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Analysis on fishing fisheries resources management sustainability of oxbow barito mati lake, south barito regency, central kalimantan province, Indonesia

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Abstract

Oxbow Barito Mati Lake in South Barito is important not only from economic aspect, but hydrological and ecological aspects as well. Lake and its flooding areas directly connecting to Barito River is an important area for fish migration, spawning and growth. Nevertheless, in its development, the important role of Oxbow Barito Mati Lake seems to be not meaningful due to human activities, such as pollution, excessive lake resources utilization, land conversion, residential development, and etc. This, of course, has negative impact on the lake sustainability itself due to degraded aquatic and fisheries resources which then affect the lake function and benefit values in the present or future. This study was aimed at reviewing the freshwater fishries contribugtion to the gross regional domestic product of South Barito Regency, reconsidering the sustainable fishing fisheries resources management in Oxbow Barito Mati Lake, South Barito Regency, and producing the sustainable fishing fisheries resources management strategy in the lake. The sustainability status in fishing fisheries resources management of Oxbow Barito Mati Lake in ecological dimension had a sufficiently sustainable status (56.09) with sensitive attributes in waste disposals (4.52) and lake water pollution (3.52). In economic dimension, it had less sustainable status (36.3) with sensitive attributes in budgetting from government/private institutions (3.42) and labor absorption (2.71). Moreover, for social-cultural dimension, it had sufficiently sustainable status (54.1) with sensitive attributes in the government role in lake destruction prevention effort (4.10) and the community role in lake destruction prevention effort (2.83). Technological dimension showed less sustainable status (45.28) with sensitive attributes in the undestructive fishing effort (4.61) and the use of selective fishing gear (3.24). Legal/institutional dimension had less sustainable status (38.32) with sensitive attributes in ecosystem protection-related government policy (5.12), fishing fisheries resources management-related legal socialization (4.13) and fishing fisheries resources management zone establishment (3.60). Finally, the multidimension, the combination of each dimension, showed less sustainable status (49.2) in the fishing fisheries resources management of Oxbow Barito Mati Lake.

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Introduction

South Barito Regency has geographic position along the bank of Barito River and has a flat to wavy topography, and there are only few hilly areas (Gunung Bintang Awai District). Most South Barito Regency areas are low land with 0-40 M above sea level (DKP Prov. Central Kalimantan, 2011). The area of flat topography is generally around the riverbank of Barito River, where there many Oxbow lakes (dead river), such as Oxbow Barito Mati Lake.

The presence of Oxbow Barito Mati Lake is potential enough, particularly fishing fisheries, since this lake is freshwater fish producer as local fish which have not only high economic value, but also can support the protein demand for surrounding human communities. In spite of that, the fishing fisheries productivity of the lake in South Barito Regency is highly influenced by dry season and rainy season. In transitional season from dry season to rainy season, Oxbow Barito Mati Lake will gradually have water reduction due to decreased water debt from Barito River. At this time, local fish get together in small rivers and work to migrate to Barito River, and this time is a fish harvest season in which fishermen raise their fishing intensity. On the other hand, by dry season, at which time Oxbow Barito Mati Lake has drought, the fishermen move to flooding areas for fishing. Fish species caught are high economic local fishes, such as shark catfish (*Pangasius sp*.), belida (*Notopterus chitala*), sanggang (*Pangasius sutchi*, catfish), gourami (*Trichogaster sp*.), baung (*Hemibagrus sp*., catfish), adungan (*Hampala macrolepidota*), tapah (Wallago, Siluridae), and junu (ornamental fish).

Important role of the freshwater ecosystem, including Oxbow Barito Mati Lake in South Barito Regency, is not only from economic aspect, but also hydrological and ecological aspects. Hydrologically, it is a regulator of water balance in the watershed of Barito, while it could ecologically maintain the aquatic resources conservation, especially fishes living in the area. Lake and its flooding areas directly connecting to Barito River are an important area for fish migration, spawning, and growth.

However, in its development, the important role of Oxbow Barito Mati Lake seems to be not meaningful due to human activities, such as pollution, excessive lake resources utilization, land conversion, residential development, and etc. This, of course, has negative impact on the lake leading to the aquatic resources degradation of Oxbow Barito Mati Lake. Degradation of aquatic and fisheries resources in this lake has given clear idea regarding human activity pressures on the lake fisheries resources. This degradation will affect not only the lake resources potency, but then affect the lake function and benefit values in the present or future.

Based on these issues, the study was aimed at reviewing the fishing fisheries resources management sustainability of Oxbow Barito Mati Lake in South Barito Regency based on 5 sustainability development dimensions, ecological, economic, social-cultural, technological, and legal/institutional dimensions.

Method

The study site was conducted in Oxbow Barito Mati Lake, Penda Asem, Dusun Selatan District, South Barito Regency, Central Kalimantan, from December 2011 to June, 2013. Data used were secondary and primary data. The former was gathered from literature study and several institutions ralating with the study. The latter was collected through questioners by determining expert respondents related to the sustainability development of each dimension. Several considerations in determining the expert respondents used the following criteria: (a) having good experience regarding the studied dimension; (b) having good reputation, position in their cometence with the studied field; and (c) having high credibility, readiness, and or being in the studied location.

