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SUSTAINABLE REGIONAL DEVELOPMENT OF SEBUKU STRAIT AT KOTABARU REGENCY, SOUTH KALIMANTAN

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ABSTRACT

Regional development at Sebuku Strait through the utilization of existing potential, which is productive coastal resources of renewable resource, non-renewable resource or environment services, is expected to refer to the principle of sustainable development. This research aims to find out the status of sustainability index of Sebuku Strait. Sustainability analysis on Sebuku Strait area is using Multi Dimentional Scalling (MDS) method adopted from Rapfish (Rapid Appraisal of Fisheries) or in this research it is called Rap-Sebuku. Rap-Sebuku is a sustainability estimation technique on five dimensions with attributes that are easy to be valuated based on time and cost consideration and applied in various multidiscipline valuation aspects. Indicators representing sustainable regional development consist of five dimensions: ecology, economy, social, technology and institution. Result of valuation on the weight of interest level for every dimension on the performance of Sebuku Strait area shows that the weight of each dimensions are as follow: 45.55 for ecological dimension, 48.20 for economic dimension, 53.08 for social dimension, 53.92 for technological dimension and 50.49 institutional dimension. Based on the weight of five dimensions of regional development at Sebuku Strait in average their value index is in 50.248. It means that Sebuku Strait index is in status of fairly sustainable based on the sustainability scale of 0-100. Based on the existing condition, Sebuku Strait area is fairly sustainable with seventeen sensitive attributes having influence on sustainability index value. To enhance the status in the future, a comprehensive improvement should be conducted on sensitive attributes. The sustainability is expected to follow the type of condition and trend indicators describing linier tendency of resource development to the optimum limit. A scenario strategy could be used to enhance the current sustainability status is moderate scenario (scenario 2), which is a scenario considering budget, time and human resources with sustainability index of 7.362 and conducting improvement around 53.9% in sensitive attributes influencing the enhancement of sustainability status of the area.

Key Words: regional development, renewable resource, non-renewable resource, environmental services and sustainability

1. INTRODUCTION

The important implication of the increasing in economic activities volume was more utilization of natural resources and environment. As already known, natural and environmental aspect is the important factor to achieve economic growth and sustainable development. An overwhelming utilization of natural resources for economic activities could create detrimental negative externality in regional development context (Mukhlis, 2009). Meanwhile, Sustainability has evolved as the principles and processes that integrate socio-economic development with environmental management and conservation and supported by institutional reform. (Allahyari, 2010). Therefore, the need to reform the old development paradigm to a new paradigm by integrating all dimensions of development so as to support sustainable development (Tajerin, 2009)

Sustainable development is a development process optimizing the sustainable utilization of natural and human resources by harmonizing human activities based on the ability of the supporting natural resources in land, ocean and air areas as a unity through rational and wise management (Sugandhy and Hakim, 2009). The concept is in accordance with a concept of sustainable development that combining environmental (natural capital), social (social capital) and economic (man-made capital) aspects (Nugrogo and Dahuri, 2012). Sustainable development assures present and future

generation to have the same right for nature and its content (Subrada and Nadra, 2006). According to Lim (1998) and Goodland (1995), sustainable development concept has four dimensions: ecology, social-economy-culture, social politic and law and institution to solve problems in coastal areas.

Therefore, the purpose of economic and social development should be conducted in sustainable way (Fauzi and Octavianus, 2014). The success of sustainable development should be compatible with legal / regulation situation and political education, economy, social, culture, institutions, technology and environment (Kaklauskas et al, 2009). However, sustainable development tends to be seen in long term, thus it needs monitoring and implementation evaluation to direct it to the right process (Rozema and Martens, 2010). Pezzey (1992) saw sustainability in different side, which is from static and dynamic definitions. Static sustainability is the use of renewed natural resources through constant technological rate. Dynamic sustainability, on the other hand, is the use of non-renewed resources with changing technological level. However, the sustainability of resources utilization is determined by the utilization level of the resources that is not exceeding the carrying capacity Manafi etc, 2009).

One of important areas to be developed in sustainable way is coastal area. The characteristics and natural coastal and marine ecosystems that are ecologically interlinked with each other requires that the management of coastal and ocean resources in an optimal and sustainable can only be realized through an integrated approach and holostik (Lekipiouw, 2010). Therefore, it is important for resources manager who work in the coastal area to consider the impact of change caused by the use of resources or exploitation on the balance (Gunawan, 1998).

Integrated coastal management can be a useful process to reconcile economic development and conservation values. (Muir, 2002). The need for Integrated Coastal Management Implementation which is a development of coastal area management by integrating the use of land and sea for environmental interest and for people who use it (Havard et al, 1996). The Integrated Coastal Management Implementation will have significant impact and give contribution to the management of coastal and sea areas in Indonesia (Farhan and Lim, 2010).

