Assessment of Sustainable Use of Coastal Resources of Regional Waters Conservation Area Biak Numfor Regency, Papua Province, Indonesia

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Abstract

Utilization of fishery resources in an optimal, continous and sustainable manner is an urgent demand for the prosperity of the people, especially to improve the welfare of fishermen and coastal communities.The level of sustainable use of coastal resources in water conservation is very important, so that the utilization does not exceed the carrying capacity of the environment. The purpose of this study was to determine the level of sustainable use of coastal resources Biak Numfor, associated with the utilization of fisheries, aquaculture and tourism. The study was conducted in June to December 2015 and October to November 2016. The primary data obtained by interview and direct discussion through Focus Group Disscution (FGD) with fishermen community, tourist and tourist entrepreneurs as well as related officials in the Office of Fisheries and Marine Affairs, and Tourism Office of Biak Numfor Regency*. Methods of data analysis approach sustainability analysis conducted by the method of MDS (Multi-Dimensional Scaling) with the help of software Rapfish. Based on the survey results revealed that the value of fisheries ordinated to achieve 57.66%, 44.80% aquaculture, and tourism 46.25%. With these achievements ordinated value, it can be concluded that the use of sustainable capture fisheries are still classified by the lever sustainability attributes include; the type of fishing gear, vessel types used and the catch per unit effort (CPUE). Meanwhile the relatively less sustainable aquaculture with the sustainability lever attributes include; cultivation technology, the number of business units with different types and species of fish. For tourism utilization is still considered less sustainable with levers sustainability attributes include the number of tourists, the type and number of amenities and facilities and infrastructure*

Keywords: Sustainability, utilization, waters conservation area (KKPD), MDS-Rapfish

Introduction

Efforts to utilize fish resources optimally, sustainably and sustainably is a very urgent demand for the greatest amount of prosperity of the people, especially to improve the welfare of fishermen and fish farmers. Based on this, in order to provide maximum benefits for the people and the state of Indonesia and ensure the sustainability of fishery business itself, it should be the development and national fishery activities as soon as possible directed to apply the rules of sustainable fisheries. Gombos *et al.* (2013) argues that over-exploitation of coastal and marine resources is extremely dangerous in the sustainable use of resources, while accelerating the loss of biodiversity and ecosystem stability. Adam (2012) states that the exploitation of fishery resources should not be done destructively, and should consider sustainable use

The sustainable use of coastal and marine resources especially capture, cultivation and tourism become very important in a management effort. Efforts to utilize coastal resources optimally, sustainably and sustainably is a very urgent demands for the great-prosperity of the people, especially to improve the welfare of fishermen and fish farmers. Based on Itam *et al*. (2014) small-scale fisheries in developing countries make important contributions to nutrition, food security, sustainable livelihoods and poverty alleviation. Potential utilization of coastal and marine resources, not only in the fishery sector, but also in other economic sectors such as tourism, marine transportation and renewable energy. Currently the utilization of coastal and marine resources especially in conservation areas is still very limited. Tajerin *et al*. (2010) found that in general the position of linkage of marine and fishery sub-sector with other sectors in Indonesian economy is included

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ijms.undip.ac.id
DOI: 10.14710/ik.ijms.22.2.75-84
Received : 18-01-2017
Accepted : 02-03-2017

in potential groups and less developed groups. Furthermore, according to Yusvianty (2010), along with the depletion of natural resources in the mainland and the abundance of coastal resources and oceans owned by Indonesia become one of consideration with the paradigm shift toward the maritime state from the original terrestrial state. This is one reason for the importance of development in the field of marine and fisheries.

The existence of regional waters conservation area Biak Numfor actually play a very important role for the preservation of marine resources in the coastal region. But the area has also been used for various economic activities, and is a source of livelihood for most communities around the coastal area. Resource sustainability analysis can provide input and consideration for Local Government in developing, managing and utilizing fishery resources and maritime tourism in Biak Numfor watershed conservation area in a sustainable manner. Therefore, the purpose of this study is to determine the level of sustainability of resource utilization of Biak Numfor Regency related to the utilization of capture fishery, aquaculture fishery and tourism. This data was obtained by interview and direct discussion through Focus Group Disscution (FGD) with fishermen community, tourist and tourist entrepreneurs as well as related officials in the Office of Fisheries and Marine Affairs, and Tourism Office of Biak Numfor Regency.

