THE SUSTAINABLE LIVELIHOODS STATUS OF FLOATING NET CAGE FISH FARMERS IN LAKE RANU GRATI, PASURUAN

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ABSTRACT

Ranu Grati Lake is one of the few natural lakes in the form of maar in East Java. This lake is located in Grati District, the eastern part of Pasuruan Regency. Besides having ecological potential in the form of water resources that never recede, the existence of Lake Ranu Grati also has economic potential which is developed by the community through cultivation activities. Cultivation in floating net cages (cage culture) is one of the empowerment-based community livelihood models that can be developed for poverty alleviation for people who live around aquatic resources such as in Ranu Grati, Pasuruan. Until now, there has never been an assessment of the sustainability of floating net cage cultivation activities in Ranu Grati. This research aimed to measure the status of the sustainability of fish farming activities in floating net cages at Lake Ranu Grati and to assess the attributes that have an important role in increasing its sustainability value. The research was conducted using quantitative methods with a multidimensional analysis approach, leverage, and key attribute analysis. Analyzes were performed using Rapid Appraisal for Fisheries or RAPFISH software. The results show that the index for the sustainability of cultivation activities was at a "sufficiently sustainable" status. The highest value of the sustainability index for all farmer groups is on the social dimension, with a value of 80.52. The next is the values in the economic and ecological dimensions, with values of 69.22 and 59.53 respectively. The values in the two lowest dimensions are 37.55 for the institutional dimension and 37.50 for the technological dimension. The five key attributes that have the highest effect of the overall dimensions studied are the existence of farmer group associations from institutional dimension, intensity of member interaction from social dimension, intensity of fish thinning from technology dimension, level of farmer education, and creation of a conducive atmosphere due to the lack of conflict between cage culture farmers from social dimension. These attributes which needs to be maintained or improved so that the value of sustainability can be increased at a higher level. This research is expected to be a reference for assessing sustainable cultivation for natural lakes with similar characteristics to Ranu Grati.

Keywords: Sustainability Analysis, Rapfish, Lake Resources

INTRODUCTION

Lakes are bodies of water that are inundated all year round and have great potential. Lake is a form of ecosystem that occupies a relatively small area on the earth's surface compared to marine and terrestrial habitats (Haryani, 2013). The existence of lakes ecosystem provides beneficial functions for human life (household, industry, and agriculture) (Safitri, 2017).

Management of fishery resources such as lakes must meet at least 3 criteria; Efficiency criteria and indicators which can simply be illustrated that the fish caught in the ecosystem should not exceed the Maximum Sustainable Yield (Maryunani, 2018). The second criterion is sustainability, which can be interpreted by the attitude or behavior of the surrounding community which tends to maintain productivity balanced with the ecological characteristics of the resource (Yuniarto, 2013). In the technical aspect, this second criterion will usually be realized in the context of cultivation to maintain the sustainability of existing fish resource stocks. The third criterion is equity, this is based on the fact that fishery resources are public goods that can be shared (Maryunani, 2018).

One of the efforts to realize lake management that meets these three criteria can be done through cultivation activities (Fauzi, 2004). At Lake Ranu Grati, aquaculture activities are carried out by the method of making compartments of cage nets as a place for fish rearing which is commonly known as floating net cages (cage culture) (Soltan, 2016). Cultivation in floating net cages is also one of the community empowerment models that can be developed for poverty alleviation in Grati sub-district. In another dimension, efforts to strengthen efficiency indicators have not been accompanied by strengthening sustainability indicators. Strengthening efficiency indicators through community cultivation has had a negative impact on the environment around the lake. Currently, the waters of Lake Ranu Grati have decreased in quality due to increased feed contamination and fish manure in floating net cage cultivation, agricultural waste residues, and poorly organized cage nets compartments (Mulyanto, 2017).