The coastal zone has high population density and it has increased conflict among coastal societies. The conflict was due to the competition in space utilization since coastal area is a strategic area with utilization in environmental, economic and social aspects. Therefore, solution for various problems is an important consideration when forming policy for sustainable development and the need for integrated and coordinated management policies (Ramesh and Senthil, 2011). The process of Integrated Coastal Management consists of three main components: coastal zone policy, coastal development strategy and priority investment program (Islam et al, 2009).

Coastal areas are rich in bio diversity thus it needs to be arranged on sustainable policies, implementation of space layout by considering geographical condition, social-cultural such as demographic and population distribution and other potential and strategic aspects. Result from the implementation of space layout is expected to be able to achieve sustainable development by integrating economic, social cultural, environmental and developmental equity pillars (Marliana etc, 2014).

As a coastal area, the existence and function of Sebuku Strait is very important. Sebuku Strait is a very potential area and optimally untapped and is tended to be left behind (poor area). Sebuku Strait area has productive natural resources including renewable resource especially fishery, non-renewable resource especially coal deposit or environment services such as marine tourism. Therefore, Sebuku Strait is the hope of the society in fulfilling their future life needs.

In order to accelerate development in the area, Kinnear and Odgen (2014) stated that regional development is becoming important by paying attention on and utilizing resources of the area through innovation efforts on regional planning; thus, creating better socio-culture, economic and environment. Moreover, since the ecological and economic aspects are tended to be in conflict; therefore, in order to maintain the sustainability aspect a utilization plan is needed through adaptive capacity of resources utilization system based on its characteristic (Brunkhorst, 2005). Regional Development referring to sustainable development principle through the utilization of natural resources, then resource management decisions should consider the input, views and influence of various stakeholders (Abubakar, 2010). Thereby, it is important to understand that sustainability principle in utilizing Sebuku Strait resources through integrated layout plan will bring regularity in the implementation of development.

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2. RESEARCH METHODOLOGY

2.1. Research Location

Sebuku Strait is located between Laut Island and Sebuku Island, Kotabaru Regency, South Kalimantan (Figure 1).

