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Sustainability analysis on fisheries resources of tidal marsh in Barito Kuala district, South Kalimantan

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Abstract

Barito Kuala district is a region that is mainly composed of tidal marsh. Marsh area is a crucial area for agropolitan development on fisheries resources. With the current issues of land use converted function, we need to assess the sustainability level of the marsh area. This study aimed to assess the sustainability of tidal marsh fishery resources in the Barito Kuala district based on five dimensions of sustainability, i.e. ecological, economic, socio-cultural, technology, as well as legal and institutional dimensions. We used Multi-Dimensional Scaling (MDS) approach which was called Rap-Batola and the results were expressed in index and status of sustainability. The results showed that the Kuripan Sub-district has the highest sustainability index (59,37) compared to the Marabahan Sub-district (59,27) and Cerbon Sub-district (58,21). However, in general it can be stated that the fishery resources of tidal marsh in three sub-district areas were quite sustainable. Thus it can be stated that the fisheries resources of tidal marsh in the Barito Kuala district has sustained sufficient status.

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Introduction

Tidal marsh land opening was firstly done with purpose to transmigration resettlement program that began in *Pelita I* (New Order) around 1969 through program of Tidal Rice Field Opening Project (*P4S*). Tidal land use for agriculture is a strategic choice in balancing the shrinking land equilibrium in the island of Java that was converted to non-agricultural sectors such as housing, highways, industry and other development.

Barito Kuala district is one of the regions of South Kalimantan Province, which is geographically located about 45 km in the north of Banjarmasin City (the capital of South Kalimantan Province), the width of 299.686 ha, with an area of 287.922 ha marsh and lowland marsh 11.774 ha. Meanwhile, land use of tidal marsh area was converted into oil palm plantations in Barito Kuala district covering 45.622 ha, with smallholding farm is 20% of the total plantation, managed by private companies, i.e. 9.124 ha (Forestry and Plantation of Barito Kuala District, 2010).

Tidal marsh land area in the district of Barito Kuala may potentially be used as local fish farming. Stagnant water tidal peat marsh among oil palm plantation, rice and horticulture and citrus crops are still not used as a location for the local fish farming. Stagnant water can be converted into a local pond fish culture. Less productive tidal peat marsh began to be used as oil palm plantations. To increase the additional value of stagnant water between the palm trees is necessary to be used as a local fish farming location. Local fish is generally very tolerant in the waters of this region. Local fish farming ponds or among palm trees, rice and citrus can give additional value to the community as an additional source of family income and consumed animal protein.

Based on the above issues, the study aimed to assess the sustainability of fishery resources in the tidal marsh of Barito Kuala based on five dimensions of sustainability, i.e. ecological, economical, social-cultural, technological, and legal and institutional dimensions.

Materials and methods

Study Site

Research on the management of tidal marsh for fish farming in the perspective of regional autonomy in Barito Kuala district has 17 administrative districts namely Tabunganen, Tamban, Mekarsari, Anjir Pasar, Anjir Muara, Alalak, Mandastana, Belawang, Wanaraya, Barambai, Rantau Badauh, Cerbon, Bakumpai, Marabahan, Tabukan, Kuripan, and Jejangkit. The study was conducted from December 2011 to June 2013.

Data Collection

The data consisted of secondary and primary data. Secondary data was obtained through the study of literature and documents from several institutions associated with research. Meanwhile, primary data obtained from expert opinion. Some considerations in determining who will be the experts respondent, using the following criteria: (a) has competent experience in accordance with the studied field, (b) have a reputation, position/job in the field of assessed competence, and (c) have a high credibility, willing, and or are in the studied locations.

Data Analysis

The overall sustainability resources of tidal marsh were analyze use Multi Dimensional Scaling (MDS) which was a modified approach of the RAPFISH (Rapid Assessment Techniques for Fisheries) program that developed by Fisheries Center, University of British Columbia (Fauzi, 2000; Kavanagh, 2001; Fauzi and Anna, 2003). This method can widely include dimensions associated with the presence of marsh resources by determining a baseline of "good" and "bad". MDS can analyze a complete picture of the state of the marsh resources. This method is basically a multivariate method that can handle non-metric data and is also known as one of the ordination (dimensions) to minimized space. Ordination itself is a process of "plotting" object point

(position) along the axes that arranged according to two or more particular relationship (an ordered relationship) or in a graphics system (Susilo, 2003). Another advantage of this method is it summarizes multidisciplinary data to produce plenty quantitative information and projections. The approach of this method has been developed to analyze the environmental data (Susilo, 2003).