Data Analysis

Sustainability analysis in fishing fisheries resources

management of Oxbow Barito Mati Lake was carried out using a Multidimensional Scaling (MDS) method with RAPFISH (Rapid Assessment Techniques for Fisheries) approach developed by Fisheries Center, University of British Columbia (Kavanag, 2004; Fauzi and Anna, 2002). This method could widely cover dimensions ralating with the fishing fisheries resources management of Oxbow Barito Mati Lake by determining the category basis, "good" and "bad". This method is basically a multivariate method capable of handling non-metric data dan known as one of the ordination in reduced space.

Ordination itself is process of plotting the object position along the axes structured in ordered relationship or in a graphic system consisting of two axes or more (Legendre and Legendre in Susilo, 2003). This RAPFISH approach has been highly developed to analyze environments (Susilo, 2003). Furthemore, this program was developed to be Rap-DanOXBOW (Rapid Appraisal-Oxbow Barito Mati Lake) that could have a specificity and also have specific interpretation value in relation with Oxbow Barito Mati Lake condition. Rap-DanOXBOW (Rapid Appraisal-Oxbow Barito Mati Lake) is intended to measure the sustainability status of 5 dimensions and multidimension in fishing fisheries resources management of Oxbow Barito Mati Lake.

The sustainability index and status values of each dimension and multidimension in the fishing fisheries resources management of Oxbow Barito Mati Lake were separated into 4 sustainability categories (Table 1).

Sensivitity Analysis

After the MDS analysis and the swamp resources sustainability index was obtained, the sensitivity analysis of the attributes was necessary to do. Its advantage was to know which attributes give the contribution to the resources sustainability value. This sensitivity analysis used the attribute leveraging to see the change in the MDS analytical output. The effect of each attribute was seen in the change form of root mean square (RMS), particularly on the x-axis for resources sustainability scale and the y-axis change is not considered. It was just to see the RMS change. The RMS formula is as follows:

$$RMS = \sqrt{\left[\frac{\sum_{i=1}^{n}\{Vf\,(i,1) - Vf\,(,1)\}^2}{n}\right]}$$

Vf (i1) = Value of MDS output (after rotation and flifing).

Vf(,1)= Median of MDS output in column-1.

Table 1. Sustainability criterion in fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency.

Index value	Category
0 – 25	Unsustainable
26 – 50	Less sustainable
51 – 75	Sufficiently sustainable
76 – 100	Highly sustainable

Source : Susilo (2003).

Monte Carlo Analysis

Monte Carlo analysis was done to evaluate the error effect by assessing the ordination. The effect of error could be caused by various conditions, such as error in scoring due to imperfect understanding of the attribute or field condition, score variation from different opinion or valuation of the researcher, repeated MDS analytical process, error in data input or missing data, iteration stability, and high stress value (acceptable stress value should be <25%) (Kavangh, 2004; Fauzi and Anna, 2002).

Discussion

Multi-Dimensional Scaling (MDS) analysis through RAPFISH Program (Rapid Assessment Techniques for Fisheries) was specifically developed to be Rap-DanOXBOW (Rapid Appraisal- Oxbow Barito Mati Lake) in order to measure the sustainability of ecological, economic, social-cultural, technological and legal/institutional dimensions, as well as multidimensional measurement which a combination of all attributes of the five sustainability dimensions.

Also, a leverage analysis was used to know which attributes are sensitive or what intervention could be done to the sensitive attributes to increase the sustainability status of Oxbow Barito Mati Lake fishing fisheries resources management. The leverage was calculated based on the standard error of scores with and without attribute differences. Monte Carlo analysis was used to assess the error effect in the analytical process at the confidence limit of 95%. According to Spence and Young (1978) in Purnomo *et al.*, (2002), this analysis describes the stability level of the ordination output that basically indicates the pertubation level against the ordination value. With this stablity indicator, it could be found how far the result is reliable. The result is expressed in Monte Carlo index value which is then compared with that in MDS analysis. Slight difference between both index values indicates (a) the error in scoring each attribute is relatively small, (b) scoring variation from opinion difference is relatively small, (c) analytical process repeatedly done is stable, and (d) error in data input and lost data could be avoided.

Table 2. Summary of the sustainability status and statistical parameters (goodness of fit) in fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency.

Dimension	Sustainability		Iteration	R^2	Parameter	
	Index	Status			Stress	Decision
Ecological dimension	56.1	Sustainable enough	3	93.7%	14.0%	goodness of fit
Economic dimension	36.3	Less sustainable	3	94.9%	14.8%	goodness of fit
Social-cultural d.	54.1	Sustainable enough	3	91.7%	15.1%	goodness of fit
Technological d.	45.3	Less sustainable	3	94.5%	14.9%	goodness of fit
Legal/Institutional d.	38.3	Less sustainable	3	95.0%	14.0%	goodness of fit
Multidimension	49.2	Less sustainable	2	95.4%	12.9%	goodness of fit

Source : Primary data processed, 2014.