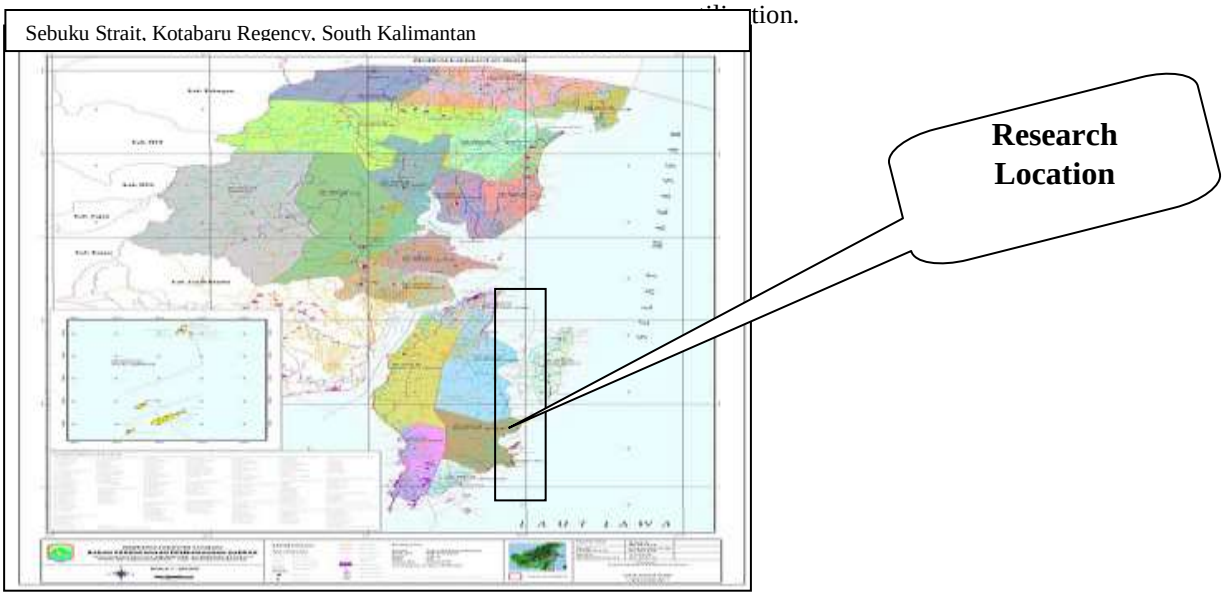

Figure 1. Sebuku

Strait2.2. Analysis Used

Sustainability analysis of regional development at Sebuku Strait area used *Rap-Sebuku* method. The method is the development of Rapfish (Rapid Appraisal of Fisheries) method. RAPFISH is a rapid appraisal technique designed to allow an objective, transparent, multi-disciplinary evaluation, but it is not intended to replace conventional stock assessment for setting (Pitcher , 1999). This dynamic and multi-criteria analysis using Rapfish provides a useful tool. Firstly, it enables an assessment of the effectiveness of fisheries management. Secondly, the results provide information to policy makers about the best policy options for the sustainable management of fisheries in the future (Murillas et al. / Fisheries 2008). Rapfish method was developed by Pitcher et al. (1998) and continued to be improved and initially applied to evaluate the sustainability of catching fishery (Pitcher and Preikshot 2001; Kavanagh 2001; Alder *et al.* 2002; Fauzi and Anna 2002 *in* Fauzi and Anna, 2005). Still irrelevance uses RAPFISH analysis in Indonesia because the actual data that describes the condition of the water management area in Indonesia is still very minimal. On the other hand the need for sustainable management of the region increasingly urgent (Hartono et al, 2005). Rap-Sebuku method is a sustainability estimation technique with attributes that are easy to be valuated based on time and cost and to be applied in various multidiscipline valuation aspects. The method is also able to show the current sustainaility level of Sebuku Strait area based on development concept and various tion.

In short, Rap-Sebukum method and procedures of MDS Rap-Sebuku analysis was conducted in the following stages:

1. Determination of Research Study

The determination of research study in this case was the study on the sustainability of regional development at Sebuku Strait Area. The study tried to find out the current status of the sustainability of regional development at Sebuku Strait Area. The sustainability status would then become the material to give recommendation on sustainable regional development.

2. Determination of Indicators for the Sustainability of Regional Development

The indicators were indicators that representing sustainable regional development consisting of five dimensions: ecology, economy, social, technology and institution.

3. Determination of Each Sustainable Attributes for every Dimension

Attributes are chosen to refect sustainability within each discipline, and although intended to remain fixed for all analyses, may be refined or substituted as

improved information becomes available. Ordinations of sets of attributes are performed using multi-dimensional scaling (MDS) followed by scalingand rotation (Pitcher dan Preikshot, 2001). Multidimensional scaling (MDS) is an exploratory data analysis technique that can be used in testing the hypothesized existence of particular dimensions or structures within a data set. The use of MDS in data analyses offers several advantages. Namely, MDS is an extremely flexible technique, one that can model non-linear relationships and is not bound by the numerous assumptions associated with general linear models or even with factor analyses (Jaworska and Anastasova, 2009).

To evaluate the sustainability status of a system to be studied, preparation was needed on the appropriate sustainable attributes. The general criteria for attribute determination for each dimension was the easiness to give objective score and having sustainable extreme point that able to be stated in simple way as good or bad. The attributes chosen in one dimension reflected the sustainability from the dimension and could be modified with other attributes if the information available. Those attributes were referred to and modified by Bintoro (2005), Sinaga (2010), Sujiman (2010), Nur (2011) and Putera (2013) and additional attributes based on research location.

- Ecological Dimension
  The dimension is the reflection of environmental quality and system order that support sustainable regional development. The definition of the dimension was explained in nine attributes. Operationally, all attributes could describe the ecological point of view of the condition of Sebuku Strait area being analyzed.
- Economic Dimension
  The dimension is the reflection of financial self sufficiency and resources based utilization of the area that able to increase regional prosperity and income and in turn, could support sustainable regional development. The definition of the theory was explained in nine attributes. Operationally, all attributes could describe the economic point of view of the condition of Sebuku Strait area being analyzed.
- Social Dimension
  The dimension is the reflection of human social system that supports sustainable regional development. The definition of the dimension was explained in nine attributes. Operationally, all attributes could describe the social point of view of the condition of Sebuku Strait area being analyzed.
- Technological Dimension
  The dimension is the reflection of technological system that supports sustainable regional development. The definition of the dimension was explained in five
  attributes. Operationally, all attributes could describe the technological point of view of the condition of Sebuku Strait area being analyzed.
- Institutional Dimension
  The dimension is the reflection of institutional system that supports sustainable regional development. The definition of the dimension was explained in six attributes. Operationally, all attributes could describe the institutional point of view of the condition of Sebuku Strait area being analyzed.

4. Determination of value and scoring for every attributes

Value determination for every attribute was based on the real condition at research location. Value determination for every attribute was gained from analysis result on those attributes by competent respondents or respondents who know about research location, such as resources user, government, legislative, NGO or academic (higher education institutions). Heersman et. al. (1999) stated that there are 3 (three) options of value in every attributes: bad was given value 0 (zero), middle value was given value 1 (one) and good was given value 2 (two). Every attribute had one value. The value was the reflection of the attribute condition. Criteria in determining value for every attribute were based on scientific judgment.

5. Determination of Rap-Sebuku ordination for every attribute

Rap-Sebuku (Multidimensional Scaling) ordination was performed on all data from the attributes considered in the research to determine one point reflecting the position of sustainability of regional development being studied toward two main reference points, which were good and bad points. The ordination was conducted after giving value to every indicator of each dimension, determining main reference points of horizontal direction (good and bad), determining other main reference points of vertical direction and creating useful additional reference points so that points studied would not be out of the reference points. Through Rap-Sebuku ordination, the position of sustainability point was visualized in two dimensions (vertical and horizontal axis). Through axis rotation method the position of those points could be projected in horizontal line where bad points were given with 0% value and

good points were given with 100% value. The position of sustainability of the regional development studied would be between those two points and its sustainability index could be analyzed by observing the percentage value of sustainability of regional development on the horizontal line.