Moving on from this problem, the researcher assess the need for research that specifically examines the analysis of the sustainability of aquaculture in lake communities which is reviewed from several dimensions, not only in the economic dimension, but also considering the more comprehensive aspects in both the economic, ecological, and institutional chiefly, and other necessary dimensions (Gibson et al., 2013).

The research began by exploring the context and conditions that occur in the environment around the lake. At this stage, the scope of observations carried out included the use of lake natural resources for freshwater fish farming activities – carried out by the community around the lake and the occurrence of environmental pollution/ decrease in the quality of lake water, one of which is due to waste from the freshwater fish farming activities.

The next stage was to explore the characteristics of the research respondents which include demographic, condition, climate, and cultural aspects in the lake environment. This stage was carried out by structured interviews using questionnaires and in-depth interviews to obtain more detailed observation results from respondents so that descriptive data exposure can be deeper.

The next process was to analyze the interview data obtained in the field based on the predetermined sustainability dimensions, including the ecological, economic, social, institutional, and technological dimensions in aquaculture carried out by the community around the lake. Data from the five dimensions were then analyzed using a multidimensional scaling approach with the Rapfish software. From this analysis process, it can be seen the level of sustainability of each dimension and as well as which attributes are the key attributes in the sustainability of the aquaculture business.

Research Objectives

The research objectives that would be achieved based on the formulation of the research problem are as follows:

1. To analyze the sustainability level of floating net cage (cage culture) aquaculture in Lake Ranu Grati.
2. To find out what lever attributes affects the sustainability of floating net cage cultivation in Lake Ranu Grati

METHODOLOGY

The method used in this study was a quantitative approach with multi-dimensional analysis techniques of scaling, leverage, and lever attributes analysis obtained from the Rapfish software "R" version which is combined with descriptive exposure data from in-depth interviews with respondents and secondary data – to get a more detailed picture of the material studied.

Location and Time of Research

The research was conducted in Lake Ranu Grati, Pasuruan Regency, which included the lake's waters with an area of 198 hectares and land use activity areas with an area of 64 hectares (Safitri, 2017). The process of field data collection in this study was planned to be carried out in April- August 2020. Meanwhile, the analysis process from the results of data acquisition in the field was carried out in September 2020.

Population and Sampling Method

The population of floating net cage fish farmers in Lake Ranu Grati is as many as 113 farmers groups, spread over four farmer groups. The number consists of 23 people from the Mina Sari group located in Sumber Dawe Sari Village, 40 people from the Mina Makmur group located in Ranu Klindungan Village, and 26 people from the Mina Tirta 1 group as well as 24 people from the Mina Tirta 2 group located in Grati Tunon Village.

Data analysis

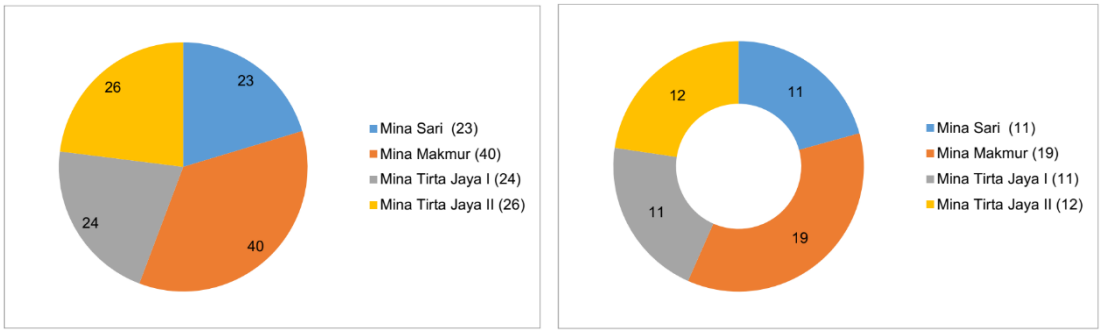
In this research, the data analysis process used the Rapfish (Rapid Appraisal for fisheries) software using the MDS (Multi-Dimensional Scaling) approach. Rapfish is a performance assessment technique for various aspects that affect the sustainability of an activity (Pitcher & Preikshot, 2001).