Materials and Methods

Time and location

The research was conducted in June to December 2015 and October to November 2016. This research was conducted in the waters conservation area (KKPD) Biak Numfor, which includes three (3) region, i.e. 1) KKPD Biak East Coast, 2) KKPD Biak West Coast and 3) KKPD Numfor Island (Figure 1). Location study include eight (8) districts included in the KKPD of the 19 districts in Biak Numfor regency.

Type and source of data

Types of data collected in the study of the sustainability level of resource utilization in regional waters conservation area (KKPD) Biak Numfor, consist of primary and secondary data. Primery data was obtained by interview and direct discussion through Focus Group Disscution (FGD) with fishermen community, tourist and tourist entrepreneurs as well as related officials in the Office of Fisheries and Marine Affairs, and Tourism Office of Biak Numfor Regency. While secondary data is data obtained from the relevant office in the form of reports, data and other information. Types and methods of data collection is done, in more detail in Table 1.

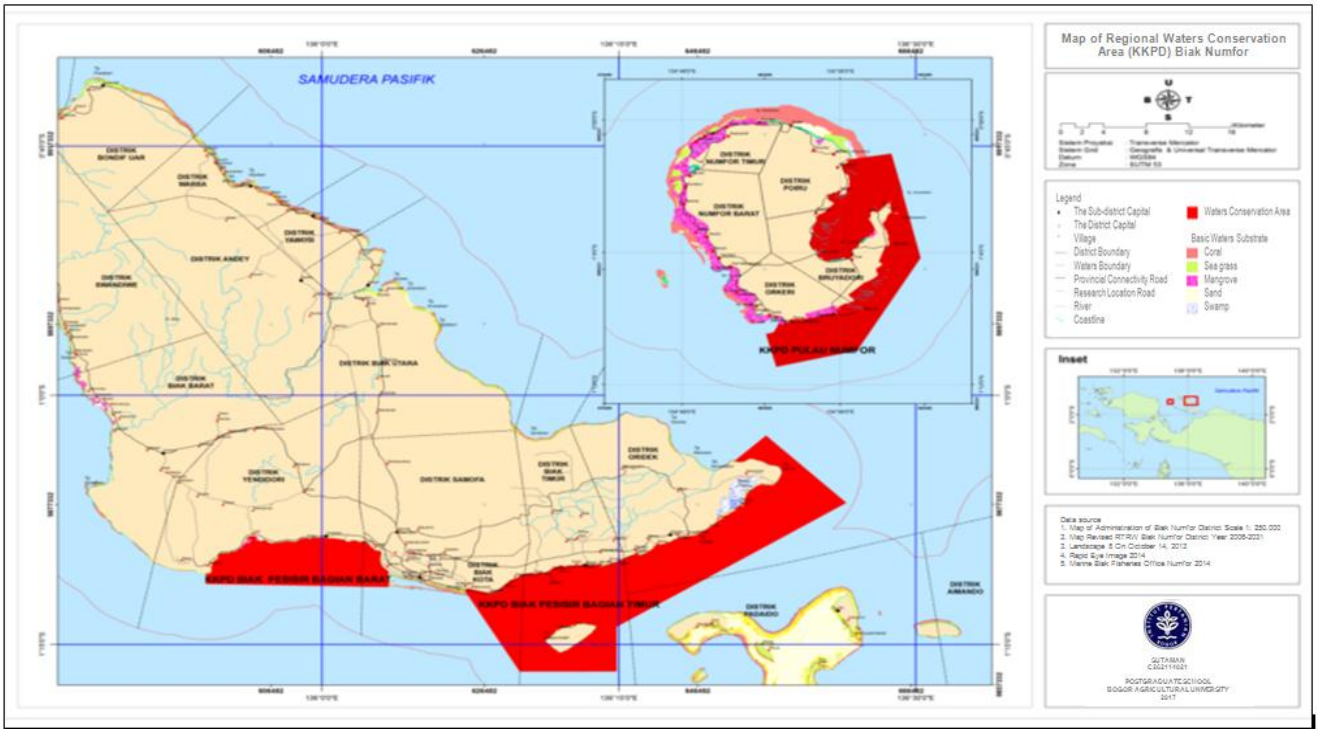

Figure 1. Map of Regional Waters Conservation Area (KKPD) Biak Numfor

Table 1. Type and source of data

Aspects	Variable	Type	Sources
Capture Fisheries	Potential of fish resources (capture fisheries)	Secondary data	MF Officer
	Length capture (LC)	Primary data	Insitu
	Harvest based on trophic group (trophic level)	Secondary data	MF Officer
	Catch per unit effort (CPUE)	Secondary data	MF Officer
	Maximum sustainable yiled (MSY)	Primary data	MF Officer
	Type of fishing gear are allowed	Secondary data	MF Officer
	Type of environmentally friendly fishing gear	Primary data	Observation
	Vessel type are allowed	Secondary data	MF Officer
	Operating method of fishing gear	Primary data	Observation
	Potential conflicts on utilization of fisheries	Primary data	Observation
	Technology's fisheries (fishing gear)	Primary data	Observation
	Fishing equipments	Primary data	Observation
Marine Culture	Potential of marine culture	Secondary data	MF Officer
	Amount of aquaculture businesses	Secondary data	MF Officer
	Farmed fish species	Secondary data	MF Officer
	Source of fish seed cultivation	Secondary data	MF Officer
	Type of feed are allowed	Secondary data	MF Officer
	Fish farming technology	Primary data	Observation
	Amount of business units are allowed	Secondary data	MF Officer
	Value of Net B/C	Primary data	Analysis
	Social and cultural support for aquaculture	Primary data	Observation
Tourism	Kinds of tourism	Secondary data	MF Officer
	The number of actors and the amount of effort that can be allowed	Secondary data	MF Officer
	Opportunity for community engagement in marine tourism activities	Secondary data	MF Officer
	The number of tourists allowed per period of time/place	Secondary data	MF Officer