6. Determination of index and category of sustainability status of regional development

The result of Rap-Sebuku ordination was a sustainability index of regional development with range of 0-100. The sustainability index of regional development gained from the ordination was used to find out the status of sustainability of regional development.

The score of each attribute was analyzed in multidimensional to determine one or few points reflecting the position of sustainability of regional development based on resources utilization at Sebuku Strait, Kotabaru Regency. The scores of sustainability index of every dimension is presented in Table 1.

Table 1. Index Value Scale and Category of Sustainability Status

Index Value	Category
0 - 25	not sustainable
>25 - 50	less sustainable
>50 - 75	fairly sustainable
>75 - 100	sustainable

Source : Sinaga (2008)

7. Monte Carlo and Leverage Analysis

Monte Carlo analysis is conducted to see the stability of sustainability index of regional development gained. Method used for Monte Carlo analysis is scatter plot method that shows ordination of every dimension. If the result shows an accumulate plot, the sustainability index of the regional development is stable. On the contrary, if the plot is scattered, the sustainability index of the regional development is unstable. After ordination and good and bad index of the regional development was known, leverage analysis was conducted from those attributes. Leverage analysis was conducted to see what attribute that sensitive to give contribution to the formation of sustainability index of regional development. Leverage analysis was conducted by observing any change on ordination if certain attribute was removed from the analysis. All attributes were successively removed from Rap-Sebuku ordination. The influence of each attribute was seen from root mean square (RMS) on its x-axis. If an attribute was removed from Rap-Sebuku ordination and it did not change the RMS value, the attribute was considered insensitive in forming sustainability index of regional development and conversely. Result of the analysis was the value of change on RMS in every attribute.

8. Preparation of recommendation on sustainable regional development at Sebuku Strait

The preparation of recommendation on sustainable regional development was based on the result of leverage analysis. The result itself helped to see what attributes that sensitive to contribute to the formation of sustainability index of regional development. The sensitive attributes would be a base to make policy since they influenced the preparation of sustainability index of regional development. Whereas, insensitive attributes was ignored in making policy since they have no influence on the formation of sustainability index of regional development. Policies are made to improve sensitive attributes that currently have bad scores and to maintain those with good scores.

3. RESULT AND DISCUSSION

The determination of index and sustainability status of Sebuku Strait in Kotabaru Regency is very important in order to have detail picture on the existing condition. Understanding on the existing condition and influential factors will facilitate policies formation or program planning. Result from attributes valuation conducted by experts and other respondents showed that thirty eight attributes or factors had mutual relevance relationship that influenced every dimension of Sebuku Strait in Kotabaru Regency consisted of: ecological, economic and social dimensions were each influenced by nine attributes, technological dimension was influenced by five attributes and institutional dimension was influenced by six attributes.

Result from index analysis and sustainability status of every dimension of regional dimension at Sebuku Strait conducted through Rap-Sebuku ordination technique with MDS method is described as follow:

3.1. Sustainability Index and Status of Ecological Dimension

Result from Rap-Sebuku ordination analysis on nine attributes influencing the ecological dimension showed that the sustainability index value of ecological dimension was 45.55%. The value was in the interval of 25.00 – 50.00 of sustainability scale with status of less sustainable as shown in Figure 2.

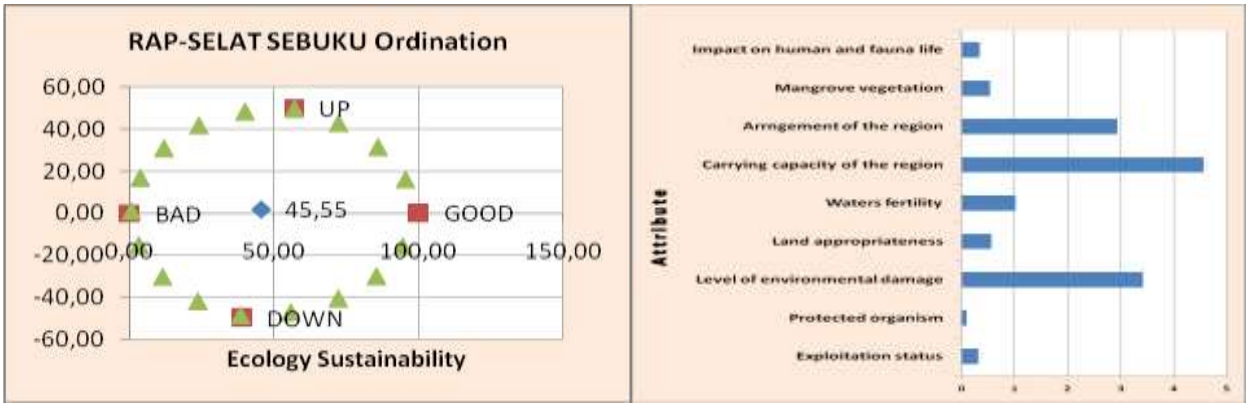

Figure 2. Sustainability index value and sustainability status of ecological dimension and sensitivity value of ecological dimension attributes stated in the change of RMS of sustainability scale of 0-100

Result of leverage analysis on nine attributes of ecological dimension showed three sensitive attributes: 1) arrangement of the region, 2) carrying capacity of the region and 3) level of environmental damage as shown in Figure 2.

