



Assessment of Sustainability Management on Taman Buru Lingga Isaq

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Abstract

The sustainability management of Taman Buru Lingga Isaq (TBLI) becomes very important, considering the main function and role of TBLI existence, as a conservation area and socio-economic benefits to society around TBLI area. The purpose of this research is to assessment of sustainability management of TBLI. The research method used MDS approach with Rap_TBLI (Rapfish modification). The results obtained, the level of sustainability are ecology dimension (51.55%) or categorized as quite sustainable, economic dimension (20.14%) or categorized as bad sustainable, social dimension (55.15%) or categorized as quite sustainable, and institutional dimension (47.68%) or less sustainable. There are 6 (six) leverage attributes of TBLI sustainability, including; soils (7.9485), topography (7.4386), access to the market (11.2219), access to resources (8.5984), population density (5.3440) and property right (4.1657).

Keywords: Sustainability; management; TBLI; Rap_TBLI; MDS-Rapfish.

1. Introduction

The sustainability management of Taman Buru Lingga Isaq (TBLI) becomes very important, considering the main function and role of TBLI existence, as a conservation area on one side and on the other side can give economic and social benefits to society around of TBLI area. Sustainability can be interpreted as an effort to maintain the sustainability of a program in all development dimensions, such as; ecological, economic, and social. [1] argues that sustainability is seen in three demands as a triangular framework namely; economic, social and ecological sustainability. Reference [2] adding the institutional dimension as the fourth democracy of sustainability, so that the four demands form the prism of sustainability. In addition to these four dimensions, the technological dimension also becomes one of the most important dimensions in the sustainability of a program or the management of natural resources. Taman Buru Lingga Isaq is a hunting park located in Aceh Tengah District and Bener Meriah District of Aceh Province with an area of 86,320 hectare. Based on the characteristics of the location, topography, and the condition of land use and the condition of transportation facilities around the area, TBLI is very likely to get various pressures, either through community activities around TBLI or from outside communities entering the area and passing along the road dividing TBLI . Thus, the importance of sustainability assessment in four dimensions of management, namely; The ecological, economic, social and institutional dimensions, in order to determine the sustainability level of each management dimension. The objective this research is to assesment of sustainability management on Taman Buru Lingga Isaq.

2. Method

2.1. Type and Source of Data

The types and sources of data collected on sustainability assessment of TBLI are primary and secondary data. Primary data is data obtained directly from the first source. Primary data obtained from the results of interviews with the community. Secondary data is data obtained not directly from the research object [3]. Secondary data is obtained from relevant offices/agencies in the management of TBLI, such as; BKSDA (Indonesia Nature Conservation Agency), Forestry Agency, Bureau of Statistics, NGO, Universities and other secondary sources. Types and sources of data, in more details as follows:

Table 1: Type and source of data

Aspects	Variable	Type of data	Source of data
Sustainable level of TBLI	Dimension and attribute of sustainable	Primary data Secondary data	- Analisis result - Interview result - Document from Bureau of Statistics/others document
Variable/leverage attribute of TBLI sustainable	Leverage attribute of each dimension	Primary data Secondary data	- Rap_TBLI analisis result
Trade off for TBLI sustainable	Sustainable ordination	Primary data	- Rap_TBLI analisis result

2.2. Data Collection Method

Methods of data collection is done by survey method (interview) and literature study method. Survey method is a method of collecting data that is done to obtain facts from the existing symptoms and seek factual explanations from a group or a region [4]. Survey method was conducted for primary data collection by conducting interviews and observation (visual observation) related to TBLI management. The literature study method is a technique of data collection by conducting studies of penance on books, literatures, records, and reports relating to problems solved [5]. The literature study method was conducted for secondary data collection in the form of documents related to the management of TBLI. Methods of data collection, in more details as follows:

Table 2: Data collection method

Aspects	Variable	Type of data	Method
Sustainable level of TBLI	Dimension and attribute of sustainable	Primary and secondary	- Survey (interview) - Desk study
Variable/leverage attribute of TBLI sustainable	Leverage attribute of each dimension	Primary and secondary	- Survey (interview) - Desk study
Trade off for TBLI sustainable	Sustainable ordination	Primary data	- Survey (interview) - Desk study

2.3. Data Analysis Method

The method of analysis used in this study is based on the research objectives, namely to sustainability assessment of TBLI management. MDS approach with Rapfish analysis, to determine the level of sustainability and attributes of the leverage of the four dimensions of TBLI management. More details as follows:

Table 3: Data Analysis Method

Aspects	Variable	Analysis method	Output
Sustainable level of TBLI	Dimension and attribute of sustainable	MDS (<i>Rapfish Analysis</i>)	- Ordination/value of sustainability
Variable/leverage attribute of TBLI sustainable	Leverage attribute of each dimension	MDS (<i>Leverage Attribute</i>)	- Leverage attribute
Trade off for TBLI sustainable	Sustainable ordination	Microsoft Excel (<i>Kite Diagram</i>)	- <i>Trade off</i>

The MDS analysis is intended to derive a sustainability figure from each of the dimensions of TBLI. Analysis of MDS (Multi Dimensional Scaling) is done with Rapfish modification software (Rap_TBLI). Rap_TBLI is an abbreviation of Rapid Appraisal for TBLI which is a Multi Dimensional Scaling (MDS) analysis approach with modified ordination techniques from Rapfish (Rapid Appraisal for Fisheries) developed by Pitcher [6]. This approach is based more on the principle of Multi Criteria Analysis (MCA) by relying on an algorithm called the MDS algorithm [7]. Operational stage of Rap_TBLI referring to [8] as follows:

- Deciding on objective of study was TBLI sustainability.
- Determine the aspect of the study, includes; ecological dimension, economic dimension, socio dimension and institutional dimensions.
- Define the attributes of each aspect of the study, include; ecological dimension (7 attributes), economic dimension (6 attributes), socio dimension (7 attributes) and institutional dimensions (7 attributes).
- Provide scoring (bad-good) on each attribute.
- Enter the value/score of the assessment results of each attribute into Rapfish software.
- Run Rapfish software.
- Bring up the Rap analysis (sustainability ordinate). Rap analysis is used to determine the percentage of each dimension of sustainability management.
- Run leveraging to obtain leverage of attribute, which is a determination attribute lever of every aspect/directive use. The attribute lever is an attribute whose existence affects sensitively to increase or decrease of the sustainability status, the greater the RMS value is, the greater the role of these attributes to the sensitivity of the sustainability [9].
- Run Monte Carlo with a confidence interval of 95%. Monte Carlo analysis is used to see the effect of the error, in order to increase the confidence in the results of the analysis. The difference in results of Monte Carlo analysis is inferior to the results Rapfish Analysis (value-ordination) showing that the impact of an error scoring is relatively small. If the value of the difference between the two analyses (Monte Carlo Analysis and Analysis Rapfish > 5%), the results of the analysis is not recognized as the estimated value of sustainability index.
- Showing the value squared correlation (R^2) as an assessment of the accuracy (goodness of fit). Squared correlation (R^2) is the square of the correlation coefficient indicates the proportion of a variant of the optimally scaled data, which was donated by multidimensional scaling procedure with a size of a match/accuracy (goodness of fit measure). The R^2 shows the number/amount of various data that can be explained in the model. The squared correlation value is used to determine the proximity between perceptual map data whether the data is mapped well or not. The R^2 is getting closer to 1 means the data that is increasingly mapped perfectly or in other words, the higher the value of R^2 is, the better the model in explaining the variance data. [10] states that the value of $R^2 > 80\%$ indicates that the prediction of index model is sustained and adequate to use.
- Showing the value of stress to indicate the size mismatch (a lack of fit measure). Stress value is the inverse of the value of R^2 . Stress value is used to see if the results of output approaching the real situation or not. If the stress value is closer to zero, the output produced is more similar to the actual situation. The lower the value of stress, the better/fit of the model is. On the other hand, the higher the