	The type and amount of infrastructure that allowed	Secondary data	MF Officer
	The number of vessels allowed in one place	Secondary data	MF Officer
	Type and number of health facilities, and paramedics	Secondary data	MF Officer
	Facilities and infrastructure supporting the tourism	Primary data	Observation
	Institutional of tourism management	Primary data	Observation
	Tourism information	Primary data	Observation

Analysis method

The data analysis method based research purposes, are to know of sustainability level of resource use (capture fishing, marine culture and tourism) in KKPD Biak Numfor. Methods of data analysis is conducted sustainability analysis approach by MDS method with Rapfish software. Rapfish (*Rapid Appraisal for Fisheries*), developed by Pitcher since 1999. This approach is based on the principle of Multi Criteria Analysis (MCA) by relying on an algorithm known as MDS algorithm (Herdiansyaah *et al*., 2014). Multi Dimensional Scaling (MDS) is a method of computer-based statistical analysis techniques using the software Microsoft Excel or SPSS, which perform transformations on each dimension of sustainability. (Herdiansyah *et al*., 2014; Cahya, 2016; and Ratnaningtyas *et al*., 2016).

Indexing and status of sustainable use of coastal and marine resources KKPD Biak Numfor of each aspect and attributes, follows the concept developed by Pitcher since 1999 (Yusuf, 2016). Assessment scores every aspect represented by the worst scale (bad) 0% up to the best (good) 100%.

Value index of>50% can be stated that aspects of the examination have been sustained. Conversely, if the index value <50% of these aspects have not been or are not sustainable. Category sustainability index presented in Table 2.

Results and Discussion

The results of sustainability analysis of resource use KKPD Biak Numfor covering the activities are capture fisheries, marine culture and tourism activities, obtained the value of sustainability ordination (MDS), Monte Carlo values and statistical values in Table 3.

Based Rapish analysis it was found that the results of the validation test Monte Carlo showed the difference very small is between 0.08% up to 0.68% or less than 1%. These values indicate that error effect or the impact of a scoring error is relatively small. Thus, the model developed Rapfish, otherwise inadequate as probe index values of sustainability. According to Primawaty *et al.* (2013) and Herdiansyah *et al*. (2014) that the analysis of Monte Carlo simulation can be used as a method to evaluate the impact of random error in statistical analysis is done. The same thing also expressed Herdiansyah *et al*. (2014) that the Monte Carlo analysis can be an indicator of an error caused the provision of scoring in every attribute, variation of scoring in multidimensional for their opinions differ, the process of data analysis performed repeatedly, and errors in input data or data missing.