MDS analyzing each attribute of marsh resources by scoring all secondary and primary data. The assessment showed differences which depend on the number of theoretical basis' ratings. Analyses were performed using MDS referred to Susilo (2003) as follows:

1) Determine the other two main point, called "central point" of bad and good points; two additional main point is also determine in a vertical direction that marked as "up" and "down"
2) Create an additional reference point called the "anchor" that used for the ordination. The point act as a stabilizer – a kind of *envelope* that pinpoints the location of research in Barito Kuala is not beyond the envelope. These points are also useful in the regression analysis to calculate the "stress" as a part of the MDS.
3) Standardize the scores of the attributes to:

$$X_{ik}sd = \frac{x_{ik} - x_k}{s_k};$$

$X_{ik}Sd$ = standard score of the study sites (including point reference) to i = 1, 2,... n, on each attribute to k = 1, 2,.... p;

X_{ik} = the value of the initial score of the study site (including its reference point) to i = 1, 2,... n, on each attribute to k = 1, 2,... p ;

Xk = midpoint scores on each attribute to k = 1, 2,.... p ;

Sk = standard deviation scores for each attribute k = 1,... 2,..., p.

4) Calculate the distance between the location of resources in the marsh with the Euclidean distance method of n dimension as follows:

$$D^2_{(ij)} = \sum (X_{ik} - X_{ik})^2$$

5) Ordinate all attributes for each dimension based on MDS analysis algorithm aspect into two dimensional axis, X and Y. Results of ordination is the V matrix (nx 2) where n is the number of assessed sites.
6) The distance between the objects is calculated by regressing the Euclidean distance (dij) with the origin (DIJ).The equation as follow :

$$d_{ij} = \alpha + \beta\delta + \varepsilon$$

Regression analysis in MDS which included stress assessment by the goodness of fit becomes very crucial, because the goodness of fit reflects the value of S (stress) indicator when referring to the level of RAPFISH S value (stress > 0.25). The manufacture of sustainable scale (sustainability) from "Poor" to "Good" (0-100) refers to Susilo (2003), at a ± 50 point above the x-axis on the scale and 50points lower the y-axis.

Stress values and coefficient of determination (R^2) determined whether the addition of attributes is accurately reflected the dimensions or not (approach on actual conditions). Stress values reflect the goodness of fit in MDS, which shows the exact size of a point configuration to reflect the original data. Lower stress value indicates a good fit, while high stress values indicate the opposite. In the model of Rapfish, the desired stress value is smaller than 25% (Fauzi and Anna, 2003).

For i = 1, 2, ...n;

$$Vf(i,1) = 100\left[\frac{V(i,1) - V(Ibad,1)}{V(Iup,2) - V(Idown,2)}\right]$$

$$Vf(i,2) = 100\left[\frac{V(i,2) - V(Ibad,2)}{V(Iup,2) - V(Idown,2)}\right] - 50$$

$$Vf_{(i,2)} = Vf_{(i,2)} - Vf_{(I\,good,\,2)}$$

Index values for the dimensions of the marsh resource of Barito Kuala are sustainable if it's > 50 and if the index is < 50 it means it is not sustainable. Sustainability index for this study were made in four categories (Table 1).

Table 1. Sustainability Index and Status

Index Value	Category
0 – 25	Not sustainable
26 – 50	Less sustainable
51 – 75	Fair sustainable
76 – 100	Highly sustainable

Sensitivity Analysis

After the analysis of MDS and resource sustainability indices obtained, we conducted sensitivity analysis of these attributes. The analysis was used to determine the attributes that influence or contributes to the sustainability of the resource's value. The sensitivity analysis use the "attribute leveraging" to see a change from the results of the MDS analysis. The influence of each attribute is implied in the form of changes of root mean square (RMS), especially on the x-axis scale, the sustainable resource. Otherwise, conversely the change on the y-axis is not concerned. The RMS formula is:

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

Description:

Vt (i1) = Value of MDS (after rotating and flipping);

Vt (,1) = the middle value of MDS in column – 1

Leverage analysis is used to determine the sensitive attributes, or interventions that can be performed to enhance the sustainability status of fisheries resources of tidal marsh in Barito Kuala District. Leverage is calculated based on the difference standard error between the attribute scores and scores that obtained without attributes.

Monte Carlo Analysis

Monte Carlo analysis was performed to evaluate the effect of statistical error value of particular aspect, in 95% confidence interval. Spence and Young (1978) stated that this analysis is assessing the stability on the ordinance analysis, which is essentially intended to see the level of disturbance (perturbation) against the value of the ordinance. The stability indicator implied that the results of the analysis are valid and trusted. The results of the analysis are expressed in the form index value of Monte Carlo, which is further distinguished by the index value of the MDS. Analysis of Monte Carlo (Kavanagh, 2001; Fauzi and Anna, 2003) is use for assessing:

1) The effect of the error from the attribute scores which describes the conditions of marsh's resources.
2) Effect of scores variation due to different opinion or judgment by other studies.
3) Stability of the MDS was processed repeatedly (iteration) and also considered to perform further analysis on the quality of the reference points stability.
4) The error on data entry or missing data.
5) The high value of the results of stress analysis.

The small index value indicates: (a) errors in score of each attribute is relatively small, (b) variation of scores is relatively small due to differences of opinion, (c) the analysis that conducted repeatedly is stable, (d) data entry errors and lost data can be avoided.