stress value is, the more the result will not fit the model. Stress value that can be tolerated is <20% [9].

- Shows the value Root Mean Square (RMS) of each dimension. The larger the RMS value is, the greater the role of these attributes to the sensitivity of the sustainability [9]
- Make a diagram of a kite (kite-diagram) of dimension on TBLI management. Kite-diagram is used as a trade-off of sustainability.

Preparation of index and sustainability level of TBLI management from each dimension, and attribute following concept developed by [6]. Scores for each dimension are expressed on the worst (bad) scale 0% to best (good) 100%. The category of sustainability index is as follows:

Tabel 4: Index of sustainable category

Index values	Sustainable category
0 – 25	Bad; not Sustainable
26 – 50	Less; Less Sustainable
51 – 75	Quite; Sustainable enough
76 – 100	Good; very Sustainable

Sources: [6]

Index value > 50% can be stated that the studied dimension has been sustained, otherwise <50% dimension is not yet or unsustainable. The result of determining the sustainability of each dimension, then made in kite diagram to see the trade-off of sustainable management of TBLI.

3. Results

3.1 Validation

Validation is intended to see the extent to which the results obtained are acceptable, in other words, how far the model can explain the data. Validation is seen in 3 (three) factors, namely; The difference between the Monte Carlo value and the sustainability value is not more than 5%, the value of Squared Correlation (R^2) and the stress value (*a lack of fit measure*). The results of the analysis, obtained validation values on the four dimensions of TBLI management as follows:

Table 5: Validation values of TBLI sustainability

Dimensions	Sustainability index (%)	Monte Carlo values (%)	Stress values (%)	R^2 (%)
Ecology	51.55	52.59	14.78	94.38
Economy	20.14	21.97	14.36	95.01
Social	55.15	55.07	15.13	94.73
Institutional	45.68	45.98	16.08	94.29

Sources: Results of Rap_TBLI (2017)

The validation value of the difference between the Monte Carlo value and the sustainability value obtained ranges from 0.08-1.83% indicating a difference value of less than 5%. Thus based on the Monte Carlo validation criteria, it can be concluded that the resulting model is categorized as valid or adequate as an estimate. The value indicates that the effect of error, or the impact of the scoring error is relatively small. Therefore, the Rap_TBLI model, stated sufficiently as a predictor of the value of the sustainability index. According to [9], that Monte Carlo analysis can be used as a simulation method to evaluate the impact of random error in statistical analysis performed on all dimensions. The same is also suggested [7] that Monte Carlo analysis can be an indicator of error caused by scoring on each attribute, multidimensional scoring variations due to different opinions, repeated data analysis process, and errors in doing input data or missing data.

The result of *goodness of fit test* also shows that the sustainability index prediction model can be used, where the results of Rap_TBLI obtained Squared Correlation (R^2) ranged from 0.9429-0.9501 or generally close to 1. *R-square* value approaching 1 means data which is increasingly mapped out perfectly. The value specifies that about 94-95% of the model can describe the data well, and the remaining 5-6% of data is described by other attributes. [10] mentions that a Squared Correlation (R^2) value of more than 80% indicates that a good and adequate sustainability index prediction model is used. Beside that, the result of a lack of fit measure or stress value ranges from 0.1436-0.1608 or close to 0 (zero). The value of stress is close to zero, then the resulting output is more similar to the actual situation or the lower the stress value, the better / fit the model. Conversely, the higher the stress value, the less suitable the model. [10] mentioned that the tolerable stress value is less than 20%. Thus the model can be well received with stress values ranging from 14-16%.

3.2 Sustainability

A. Ecology Sustainability Index

Ecological sustainability is a description of environmental function and support for the management of TBLI. The ecological dimension is very important in relation to the sustainability of the program from the ecological aspect. Some ecological indicators for the sustainability of TBLI management include: landcover, species abundance, climate, soils, topography, and accessibility. Graph of ordination ecology dimension, as follows:

The result of Rap_TBLI analysis for ecological dimension (ecological sustainability) was obtained by 52.12% sustainability value or categorized as quite sustainable. The condition is quite sustainable that occurred more because, TBLI area is a wildlife conservation area (fauna) which is intended as a hunting area. This is evident from changes in land cover for plantations and shrubs. Based on the result of image data analysis, it is found that the change of forest area occurring within the last 10 years, is not significant. The landcover data shows that in 2006 the forest area is 37,713.10 ha and the data of 2015 is 37,622.54 ha, which means a reduction of 90.56 ha or only about 0.24%. On the other hand, pressure from the forest utilization aspect is also increasing. Changes in land cover / forest that occurred is more in the area close to the settlement or community garden. This is because

the main work of communities around the forest is dominated by farming and gardening which reached 77.00%. The interview result obtained that generally people have a land area of 1.0 hectare and coffee plantation land area of 1.0-3.0 ha. Coffee garden land is generally located within the TBLI area, indicating that the community is very dependent on the area, as a source of community income. According to authors no [11] that forest villagers whose farmers' kind of jobs tend to increase the pressure of their inhabitants into the forest area, this is due to the increasingly limited agricultural land due to the increase of population. Furthermore [12] mentioned that the limited land owned by the community around the forest will result in the condition of the surrounding forest, they will rely on the forest around their settlements to meet the increasing needs of life.