The results of goodness of fit also shows that the sustainability index prediction model can be used. Results obtained that value of Squared Correlation (R^2) is between 0.9410 up to 0.9516 or close to 1. The value of R-square is getting closer to 1 means data is mapped perfectly. The value illustrates that more than 90% can be explained by the model well, and the remaining <10% are explained by factors/other attributes. Yusuf (2016) states that the value of Squared Correlation (R^2) of more than 80% indicates that the prediction model sustainability index and adequate use.

In addition, the results of a lack of fit measure test or stress values obtained 0.1354 up to 0.1379 or close to 0 (nil). Stress value near nil, then the output produced more similar to the actual situation or the lower the stress, so that model is very better. Conversely, the high stress values show that model does not fit. Yusuf (2016) states that stress values can be tolerated is <20%. Thus the model can be received well.

Table 2. Index of sustainable category

Value Index	Sustainability Categories
0 – 25	Bad; not Sustainable
26 – 50	Less; Less Sustainable
51 – 75	Enough; Sustainable enough
76 – 100	Good; very Sustainable

Sources: Pitcher (1999)

Capture fisheries sustainability

Sustainable of fisheries use is describe the sustainability level of fisheries activities in the waters conservation area (KKPD) Biak Numfor (Figure 2).

Results of rapfish analysis for capture fisheries found that ordination value is 57.66% or classified as sustainable. Monte Carlo values is 56.99% which showed the difference is very small (0.67%) or less than 1%. These values indicate that error effect or the impact of a scoring error is relatively small. Thus, the rapfish model was developed, be avowed adequate as probe value sustainability index. According to Primawaty *et al.*, (2013) and Herdiansyah *et al*. (2014), that the analysis of Monte Carlo simulation can be used as a method to evaluate the impact of random error in statistical analysis is done.

The ordination value is describe utilization conditions of resources is categorized as good (sustainable) on the side of capture fisheries. That is because, the activities of fishing is done by fisherman in core zone of KKPD Biak Numfor, generally using fisheries tools is traditional type, so that fish stocks around the region are very abundant. Besides, the public awareness to keep the waters conservation area also played a role to protecting the habitat of reef fish. Based on research

Table 3. Index of sustainability (MDS, Monte Carlo and Statistic values)

Dimensions	Sustainability Index (%)		Difference	Statistic Values	
	MDS	Monte Carlo		R^2	Stress
Capture fisheries	57.66	56.99	0.67	0.9516	0.1363
Marine culture	44.80	44.88	0.08	0.9410	0.1379
Tourism	46.25	45.99	0.26	0.9467	0.1354