Stress value and determination coefficient (R^2) functions to determine whether the attribute addition is needed or not in order to reflect the dimension accurately studied (approaches to the actual condition). The stress value indicates the goodness of fit in the multi-dimensional scaling (MDS), which shows how accurate the configurstion of a point could reflect the authentic data. Low stress value indicates the good fit, but the high one expresses a contrariwise condition, and the desired stress value is less than 25% (Fauzi and Anna, 2005).

Table 3. Comparison between the output of MDS and Monte Carlo analyses for each dimension and multidimension through Rap-DanOXBOW approach at 95% confidence limit.

Dimension	MDS	Monte Carlo	Difference
Ecological dimension	56.1	56.5	0.4
Economic dimension	36.3	35.8	0.4
Social-Cultural dimension	54.1	54.0	0.1
Technological dimension	45.3	45.4	0.1
Legal/institutional dimension	38.3	38.8	0.5
Multidimension	49.2	49.5	0.3

Source : Primary data processed, 2014.

Ecological Dimension Sustainability Status

Determination of the ecological dimension sustainability index and status in fishing fisheries resources management of Oxbow Barito Mati Lake in south Barito Regency was carried out using MDS analysis with Rap-DanOXBOW (Rapid Appraisal-Oxbow Barito Mati Lake) approach. In relation to this, the attributes considered are capable of affecting the ecological dimension sustainability status in this fishing fisheries resources management, consisting of

10 attributes as follows: [1] fishing fisheries resources exploitation; [2] Lake area rehabilitation; [3] Lake sedimentation; [4] Lake water pollution; [5] Underground water utilization; [6] Waste disposal into the lake; [7] TPA availability; [8] Lake abrasion; [9] Change in caught fish size; and [10] Change in number of caught fish species.

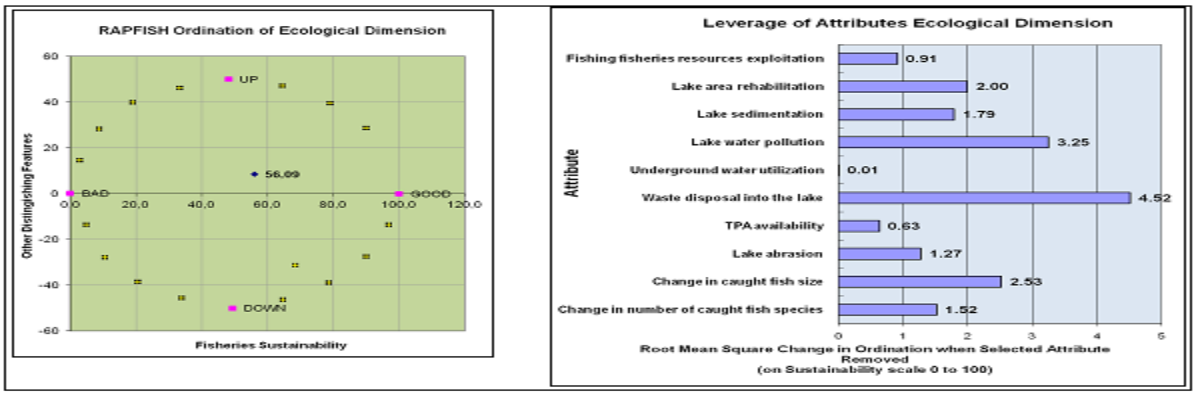

Fig. 1. The ordination and the leverage analysis of the ecological dimension in fishing fisheries resources management of Oxbow Barito Mati Lake.

The ordination of ecological dimension using the Rap-DanOXBOW approach with 3 iterations results in a sustainability index of 56.09 (sustainable enough) and determination coefficient (R^2) of 93.7%, and stress value (S) of 14%. The last two values function to determine whether the attributes need or need not to add in order to accurately reflect the studied dimension (approaches the actual condition). The stress value indicates the goodness of fit in Multi-Dimensional Scaling (MDS) reflecting the configurational accuracy scale of a point showing the authentic data. The desired value in the RAPFISH model must be less than 25% (Fauzi and Anna, 2005). On this basis, the ecological dimension sustainability analysis in fishing fisheries resources management of Oxbow Barito Mati Lake shows the goodness of fit (14% < 25%) and good condition (93.7% approaches to 1).

