                         | 2017-2018        | 0.21              | m/s  | Triyanto [15]                              |

*Primary data from marine and fisheries service Palabuhanratu, Sukabumi, Jawa Barat.
Figure 1. Site of eel fishing downstream and upstream.

Station 1 is the point where local eel fishermen and collectors catch eel seeds at the mouth of the Cimandiri River. There is an eel village in Loji village where most of the people are eel fishermen and local eel collectors. The more eels that rise into the Cimandiri River, the more eels the fishermen will catch. Station 2 is an eel catching area by anglers. Station 2 is located in the village of Cicatih, not far from the mouth of the Cimandiri River. This location is an area that tends to be easily accessible because it is close to a highway, so that fishermen at night and daytime catch a lot of fish. Stations 3 and 4 are Citarik Rivers located in the village of Cijambe which are also used as water tourism areas, where there are rafting tours. This water tourism can improve the economy of the people around the river, but it can also threaten the survival of the eels at the site. Meanwhile, station 5 is located in the village of Bencoy or Cilubang, which is a hilly area with very thick vegetation around the river. In general, the location is used as a plantation area, freshwater fish cultivation, and small-scale factories. Station 5 is one of the sites for local anglers and fishing communities who have special targets when fishing, one of which is fishing for eel itself. Anglers only fish for eels in post-rain conditions with heavy river currents and certain water depth. Meanwhile, station 5 is located in the village of Bencoy or Cilubang, which is a hilly area with the vegetation around the river. In general, the location is used as a plantation area, freshwater fish cultivation, and small-scale factories. Station 5 is one of the sites for local fishermen and fishing communities who have a special target when fishing, one of which is fishing for eel itself. Anglers only fish for eels during after-rain conditions with heavy currents and certain water depths. Meanwhile, station 5 is located in the village of Bencoy or Cilubang, which is a hilly area with the vegetation around the river. In general, the location is used as a plantation area, freshwater fish cultivation, and small-scale factories. Station 5 is one of the sites for local fishermen and fishing communities who have a special target when fishing, one of which is fishing for eel itself. Anglers only fish for eels during after-rain conditions with heavy currents and certain water depths. Meanwhile, station 5 is located in the village of Bencoy or Cilubang, which is a hilly area with the vegetation around the river. In general, the location is used as a plantation area, freshwater fish cultivation, and small-scale factories. Station 5 is one of the sites for local fishermen and fishing communities who have a special target when fishing, one of which is fishing for eel itself. Anglers only fish for eels during after-rain conditions with heavy currents and certain water depths. Meanwhile, station 5 is located in the village of Bencoy or Cilubang, which is a hilly area with the vegetation around the river. In general, the location is used as a plantation area, freshwater fish cultivation, and small-scale factories. Station 5 is one of the sites for local fishermen and fishing communities who have a special target when fishing, one of which is fishing for eel itself. Anglers only fish for eels during after-rain conditions with heavy currents and certain water depths. Meanwhile, station 5 is located in the village of Bencoy or Cilubang, which is a hilly area with the vegetation around the river. In general, the location is used as a plantation area, freshwater fish cultivation, and small-scale factories. Station 5 is one of the sites for local fishermen and fishing communities who have a special target when fishing, one of which is fishing for eel itself. Anglers only fish for eels during after-rain conditions with heavy currents and certain water depths. Meanwhile, station 5 is located in the village of Bencoy or Cilubang, which is a hilly area with the vegetation around the river. In general, the location is used as a plantation area, freshwater fish cultivation, and small-scale factories.
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3.3. Stakeholder perceptions
The results of interviews to stakeholders of the Cimandiri River both downstream and upstream of the river, including DKP Sukabumi, large-scale local eel collectors, small-scale local eel collectors, eel fishermen, and fishermen. Currently, the local government, DKP Sukabumi, is working on the sustainability of eel fisheries in the Cimandiri River. Some of the efforts that have been made include collaborating with several parties, such as NGOs, institutions, and the private sector. Activities that have been carried out by DKP currently include restocking activities for eel seeds, forming and coaching community groups in the Cimandiri River for habitat protection through mangrove planting, river cleaning, and restocking. Currently, the government is building a place to grow eels so that they can accommodate glass eels from fishermen in order to increase the quota needed by the company. Because recently, the needs of eel for fishing only depends on the company's needs in meeting the rearing ponds.

Eel fishing activities at river estuaries greatly affect the economy of eel fishermen. According to the fishermen, in river management, the government should make a sustainable program which in its implementation involves the people to make training on eel cultivation. The hope is that fishermen can process eels to the elver stage. As well as making cultivation facilities so that fishermen are independent. Meanwhile, in the upstream area of the river, eels tend not to have special attention either for the government or for eel fishermen. The interest of eel for anglers is only a hobby, but the fishing community now makes eel a challenge in fishing.