RESULTS AND DISCUSSION

Fish Farmer Groups

Tracing of farmer groups data was carried out through interviews with the head of the fish farmer groups. To date, there are four groups of floating net cage fish farmers around the lake, consisting of the Mina Sari farmer group who lives in Sumber Dawe Sari Village. The distribution of cages in this group is located on the eastern side of the lake, which is adjacent to the village territory. The number of members in this group is 23 people and led by Mr. Sumitro as the group leader and Mrs. Jumik as group treasurer.

Figure 2. Composition of Farmer Group Members (Left) and Respondents (Right)



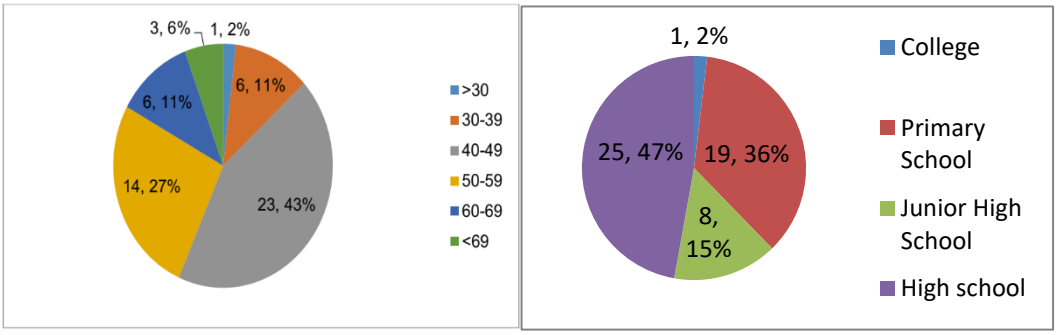
The second group is Mina Makmur, who lives in the Ranu Klindungan Village. The distribution of cages of this farmer group is located on the north side of the lake. The number of members of this second group is 40 people. While the number of cage plots of each member of this group is relatively small, more dominant under 10 plots per member. Some members of the Mina Makmur group are retirees who fill their full time with floating net cage fish farming. The Mina Makmur group is led by Mr. Nur Hasbullah as the group leader.

The third and fourth groups are the Mina Tirta Jaya I and Mina Tirta Jaya II farmer groups who live in the Grati Tunon sub-district. The distribution of cages of these two groups is located on the west side of the lake. The third group and the fourth group were initially one fish farmer group, but because of the large number of members and the wide distribution of cages, the farmer group was eventually divided. The cages of the Mina Tirta Jaya I group are spread out on the northwest side of the lake, while the cages of Mina Tirta Jaya II group are spread out on the southwest side of the lake. The number of members of the Mina Tirta Jaya I group is 26 people, while the number of members of the Mina Tirta Jaya II group is 24 people. The Mina Tirta Jaya group is led by Mr. Umar Sinoto as the group leader and the Mina Tirta Jaya II group is led by Mr. Didik as the group leader.

Respondent Characteristics

Respondents selected in this study are fish farmers who are the floating net cage owners. The number of selected respondents was 53 people who were divided into four farmer groups. The distribution of respondents was carried out proportionally to each farmer group with the following distribution:

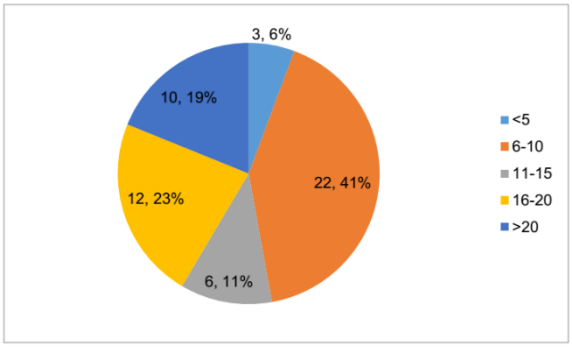
Figure 3. Age Composition (Left) and Education Level of Respondents (Right)