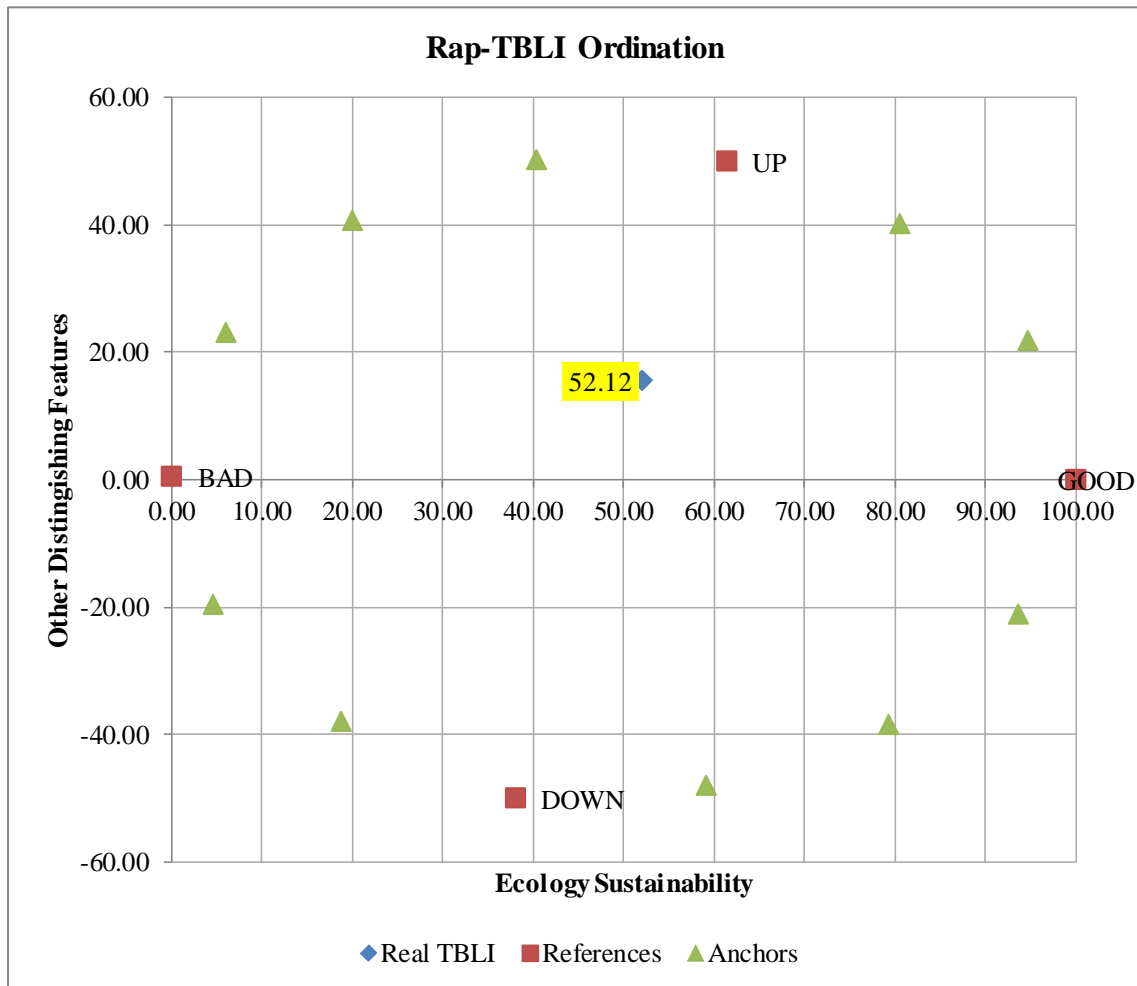


Figure 1: Graphic of ecological sustainability

TBLI has a high potential of flora and fauna. Some of the key species in the region, among others; Sumatran tiger (*Panthera tigris sumatrae*), Sumatran orangutans (*Pongo abelii*), Sambar deer (*Cervus unicolor*), deer (*Muntiacus muntjak*), jungle goat (*Capricornis sumatrensis*), sun bears (*Halarctos malayanus*), *Rafflesia* sp, Tusam (*Pinus merkusii Aceh strain*) that live and thrive on various types of ecosystems. Mammal survey results found 14 species of large mammals found in all types of land cover and some forest areas. The mammal species is dominated by the Bovidae family (4 species) and Cercopithecidae (3 species). The conservation status of mammal communities found by mammals includes 5 species including the Least Concern (LC), 1 species enter

Critically Endangered (CE), and there are three animals found in conservation areas, whereas according to CITES there are 3 species including Appendix 1, and according to PP No.7 / 1999 there are 4 species belonging to protected species .

B. Economy Sustainability Index

Economic sustainability is a description of the economic conditions of the people around the TBLI area. The economic dimension is very important in relation to the sustainability of the management of TBLI from the economic side. Some indicators of the economy sustainability of TBLI, include; income, land ownership, contribution to regional revenue, livelihoods, access to the markets, and access to resources. Graph of ordination economic dimension, as follows:

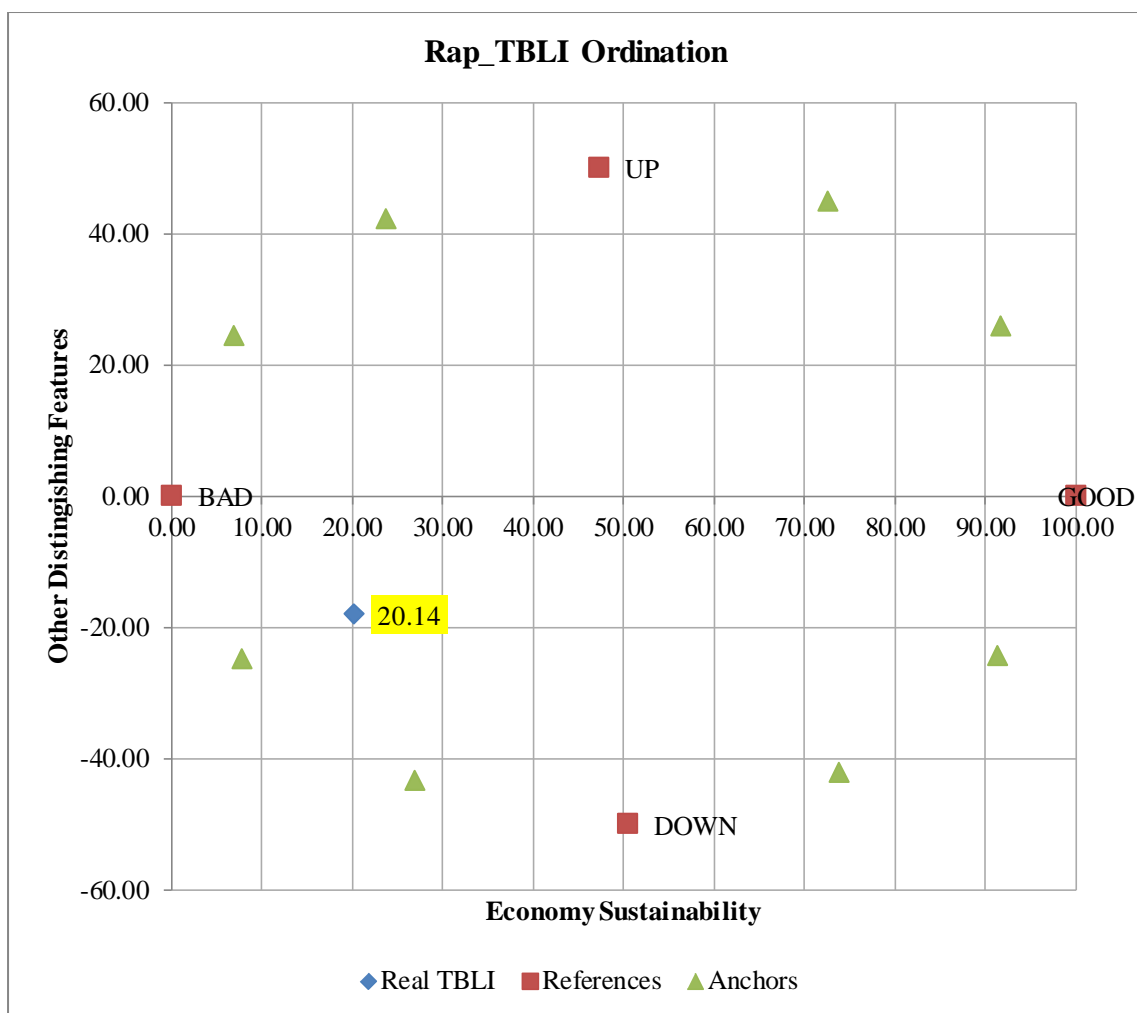


Figure 2: Graphic of economic sustainability

The result of Rap_TBLI analysis for economic sustainability obtained 20.14% sustainability value categorized not sustainable. Non-sustainable economic aspect/dimension is more due to low utilization rate of area/forest for economic activity, such as; Non-existent tourism activities as well as other environmental services utilization activities. Generally people around the area/forest only use in the form of utilization of fruit collection, firewood

and so on, which is very low economic value. The results of interviews with the community found that forest utilization activities generally are looking for and collecting fruit or firewood and wood patok/pole. According to the authors no [13] that the interaction of people around the forest with forest is characterized by collecting forest products in the form of; Foodstuffs, firewood, fodder, tubers and other forest services. [14] further states that in relation to community interaction with forests, it can be either positive or negative. Positive interaction is if the interaction is mutually beneficial for both the community and for the forest, whereas the negative interaction is if the interaction is harmful for either the party either for the community or for the sustainability of the forest, or for both.

C. Social Sustainability Index

Social sustainability is a description of social conditions in the management of TBLI. The social dimension is characterized in 7 (seven) attributes of sustainability management, i.e; community participation, understanding of the environment, education level, potential conflict, population density, local wisdom and social structure. Graph of ordination social dimension, as follows:

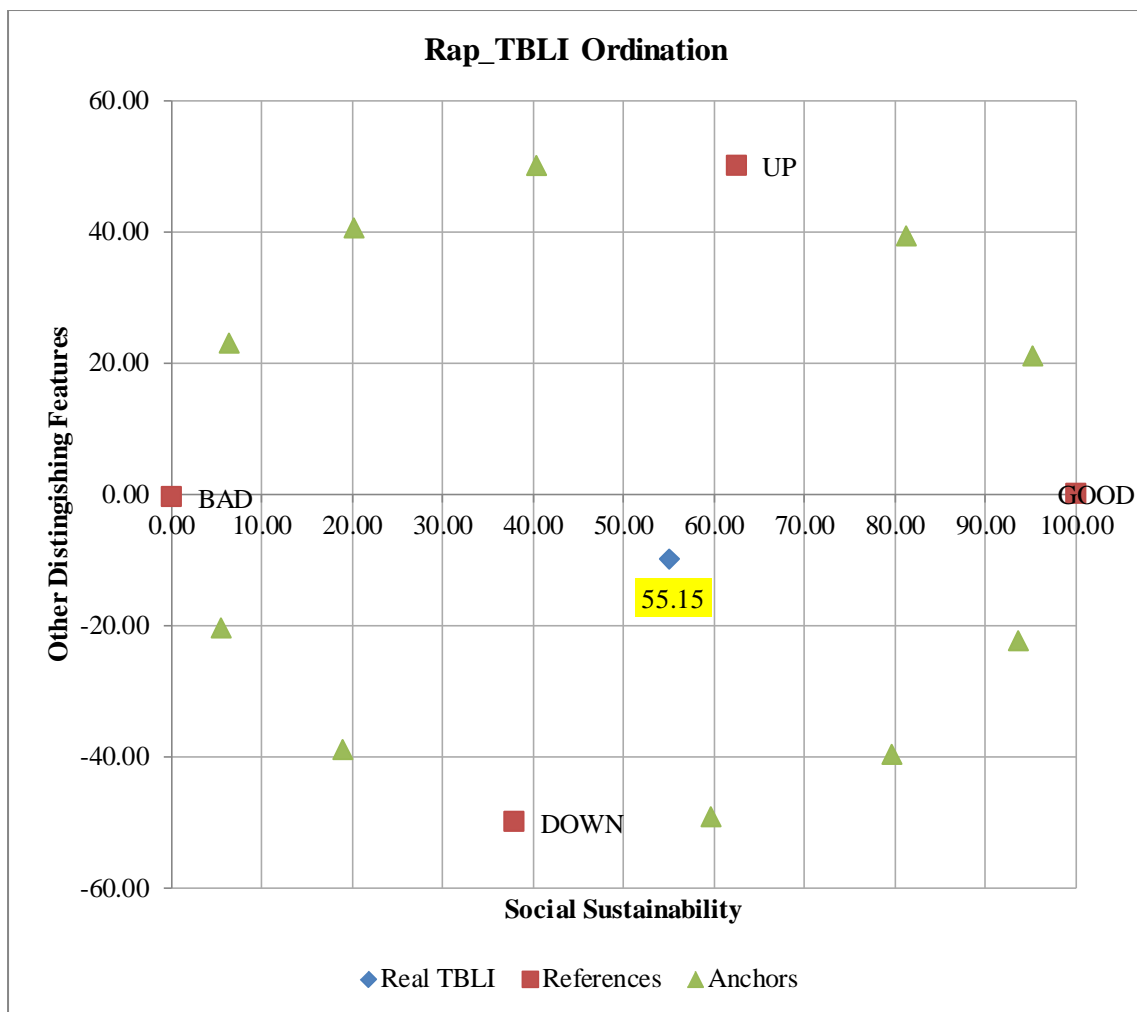


Figure 3: Graphic of social sustainability

The result of Rap_TBLI analysis for social sustainability obtained 55.15% sustainability value or categorized quite sustainable. The level of sustainability of social aspect / dimension is good enough, due to the low level of population density on the one hand and the abundance of potential resources on the other hand. Thus, sustainability can be well preserved. One of the most common factors associated with social aspects is conflict. Conflict can occur because of the high friction that occurs in the middle of society. The potential for conflict is a serious threat to the sustainability of TBLI management. Ownership of land, which is generally the right of utilization can be one of the triggers of the high potential for conflict. On the other hand, increasing population will increase the potential for conflict and increased pressure on forest areas. According to [15] that the source of conflict can come from community relations or sourced from the fulfillment of human needs. Similarly, in the utilization of forest areas in TBLI, the potential for conflict can be sourced from efforts to utilize the area to meet the needs of life.