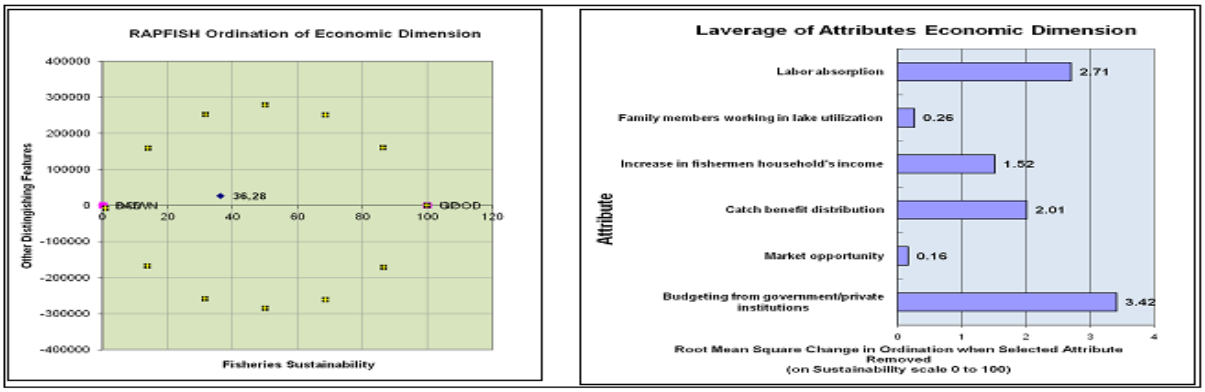

Fig. 2. The ordination and the leverage analysis of economic dimension in fishing fisheries resources management of Oxbow Barito Mati Lake.

The leverage analysis of the attributes shows that the sensitive attributes to the ecological dimension sustainability in fishing fisheries resources management of Oxbow Barito Mati Lake are waste disposals into the lake (4.52) and lake water pollution (3.52), respectively. In fact, most people around the lake take out the trash, especially domestic and agricultural wastes, into the lake. It would certainly

impact on the lake water pollution. On the other hand, uncontrolled floating net system-fish culture has also left fish feed wastes into the lake causing additional water pollution.

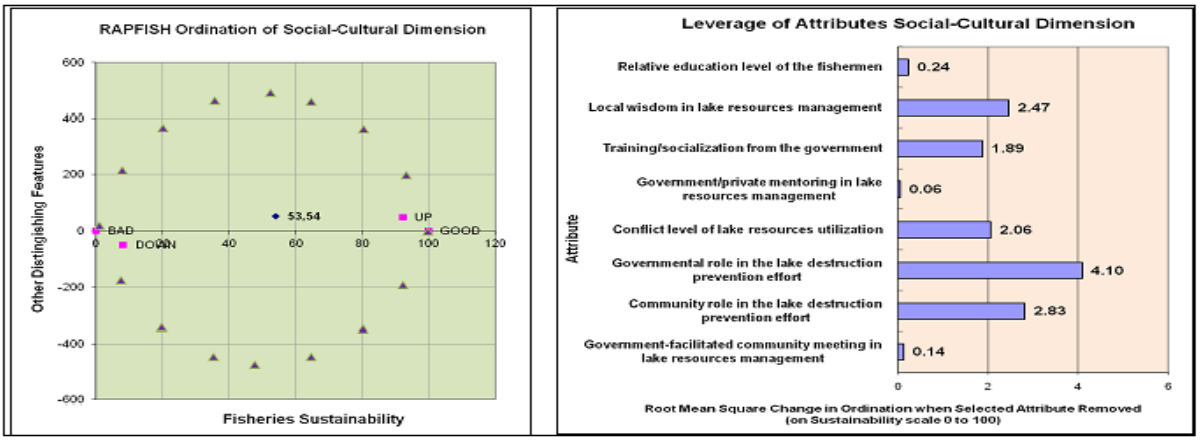

Fig. 3. The ordination and the leverage analysis of social-cultural dimension in fishing fisheries resources management of Oxbow Barito Mati Lake.

Domestic wastes, beside erosion, will increase the lake sedimentation and affect the freshwater fish habitat. Higjh sedimentation will cause the fish habitat get smaller and the food organisms get less if the management is not wisely done. Sedimentation and waste disposals will affect the water quality (Huey dan Meyer, 2010). Based upon the statement of Living Environmental Minister (2014), 70%-75% Indonesian rivers are lightly to heavily-polluted from domestic wastes. It reflects that sedimentation and domestic wastes are the ecological dimension indicator mostly affecting the tidal swamp for a sustainable fisheries culture. Sedimentation and wastes from the laystall could cause the tidal swamp have euthrophication. Eutrophication makes the predatory fish and fish natural food stressed (Salihoglu and Sevinc, 2013).