Result and discussion

Sustainability Status on Ecology Dimensions

The attributes that considered affect the sustainability of fishery resources in the tidal marsh of Barito Kuala District in the ecological dimension. It consists of 12 attributes, i.e. (1) exploitation of fish resources; (2) land pressure; (3) rehabilitation of wetlands; (4) sedimentation; (5) water pollution; (6) utilization of tourism object; (7) utilization of ground water; (8) disposal waste into the marsh; (9) availability of landfill; (10) marsh abrasion ; (11) changes in the size of fish caught; and (12) changes in the number of fish caught (Fig. 1).

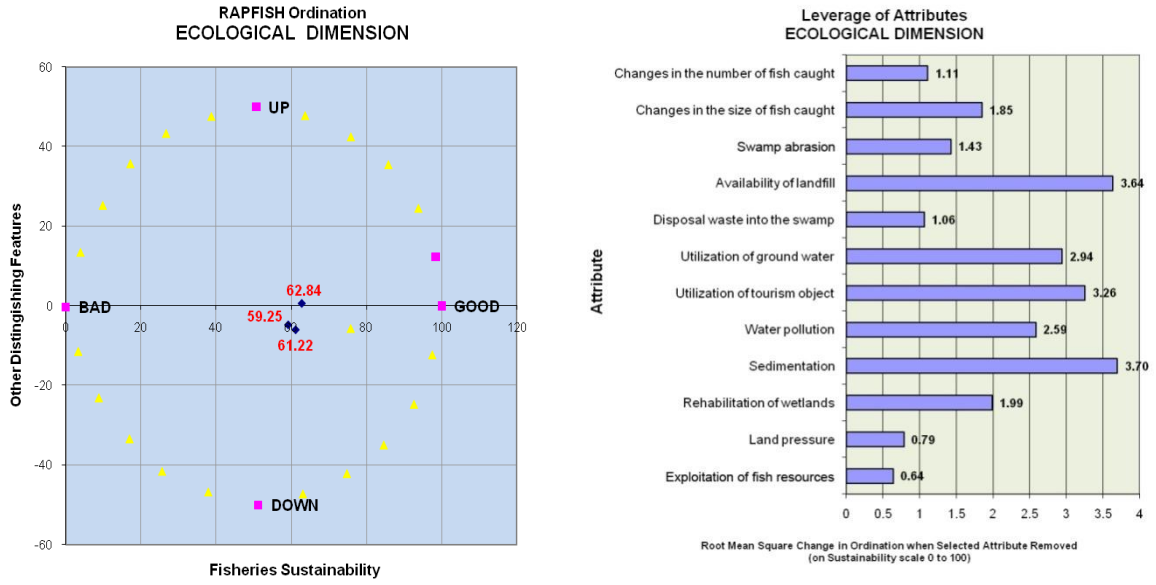

Fig. 1. Ordinance and leverage on ecological dimension to the sustainability of tidal marsh fishery resources in Barito Kuala

Rap-Batola is directed to produce the ecological dimension ordinate that determine the relative position of each fishery resources of the tidal marsh ordination in the good range value of 100, and the bad with a value of zero. Based on this ordinate, we could calculate the index and the sustainability status of fisheries resources in tidal marsh on ecology dimension.

The results of the Rap-Batola ordinance analysis on the ecological dimension with three times iterations is a coefficient of determination (R^2) of 93.3% and the value of stress (S) by 14%. Thus, the ecological dimension analysis in this study indicates the condition goodness of fit, given the stress value 14%.

The results of the analysis leverage all the attributes or dimensions of ecological indicators. It indicate that the attributes sensitive to sustainability. The sedimentation valued 3,70 and the availability of landfill has a value of 3,64. The high tidal marsh sedimentation in Barito Kuala is closely related to land pressure, in the form of land-use change into plantation and farming. The land-use changes are not well ordered as the presence of new rice fields. The irrigation systems are also less managed. While the opening of oil palm plantations is on a large scale, farming practices was poorly managed. Nevertheless, the lack of landfill availability for garbage disposal was not considering the impact of environmental pollution. This will certainly have an impact on the marsh ecosystem, which in turn will affect the growth of fish within. Both of these attributes must be managed better so that the value on ecological dimension of sustainability indices increased in the future. Meanwhile, Monte Carlo analysis with scatterplot on the ecological dimension indicates that the tidal marsh fishery resources in Kuripan Sub-district, Cerbon Sub-district and Marabahan Sub-district have not experienced much disturbance (perturbation) (Table 2).

Table 2. Sustainability of fisheries resources in Barito Kuala tidal marsh: ecology dimension

Site of Marsh	Sustainability	
	Index	Status
Cerbon Sub-district	62,84	Fair Sustainable
Kuripan Sub-district	61,22	Fair Sustainable
Marabahan Sub-district	59,25	Fair Sustainable

Sedimentation is an indicator of the ecological dimension that is more sensitive than the landfill.