A total of 11 respondents were selected from the Mina Sari farmer group, 19 respondents from the Mina Makmur farmer group, 11 respondents from the Mina Tirta Jaya I farmer group, and the remaining 12 people from the Mina Tirta Jaya II farmer group. The education level of respondents is dominated by high school level with a total of 47 percent. The second most dominated level is the primary school level with a total of 36 percent. Meanwhile, respondents with junior high school education level are 19 percent, and the remaining 2 percent are respondents with tertiary education levels.

The number of compartments of cages cultivated by respondents was classified at 5 plot intervals. The highest number of plots owned by respondents is in the range of 6-10 plots with a total of 22 people or 41 percent. Respondents with 11-15 cage plots are 6 people or 11 percent. Respondents with 16-20 cage plots are 12 people or 23 percent, and respondents with a number of plots of more than 20 cages are 10 people or 19 percent. The remaining 3 people have fewer than 5 plots.

Figure 4. The Number of Respondents Active Cage Plots



Sustainability Measurement

The measurement of business sustainability was carried out in 5 dimensions, consisting of the ecological dimension, the economic dimension, the social dimension, the institutional dimension, and the technological dimension. Dimensions were measured using the "R" version of the Rapfish application. The results of the measurement of the five dimensions are as follows:

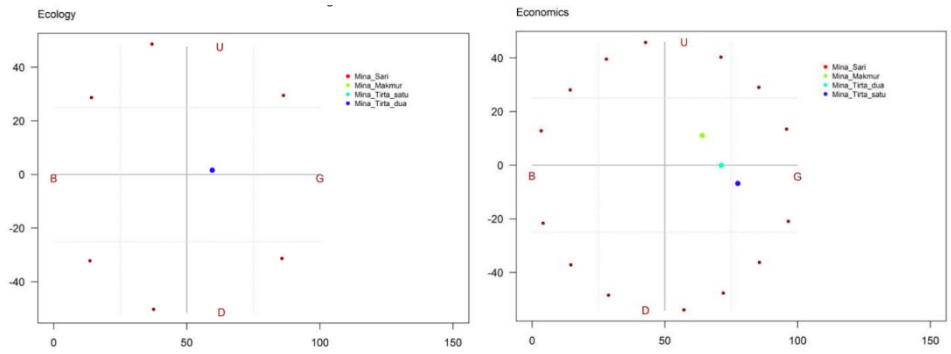
Ecological Dimension Results

The ecological dimension aimed to measure the level of sustainability of economic activity from an environmental approach. The attributes used in this dimension included water quality, frequency of upwelling or *sapon*, disease attack on fish, fish mortality, and good fish farming procedures. Of the five attributes, a sustainability index of 59.53 was obtained for the four farmer groups. There is no difference in value between farmer groups. If viewed from the sustainability index table, the value of the ecological dimensions of the five attributes is in the fairly sustainable category.

Economic Dimension Results

The economic dimension is one of the sustainability variables that measure the economic aspects of aquaculture activities in Lake Ranu Grati. This dimension consists of nine attributes including the benefits of cultivation, business levies from the government, product sales, product price stability, investment offers from other parties, capital assistance from the government, the number of plots that are actively cultivated, the amount of production (cultivated fish), and the number of empowered workers.

Figure 5. Results of Ecological Dimension (Left) and Economic Dimension (Right)



The results of the assessment of the nine attributes of the economic dimension are divided into 3 different values for farmer groups. The sustainability value of the economic dimension in the Mina Sari and Mina Makmur group is 64.07, the value in the Mina Tirta Jaya 2 group is 71.28, and the highest score in the Mina Tirta Jaya 1 group is 77.45. From these results, fish farmer groups can be classified into two index categories in the economic dimension, namely the Mina Tirta Jaya 1 group in the good or sustainable category and the three other groups, the Mina Sari, Mina Makmur, and Mina Tirta Jaya 2 groups in the moderate or quite sustainable category.