3.2. Sustainability Index and Status of Economic Dimension

Result from Rap-Sebuku ordination analysis on nine attributes of economic dimension indicated that the sustainability index value of economic dimension was 48.20 with category of less sustainable as presented in Figure 3.

Leverage analysis on nine attributes of economic dimension resulted in four sensitive attributes on the sustainability of economic dimension: 1) contribution to PAD (Regional Real Income) and PDRB (Gross Domestic Regional Product); 2) society income, 3) access to resources and 4) local business development as presented.

Figure 3. Sustainability index value and sustainability status of economic dimension and sensitivity value of economic dimension attributes stated in the change of RMS of sustainability scale of 0-100

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3.3. Sustainability Index and Status of Social Dimension

Result from Rap-Sebuku ordination analysis on nine attributes of social dimension indicated that the value of sustainability index of social dimension was 53.08 with category of fairly sustainable as presented in Figure 4.

Leverage analysis showed that from 9 attributes of economic dimension analyzed there were 4 attributes showing high sensitivity value on the sustainability of social dimension: 1) level of education; 2) role of private sector, 3) potential of conflict and 4) role of government as presented in Figure 5.

Potential of conflict was a serious threat for the sustainability of strait area since it had detrimental impact. On the other hand, the role of government and private sector and participation from the society had influence on sustainable management of strait area; therefore they had impact on productivity of resources at the strait area.

Figure 4. Sustainability index value and sustainability status of social dimension and sensitivity value of social dimension attributes stated in the change of RMS of sustainability scale of 0-100

3.4. Sustainability Index and Status of Technological Dimension

Current condition of technology had important role in determining sustainability status of Sebuku Strait area. Result from Rap-Sebuku ordination analysis indicated that the value of sustainability index of technological and infrastructure dimension was 53.93 with category of fairly sustainable as presented in Figure 5.

Result from leverage analysis showed that from five attributes analyzed there were three attributes showing high sensitivity: 1) technology of non-renewable re-sources utilization, 2) technology of renewable resources utilization and 3) port affairs

Figure 5. Sustainability index value and sustainability status of technological dimension and sensitivity value of technological dimension attributes stated in the change of RMS of sustainability scale of 0-100

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3.5. Sustainability Index and Status of Institutional Dimension

Result from Rap-Sebuku ordination analysis on six attributes of institutional dimension showed that the value of sustainability index of policy and institutional dimensions was 50.49 with category of fairly sustainable as presented in Figure 6.

Result from leverage analysis showed that from six attributes analyzed there were three attributes showing high sensitivity: 1) technology of non-renewable re-from institutional dimension: 1) resources management planning; 2) resources management regime and 3) availability and completeness of the rules.

Figure 6. Sustainability index value and sustainability status of institutional dimension and sensitivity value of institutional dimension attributes stated in the change of RMS of sustainability scale of 0-100

3.6. Sustainability Index and Status of Multi-Dimension

Sustainability index value and sustainability status of five dimensions of regional development of the strait is visualized in kite diagram as presented in Figure 7.

The result of weight evaluation of interest level for each dimension on the performance of Sebuku Strait area showed that the weight for each dimension is: 45.55 for ecology, 48.20 for economy, 53.08 for social, 53.92 for technology and 50.49 for institution. It can be seen that, in average, the five dimensions of regional development of Sebuku Strait were in 50.248 of index value with sustainability scale of 0-100, thus the status was fairly sustainable.

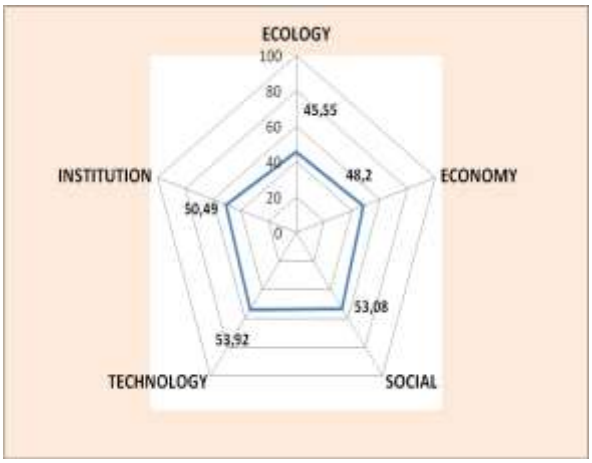


Figure 7. *Kite diagram* of multi-dimension sustainability of regional developmet at Sebuku Strait

3.7. Stress Value and Coefficient of Determination

The accuracy of configuration of one point reflecting the real data can be measured by observing stress value from Rap-Sebuku ordination analysis on every dimension analyzed. The ability of every attribute to explain and give contribution to the sustainability of studied system can be seen from its coefficient of determination (R2) value. Stress value and coefficient of determination of every dimension can be seen in Table 2.