D. Institutional Sustainability Index

Institutional sustainability illustrates how institutional role or influence in the sustainability of TBLI management. Attributes of institutional sustainability include; completeness of rules, human resources, property rights, regional management planning, completeness of management institutions, the existence of community institutions (NGO), and budgetary. The ordination chart of the institutional dimension, as follows:

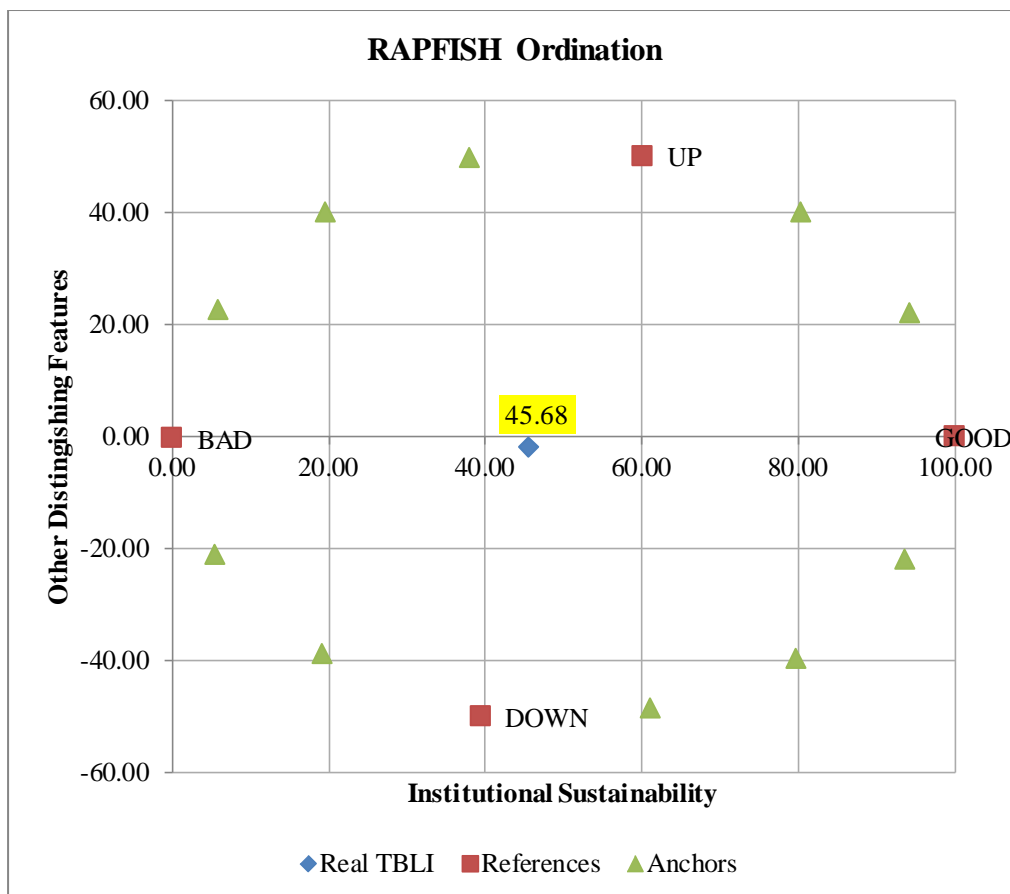


Figure 4: Graphic of institutional sustainability

The result of Rap_TBLI analysis for institutional sustainability score obtained 45.68% sustainability value or categorized less sustainable. The low level of institutional sustainability is more due to the uncertainty of land tenure which is a forest area, where the pattern of control is only a right of utilization. TBLI area is a conservation area devoted to special purpose of hunting park. The management of the park is currently at the stage of protection of the area and the designation of the area into the Conservation Area Management of Lingga Isaq (KPHK), through a Decree of the Minister of Environment and Forestry Number SK.747 / MENLHK / PLA.0 / 9/2016.

3.3 Leverage Attribute of TBLI Sustainability

The leverage attribute of sustainability is an attribute that has the highest contribution to any managerial dimension. The amount of contribution is seen from the *root mean square value* (RMS) which is the value of RMS changes in sustainability ordination when one attribute is omitted. The RMS value describes the amount of value changes that can occur when one of the attributes is omitted. Thus, the higher the RMS value the greater the change in ordination value that can occur if the attribute is omitted. [9] stated that the RMS value indicates the role of each attribute to the sensitivity of sustainability status. Here are the attributes of sustainability levers from each of the dimensions of TBLI management.

Table 6: RMS values of leverage attribute

Leverage Attributes	Dimension	RMS Values
Soils	Ecology	7.9485
Topography	Ecology	7.4386
Access to the market	Economy	11.2219
Access to resources	Economy	8.5984
Population density	Social	5.3440
Property right	Institutional	4.1657

Sources: Results of Rap_TBLI (2017)

A. Leverage Attribute of Ecology Sustainability

The result of leverage analysis for ecological dimension are 2 (two) attributes that become attributes of ecological sustainability lever namely; soils (7.9485), and topography (7.4386). More detailed as in the following graph:

One of the most important factors in the sustainability of ecological aspects of protected areas is land. The soil will greatly determine the type of vegetation that grows. The soil condition is strongly influenced by its constituent components, namely: (1) solid material in the form of mineral material, (2) solid material in the form of organic material, (3) water, and (4) air. The fertile mineral soil is composed of 45% mineral soil material, 5% soil organic matter, 25% water and 25% air. Soil eruption also appears in vegetation growing on it. It also appears from the community activities in utilizing the land. Fertile soil with vegetation growing on it will

greatly determine the extent of species or fauna that exist within the area. Abundance of species is generally an indicator of the ecological changes of a forest area, especially the TBLI area which is a hunting park (hunting area). The abundance of mammalian species is strongly influenced by vegetation conditions [16]. Decrease in species abundance can be caused by the amount of pressure on forests, such as; Activities of forest product utilization and conversion of forest land into coffee plantations impacted the decline in the wealth and abundance of mammal species [17].

