Features, Innovation, and Environmental Sustainability of Mayangan Fish Port, Probolinggo, Indonesia: an analysis of MDS

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Abstract. The Mayangan Fish Port in Probolinggo, East Java, is a growing traditional infrastructure. Development activities are at risk of causing adverse impacts on the surrounding environment, especially on local communities condition. This study aims to review the Mayangan Fish Port sustainability through MDS and RAP-Fisheries based on 5 dimensions: institutional, economic, technological, environmental, and social. MDS results show that the technology dimension has the highest sustainability value (64.42), then institutional (58.20), ecology (54.12), social (50.87), and economy (49.35). Culture is very strong underlying all dimensions and supporting sustainability. Product diversification can increase the competitiveness and economic benefits of the community. The further challenges are to build the institutional, technological and social level management of the community to be ready to face global and broader competition by government assistance.

Keywords: culture, sustainable, Mayangan, MDS, Fish Port

1. Introduction

The fishery sector is an important player in the global economic system [1]. After a long trade growth, industrialization and economic benefits of fisheries since the globalization era, people began to concentrate on environmental and social issues, such as resource depletion, climate change, and pollution [2]. Many countries have competed to create fish ports as a modern, integrated, and eco-friendly infrastructure [3].

The ideas of sustainable port infrastructure continue to emerge as the needs of a world community [4]. This depends on the need for port management to mitigate negative environmental impacts without disrupting the growth of the economic progress. These environmental factors consist of natural resource assets, physical and management suitability with nature, and sustainability.

Mayangan Fish Port (MFP), Probolinggo, East Java, is an infrastructure that was built since 2000 and continues to grow until now. This development is at risk of being the cause of various adverse effects on the surrounding environment [5]. An urgent interest that there be approaches to understanding sustainability and its impact, both through economic, technological, environmental, and social benefits. With our research, we are closely analyze the factors that influence the sustainability of MFP, which is viewed from 5 dimensions: institutional, economic, technological, environmental,
and social. Explicitly, not fulfilled or this dimensional imbalance will have an impact on the cessation of the role of the MFP along with the social and cultural life of the community, and its balance with the environment. This survey will offer direction for future of MFP management and an important direction on sustainable development in East Java region.

2. Material and method
The preliminary study was held purposely. MFP in Mangunharjo Village, Mayangan District, Probolinggo City was chosen because it is the largest fishing port in the north coast of East Java. In addition, Probolinggo will have an International Port for export-import activities. This was expected to have an influence on the development of the sustainability of the MFP. In addition, the fisheries development in MFP have great economic benefits, while at the same time, it support environmental sustainability.

2.1. Data collection
Participatory Rapid Appraisal (PRA) was used to approach and disclose problems holistically. The main data was collected through questionnaires on various respondents (port leaders, employees, and fishermen groups). We expect to get general and valid information based on various respondents. In-depth interviews were conducted to provide an explanation of the facts. Secondary data is collected through documentation on direct observation that describes the field conditions. Likert scale is on category, rank, and construction distance of the data (Table 1).

2.2. Rapid appraisal for fisheries (rap-fisheries) and Multi-Dimensional Scaling (MDS) analysis
Rap-fisheries techniques were applied with MDS in research. MDS-fisheries is intended for the sustainability of a system, process, or activity [6]. Both are used in understanding the level of sustainability and conservation of fisheries systems in MFP. Sustainability can be viewed from typical dimensions, which are believed to support the process. This study uses 5 dimensions: institutional, economic, social, technological, and ecological. Each dimension will be evaluated to show the sustainability of activities carried out in the MFP, Probolinggo. Data then scored, so that it interprets the status of sustainability, ie the scale of 0-100 (see Table 2).

| Table 1. The main data variable used |
|-------------------------------------|
| **Answer Choice** | **Score** | **Meaning of answer** |
| A | 5 | Strongly agree |
| B | 4 | Agree |
| C | 3 | Netral |
| D | 2 | Disagree |
| E | 1 | Strongly disagree |

3. Results

3.1. Institutional Dimension
Handling Ecosystem damage is the most influential attribute (4.81, figures 1). MFP needs the sustainability of fisheries that is essential and a policy to manage it. Port institutions are able to regulate infrastructure well in addressing pollution and damage to ecosystems in coastal environments. On the other hand, the lack of an institutional dimension appears at the level of access to resources (2.48). This is influenced by the lack of support and guidance from the government to developing the existing institutional system. So far, the system has only been supported in the form of local cooperation. Therefore, access to resources cannot be maximally implemented. The form of local cooperation is also insufficient to support the level of adequacy of legislation (2.69).
The results of Fisheries show that the attributes occupy more of the middle region of RAPFISH graph (figure 2). This illustrates that most of the attributes used have a medium influence on the institutional dimension sustainability.