Social Dimension Results

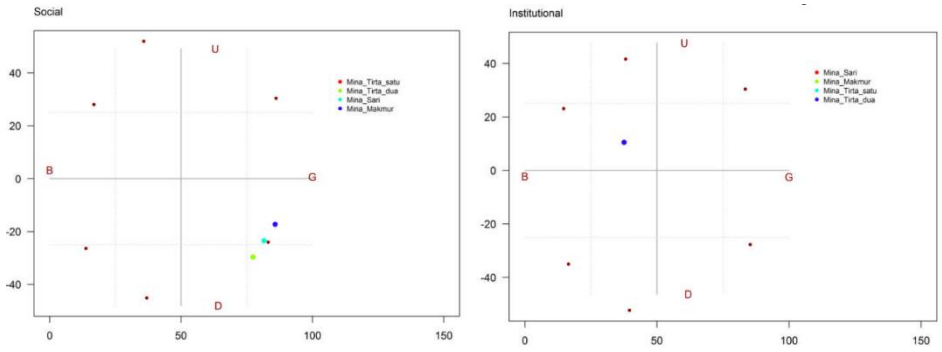
The social dimension in this sustainability analysis was used to measure the sustainability index of the social aspects of the fish farmer groups. The attributes used in this dimension consist of five attributes, namely: farmer education level, frequency of counseling or training from non-governmental organizations (NGOs), conflicts that occur between fish farmers, cage ownership status, and level of fishing theft.

From the results of the assessment of the social dimension, it was obtained that the Mina Tirta Jaya 1 and Mina Tirta Jaya 2 farmer groups have the same value of 77.36, while the Mina Sari group have a value of 81.57, and the Mina Makmur group have the highest value of 85.78. From these results, the four farmer groups can be classified as good or sustainable in the social dimension.

Institutional Dimension Results

The institutional dimension in this sustainability analysis was used to measure the status of sustainability in the institutional aspect of the Lake Ranu Grati fish farmer groups. The institutional dimension is composed of four attributes. The four attributes consist of, first, policies or regulations governing the number and placement of cage compartments implemented by the local government. The second attribute is the frequency of training held by the related offices. The third attribute is the existence of farmer group associations and their existence, and the last attribute is the existence of a joint business entity managed by each farmer group.
Of the four attributes, the same assessment results are obtained from the four farmer groups with a value of 37.55. These results indicate that in the institutional dimension, the sustainability status obtained by all farmer groups is in the category of poor or less sustainable. The results of the institutional dimension assessment can be seen in Figure 6.

Figure 6. Results of the Social Dimension (left) and Institutional Dimension (Right)

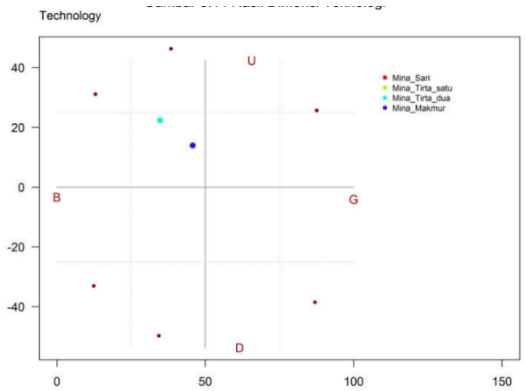


Technological Dimension Results

The technological dimension in this sustainability analysis was used to measure the index of the sustainability of aquaculture activities in the technological aspect. In this dimension, five attributes are used to measure the level of sustainability. The attributes of the technology dimension consist of the thinning process of fish from the initial stocking phase to harvest time, independent fish breeding by farmers, technology for making floating net cages, lighting networks in the floating net cage area, and post-harvest processing methods for farmers' fish products.