Disposition of landfill that adjacent to marsh waters may cause physical, chemical and biological changes in the water (Ahiablame *et al*., 2010). Domestic waste which discharged into waters may cause muddiness, total suspended solids (TSS) increases, accelerates siltation of tidal marsh, and increases microbes in the water. Huey and Meyer (2010) stated that besides previous effects, forest and grassland fires, and microbes are the biggest threat to the sustainability of fisheries resources. Domestic waste and erosion increased sedimentation of tidal marsh, led to the diminishing of fish habitat and food biota if not wisely managed. Furthermore, sedimentation and waste from landfill could lead to eutrophication. Eutrophication caused predatory fish and natural feed pressed (Salihoglu and Sevinc, 2013). Consider the impacts, the management of domestic waste (landfill) and the prevention of sedimentation should be managed well to preserve the sustainability of fishery resources.

Sustainability Status on Economic Dimensions

Nine attributes are considered to affect the sustainability level of fishery resources in the tidal marsh of Barito Kuala on the economic dimension, i.e. (1) absorption of labor, (2) increasing the income of farmers/fishermen; (3) equity on profitability, (4) contributions to the local economy (GDP), (5) contributions to revenue (PAD); (6) central/regional government subsidies; (7) the pattern of partnership; (8) market opportunities, and (9) Institutional financing (Fig. 2).

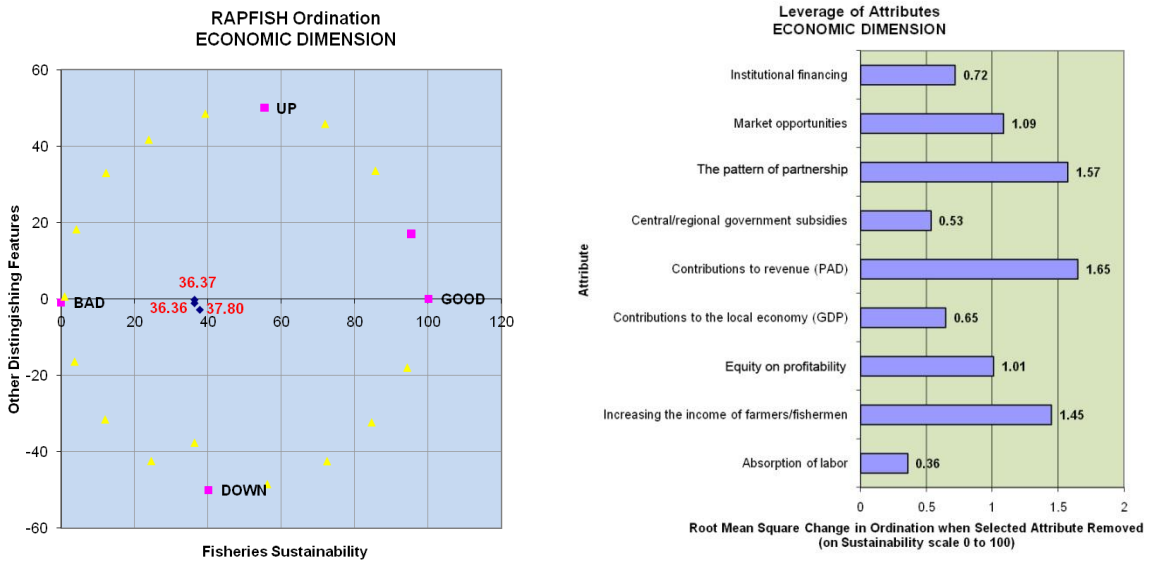

Fig. 2. Analysis of the ordinance and analysis of leverage economic dimension to the sustainability of fishery resources in the tidal marsh of Barito Kuala

The results of the analysis of the Rap-Batola ordinance on the economic dimension show coefficient of determination (R^2) of 92,9% and a stress value (S) of 17,4%. This indicates the condition of the area is goodness of fit, given the stress values obtained for 17,4%.

The results of the leverage analysis on all attributes/dimensions of economic indicators are essentially having no sensitivity to the sustainability of fishery resources in the tidal marsh of Barito Kuala (Table 3). However, improvement prioritizeson the highest attribute values: (1) contribution to local revenue (PAD) and (2) income of farmers/fishermen. Fisheries marsh in Barito Kuala is lack contribution to the increased local revenue (PAD), due to the low level of knowledge and awareness in the utilization of the marsh itself as aquaculture farming areas which potentially will improve the community's economy. In addition, the government is still passive in optimizing

the function of marsh resource in effort to increase the local revenue.

Table 3. Sustainability of fisheries resources of Barito Kuala tidal marsh: economic dimension

Site of Marsh	Sustainability	
	Index	Status
Cerbon Sub-district	36,36	Less Sustainable
Kuripan Sub-district	37,80	Less Sustainable
Marabahan Sub-district	36,37	Less Sustainable

The economic dimension of sustainability must be managed better to be increased. Meanwhile, Monte Carlo analysis with scatterplot on the economic dimension of fisheries indicates that the tidal marsh in Kuripan, Cerbon and Marabahan Sub-district has not experienced much disturbance (perturbation).