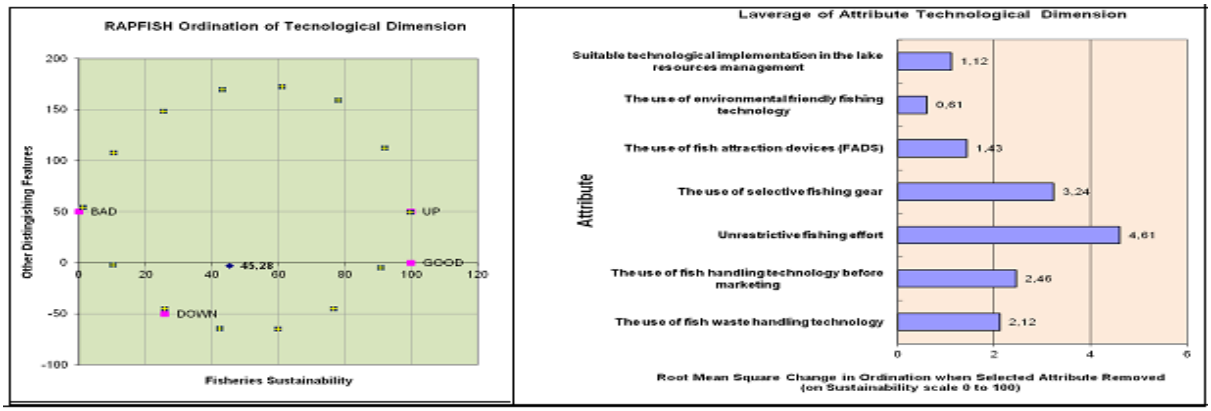

Fig. 4. The ordination and the leverage analysis of technological dimension in fishing fisheries resources management of Oxbow Barito Mati Lake.

The organic matters from domestic wastes entering the lake will partly be absorbed by the aquatic plants. The rest, with the aquatic plant mass decomposition, will gravitate onto the aphotic lake bottom. Whenever water mass upwelling occurs from the aphotic to the photic zone, the blooming algae could threaten the aquatic life. The threat usually occurs at night due to competition in oxygen demand between plants and animals. When the water upwelling comes from the hypolimnion, it would be fatal, not only at night but also during the day. It could result from the water mass of the hypolimnion also containing toxic gases,

such as H_2S (Hydrogen Sulphide), NH_3 (Ammonia), and CH_4 (Methane). Materials suspended in the lake water bottom is a time bomb for aquatic life in the lake (KNLH, 2008).

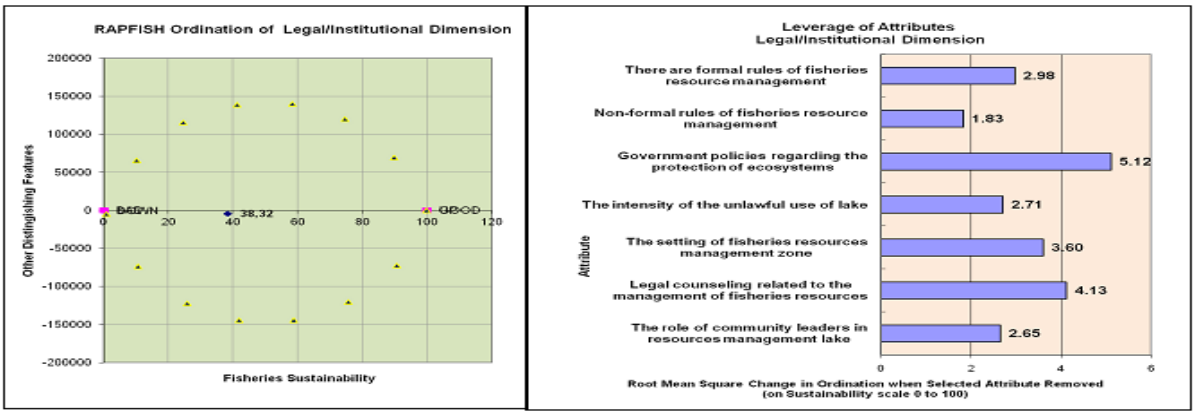

Fig. 5. The ordination and the leverage analysis on legal/institutional dimension in fishing fisheries resources management of Oxbow Barito Mati Lake.

Economic Dimension Sustainability Status

Determination of the economic dimension sustainability index and status in fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency used MDS analysis with Rap-DanOXBOW (Rapid Appraisal-Oxbow Barito Mati Lake) approach. The attributes considered capable of affecting the economic dimension sustainability status consist of 6 atributes: [1] labor absorption; [2] family members working in lake utilization; [3] increase in fishermen household's income; [4] catch benefit distribution; [5] market opportunity; and [6] budgetting from government/private institutions.

The ordination of the economic dimension obtained from Rap-DanOXBOW approach with 3 iterations has a sustainability index of 36.3 (less sustainable), determination coefficient (R^2) of 94.9%, and stress value (S) of 14.8%. The last two values serve to determine whether the attribute addition is needed or not in order to reflect the accurately reviewed dimension (approaches the actual condition). The desired stress value in the RAPFISH model must be less than 25% (Fauzi and Anna, 2005). Based on this, the economic dimension sustainability analysis in the fishing fisheries resources management of Oxbow Barito Mati lake shows the goodness of fit (14.9% < 25%) and good condition (94.9%, approaches to 1). The leverage analysis of the attribute shows that the sensitive attributes affecting the economic dimension sustainability in this fishing fisheries resources management are budgetting from government/private institutions (3.42) and labor absorption (2.71). The fisheries resources in Oxbow Barito Mati lake is not capable of supporting the people economy of surrounding area. This is not only due to Barito Mati lake being productive merely in rainy season, but also unsufficient role of the government/private institutions in optimizing the available fisheries resources.