3.4. Eel fisheries management strategy
The SWOT analysis was carried out based on the identification results of IFAS (Internal Strategic Factor Analysis) and EFAS (External Strategic Factors Analysis) from interviews conducted with respondents [22, 23]. The SWOT analysis criteria include strength, weakness, opportunities, and threat. The following is an IFAS (Internal Strategic Factor Analysis) assessment in table 3.

| Strength                                                                 | Weight | Ranking | Score |
|-------------------------------------------------------------------------|--------|---------|-------|
| 1 Government policies that support freshwater eel fisheries activities  | 0.12   | 3       | 0.36  |
| 2 Eel fishery business network                                          | 0.15   | 4       | 0.60  |
| 3 NGO activity                                                          | 0.12   | 3       | 0.36  |
| 4 Existing community (Pokmaswas)                                        | 0.10   | 2       | 0.20  |
| 5 Culture community are still high                                      | 0.06   | 2       | 0.12  |
| Total of Strength                                                       | 0.55   |         | 1.64  |

| Weakness                                                                | Weight | Ranking | Score |
|-------------------------------------------------------------------------|--------|---------|-------|
| 1 Fishermen’s capital depends on collectors                             | 0.11   | 3       | 0.33  |
| 2 The facilities and infrastructure are still classified as traditional | 0.10   | 1       | 0.10  |
| 3 The catch depends on the season                                      | 0.10   | 3       | 0.30  |
| 4 The catch amount depends on the company quota and the government     | 0.05   | 2       | 0.10  |
| Total of Weakness                                                      | 0.45   |         | 1.10  |
| Total of Internal Factors                                              | 1      |         | 2.74  |
Based on the results of the IFAS analysis in table 3 showed that the total value is 2.74. The greatest strength value is the eel fishery business network with a score of 0.6 and a total strength value of 1.64. Meanwhile, the biggest weakness lies in the capital of fishermen who still depend on collectors with a score of 0.33 and a total weakness score of 1.1. The value of internal factors is very strong with the maintenance of a good relationship in the eel fishery business network from fishermen to collectors and eel growing companies. The eel fishery business network can still run quite well even though the fishermen's capital depends on local collectors. Fishermen have an unwritten agreement and trust principle so that every fisherman who gets capital from the collectors will sell the eels to the collectors who provide the capital.

In addition to the internal factors that are considered in the eel fisheries management strategy, an EFAS (External Strategic Factor Analysis) analysis is also needed. The results of the assessment from EFAS (External Strategic Factor Analysis) are presented in table 4.

Table 4. Assessment of external factors (EFAS) of the socio-economic conditions of the Cimandiri River eel fishery.

| External Factors | Weight | Ranking | Score |
|------------------|--------|---------|-------|
| Opportunities    |        |         |       |
| 1 The catching area for eel at the Cimandiri estuary is carried out by the local community | 0.09   | 3       | 0.27  |
| 2 Local government support | 0.12   | 4       | 0.48  |
| 3 The potential river estuaries for the sustainability of eel | 0.14   | 3       | 0.42  |
| 4 Community development | 0.10   | 2       | 0.20  |
| 5 Skill to use fishing gear | 0.08   | 2       | 0.16  |
| Total of Opportunities | 0.53   |         | 1.53  |
| Threat           |        |         |       |
| 1 Environmental damage issues | 0.12   | 4       | 0.48  |
| 2 Community income apart from eel is very low | 0.10   | 2       | 0.20  |
| 3 Handling of the catch is very simple | 0.08   | 1       | 0.08  |
| 4 Eel fishery management is not optimal | 0.09   | 3       | 0.27  |
| 5 Concern for the environment is still low | 0.08   | 3       | 0.24  |
| Total of Threat | 0.47   |         | 1.27  |
| Total of External Factors | 1      |         | 2.80  |

Based on the results of the EFAS analysis in table 4, the total value is 2.80. The greatest opportunity value is local government support with a score of 0.48 and a total opportunity value of 1.53. While the biggest threat lies in the issue of environmental damage due to the many activities in the river that do not pay attention to the sustainability of the surrounding ecosystem with a score of 0.48 and a total threat value of 1.27. The external factors value from local government support is able to minimize the existing threats. Government support for eel fishing activities in the downstream or river mouths has the potential to minimize the threat from environmental damage issues.