Contribution of fisheries resources in the District of Cerbon, Kuripan and Marabahan to local revenue and income of fishermen is relatively low. We assume that fishing activities in the natural tidal marsh should be followed by fish farming and fishery business diversification to increase the income of fish farmers. Salusu (2006), Grygoruk *et al.* (2013), and Xiang *et al.* (2014) stated that an integrated environmental management system is necessary to improve the quality of the aquatic environment to support socio-economic development and sustainable management of the local water environment.

Sustainability Status on Socio-Cultural Dimensions

Eleven attributes are considered to affect the level of fishery resources sustainability in the tidal marsh of Barito Kuala on the socio-cultural dimension. Theattributes are: (1) the relative education level of the community, (2) local knowledge, (3) guidance and counseling to the community, (4) socialization of marsh resource policy, (5) The number of family members working in utilization of marsh resource, (6) the conflicts level of resource marsh use, (7) efforts to repair marsh damage, (8) the community role in the marsh management, (9) meetings frequency between related parties to the local management that facilitated by the government, (10) time spent for remediate the utilization of marsh resources, and (11)alternative business besides using the fish resources (Fig. 3).

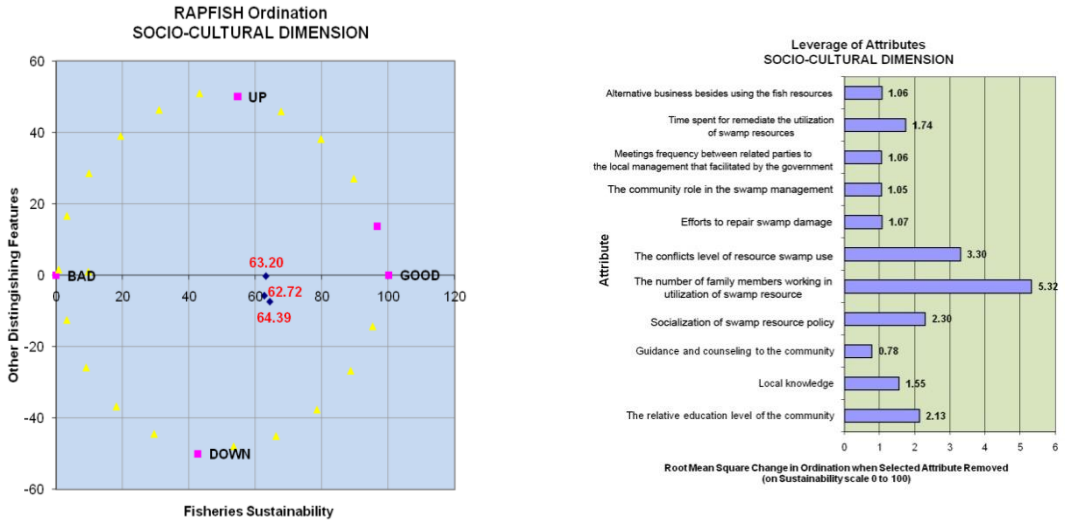

Fig. 3. Analysis of ordinance leverage and socio-culture dimensions on the sustainability of fishery resources of tidal marsh in the Barito Kuala District.

The results of the analysis of the ordinance by Rap-Batola in socio-culture dimension resulted R^2 of 94,5% and a stress value (S) of 14,2%. Stress values reflect the goodness of fit in the MDS, where the

analysis of the socio-cultural dimensions indicate the condition of goodness of fit, given the stress value obtained was 14,2%.

The results of the leverage analysis on all attributes or indicators of socio-cultural dimensions that have a sensitivity to the sustainability of fishery resources in the tidal marsh are: 1) The number of family members working in the utilization of marsh resource (5,32) and 2) the level of conflict with the value of marsh resource utilization (3,30). Family members who work in the utilization of marsh resources in Barito Kuala still limited. The family members prefer to work in other sectors such as agriculture and private companies, especially oil palm plantation companies. Meanwhile, related to the conflict in marshes resource utilization is only occurred between certain people with oil palm plantation owners. Conflicts that arise mainly due to land clearing, companies expand arable land area so there rarely no wetlands that has not turned into plantations area, narrowing the width of marsh itself. Monte Carlo analysis on the socio-cultural dimension suggests that fisheries resources in Kuripan, Cerbon and Marabahan Sub-district in Barito Kuala have least disturbance (perturbation) (Table 4.).

Table 4. Sustainability of fisheries resources of Barito Kuala tidal marsh: socio-cultural dimension

Site of Marsh	Sustainability	
	Index	Status
Cerbon Sub-district	62,72	Fair Sustainable
Kuripan Sub-district	64,39	Fair Sustainable
Marabahan Sub-district	63,20	Fair Sustainable

Utilization of fisheries resources need government regulation to avoid conflicts between fishermen and the fish farming developer, and also maintained the economic sustainability of the fisheries sector. This issue can be countered by planning the sustainable development on economic-aquatic environment management system by utilizing local potencies with water reclamation (Xiang *et al*., 2014). Development of tidal marsh can be done technically by plotting the tidal marsh according to its potency, perform reclamation to improve the quality and productivity of the area, and empower surround farmers/fishermen to manage and supervise the being developed area (Tejoyowono, 2006; Salusu, 2006).