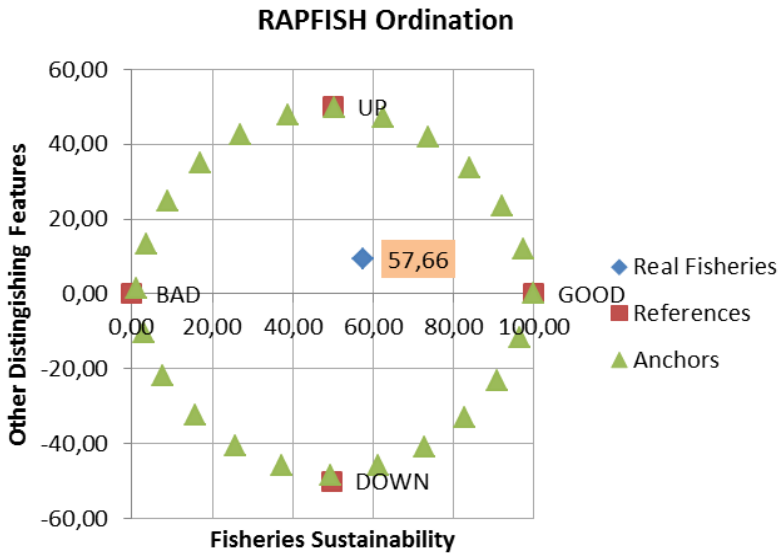

Figure 2. Graph ordinated sustainable of capture fisheries

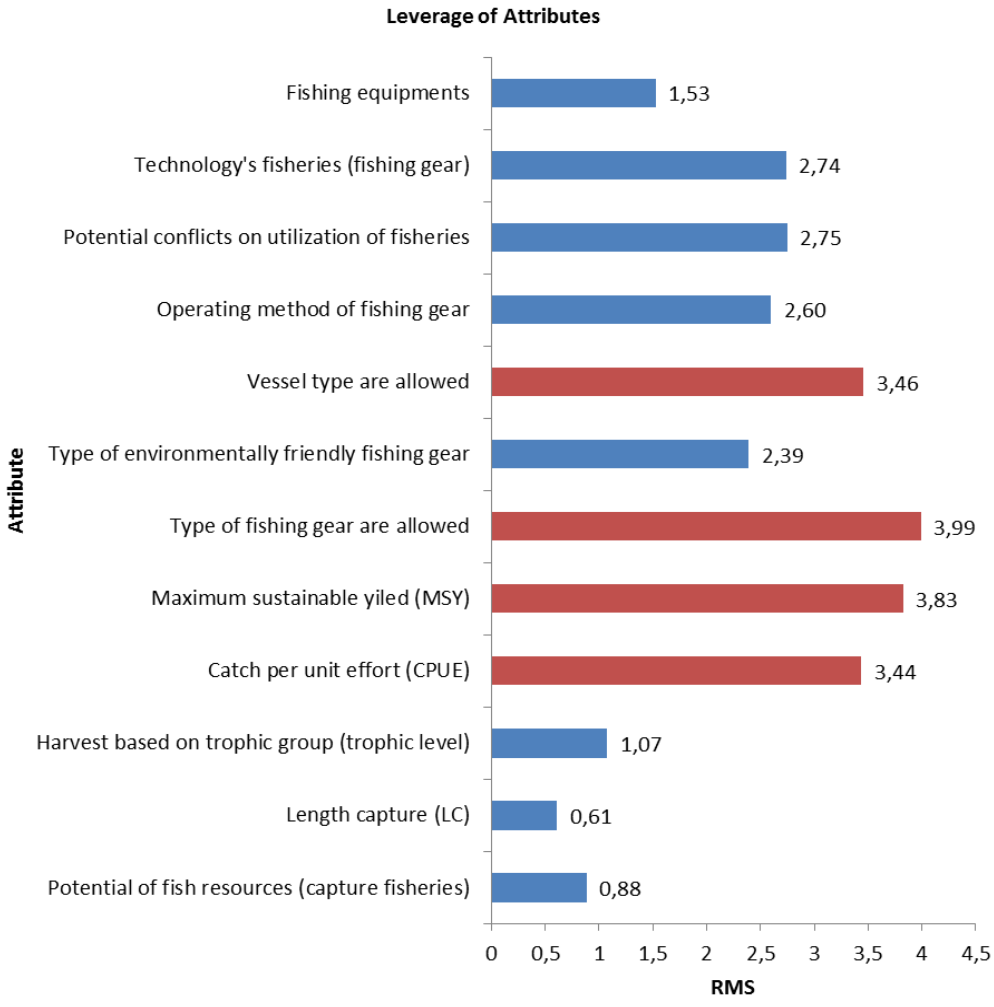

Figure 3. Graph leverage attribute of capture fishries sustainability

Leleu *et al*. (2012), Reuchlin-Hugenholtz and McKenzie (2015) note that Marine Protected Areas (MPA) has beneficial effects on marine resources and the results when dealing with no-take zones (NTZs), artificial reefs and with regulations of over-fishing. Figure 3 is graph leverage atributte of capture fisheries.

Results of leverage analysis for capture fisheries obtained 4 (four) attribute which became