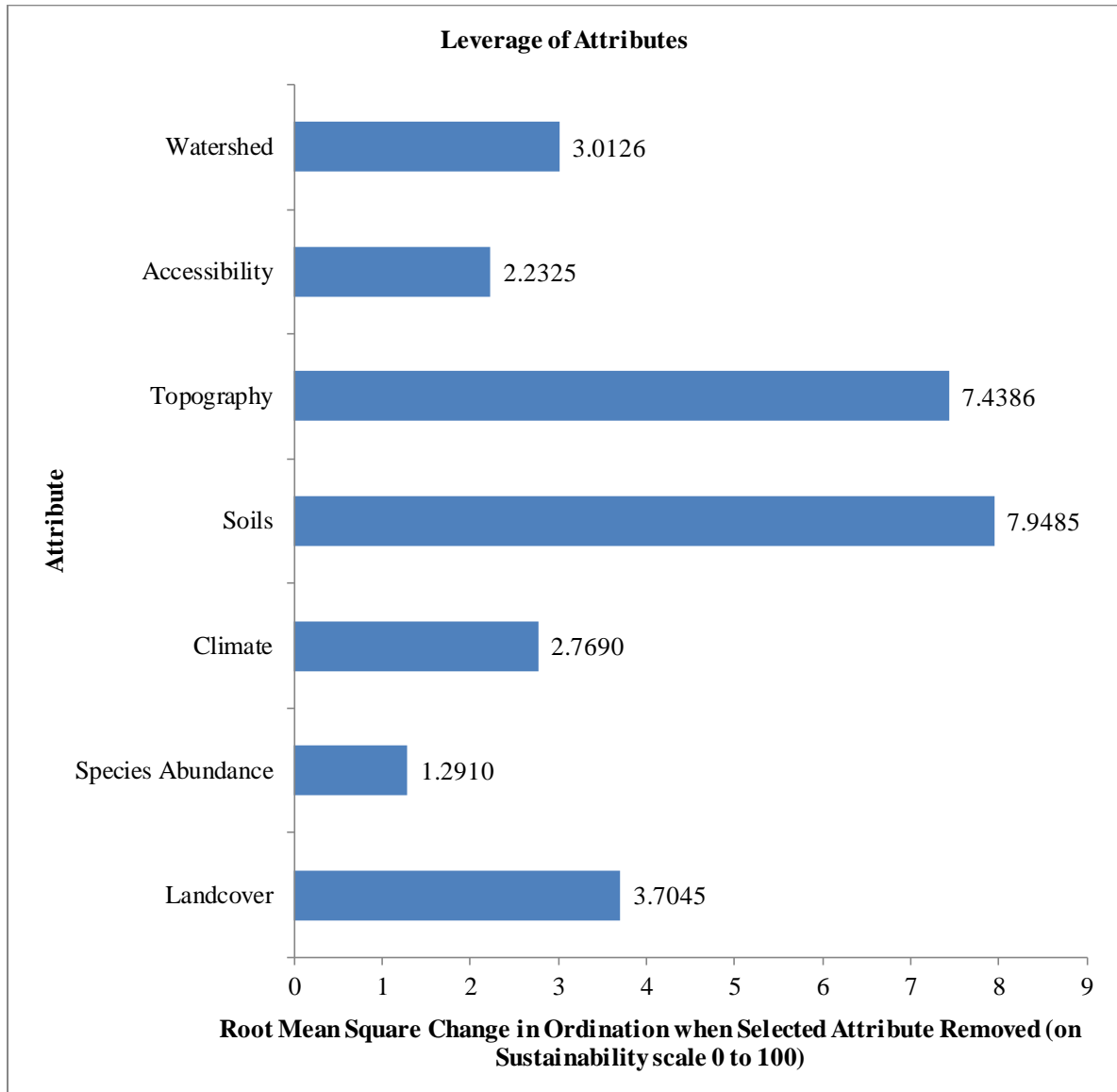


Figure 5: Leverage attribute of ecological sustainability

Soil conditions and tofografi will greatly affect the vegetation (land cover). Landcover is the appearance of vegetation in an area. [18] mentioned that land cover is a physical (visual) embodiment of vegetation, natural objects, and cultural elements that exist on the surface of the earth regardless of human activity on the object. While [19], say that the earth's surface is partly composed of natural features (land cover) such as; Vegetation, snow, etc., and partly the appearance of human activities (land use). Changes in vegetation are mostly caused by

human activities in their use (land use). According to [20], land use is a permanent or periodic intervention of man to the land for the purpose of meeting the needs, both material, spiritual and combined needs. The results of field interviews obtained that generally people take advantage of forestland land as an area of cultivation / gardening. Planting / gardening activities have the potential to reduce land cover (vegetation).

B. Leverage Attribute of Economy Sustainability

The result of leverage analysis to the economic dimension, obtained 2 (two) attribute of the most prominent levers namely; access to the market (11.2219) and access to resources (8.5984). More detailed as in the following graph:

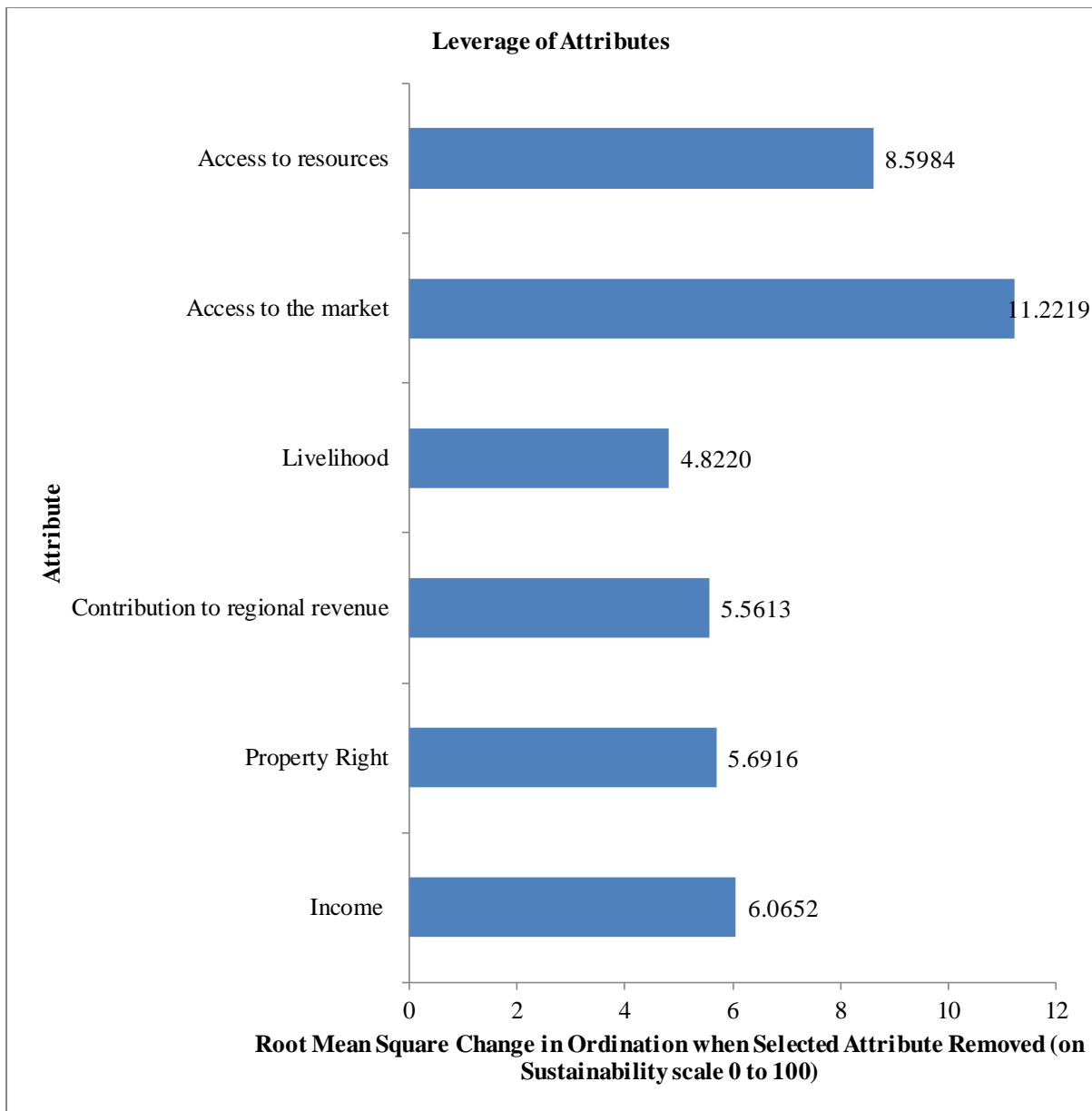


Figure 6: Leverage attribute of economic sustainability

Access to the market is an attribute of the leverage of economic sustainability of the forest area in general and the area of TBLI in particular. The main commodities produced by communities from around the forest area are harvesting of forest products, such as; Coffee, pepper, cloves, durian and other forest products. Generally, forest products are abundant but the marketing aspect (buyer) is a constraint. Remote market access with very difficult accessibility of roads and communications makes the community's income from harvesting the forest is not optimal. The results of the interviews were obtained that the whole community utilized the forest area as a place of livelihood, both as harvest of forest products and cultivation, such as; Gardening and farming. As many as 77.0% of people's livelihoods around TBLI area are generally farmers and gardeners, 13% as pine tappers and the remaining 10% is other work. According to the authors no [11] that forest villagers whose farmers' kind of jobs tend to increase the pressure of their inhabitants into the forest area, this is due to the increasingly limited agricultural land due to the increase of population. Furthermore [12], mentioned that the limited land owned by the people around the forest will result in the condition of the surrounding forest, they will depend on the forest around their settlements to meet the increasing needs of life.

C. Leverage Attribute of Social Sustainability

The result of leverage analysis for social dimension is found there is only 1 (one) attribute of leverage, namely; density population (5.3440). More detailed as in the following graph:

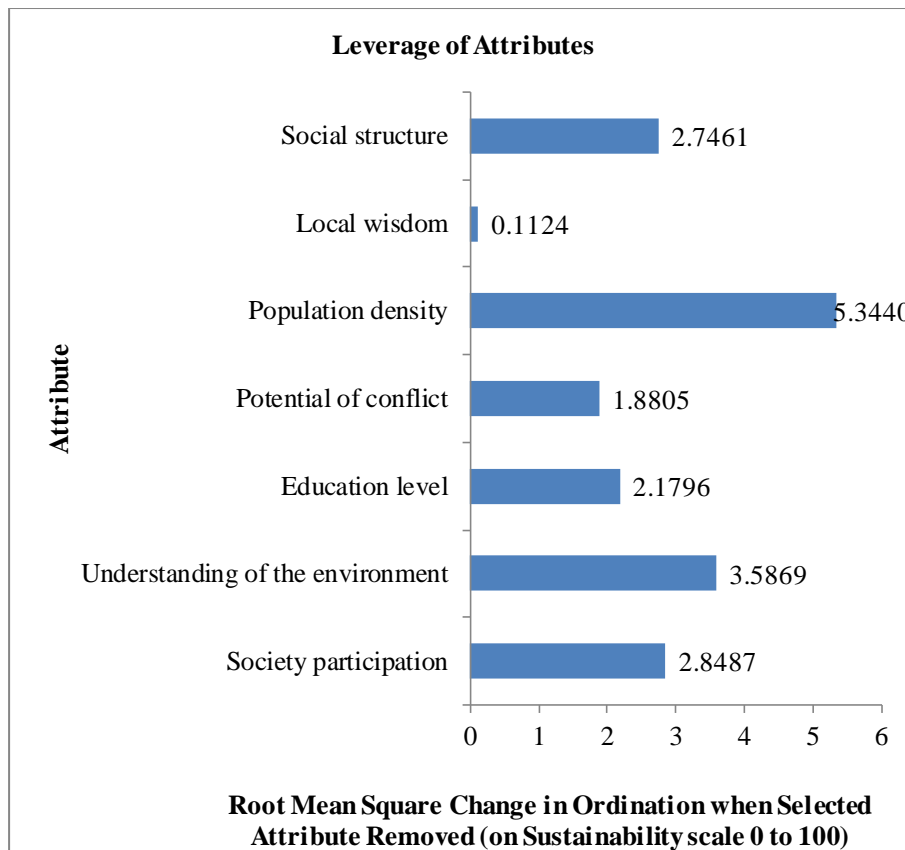


Figure 7: Leverage attribute of social sustainability

Population density is the number of people inhabiting a certain region or region with units per square kilometer. Characteristics of increasingly high population densities are the continued high population growth and the increasing number of settlements in the area. A region with high population density will easily lead to horizontal conflicts. Such conflicts can occur due to high friction due to various interactions such as; Activities of forest area utilization and so on. The potential for conflict in forested areas, such as the TBLI area, is generally very high. This is because the right of ownership is only a right of utilization, so that the existing land can only be managed and utilized but can not be owned permanently. According to [21] that conflict is a clash that occurs between two parties / more, due to differences in value, status, power and scarcity of resources. Further [15], states that conflict is a relationship between two parties / more (individuals / groups) who have or who feel ownership, goals that are not in line.