Social-Cultural Dimension Sustainability Status

Determination of the social-cultural dimension sustainability status in the fishing fisheries resources management of Oxbow Barito Mati lake in South Barito Regency used the MDS analysis with Rap-DanOXBOW (Rapid Appraisal-Oxbow Barito Mati Lake) approach. The attributes considered capable of influencing the sustainability status in this fishing fisheries resources management consist of 8 attributes: [1] relative education level of the fishermen; [2] local wisdom in lake resources management; [3] Training/socialization from the government; [4] government/private mentoring in lake resources management; [5] conflict level of lake resources utilization; [6] governmental role in the

lake destruction prevention effort; [7] Community role in the lake destruction prevention effort; and [8] government-facilitated community meeting in lake resources management.

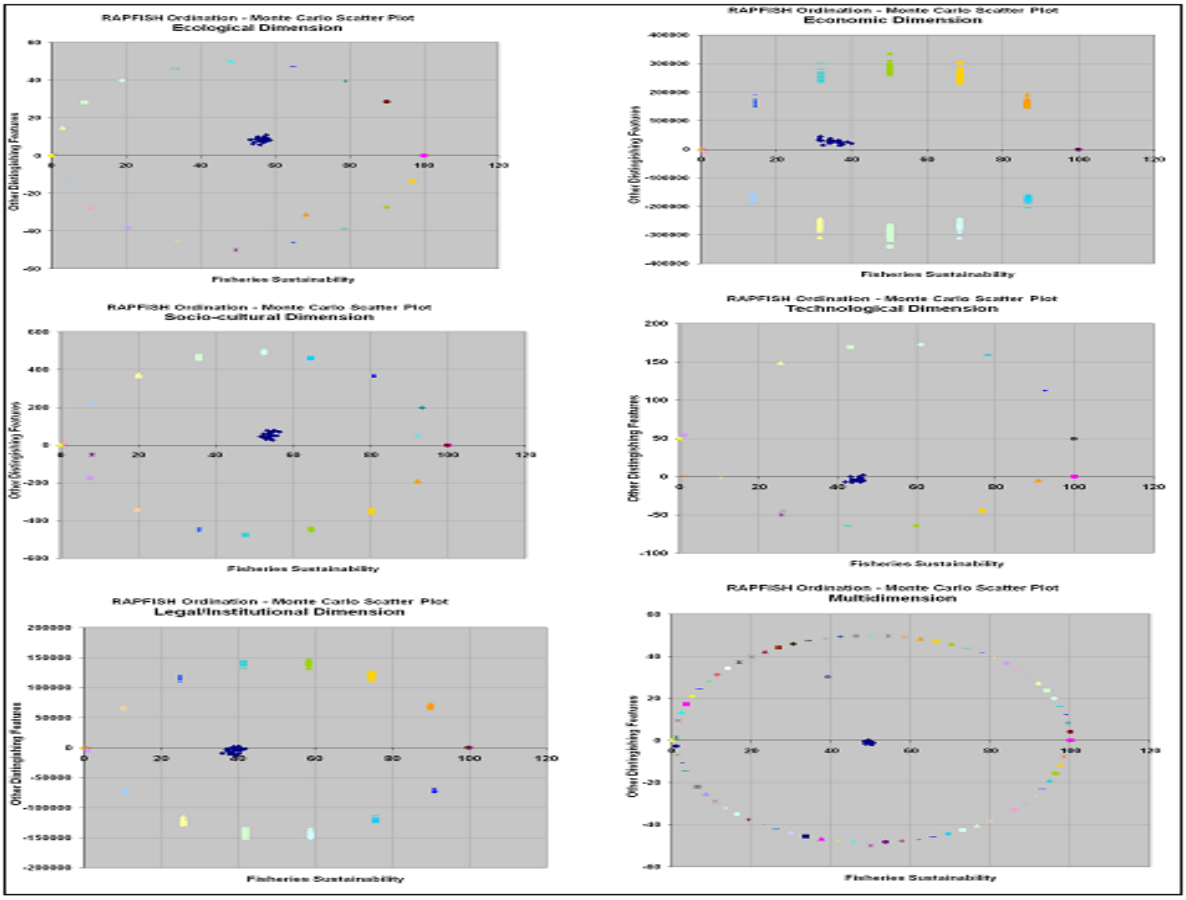

Fig. 6. Scatter-plot of ordination value stability of each dimension and multidimension from Rap-DanOXBOW approach using Monte Carlo.

The ordination of the social-cultural dimension from the Rap-DanOXBOW analysis with 3 iterations gives the sustainability index of 54.1 (sustainable enough), determination coefficient (R^2) of 91.7%, and stress (S) value of 15.1%. The last two values serve to determine whether the attribute addition is needed or not in order to indicate the accurately revewed dimension (approaches the actual condition). The desired stress value in the RAPFISH model must be less than 25% (Fauzi and Anna, 2005). Based on this, the social-cultural dimension sustainability analysis in the fishing fisheries resources management of Oxbow Barito Mati lake shows the goodness of fit (15.1% < 25%) and good condition (91.7%, approches to 1).