Table 2. Stress Value and Coefficient of Determination of Multi-dimension

DIMENSION	STRESS VALUE	R^2 Squared Correlation= (RSQ)	SUSTAINABILITY VALUE	MONTECARLO
ECOLOGY	0,1408223	0,9502316	45,55	45,83
ECONOMY	0,1592253	0,9407296	48,20	48,17
SOCIAL	0,1363429	0,9437857	53,08	52,48
TECHNOLOGY	0,1482640	0,9291337	53,92	53,15
INSTITUTION	0,1529214	0,9427338	50,49	50,00
Average	**0,14751518**	**0,941323**	**50,248**	**49,926**

Source: Analysis Result, 2014

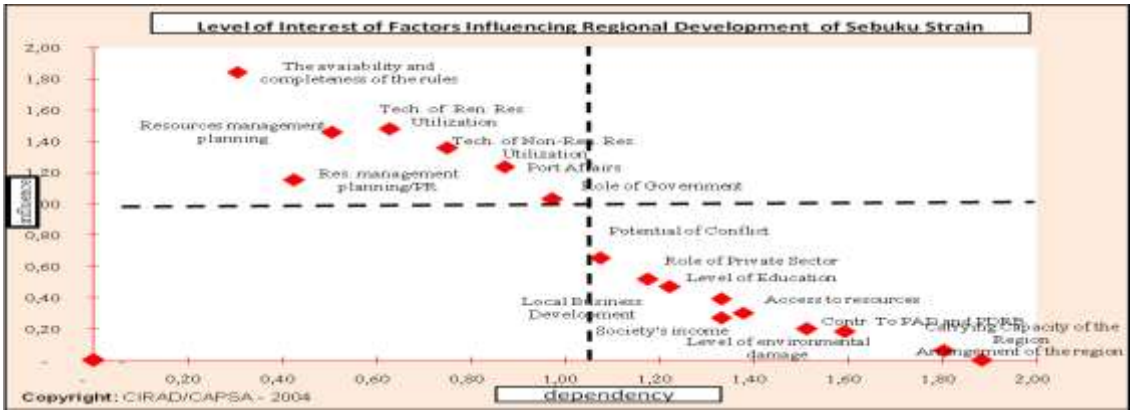
Table 2 shows that the average stress value of the dimensions is 0.1475 and average R^2 is 0.9413. In sustainability, good stress value is < 0.25 (Malhotra, 2006) means goodness of fit in MDS stating that attribute configuration could reflect its actual data. Whereas R^2 of 0.9413 shows that attribute or factor in every dimension is able to explain and give recommendation of 94.1323% to the sustainability of system studied. According to Kavanagh (2001), good R^2 value is >80% or close to 100%.

3.8. The influence of Error

Evaluation on the influence of random error through Monte Carlo Analysis is aimed to find out: (a) the influence of error in determining attribute score, (b) the influence of scoring variation, (c) the stability of repetitive MDS analysis process, (d) error in data entry or missing data and (e) acceptable stress value, which is < 20%. Result from Monte Carlo analysis and multi-dimension stress value showed that there was no significant difference on the value of sustainability index from Rap-Sebuku and from Monte Carlo analysis (stress value of 5%) both on distribution value and the influence of error in level of 95%. It confirms that error on scoring, the influence of score variation, stability of repetitive MDS analysis process and error in data entry or missing data had no significant influence on resulted output.

3.9. Key Factors from MDS Analysis Result

Result from leverage (sensitivity) analysis in MDS indicated that from 38 attributes analyzed, there were seventeen sensitive attributes or factors influenced the sustainability of regional development at Sebuku Strait, consisted of ecological dimension with three attributes, economic dimension with four attributes, social dimension with four attributes, technological dimension with three attributes and institutional dimension with three attributes. Those seventeen sensitive attributes were analyzed for the level of interest among factors to regional development of Sebuku Strait by using prospective analysis. Outputs from prospective analysis were ranking and sector of each attribute illustrated in four sectors/quadrants diagram along with their coordinate. The diagram is presented in Figure 8.



Source: Analysis Result, 2014

Figure 8. Level of Interest of Factors Influencing Regional Development of Sebuku Strait

According to Bourgeois and Jesus (2004), determinant factors or driving variables located in the first quadrant (1) consist of factors with strong influence but less dependency. Factors in this quadrant are the determinant or driving factors included in the strongest factors category in the system studied. Quadrant two (2), connecting factors (leverage variables), shows factors with strong influence and dependency among factors; therefore factors in this quadrant are considered as strong factors or variables. Quadrant three (3), dependent factors (output variables), represents output factors with small influence but high dependency. Whereas, factors in quadrant four (4) are called independent factors (marginal variables), that are marginal factors with less influence and low dependency; therefore these factors are free in the system.