Sustainability Status on Technological Dimensions

There are eight attributes on technology dimensionthataffect the sustainability level of fishery resources of tidal marsh in Barito Kuala. These attributes are: (1) the use of appropriate aquaculture technology; (2) use of environmental friendly technologies; (3) use of catching tools (fish attraction devices, fads); (4) the use of selective fishing gear; (5) the use of destructive fishing gear; (6) aquaculture method that is not environmental friendly; (7) Post-harvest handling prior to shipping, and (8) utilization of fish waste handling technologies (Fig. 4).The results of the ordinance analysis and Rap-Batola on the technology dimension resulted R^2 of 93% and a stress value (S) of 15,4%.

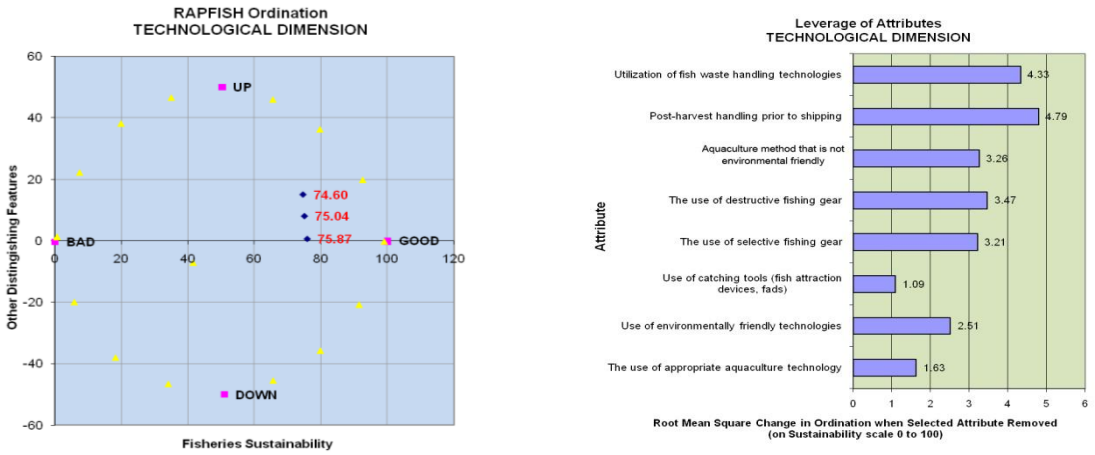

Fig. 4. Analysis of the ordinance and dimensional leverage on the sustainability of fisheries technology in tidal marsh of Barito Kuala District

Leverage analysis on the technological dimension attributes has a sensitivity, particularly to the attributes: 1) post-harvest handling prior to shipping (4,79) and 2) utilization of fish waste treatment technologies (4,33). The catch is sold directly to collectors or to the consumer, caused incapability in providing a better selling point. The fish should be processed first, i.e. salting or preserved through the process of fermentation (*wadi* – local preserved process). While the existence of waste is also less considered and disposed down to the drainage and was not fully re-utilized. Therefore, the role of technology is very crucial. It is not only for the processing of the fish, but also the processing of fish's waste to be more useful, such as used as fertilizer or animal feed. Monte Carlo analysis shows that the technological dimension of fisheries resources in tidal marsh of Kuripan, Cerbon and Marabahan Sub-district has not experienced much disturbance (perturbation) (Table 5).

Table 5. Sustainability of fisheries resources of Barito Kuala tidal marsh: technology dimension

Site of Marsh	Sustainability	
	Index	Status
Cerbon Sub-district	74,60	Fair Sustainable
Kuripan Sub-district	75,04	Fair Sustainable
Marabahan Sub-district	75,87	Fair Sustainable

Post-harvest handling before marketed is needs to improve the sale rate of fish, and should meet the standards of health on fishery products. It is also important to not carelessly dispose the waste into the water environment (Abdurachman *et al*, 1999). Recently, fisherman was counseled with technological knowledge of efficient wastewater treatment, to prevent water pollution. An example on proper management of waste fisheries products is fertilizer or compost, due to its high protein content with nitrogen-containing groups (-NH) that useful for plant growth. Physiologically, fishery products (fish) will rapidly decay without proper handling (Ridwan *et al*., 2004). Handling of fishery products affect the quality and have a direct impact on the selling price. Technically, post-harvest handling provides low temperature preservative systems (ice) and appropriate container technologies design to reduce impact on the environment.