The MDS analysis with the Rap-DanOXBOW method above reflects that the fishing fisheries resources management of Oxbow Barito Mati lake is socially-culturally sustainable enough. It will be better if the government's and community's role in the effort of lake destruction prevention is correctly raised, and the presence of government and community collaboration relating to lake destruction prevention will better increase the social-cultural sustainability status of Barito Mati lake. The leverage analysis of the attributes shows that the sensitive attributes affecting the social-cultural dimension sustainability in the fishing fisheries resources management of Oxbow Barito Mati lake are the government's role in lake destruction prevention effort (4.10) and the community's role in lake destruction prevention effort

(2.83). Social and cultural factors could affect the fish diversity (Pinedo-vazquez *et al.* 2001). Fishing fisheries resources management of Oxbow Barito Mati lake could not, of course, be separated from the community participation in conserving the lake ecosystem and carrying capacity. So far, the government is still giving low attention on this lake potency, such as minatourisms. Similar situation also occurs in the community due to no local wisdom being implemented in the fishing fisheries resources management of Oxbow Barito Mati Lake.

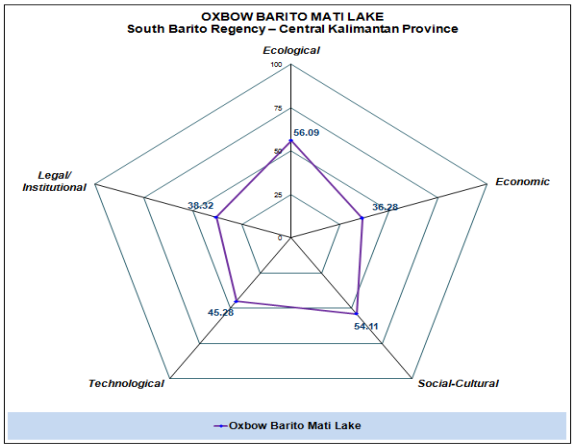

Fig. 7. Kite diagram of the sustainability status in fishing fisheries resources management of Oxbow Barito Mati Lake, in South Barito Regency

Technological Dimension Sustainability Status

Determination of the sustainability index and status of ecological dimension in the fishing fisheries resources management of Oxbow Barito Mati Lake in south Barito Regency was done using MDS analysis with Rap-DanOXBOW (Rapid Appraisal-Oxbow Barito Mati Lake) approach. The attributes capable of affecting the ecological dimension sustainability status in the fishing fisheries resources management consist of 7 attributes as follows: [1] suitable technological implementation in the lake resources management; [2] the use of environmental friendly fishing technology; [3] the use of fish attraction devices (FADS); [4] the use of selective fishing gear; [5] undestructive fishing effort; [6] the use of fish handling technology before marketing; and [7] the use of fish waste handling technology.

The ordination of the Rap-DanOXBOW technological dimension with 3 iterations has an index of 45.28 (less sustainable), determination coefficient (R^2) of 94.5%, and stress value (S) of 14.9%. The ecological dimension sustainability analysis in the fishing fisheries resources management of Oxbow Barito Mati Lake shows the goodness of fit (15.1% < 25%) and good condition (91.7%, approaches 1). The MDS analysis with the Rap-DanOXBOW method above indicates that the fishing fisheries resources management of Oxbow Barito Mati Lake is technologically less sustainable. The use of undestructive and selective fishing gears will certainly be highly influential to increase the technological sustainability status of Oxbow Barito Mati Lake. Thus, the use of undestructive and selective gears needs to be well handled that the fisheries resource of the area could be sustainable and capable of giving good contribution to the local people in the future. The leverage analysis shows that the attributes affecting the technological dimension are undestructive fishing effort (4.61) and the use of selective fishing gear (3.24). Fishing in Oxbow Barito Mati Lake seems to have less selective fishing gear, such as selambau, while there are many people practicing destructive fishing techniques, such as fish bombing and cyanide fiishing.

Legal/Institutional Dimension Sustainability Status

Determination of legal/institutional dimension sustainability status in the fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency was done using the MDS analysis with the Rap-DanOXBOW (Rapid Appraisal-Oxbow Barito Mati Lake) approach. The attributes considered capable of affecting the legal/institutional sustainability status in the fishing fisheries resources management consist of 7 attributes: [1] formal regulations of fishing fisheries resources management; [2] non-formal regulations of fishing fisheries resources management; [3] lake ecosystem conservation-related governmental policy; [4] lake resources utilization intensity violating the law; [5] fishing fisheries resources management zone

establishment; [6] fishing fisheries resources management-related legal socialization; and [7] the role of community leaders in lake resources management.