From the results of the assessment, the results are divided into two parts, where the Mina Sari, Mina Tirta Jaya 1, and Mina Tirta Jaya 2 groups have the same score of 34.76. Meanwhile, the Mina Makmur group has the highest score of 45.72 in this dimension. From these data, it can be concluded that the sustainability index values of all farmer groups fall into the category of poor or less sustainable.

Figure 7. Results of Technological Dimension



Leverage Analysis

The next analysis process in assessing the sustainability of freshwater aquaculture was in the form of leverage analysis. This analysis process was used to find out which attributes in each dimension have a large and small effect on the assessment of that dimension. The following are the results of the assessment of leverage analysis for each dimension.

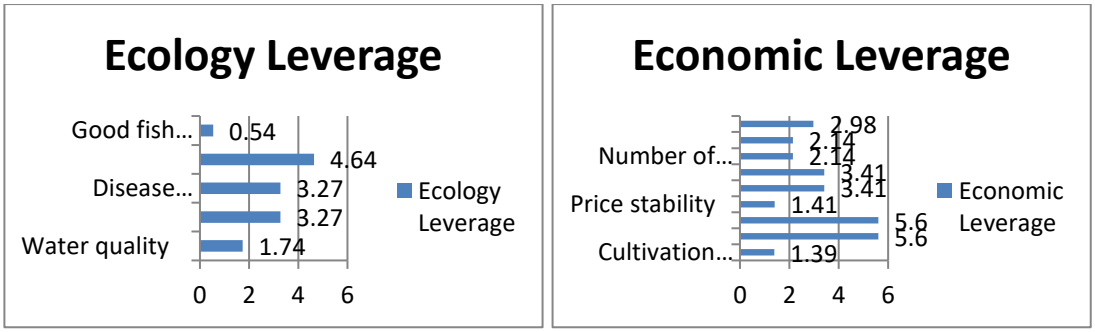
Ecology Leverage

The results of the assessment of leverage analysis on the ecological dimension show that the mortality rate of fish is the attribute with the greatest influence on this dimension, amounting to 4.64 percent. At the next level, the attributes of disease attack and the presence of upwelling or *sapon* are the second most influential attributes with the same value of 3.27 percent for both of them. Meanwhile, the attributes with the lowest influence are the attributes of water quality and good fish management procedures, with respective values of 1.74 percent and 0.54 percent.

Economic Leverage

In the economic dimension, there are two attributes with the highest effect value, namely the attributes of product sales and business levies with the same value of 5.60 percent. The third and fourth rank attributes with the highest influence on the economic dimension are the attributes of capital assistance from the government and the existence of investment offers from outside parties to farmers, with the same value of 3.41 percent.

Figure 8. Leverage Results of Ecological (Left) and Economic Dimensions (Right)



The fifth most influential attribute of the order is the attribute of the number of workers empowered by the farmers. In the next sequence are the attributes of the number of fish cultivated by farmers and the number of active plots used by farmers, with the same value of 2.14 percent. At the lowest level, there are two attributes in the economic dimension, are the attribute of cultivation profit and price stability, with a value of 1.41 percent and 1.39 percent, respectively.