Sustainability Status on Legal and Institutional Dimensions

Twelve attributes of legal and institutional dimensions affect the level of sustainability of fishery resources in the tidal marsh of Barito Kuala. The attributes are: (1) The formal instruction of marsh management in the form of law and regulations; (2) non-formal rules include customs and religion; (3) appropriate local government policy and openness in justice; (4) transparency in marsh resource policies;

(5) government policy towards protection of the marsh ecosystem; (6) intensity of illegal use of marsh; (7) zone arrangement of marsh resource; (8) institutional strengthening; (9) law information related to the management of the marsh; (10) law enforcement on marsh management; (11) ability of local government officials in supporting the marsh management, and (12) role models of society (Fig. 5).The analysis of the ordinance on legal and institutional dimensions of the number of iterations by 2 times, resulted R^2 of 94,7% and a stress value (S) of 13,7%,indicate the condition of goodness of fit, given the stress values obtained for 13,7% (<25%).

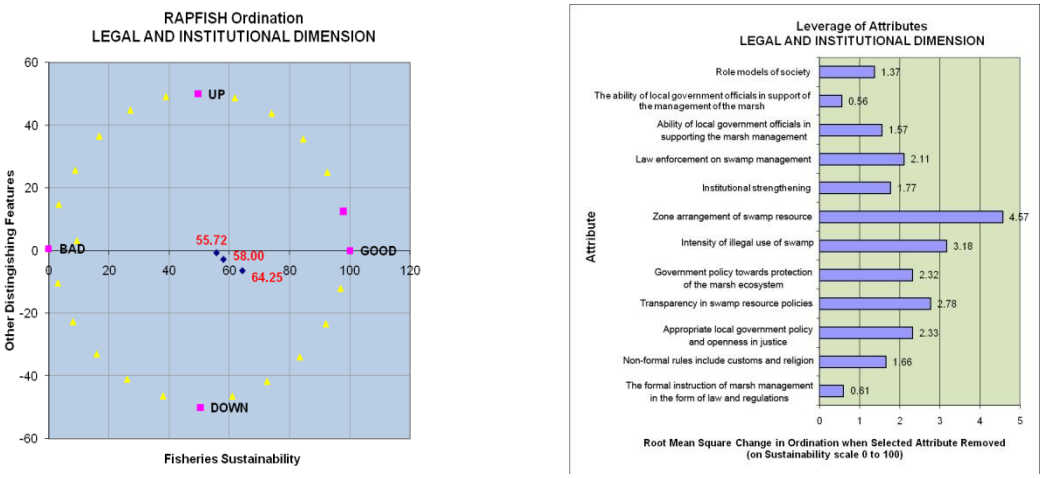

Fig. 5. Analysis of the ordinance on legal and institutional dimensions leverage to the sustainability of fishery resources in tidal marsh of Barito Kuala District

Legal and institutional attributes dimensions that have a particular sensitivity are: 1) zone setting of resource marsh (4,57), and 2) intensity of illegal use of marsh (3,18). Resources are relatedto zone settings of marsh in Barito Kuala. Marsh resource management is determined by hereditary habits and applicable customs. An example in Kuripan, *beje* is empowered as a legacy for generations and it is legally recognized by existing customary rules. Meanwhile, intensity of illegal use of marsh, most fishing activities uses toxic chemicals and electric shock. These practices will endanger the marsh ecosystem and impact on marsh ecology itself. Monte Carlo analysis on the legal and institutional dimensions indicates that the fishery resources of tidal marsh in Kuripan, Cerbon and Marabahan Sub-district have not experienced much disturbance (perturbation) (Table 6).

Table 6. Sustainability of fisheries resources of Barito Kuala tidal marsh: legal and institutional dimensions

Site of Marsh	Sustainability	
	Index	Status
Cerbon Sub-district	58,00	Simply Sustainable
Kuripan Sub-district	55,72	Simply Sustainable
Marabahan Sub-district	64,24	Simply Sustainable

Multidimensional Sustainability Status of Fisheries Resources Tidal Marsh in Barito Kuala

Sequentially, the Kuripan Sub-district has the highest sustainability index (59,37) compared to the Marabahan (59,27) and Cerbon (58,21). However, in general it can be said that the fishery resources in the tidal marsh of these three areas is quite sustainable. Monte Carlo analysis on the MDS shows that fishery resources of tidal marsh in three sub-districthas not experienced much disturbance (perturbation). This is shown by the plot that gather at one place and not

mutually exclusive (Fig. 6).Index and sustainability status of fisheries resources in tidal marsh Barito Kuala can be delivered as the Table 7 below.