The ordination of the legal/institutional dimension gained from the Rap-DanOXBOW method with 3 iterations gives a sustainability idenx of 38.32 (less sustainable), determination coefficient (R^2) of 95%, and stress (S) value of 14%. The stress value reflects the goodness of fit in Multi-Dimensional Scaling (MDS) which indicates the configurational accuracy scale of a point in describing the actual data. The legal/institutional dimension sustainability analysis in the fishing fisheries resources management of Oxbow Barito Mati lake shows the goodness of fit (14% < 25%) and good condition (95%, approches to 1).

The leverage analysis of the attributes reflects that the sensitive attributes affecting the legal/institutional dimension sustainability in the fishing fisheries resources management of Oxbow Barito Mati Lake are the ecosystem protection-related government policy (5.12), legal socialization in relation with fishing fisheries management (4.13), and fishing fisheries resources management zone establishment (3.60). In addition, there is no legal protection and specific policy issued by the Regency Government relating with the fishing fisheries resources management of Oxbow Barito Mati Lake.

Multidimensional Sustainability Status

The multidimensional sustainability analysis in the fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency used the Multi-Dimensional Scaling (MDS) method with Rap-DanOXBOW (Rapid Appraisal-SOUTH BARITO) approach. This analysis is based on the dimensions of fishing fisheries resources management of Oxbow Barito Mati Lake including [1] ecological dimension, [2] economic dimension, [3] social-cultural dimension, [4] technological dimension, and [5] legal/institutional dimension. The summary of the sustainability and statistical parameter (goodness of fit) for each dimension or multidimension in the fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency is given in Table 2.

The ordination of multidimension gained from the Rap-DanOXBOW method with 3 iterations gives a sustainability index of 49.21 (less sustainable), determination coefficient (R^2) of 95.4%, and stress (S) value of 12.9%. The multidimensional sustainability analysis in the fishing fisheries management of Oxbow Barito Mati Lake indicates the goodness of fit (12.9% < 25%), while the determination cefficient (R^2) is high enough (approaches to 1). Thus, all the attributes of each dimension and multidimension is good enough to describe the fishing fisheries resources management sustainability of Oxbow Barito Mati Lake in South Barito Regency.

The output of the Monte Carlo simulation for each dimension or multidimension in the scatter-plot form is shown in Fig. 6.

So far, the Monte Carlo analysis with scatter-plot shows that fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency does not get much perturbation, and it is shown by plot grouping on one site and unseparated. Clearly, the calculation comparison between the Rap-DanOXBOW and the Monte Carlo methods at 95% for each dimension or multidimension is given in Table 3.

The comparison between MDS Rap-DanOXBOW and Monte Carlo analyses shows that their sustainability indices in the fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency at 95% confidence limit are not so different (<1). This slightly different sustainability index of both methods reflects that error in each attribute scoring is relatively small, scoring variance from opinion difference is relatively small, analytical process repeatedly done is stable, and error in data input and

missing data could be avoided. This difference also indicates that the system reviewed has a high confidence level. Several parameters of statistical test reflect that the Rap-DanOXBOW method is good enough to use as an evaluation tool in determining the sustainability of fishing fisheries resources management of Oxbow Barito Mati Lake in South Barito Regency.

The Rap-DanOXBOW analysis for multidimension indicates a sustainability index of 49.2 or a range of 26-50 (less sustainable). Also, the analysis on each dimension shows only ecological and social-cultural dimension having sufficiently sustainability status, but three other dimensions, economic, legal/institutional, and technological ones, are less sustainable. This is shown in the kite diagram, in which the bigger the sustainability index (approaches to 100), the higher the sustainability status (good) is, but the smaller the sustainability index (approaches to 0), the lower the sustainability status (bad) is. The kite diagram above shows only ecological and social-cultural dimensions approaching to 100.

Conclusion and suggestion

Conclusion

Rap-DanOXBOW analysis shows that the sustainability status in fishing fisheries resources management of Oxbow Barito Mati Lake in ecological dimension has sufficiently sustainable status (56.09) with sensitive attributes in waste disposals (4.52) and lake water pollution (3.52) and in economic dimension, has less sustainable status (36.3) with sensitive attributes in budgetting from government/private institutions (3.42) and labor absorption (2.71). Also, in social-cultural dimension, the status is sufficiently sustainable (54.1) with sensitive attributes in the government's role in lake destruction prevention effort (4.10) and the community's role in lake destruction prevention effort (2.83). Moreover, in technological dimension, it is less sustainable (45.28) with sensitive attributes in undestructive fishing effort (4.61) and the use of selective fishing gear (3.24). In legal/institutional dimension, it is less sustainable (38.32) with sensitive attributes in ecosystem protection-related government policy (5.12), fishing fisheries resources-related legal socialization (4.13) and fishing fisheries resources management zone establishment (3.60). Finally, in multidimension, it is less sustainable (49.2) in the fishing fisheries resources management of Oxbow Barito Mati Lake.

Suggestion

The government of South Barito Regency should prioritize improvements in economic, legal/institutional, and technological dimensions. The improvements should also be given not only to sensitive attributes affecting the sustainability status development, but other attributes as well that the fisheries resources management sustainability status could be increased approaching to sustainability index of 100%.

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