Based on the distribution type of factors in influence and dependency quadrant as seen on the graph, type of distribution was accumulate from quadrant one to quadrant three. According to Bourgeois (2007) this type of distribution is an indication that the system built is stable since it shows strong relationship where driving variables strongly regulate output variables. In addition, through this type, a strategic scenario is easy and efficient to build. On the contrary, distribution type that tends to accumulate in diagonal of quadrant four to quadrant two shows that the system built is unstable since most of variables resulted are within the marginal variable; therefore, it is difficult to build future strategic scenario.

3.10. Scenario Simulation of Management Model of Sebuku Strait

Scenario of sustainable management of Sebuku Strait was performed through prospective analysis to predict possible future events based on goals to be achieved. Prospective analysis was conducted in three steps: (1) identification of future key factors, (2) determination of strategic goals and main actors' interest and (3) definition and description of future evolution and determination of sustainable management strategies of Sebuku Strait based on resources owned.

The determination of key factors in analysis was conducted by combining sensitive key factors influencing system performance resulted from sustainability analysis and key factors resulted from needs analysis. Based on the result of sustainability analysis, there were seventeen sensitive attributes. Various possibilities were formulated as follow: (1) pessimistic scenario with improvement on attributes around 24.9%; (2) moderate scenario with improvement on attributes around 53.9% and (3) optimistic scenario with improvement on attributes around 81.5%.

Pessimistic Scenario (Scenario 1)

In this scenario, improvement was done effortless or based on cost efficiency by suppressing cost as low as possible (50%). Improvement on key attributes would change their score value. Further, Rap-Sebuku analysis was conducted on some key attributes that had changed in their score value to see the level of improvement on sustainability index value of Sebuku Strait. Level of change in index value based on Rap-Sebuku analysis is presented in Table 3.

Table 3. Level of change in sustainability index value of scenario 1 (pessimistic)

No.	Sustainability Dimension	Value Index Now	Value Index Scenario 1	The Difference
1	Ecology	45,55	59,87	14,32
2	Economy	48,20	60,97	12,77
3	Social	53,08	64,42	11,34
4	Technology	53,92	68,78	14,86
5	Institution	50,49	59,87	9,38
	Multi-dimension	50,248	62,782	12,534

Source: Analysis Result, 2014

The above table shows increase in the value of sustainability index in all dimensions. Almost all dimension, including multi-dimension has sustainability index value above 50%. However, in average, all dimensions are generally in status of fairly sustainable (64.172). It implies that Sebuku Strait condition was not able to fully support sustainable development. It was because increase in index value through improvement on some attributes was not maximal. Based on index value of scenario 1, a kite diagram was made from five dimensions as shown in Figure 9.

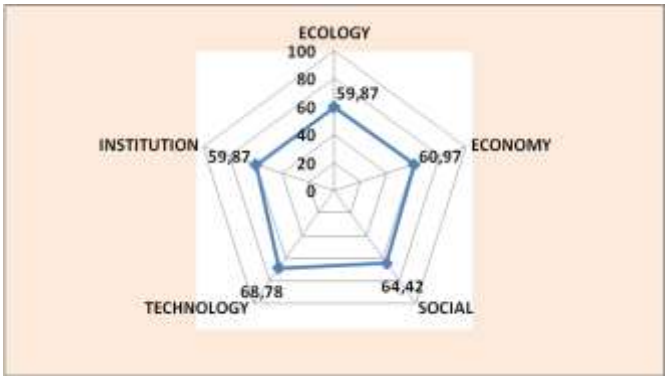


Figure 9. *Kite Diagram* of Index of Scenario 1 (pessimistic)

Moderate Scenario (Scenario 2)

In this scenario, some improvements were made based on optimality by considering cost effectiveness and efficiency factors and optimum output (81.25%). Improvement on those key attributes would bring change in score value of the attributes.

Further, Rap-Sebuku analysis was conducted on some key attributes that had changed in their score value to see the level of improvement on sustainability index value of Sebuku Strait. Level of change in index value based on Rap-Sebuku analysis is presented in Table 4.

Table 4. Level of change in sustainability index value of scenario 2 (moderate)

No.	Sustainability Dimension	Value Index Now	Value Index Scenario 2	The Difference
1	Ecology	45,55	77,70	32,15
2	Economy	48,20	73,33	25,13
3	Social	53,08	80,40	27,32
4	Technology	53,92	77,70	23,78
5	Institution	50,49	77,68	27,19
	Multi-dimension	50,248	77,362	27,114

Source: Analysis Result, 2014

The above table shows increase in the value of sustainability index in all dimensions. Almost all dimensions, including multi-dimension, has sustainability index value above 75%, except economic dimension with value of 73.33%. However, in average, all dimensions are generally in status of sustainable (77.362%). It implies that Sebuku Strait condition was able to fully support sustainable development. It was because increase in index value through improvement on some attributes was maximal. Therefore, improvement effort on those key attributes should maintain to be the main interest and improvement for the future. Based on index value of scenario 2, a kite diagram was made from five dimensions as shown in Figure 10.