![Figure 1. Institutional Leverage Chart](image1)

![Figure 2. Graph of Institutional Fisheries](image2)

3.2. Economy dimension
The results of the Leverage analysis show that the fishery business in the MFP has a low subsidy requirement (figure 3), and is a major attribute of the economic dimension (4.81). This shows that management system and implementation in the field have an impact on economic benefits, which are managed independently and show positive results with reduced dependence on subsidies. The level of business prospects ranks the second attribute (4.29). This has an impact on the prospects for advanced businesses in the form of trade in goods and services around the port, such as fish processing, transportation, repair services, fishing tools trade, and capital.

However, the weakness in the economic dimension appear in fishermen's income that are lower than in other regions (2.48). This is indicated by the lower-income of local fishermen than the standard of regional minimum salary (UMR). Although the needs of fishermen and surrounding communities are enough for everyday life, there is a gap with UMR. This also shows that there is a dominance of home industries that have smaller capital flows than modern industries. The area of fish market is one of the attributes that have a low value (2.69). Fisheries results show that the attributes used in the economic dimension are scattered (figure 4). This illustrates that most of the attributes have a medium influence on the sustainability of the institutional dimension.

![Figure 3. Economic Leverage Chart](image3)

![Figure 4. Graph of Economy Fisheries](image4)

3.3. Social dimension
The communities around MFP have traditionally recognized their needs for sustainable life (figure 5). The knowledge of fishermen on the environment is the highest scale attribute in the social dimension (3.33). Then, the results of the leverage graph illustrate that the community appreciates an active role in environmental sustainability and this occupies the second attribute (3.31) and third (3.14).

Although community and local fishing communities in MFP have been able to manage their own resources, port construction requires technical conditions that are poorly understood by local knowledge. This requires support from the government and related parties to carry out development (2.21). One of the causes is in the next lowest attribute, namely the lack of education (2.29). In a row, this will have an impact on traditional management patterns and are slow to develop. Fisheries results show that the attributes used in the social dimension are scattered (not centered) (figure 6). This illustrates that most of the attributes support the social dimension sustainability quite low.

### Figure 5. Social Leverage Chart

### Figure 6. Social Fisheries Chart

#### 3.4. Technology Dimension

Technology has traditionally been applied by the community. However, this is traditional patterns that are used for generations. Selection of fish grades based on size and quality is one of traditional attributes that strongly supports sustainability in the technological dimension (3.33, figure 7). This action supports the sustainability of fisheries because not all fish will be caught and sold in market.

However, the lack of technological dimensions is found in the selectivity of fishing tools (2.29). Fishermen still choose poor fishing gear. This is due to the lack of capital to meet equipment needs. In addition, the next shortage comes from unfavorable post-harvest handling (2.91). Although there are home industries in the vicinity of the port, unfortunately this cannot cover all catches. It is very important to increase the volume of fish production by industry. Fisheries show that the attributes in the technology dimension are spread towards strongly supporting sustainability (figure 8). This illustrates that most of the attributes have a high influence on the technology dimension sustainability.

### Figure 7. Technology Leverage Chart

### Figure 8. Graphic Fisheries Technology
3.5. Ecology Dimension

Some attributes affect the condition of sustainability in the ecological dimension (figure 9). Fish size is an attribute that has the highest scale attribute (3.33). Classification of the fish size is taken seriously to avoid damage to the fish population. The fishermen hope this action will strengthen the sustainability of the fishery in Probolinggo. Then, the fishing site is also an advantage possessed by MFP that supports sustainability (3.31). With boats under 25 GT, fishermen can fish well in the 10-30 km area. This illustrates that sea environment around the port is very good and meets the needs of fisheries. Furthermore to support sustainability, MFP has a closed season, and this ranks third on the ecological dimension (3.14). The weakness of MFP on the ecological dimension appears in the attributes that occupy the last rank, the use of fish resources (2.29). The existence of abundant fisheries potential around the port of Probolinggo, is considered to be less well used, so that the development is only in the direction of capture fisheries. Lack of technological development in improving fisheries potential, as well as its use, is then affected by the number of catches (2.91). Fish catch cannot be maximized, because of the limitations of technology and its application on traditional fishing. Fisheries graph show that the attributes used in the ecological dimension are scattered, especially to the left, but some attributes converge and support sustainability (figure 10).

Figure 9. Ecological Leverage Graph

Figure 10. Ecological Fisheries Graph

3.6. MDS

Technology becomes a dimension that has the highest sustainability value (64.42, figure 11). These results do not illustrate the existence of new high-tech to be used among fishermen, but rather towards the use of traditional environmentally friendly technology, which has enough needs.

Then, the institution became one of the strong supports for the sustainability of MFP (58.20). This institutional levels is based on fishermen / communities as the main port users. Decisions and management are carried out in discussion and carried out independently.

Ecology occupies third place of dimension (54.12). Fishing efforts that rank environmental sustainability are a common factor of this dimension, so that they have a strong impact on the sustainability of fisheries. The social dimension occupies the fourth dimension (50.87). Despite of having a strong community, it seems that the social life around the MFP is heavily affected by their economy. The Economic Dimension is the last rank of dimension (49.35). The people's income are generally felt enough to meet daily needs. However, the biggest challenges are how to develop fish processing industries to become stronger, and increase the capital flow in them. The biggest impact is increasing the standard of income into regional UMR.