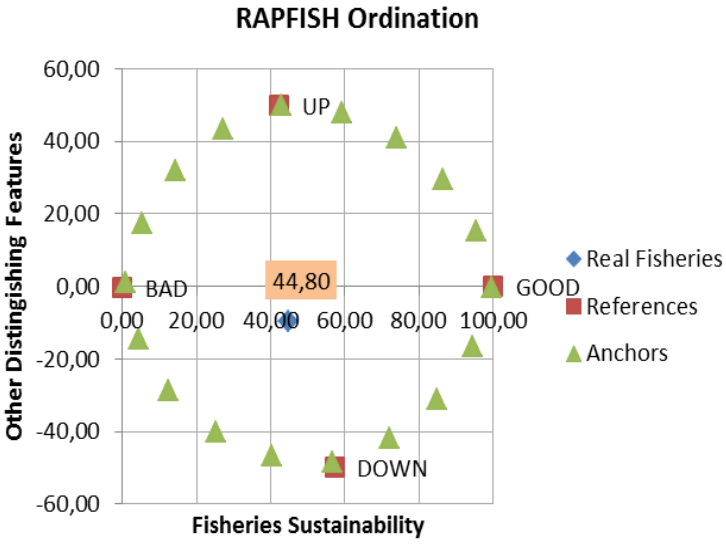

Figure 4. Graph ordinated sustainable of marine culture

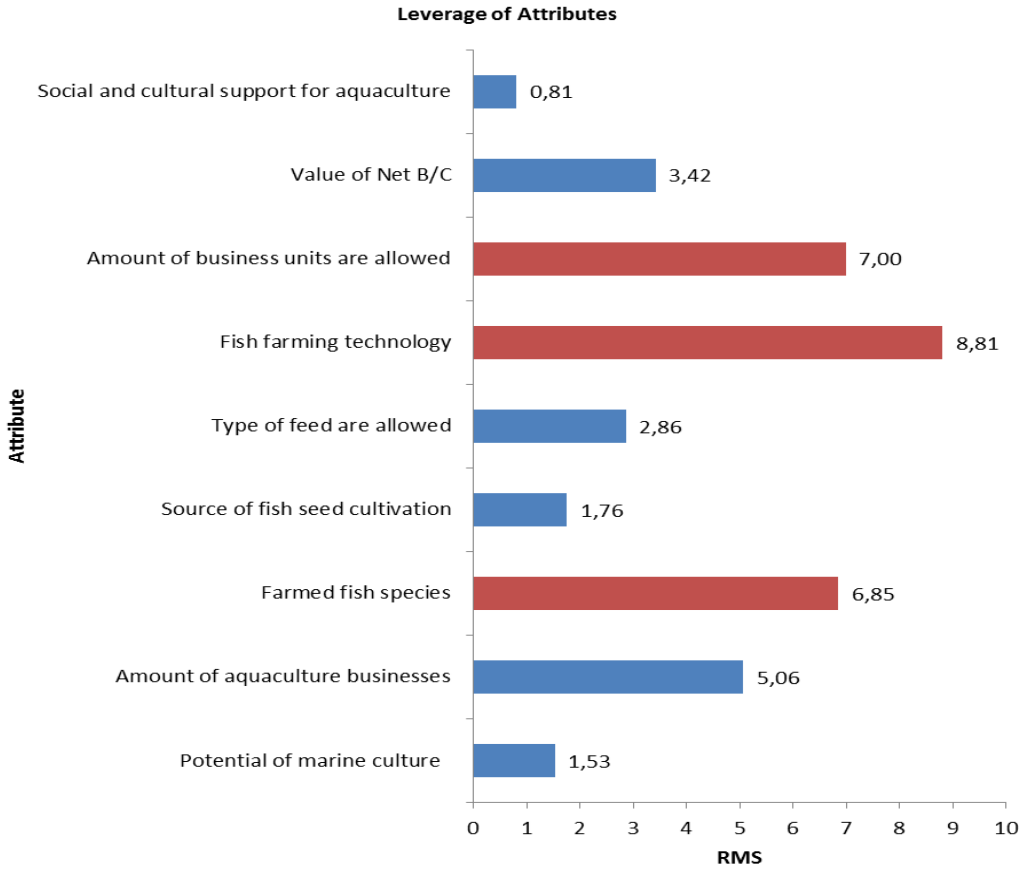

Figure 5. Graph leverage attribute of marine culture sustainability

the most important indicators of sustainability from a variety of other attributes, i.e. type of fishing gear are allowed, maximum sustainable yield, vessel type are allowed and cacth per unit of effort.

These results indicate that all four of these attributes is a sensitive factor to supporting the sustainability of capture fisheries in KKPD Biak Numfor, so it should be a serious concern by government. Yusuf (2016) states that the RMS value indicates the magnitude of the role of each attribute to the sensitivity of sustainability status.

Marine culture sustainability

Marine culture sustainability is describe the sustainability level of fisheries activities, especially cultivation activities in the waters conservation area (KKPD) Biak Numfor (Figure 4).

Results of rapfish analysis for marine culture found that ordination value is 44.80% or classified as less sustainable. Monte Carlo values is 44.88% which showed the difference is very small (0.08%) or less than 1%. These values indicate that error effect or the impact of a scoring error is relatively small. Thus, the rapfish model was developed, be avowed adequate as probe value sustainability index. According to Primawaty *et al.*, (2013) and Herdiansyah *et al*., 2014), that the analysis of Monte Carlo simulation can be used as a method to evaluate the impact of random error in statistical analysis is done.