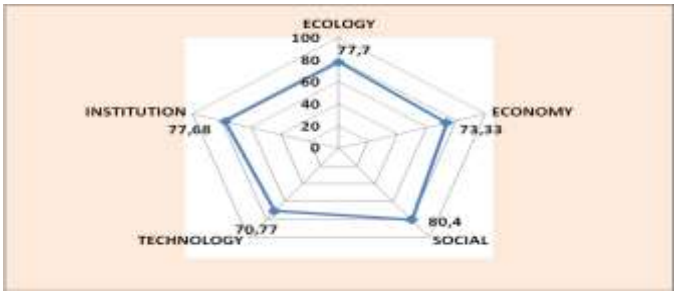


Figure 10. *Kite Diagram* of Index of Scenario 2 (Moderate)

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Optimistic Scenario (Scenario 3)

In this scenario 3, improvement efforts were done on all key attributes (81.5%). The improvement would require high cost and time. It could be done in three periods: short term period by conducting improvement on emergent attributes, intermediate term and long term periods by conducting improvement on supporting management of Sebuku Strait. The scenario was difficult to implement without strong commitment from the government as facilitator of sustainable management of Sebuku Strait.

Further, Rap-Sebuku analysis was conducted on some key attributes that had changed in their score value to see the level of improvement on sustainability index value of Sebuku Strait. Level of change in index value based on Rap-Sebuku analysis is presented in Table.

Table 5. Level of change in sustainability index value of scenario 3

No.	Sustainability Dimension	Value Index Now	Value Index Scenario 3	The Difference
1	Ecology	45,55	96,16	50,61
2	Economy	48,20	80,72	32,52
3	Social	53,08	87,12	34,04
4	Technology	53,92	96,44	42,52
5	Institution	50,49	95,59	45,1
	Multi-dimension	50,248	91,206	40,958

Source: Analysis Result, 2014

Result of analysis shows that improvement on sustainability index value in all dimensions are approaching ideal condition, which is above 75% or in good sustainability status, consisting of: (1) sustainability index value of ecology of 96.16%, (2) sustainability index value of economy of 80.72%, (3) sustainability index value of social of 87.12%, (4) sustainability index value of technology of 96.44% and (5) sustainability index value of institution of 95.59%.

The above result from multi-dimension sustainability analysis shows that sustainability condition of research location with scenario 3 is in sustainable status with sustainability index of 91.26%. This index is close to ideal and has influence on all dimensions of ecology, economy, social, technology and institution. Almost all improved sensitive dimensions were attributes influencing sustainability index of Sebuku Strait. However, it did not underestimate non- and less sensitive attributes based on leverage analysis result. According to index value of scenario 3, a kite diagram was made from five dimensions as shown in Figure 11.

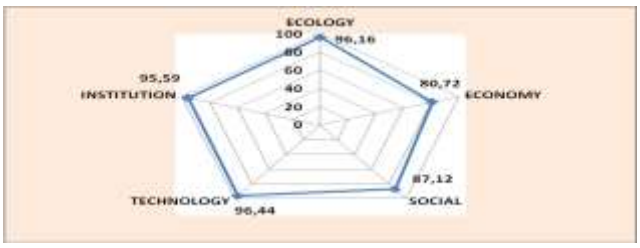

Figure 11. *Kite diagram* of five dimension of scenario 3 (optimistic)

4. CONCLUSION

Based on research result, conclusion could be drawn as follow:

1. Based on research result, the weight of interest level for each dimension on the sustainability of Sebuku Strait area was following: ecology of 45.55, economy of 48.20, social of 53.08, technology of 53.92 and institution of 50.49. Considering all dimensions of regional development of Sebuku Strait, in average the index value was 50.248 and with sustainability scale of 0-100, the status was fairly sustainable.
2. Based on sustainability analysis result, there were seventeen sensitive attributes. Various possibilities could be formulated as follow: (1) pessimistic with around 24.9% improvements on attributes; (2) moderate with around 53.9% improvements on attributes and (3) optimistic with around 81.5% improvements on attributes. The expected sustainability could follow condition and trend indicator types that describe linear tendency of resources development to optimum limit.
3. Based on criteria of scenario acceptance, in order to obtain more efficient and effective sustainability status scenario 2 was chosen through improvement on sensitive attributes having influence on the improvement of sustainability of strait area. The scenario was chosen based on factors: 1) time, 2) budget and 3) human resources condition. In addition, achieving target through pessimistic scenario was constrained by planning and management of resources utilization at the strait

since the improvement on attributes was done effortless. Whereas, achieving target through optimistic scenario was constrained by cost effectiveness and efficiency due to the large number of attributes to be improved.

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