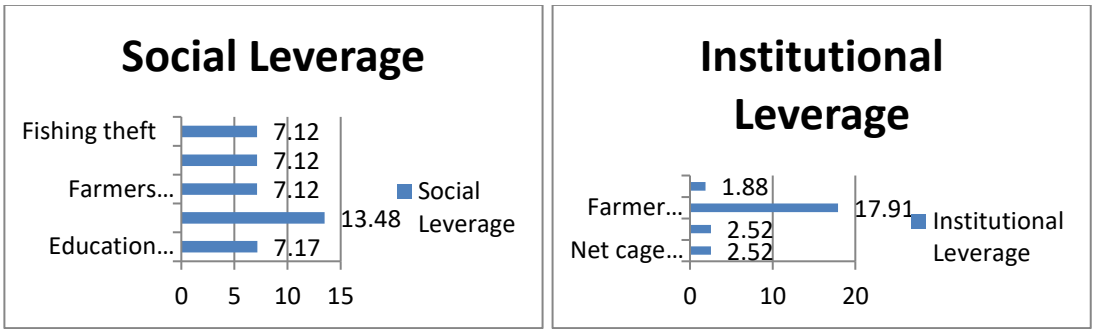
Social Leverage

The results of the analysis of the social dimension leverage show that there is one attribute with the highest value of 13.48 percent, namely group member interaction. At the next level, the attribute of farmer education level also has a significant influence on the social dimension leverage assessment of 7.17 percent. The three remaining attributes in this dimension have the same value, the lowest in the social dimension attributes assessment, but still higher than the values for the other dimension attributes. The three attributes are the level of fishing theft, ownership status of floating net cages, and also the possibility of conflict between floating net cage farmers with a value of 7.12 percent.

Institutional Leverage

Leverage analysis on the institutional dimension provided an assessment of the leverage from 4 dimensional attributes related to institutional aspects. From the results of the assessment, it is shown that the existence of farmer group associations has a very high effect of 17.91 percent. While the following two attributes have the same leverage of 2.52 percent, namely the attributes of the existence of training from the fisheries office and policies or regulations regarding the number and location of floating net cages. One remaining attribute is the attribute of the existence of a joint business entity managed by farmer groups such as a cooperative institution.

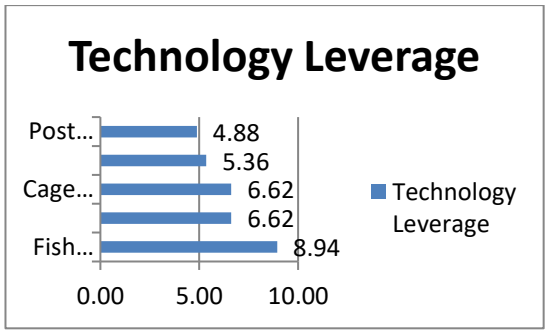
Figure 9. Leverage Results of Social and Institutional Dimensions



Technological Leverage

The assessment of technological leverage consisted of five attributes, namely the attributes of post-harvest processing of farmers' fish products, the presence of lighting network technology in the floating net cage area, the material for the floating net cage framework technology, the ability of farmers in independent fish breeding/ spawning technology, and the fish thinning process in the cultivation phase.

Figure 10. Leverage Results of Technology Dimension

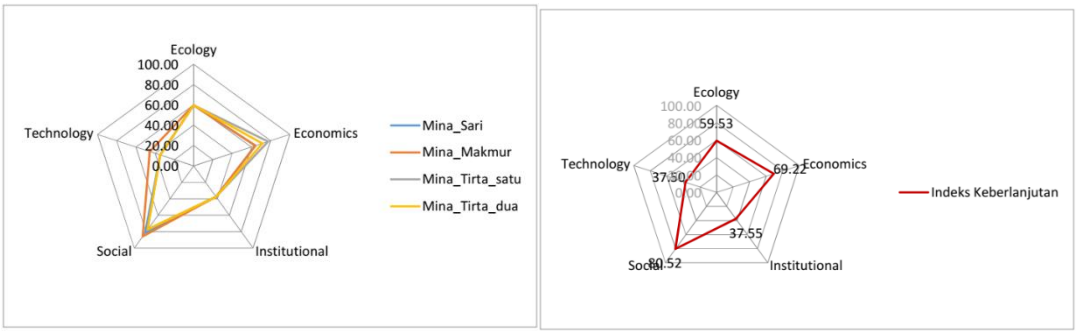


The results of the assessment of the leverage analysis on the technological dimension show that the fish thinning process has the highest assessment effect of 8.94 percent. Meanwhile, the attributes of independent breeding, cage frame material technology are in the next order of 6.62 percent. The attributes with the lowest assessment effect on the technological dimension are the attributes of the lighting network and the attributes of post-harvest processing, which have leverage values of 5.36 and 4.88, respectively.