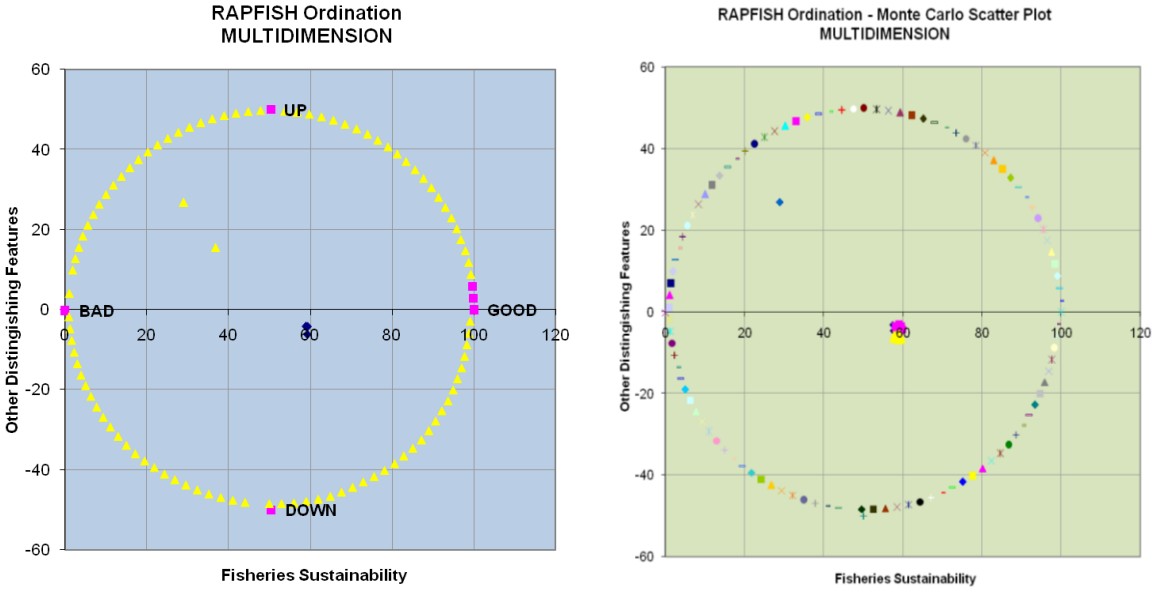

Fig. 6. Ordinance Analysis and scatter plot of Monte Carlo Analysis on the sustainability of fishery resources of tidal marsh in Barito Kuala

Table 7. Sustainability of fisheries resources of Barito Kuala tidal marsh: Multi dimensions

Site of Marsh	Sustainability	
	Index	Status
Cerbon Sub-district	58,91	Simply Sustainable
Kuripan Sub-district	59,37	Simply Sustainable
Marabahan Sub-district	59,27	Simply Sustainable

Two statistical parameters (value of Stress and R^2) show that all the attributes used in each dimension in various sub-districts of Barito Kuala is good enough to explain the sustainability of fishery resources in the tidal marsh of Barito Kuala district (Table 8). Otherwise, the level of error in MDS analysis was assessed by Monte Carlo analysis, which performed on approximately 95% confidence level with a comparison of the results as Table 9.

Table 8. Statistical parameters (*goodness of fit*) of the index analysis and sustainability on fisheries resources of tidal marsh in the Barito Kuala

Statistical Parameter	MDS	Dimension				
		Ecology	Economy	Socio-Cultural	Technology	Legal and Institutional
S-Stress	0,128	0,140	0,173	0,142	0,154	0,137
RSQ (R^2)	0,954	0,933	0,929	0,945	0,930	0,947
Iteration	2 times	3 times	3 times	3 times	3 times	2 times

Table 9. Comparison of MDS and Monte Carlo analysis for Rap-Batola (95% confidence interval)

Region	MDS	Monte Carlo	Difference
Cerbon Sub-district	58,91	58,49	0,42
Kuripan Sub-district	59,37	58,95	0,42
Marabahan Sub-district	59,27	58,90	0,37

The comparison between MDS and Monte Carlo analysis shows that the status of fishery resources sustainability index of tidal marsh in Barito Kuala district issignificantly indifferent (<1) The small difference indicate that both mistakes from the methods and the variety of scoring due to opinion differences are relatively small. This difference also shows that the studied systems have a high level of confidence. Some parameters of the statistical test results show that the method of Rap-Batolais good enough to be used as an evaluating tools to assess the sustainability of fishery resources in the tidal marsh of Barito Kuala quantitatively and rapidly (rapid appraisal).

Analysis using Multi-Dimensional Scaling (MDS) method, which is called Rap-Batola and the results are expressed in index and status of sustainability. Kuripan Sub-district have the highest sustainability index (59.37) compared to the Marabahan Sub-district (59.27) and Cerbon Sub-district (58,21). However, in general it can be said that the fishery resources of tidal marsh in threesub-district area is quite sustainable. Thus, the status of tidal marsh fisheries resources in Barito Kuala district is sustained enough to be developed for the implementation of regional autonomy.

Recommendation

Barito Kuala district government should prioritize improvements of attributes or dimensions of sustainability that have low index values, i.e. the economic dimension, because the existence of tidal marsh are passively contribute to the local economy. Furthermore, the improvement of the attributes should also not only done on sensitive attributes that affect the improvement of the status of sustainability, but also the attributes that are not sensitive to the status sustainability of the region. So it can improve the sustainability index values to 100%, by taking into account the ability of the area itself.

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