4. Analysis

MFP was established in 2000 where the Mayangan Fish Landing Base (PPI) was later built integrated by APBN, East Java Province APBD, Probolinggo City APBD and other funds from the private sector. The PPI status then increased in 2004 to become the Management Unit of Mayangan Beach Fisheries Port (UPPP Mayangan) in 2014. Since the establishment of the unit, fisheries and related economic activities at the MFP continue to increase.
The high of MDS value in the Technology dimension describes the development of fisheries targets to trigger the development of the quantity and quality of fisheries. One of them is a discovery in the use of smartphones in offering fish catches. The sales process even begins before the ship docked [7]. Through fisheries development with an ecosystem approach, fishing gear selectivity is increasingly becoming part of fisheries management. This have an effect on the target of the catch. The complexity of the target needs relates to the scale of the capture objectives, which must be closely monitored [8].

![MDS radar graph](image)

**Figure 11. MDS radar graph**

5. **Recommendations for minor attributes in dimensions**

5.1. **Economic Dimensions**
The income of fishermen who do not reach regional UMR is one of the contributors to this low dimension. In fact, instead of a sustainability, the main vision of the MFP development is the improvement of the people's economic prosperity by utilizing fish resources (KKP). Improvements need to be made with the aim of increasing the income of fishermen [9].

Cooperatives are institutions that are expected to play an active role in improving and maintaining price stability. It should characterize multi-business forms, and fishermen as the main suppliers must become members. The establishment of the main economic institutions has a major role: 1) shorten the distribution chain, 2) increasing the price of fish from fishermen, 3) maintaining the stability of prices, especially in peak season, 4) driving multi-business in the fisherman community, such as modal, savings and loans, trade of fisheries needs, distribution, and processed fish production [10].

5.2. **Social Dimension**
Fishermen are considered unable to play a full role in the construction of the MFP. One of them is that fishermen are less able to meet the modern technological needs and development of the port. This is due to the lack of education level of the fishing community, so that these two problems are related to cause and effect. One solution to this problem is to increase the level of education through the government-initiated package program. Educational needs will also have an impact on improving the community's technology, both for catching and processing fish products, so that fishermen can play more important role [11;12].

5.3. **Ecological Dimension**
The utilization level of Fish Resources is one of the problems that has a low attribute on the ecological dimension. One solution that can be implemented is to develop product diversification with MFP as a main market and fishermen as the main players, one of them is eco-tourism. This can be supported by easy access to the Port with Beejay Bakau resort, one of the mangrove tourism areas which has an area of 18,000 ha in the southern part of it. The visitors to the mangrove area can be offered a package for advanced tourism, such as fishing, seabird observation, mangrove exploration, observation of shark...
whales (*Rhincodon typus*) in certain seasons, to coral reefs. At the port area, fish shopping and products can be developed, or fish auction tours in the morning.

In a fisherman community, the tourism development process can be done easily. Formation of supporting structures for tourism, such as accommodation, promotion and marketing not dependent on large capital owners [13]. Elements of local fishermen and the support of strategies from the government can improve revenue from tourism [14].

5.4. Institutional Dimension

Observations that show that the institution in the MFP is part of the community alliance with the custom of deliberation. The weakness is the lack of institutional capacity to meet the needs of more modern innovations. Therefore, the government, whether regional, provincial, central or through private cooperation, is expected to be able to attend the mentoring of MFP management institutions.

The lifestyle of traditional fishermen is generally connected with their environment. This also underlies the formation of traditional institutions based on the sustainability of local ecosystems. But the threat from the environment, both from nature and the demands of modern development resulted in the demands of adjustment of traditional institutions before [15]. Therefore, strengthening and guiding management by government institutions is necessary. One way that can be implemented is to give expert assistance that will accompany fishermen meeting forums, as well as help the management of government assistance [16].

5.5. Technology Dimension

The use of *cantrang* results in a serious degradation of fish population, changes in ecology structure, size and species composition [17]. In fact, the use of *cantrang* will affect species vulnerability and growth rate in other species. Very intensive use will not be balance to the slow spawning process [18].

Development of storage and distribution facilities is vital, where this process concerns on storage technology at minus temperatures [19]. This needs to be addressed with innovations and the development of a seafood processing industry [20]. The food industry is the dominant of sea products, such as shredded fish, crackers, shrimp and fish paste, smoked fish, sausages, nuggets, but the improvement is still slow.

6. Conclusion

MFP sustainability is influenced by the quite high value of dimensions. Technology is the dimension that main supports the sustainability of the MFP. The type of traditional technology used is sustainable for ecology. Guidance by the government is needed to community and management to face the need for a more modern development and product diversification, such as maritime tourism and expansion of sea product absorption.

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