Multidimensional Scaling Analysis

After the assessment process through analysis of the results of each dimension and leverage analysis, the next process was to carry out a multi-dimensional analysis by presenting the results of the assessment on each dimension into a radar diagram. From the results of the radar diagram display, it can be analyzed that in general the lines formed by each farmer group are relatively the same, forming a high value on the social dimension and a low value for sustainability in the institutional and technological dimensions. Meanwhile, the results of the sustainability assessment on the ecological and economic dimensions are uniformed in the sustainable category.

Figure 11. Multidimensional Value of All Farmer Groups and Sustainability Index



From the overall existing sustainability value, an assessment of the overall average value of all farmer groups was carried out in this multi-dimensional analysis. The highest value of the sustainability index for all farmer groups is on the social dimension, with a value of 80.52. The next is the values in the economic and ecological dimensions, with values of 69.22 and 59.53 respectively. Meanwhile, the values in the two lowest dimensions are 37.55 for the institutional dimension and 37.50 for the technological dimension.

Index Assessment and Sustainability Status

From the assessment of multidimensional analysis in the previous discussion, the sustainability index value of freshwater aquaculture activities in Lake Ranu Grati can be calculated by taking the average value of all dimensions that have been analyzed in the multidimensional analysis.

The results of the assessment show that the sustainability index value for freshwater aquaculture in Lake Ranu Grati is 56.86 or in the sufficient category – which means that it is quite sustainable.

Key Attributes Analysis

Of all the constituent attributes in each dimension, some attributes have a high influence value based on leverage analysis. The attributes with the highest leverage value are the attributes that need to be improved to increase the sustainability value of aquaculture activities. Here are the five attributes with the highest influence value in this study.

Table 1. Attributes with the Highest Influence Value

No.	Attribute	Dimensions	Score
1	Farmer Group Association	Institutional	17.91
2	Member Interaction	Social	13.48
3	Fish Thinning	Technology	8.94
4	Farmer Education Level	Social	7.17
5	Conflict Between Farmers	Social	7.17

Of all the attributes in this study, the five attributes that most influence the sustainability index are, first, the existence of farmer group associations. The existence of farmer groups is very influential on the sustainability of cultivation activities. Through these farmer groups, fish farmers can increase their knowledge of aquaculture and increase social awareness among members of farmer groups. The second influential attribute is the group member interaction. Member interaction could be a process of transferring knowledge to farmers, which is very important to increase the capacity and experience of fish farmers in aquaculture activities. Through intensive interaction, it is hoped that it can increase the quality and quantity of aquaculture production.

The third attribute that has a high influence is the fish thinning process. In the technological dimension, this process aims to filter fish that have a high growth rate with a slow one. With an intensive thinning process, it is hoped that the available feed resources will be more efficient. The fourth key attribute is the farmer's education level. Most of the floating net cage farmers have primary school up to junior high school education. The level of farmer education can also be increased in value through increasing training or technical counseling that is directly related to agricultural cultivation, as in the previous key attribute.

The fifth key attribute is the existence of conflict between farmers. From the results of correspondence, conflicts between farmers are very rare in this area. This conducive condition should be maintained because it greatly affects the sustainability of the farmers' cultivation.

CONCLUSION

1. The freshwater aquaculture business using floating net cage method in Lake Ranu Grati, Pasuruan Regency shows the status of "Sufficiently Sustainable". Thus, this cultivation activity can be used as a recommendation for alternative livelihoods for the community around the lake to reduce the number of poor families living around Grati sub-district.
2. The key attributes or lever attributes that can be used to increase the sustainability status are the existence of farmer group associations, the intensity of counseling or technical training for farmers, the intensity of fish thinning, the level of farmer education, and the creation of a conducive atmosphere due to the lack of conflict between cage farmers. By increasing the activities associated with the lever attribute it is expected to create an increase in the welfare of farmers at a later stage.

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