The government’s role in managing and fostering eel fishermen by forming a community or organization called Pokmaswas Wira Mandiri hopes to make the community aware of the importance of preserving the river from environmental damage to the Cimandiri River. After the results of the table of internal and external strategic factors are obtained, so IFAS and EFAS are used as the basis for input for formulating problem solving strategies in river management and community socio-economic problems. Then, the strategy alternative is carried out into the SWOT matrix. Furthermore, alternative strategies are carried out into the SWOT matrix. The SWOT matrix presented uses the consideration of
Strategy-Opportunity, Weakness-Opportunity, Strategy-Threat, and Weakness-Threat to determine alternative strategies in the Cimandiri River as table 5.

| Table 5. Alternative management using the SWOT matrix. |
| --- |
| **IFAS** | **STRENGTH (S)** | **WEAKNESS (W)** |
| **EFAS** |
| **OPPORTUNITIES (O)** | 1. Government policies that support freshwater eel fisheries activities 2. Eel fishery business network 3. NGO activity 4. Existing community (Pokmaswas) 5. Culture community are still high | 1. Fishermen’s capital depends on collectors 2. The facilities and infrastructure are still classified as traditional 3. The catch depends on the season 4. The catch amount depends on the company quota 5. There is no intensive collaboration between fishermen and the government |
| 1. The catching area for eel at the mouth of the Cimandiri River is carried out by the local community 2. Local government support 3. The potential of the river for the sustainability of eel 4. Community development 5. Skills to use fishing gear | 1. The community cooperates with the government in expanding the eel business network (S= 1, 2, 3 O = 1, 2, 3) 2. Create coaching and training programs for people who work with expertise and related companies (S = 4, 5 O = 2, 4, 5) 3. Make programs and policies to let or release some of the caught eel seeds so that they can grow up and sustain the eel resources (S = 1, 2, 3, 4, 5 O = 1, 2, 3, 4) | 1. Creating fishery business cooperatives to support fishermen’s economy (W = 1, 2, 5 O = 2, 4) 2. Increase the capacity of fishermen, so that they have other skills besides catching eels (W = 3, 4, 5 O = 1, 2, 3, 4, 5) |
| 1. Environmental damage issues 2. Community income apart from eel is very low 3. Handling of the catch is very simple 4. Eel fishery management is not optimal 5. Environmental awareness is still low | 1. Increase cooperation with communities in habitat protection (S = 1, 2, 3, 4, 5 T = 1, 3, 4, 5) 2. Improve the quality of human resources (S = 1, 2, 3, 4 T = 1, 2, 4, 5) 3. Optimizing Salawean activities during the eel season (S = 2, 4, 5 T = 2, 3, 4) 4. Provide strict sanctions to parties who carry out activities illegally and damage the environment (S = 1, 4 T = 1, 4, 5) | 1. Maximizing existing and environmentally friendly facilities and infrastructure (W = 1, 2, T = 1, 2, 3, 5) 2. Make use of time effectively and efficiently (W = 3, 4, 5 T = 2, 3, 4) |

Research shows that socio-economic conditions of freshwater eel in the Cimandiri River have excellent strength and opportunities to be optimized in environmental management. The strategic focus
for management in the Cimandiri Cimandiri River uses SO opportunities or aggressive strategies, which can take advantage of strength by exploiting existing opportunities. Several strategies that can be carried out for environmental management in the Cimandiri River include:

1. Collaboration between related stakeholders, both the community (eel fishermen), local government, eel collectors, NGOs, and eel growing companies in an effort to harmonize the economic chain of eel fishery resources in the Cimandiri River.
2. Creating a coaching and training program for the community that involves expertise and the company to meet the quality standard needs of the company.
3. Creating programs and policies to let or release some of the caught eel seeds so that they can grow up for the sustainability of eel resources.
4. Empowering the community around the river and community groups in protecting / reforesting the area around the Cimandiri River in order to maintain the quality of the river environment.

4. Conclusion

Based on the result of the research, it can be concluded as follows:

1. The local government supports the fishing activity of eel in the Cimandiri estuary because it has high economic potential, but the lack of public concern for the environment and only on economic orientation can be a threat to the sustainability of eel fisheries, including forming community groups (Pokmaswas) and creating a greening program around rivers as an effort to protect the area and raise public awareness of the importance of protecting the environment.
2. Based on the results of the analysis in the study area, it shows that strength rank at the top, followed by the components of opportunities, so as to minimize threats and overcome these weaknesses.
3. To realize the ideal management strategy, cooperation must be created from all parties, especially the role of the government in making policies and support from the eel fishing community to the company as the eel fishery business actor, Policies that are made must pay attention to the principles of empowerment that are participatory and result oriented. However, they also pay attention to the environmental sustainability of the Cimandiri River.

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