The ordination value is describe utilization conditions of resources is categorized as bad (less sustainable) on the side of marine culture. That is because, the activities of cultivation in core zone of KKPD Biak Numfor is not managed well. The low sustainability of aquaculture due to very limited farming activities, both in the number of business units as well as the technological aspect of cultivation. it is because aquaculture is not an activity that is practiced by people in the region KKPD.

Results of leverage analysis for marine culture (Figure 5) obtained 3 (three) attribute which became the most important indicators of sustainability from a variety of other attributes, i.e. fish farming technology, amount of bussines unit are allowed, and farmed fish species.

These results indicate that all three of these attributes is a sensitive factor to supporting the sustainability of marine culture in KKPD Biak Numfor, so it should be a serious concern by government. Yusuf (2016) states that the RMS value indicates the magnitude of the role of each attribute to the sensitivity of sustainability status.

Tourism sustainability

Tourism sustainability is describe the sustainability level of using resource, especially tourism activities in the waters conservation area (KKPD) Biak Numfor (Figure 6).

Results of rapfish analysis for tourism found that ordination value is 46.25% or classified as less sustainable. Monte Carlo values is 45.99% which showed the difference is very small (0.26%) or less

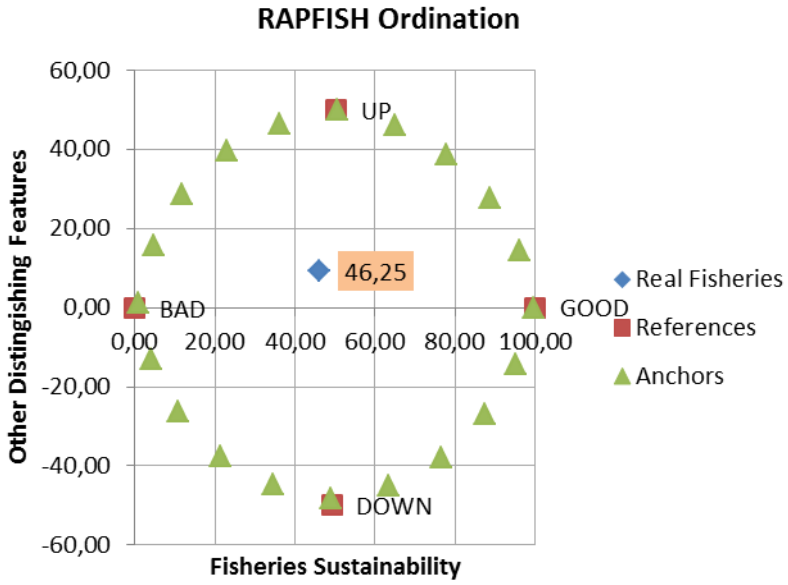

Figure 6. Graph ordinated sustainable of tourism

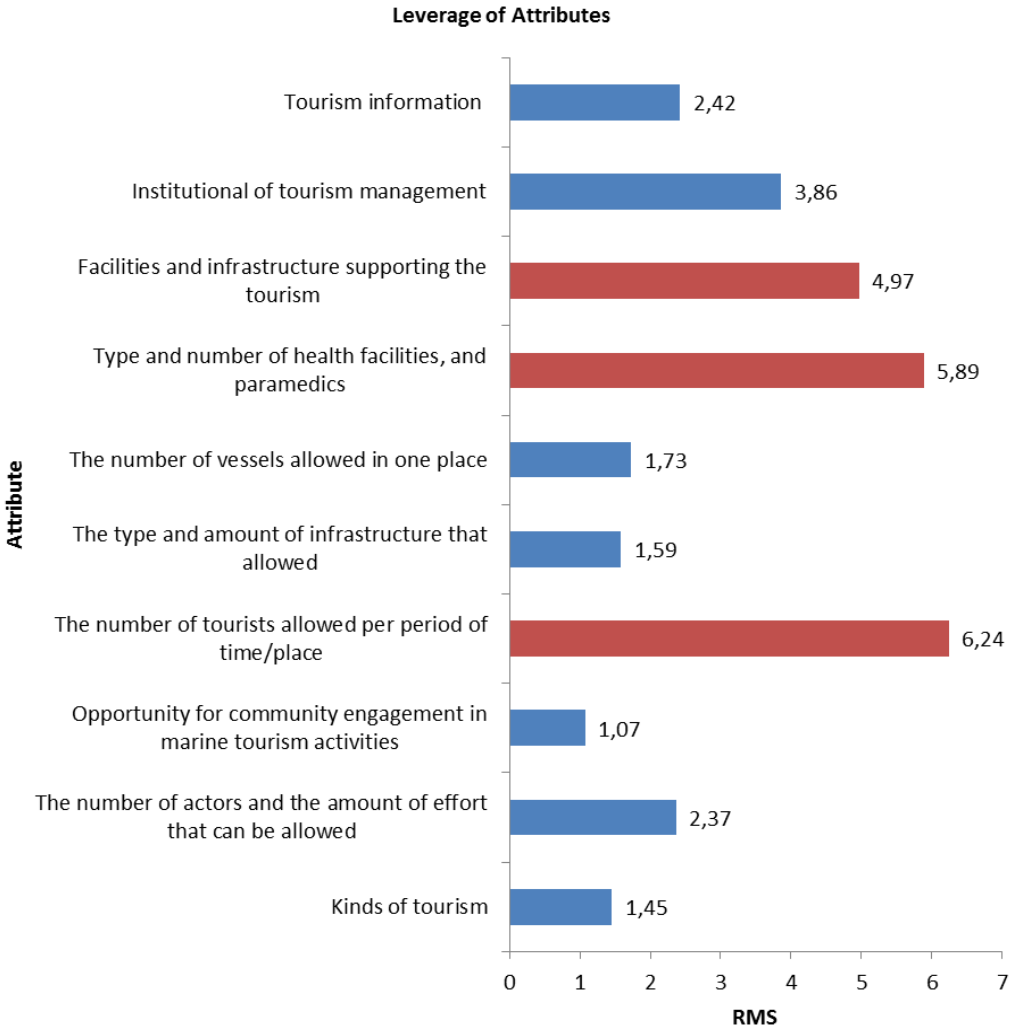

Figure 7. Graph leverage attribute of tourism sustainability

than 1%. These values indicate that error effect or the impact of a scoring error is relatively small. Thus, the rapfish model was developed, be avowed adequate as probe value sustainability index. According to Primawaty *et al.*, (2013) and Herdiansyah *et al*., 2014), that the analysis of Monte Carlo simulation can be used as a method to evaluate the impact of random error in statistical analysis is done.