D. Leverage Attribute of Institutional Sustainability

The result of leverage analysis for the institutional dimension, obtained 1 (one) attribute that has high sensitivity to the sustainability of TBLI management, that is; property rights (4.1657). More detailed as in the following graph:

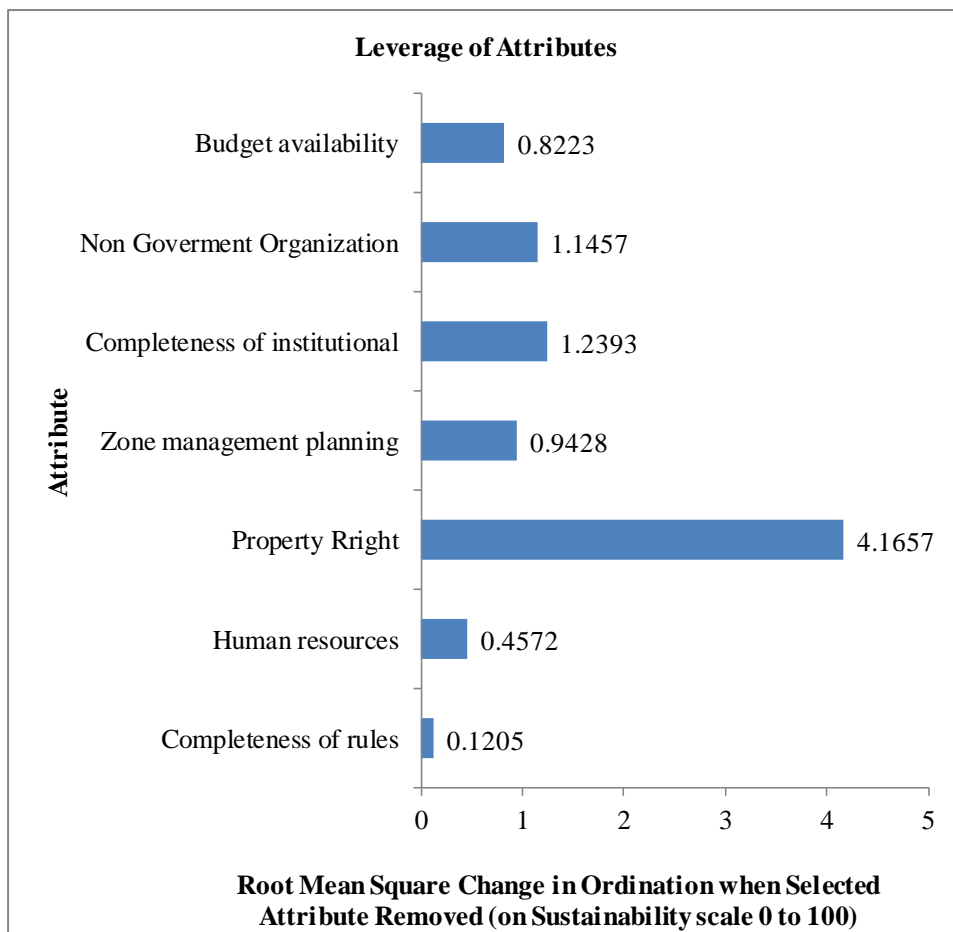


Figure 8: Leverage attribute of institutional sustainability

The right of ownership in the simple sense is the form of control over a resource, land, land or natural resources.

Generally land or natural resources around forest areas, such as; In the TBLI area is granted in the form of utilization rights. Management of a forest area, usually carried out by the FMU (Forest Management Unit) through the issuance of a Decree of the Minister of Forestry. Law No.41 / 1999 that the smallest forest management unit in accordance with its main functions and allocations, which can be managed efficiently and sustainably, among other protected forest management unit (KPHL), production forest management unit (KPHP), conservation forest management unit (KPHK) Community forest management unit (KPHKM), indigenous forest management unit (KPHA), and watershed management unit (KPDAS). Limitations in this study are the width, shape and typology of TBLI area. Distribution of many villages that make it difficult in sampling. So, the data obtained is only limited to the area that is affordable.

3.4 Trade Off TBLI Sustainability

The ordination value of sustainability of TBLI based on the four dimensions of management, then made a tradeoff chart, to see the position of each management dimension. More details as follows:

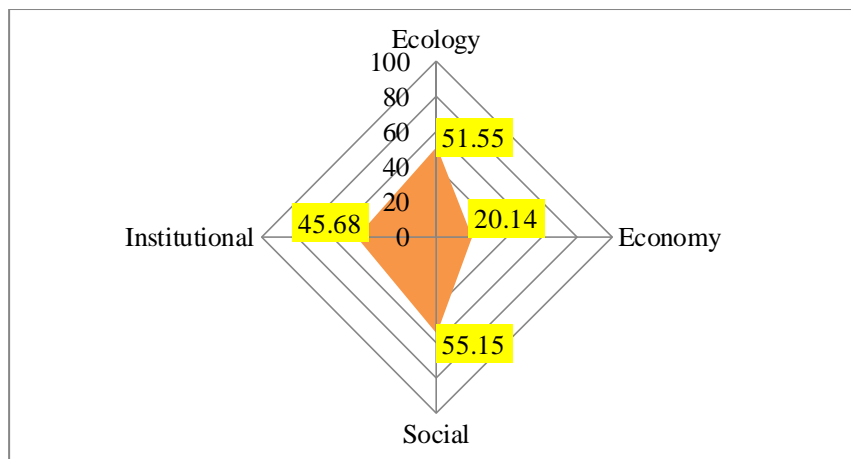


Figure 9: Trade off on TBLI sustainability

The tradeoff graph shows that the current level of sustainability of TBLI management is still relatively lame, where the economic aspect shows an unsustainable condition of 20.14%. While the social, ecological and institutional aspects are relatively good or categorized quite sustainable. Thus, the level of sustainability of TBLI management will be achieved simultaneously with increasing economic sustainability which is currently very low. Limitations in this study are the wide-scale, shape and typology of TBLI area, and distribution of many villages that make it difficult in sampling. So, the data have obtained which are only limited to the affordable areas. Further research about how to improve the economic aspects are needed, so that sustainable management of the area can be achieved holistically.

4. Conclusion

Based on the results of analysis and discussion, some conclusions can be obtained as follows:

- The ecological sustainability of TBLI, is classified as quite sustainable (sustainability value=51.55%). There are 2 (two) attributes that become the leverage of ecological sustainability namely; soils (7.9485), and topography (7.4386).
- The economic sustainability of TBLI, is classified as poor sustainable (sustainability value=20.14%). There are 2 (two) attributes that become the leverage of economy sustainability namely; access to the market (11.2219) and access to resources (8.5984).
- The social sustainability of TBLI, is classified as less sustainable (sustainability value=55.15%). There is only 1 (one) attribute of social sustainability levers, namely; population density (5.3440).
- The institutional sustainability of TBLI, is classified as less sustainable (value of sustainability = 45.68%). There is only 1 (one) attribute that has a high sensitivity to the sustainability of TBLI management, namely; land ownership/property right (4.1657).
- The Recommendations for the sustainable management of TBLI are the development of NGO's to improve the economy of the communities around TBLI by managing the sustainable TBLI resources. Providing an opportunity to develop local wisdom in the TBLI management. Building a partnership business relationship between the communities and TBLI managers.

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