The ordination value is describe utilization conditions of resources is categorized as bad (less sustainable) on the side of tourism. That is because, the activities of tourism in core zone of KKPD Biak Numfor is not managed well. Underwater scenery beautiful has not worked well, even still left naturally without optimal promotional efforts, so it has not attracted many foreign tourists to visit it. Hermantoro (2009), states that the sustainability of development based on the conservation of the natural environment has become an important part for tourism development, and is included in the concept of Suitainable tourism development supported by three pillars of economy, social culture and environment.

Results of leverage analysis for marine culture (Figure 7) obtained 3 (three) attribute which became the most important indicators of sustainability from a variety of other attributes, i.e. amount of tourism allowed per period of time/place, type and number of health facilities and paramedis and facilities and infrastructure supporting the tourism (Fauzi and Oxtavianus, 2014)

These results indicate that all three of these attributes is a sensitive factor to supporting the sustainability of tourism in KKPD Biak Numfor, so it should be a serious concern by government. Yusuf (2016) states that the RMS value indicates the

magnitude of the role of each attribute to the sensitivity of sustainability status.

The analysis results show that the continuous utilization for tourism activities is still not sustainable, especially in relation to the number of tourists is still low, and the type of tourist facilities are still limited and supporting infrastructures are still inadequate.

Conclusion

Based on the result of the research, it can be concluded that the utilization of catch fishery is sustainable with ordination value reaching 57.66%. While the use of aquaculture cultivation classified as less sustainable with ordination value only reached 44.80%. The direction of tourism utilization is classified as less sustainable with 46.25% ordination value.

Acknowledgment

This research is funded from activities organized by the Office of Marine and Fisheries of Biak Numfor Regency and Loka of Coastal and Marine Resources Management of Sorong-Papua. Our thanks go to Mr. Effendi Igirisa and Mrs. Getreda and friends of the research team from PT. Madani Multi Kreasi Jakarta. Thanks also to the reviewers team who have provided valuable suggestions in improving this manuscript.

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