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Assessment on Sustainability of Agropolitan Zone Potential Development in Bantaeng, Indonesia: Main Plantation Commodity Base

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Abstract

Sustainable development oriented in three dimensions, namely: economic sustainability (economic growth), social sustainability (social equity), ecological sustainability (environmental sustainable). The research objective was to determine sustainability level of agropolitan zone with plantation commodity base in Bantaeng. The study was conducted from January to December 2015. The research method uses MDS approach with Rap-Agropolitan (modification Rapfish). The results were obtained, the sustainability of ecological dimension (43.90%), the economic dimension (36.39%), the social dimension (51.98%), technology dimension (62.43%) and institutional dimension (53.92%).

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There are 16 (sixteen) leverage attributes of Agropolitan program, consist of; ecological dimension (climate, topography and availability of land zoning for the plantation), the economic dimension (marketable rights and access to capital), social dimension (growth domestic planters, local knowledge, knowledge of the environment and the pattern of public relations), technology dimension (technology of marketing product, harvesting and post-harvest technology, technology of cultivate and maintenance, pests and plant diseases), institutional dimension (synergy between policies and institutional, synchronization between local and central government as well as research program and community service).

Keywords: Sustainability; agropolitan; plantation; MDS-Rap Agropolitan; Bantaeng regency.

1. Introduction

The concept of sustainable development in recent decades, are increasingly being used by many countries in the world to implement development policies both at the national and international levels. Currently sustainability has been a core element for many government policies in the countries of the world and other strategic institutions [1]. The first concept of sustainable development was formulated in the Brundtland Report which is a congress of the World Commission on Environment and Development of the United Nations: "Sustainable development is development that embodies the needs of the present without compromising the ability of future generations to realize their needs" [2]. In addition to future-oriented, ethically this definition are also guaranteeing the fulfillment of life between generations. According to [3], sustainable development has implications for the dynamic balance between function maintenance (sustainability) and transformation in order to meet the necessities of life. The concept of sustainable development oriented to the three dimensions of sustainability, namely: economic sustainability (profit), social sustainability (equity), the ecological sustainability (sustain). Three dimensions affect each other so that all three must be considered impartial. System stable and healthy social and natural resources and the environment is the basis for economic activity, while the economic well-being is a prerequisite for maintaining social stability, cultural and conservation of natural resources and the environment. Unstable social system will tend to cause destructive actions undermine the sustainability of natural resources and environmental health, while the threat of environmental and natural resource conservation (eg. scarcity of land and water) can lead to chaos and social ills [4]. Sustainability agropolitan program based main commodities in Bantaeng becomes very important, considering that the program is one of the programs featured for improving the welfare of people, especially the rural and regional development in general. Sustainability can be interpreted as an attempt to sustain a program in all dimensions of development, such as; ecological, economic, and social. [3] argues that sustainability be seen in three-dimensional triangle as a framework for the sustainability of economic, social and ecological. [6] adds the institutional dimension as the fourth dimension of sustainability, so that they form a four-dimensional prism of sustainability. In addition to these four dimensions, the technological dimension is also important dimension in the sustainability of a program or natural resource management.

2. Method

2.1. Data Collection Method

Methods of data collection conducted by survey and desk study. The survey method is a method of data collection is done to get the facts from existing condition and factual particulars of a group or a region [6]. Methods survey conducted for primary data collection by conducting interviews and observations (visual observation) on the level of sustainability agropolitan program. Methods of desk study is data collection techniques to conduct a study review of the books, references, and reports that had to do with the problem being solved [7]. Methods of desk study carried out for the collection of secondary data such as documents related to the level of sustainability agropolitan program. Methods of data collection, detailed as follows:

Table 1: Data collecting method

Aspects	Variable	Type of data	Data collection method
Sustainable level of Agropolitan program	Dimension and attribute	Primary data	Survey and Desk study
		Secondary data	
Leverage attribute of sustainability program	Leverage attribute of demension	Primary data	Survey and Desk study
		Secondary data	
Trade off on sustainability program	Ordination of sustainable	Primary data	Results of analysis

2.2. Data Analysis Method

Data analysis methods adapted to the purpose of research. Such methods include; MDS analysis with Rap-Agropolitan (modification Rapfish). Methods of data analysis, detailed as follows:

Table 2: Data analysis method

Aspects	Variable	Analysis method	Output
Sustainable level of Agropolitan program	Dimension and attribute	Rap Analysis	Ordination of sustainability
		Leverage	
Leverage attribute of sustainability program	Leverage attribute of demension	Analysis	Leverage attribute of sustaibility program
		Kite diagram	
Trade off on sustainability program	Ordination of sustainable	Kite diagram	Trade off on sustainability program

MDS-Rapfish Analysis

MDS method with Rapfish Analysis. Rapfish (Rapid Appraisal for Fisheries) developed by [8]. This approach is based on the principle of Multi Criteria Analysis (MCA) by relying on an algorithm known as MDS algorithm [9]. Multidimensional Scaling (MDS) is a statistical analysis techniques that transform multidimensional [9, 10, 11]. MDS or Rapfish analysis is intended to obtain a level of sustainability of each dimension agropolitan program. MDS method is done with Rap-Agropolitan (modification Rapfish). Rap-Agropolitan is Rapid Appraisal for Agropolitan with a modified technique ordination of the Rapfish analysis. Rap-Agropolitan operational stages refers to [12], as follows:

- Define objectives, namely sustainable of Agropolitan program.
- Determine dimensions of the study, consist of; ecological, economic, social, technology and institutional dimensions.
- Determine the attributes of each dimension of the study, include; ecological dimension (8 attributes), economic dimension (10 attributes), social dimension (8 attributes), technological dimension (6 attributes) and institutional dimension (8 attributes).
- Provide scoring (bad-good) on each attribute.
- Enter the value/score of the assessment results of each attribute into Rap-Agropolitan software.
- Doing run Rap-Agropolitan.
- Raising Rap Analysis (ordination sustainability). Rap Analysis is intended to determine the percentage of each dimension of sustainability.
- Doing run Leveraging Analysis to obtain leverage of attribute, which is the determination of the dominant influence attribute or attributes of each dimension lever. Attribute is an attribute whose existence lever effect is sensitive to increasing or decreasing the level of sustainability, the greater the RMS value, the greater the role of these attributes to the sensitivity of the sustainability [10].
- Doing run Monte Carlo Analysis with a confidence interval of 95%. Monte Carlo analysis is intended to look at the effect of the error, in order to increase confidence in the results of the analysis. Differences in results of Monte Carlo analysis were small with results of Rap Analysis, show that the impact of a scoring error is relatively small. If the value of the difference between the two analyzes are (Monte Carlo Analysis Rap with Rap Analysis > 5%), the results of the analysis to be inadequate as the estimate value of sustainability index, and if the value of the difference between the two analyzes are (Monte Carlo Analysis with Rap Analysis < 5%), the results of the analysis are considered adequate to estimate the sustainability index.
- Raising 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 which is the size of a match/accuracy (goodness of fit measure). The R-Squared shows that the amount of data that can be explained variance in the model. Correlation Squared value is used to determine the proximity between perceptual map data whether the data is mapped well or not. The R-Squared is getting closer to 1 means the data that is increasingly mapped perfectly or premises other words, the higher the value of R^2 , the better the model in explaining the variance data. [13] states that the value of Squared Correlation of more than 80% indicates that the prediction model sustainability index and adequate use.
- Raising the value of stress to indicate the size mismatch (a lack of fit measure). Stress value is the inverse of the value of R-Squared (R^2). Stress value is used to see if the results of output approaching the real situation or not. The closer to zero, then the output produced more similar to the actual situation. The lower the value of the stress, the better/fit of the model. Conversely, the higher the stress, the more does not fit the model. Values stress that can be tolerated is less than 20%.
- Raising the value of Root Mean Square (RMS) of each dimension. The larger the RMS value, the greater the role of these attributes to the sensitivity level of sustainability [10].

- Make a kite-diagram of the dimensions of sustainability Agropolitan program. Kite-diagram useful as a trade-off of sustainability.
- Indexing and the level of potential development program sustainability of agricultural commodity-based agropolitan featured in Bantaeng of each dimension, and attribute follows the concept developed by [8]. Assessment scores each dimension is expressed by the scale of the worst (bad) 0% up to the best (good) 100%. Category sustainability index as follows:

Table 3: 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: [8]

Value index >50% can be stated that the dimensions of the examination have been sustained, whereas <50% of these dimensions have not been or are not sustainable. Results of determining the sustainability of each dimension, and then made a kite diagram of trade-off sustainability of Agropolitan program.

3. Results

3.1. Ecology Sustainable

Ecological dimension is an overview of the functions and support the environment against on development program of potential areas based main commodities of plantation in Bantaeng. Ecological aspect is very important related to sustainability of the ecological. Some attributes/indicators of ecological sustainability on agropolitan program, consist of; the availability of land for plantation development, land use zoning availability plantation, plantation land cover change, climate, soil conditions for Cocoa, topography of the area for plantations, Cocoa land suitability and availability of cocoa seedlings. Graph ordinated ecological dimension, as follows: The analysis results of Rap-Agropolitan for ecological dimension (ecological sustainability) ordinate value obtained 43.90% or classified as less sustainable. Rap-Agropolitan analysis results are acceptable given the results of the validation test values obtained Monte Carlo is 44.31%, that shows the difference a very small is 0.41% or less than 1.0%. These values indicate that the effect of error is relatively small. Thus, the model Rap-Agropolitan for ecological dimension is adequate as the estimate value of sustainability index. According to [10], that Monte Carlo analysis can be used as a method to evaluate the impact of random error in statistical analysis conducted on all dimensions. The same thing also expressed [9] that the Monte Carlo analysis can be an indicator of 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. Value ordinated describe that the sustainability of Agropolitan program relatively less sustainable in terms of ecological aspects. Based on Rap-Agropolitan analysis obtained that leverage attribute of ecological

sustainability is climate, topography and availability of land zoning for the plantation.

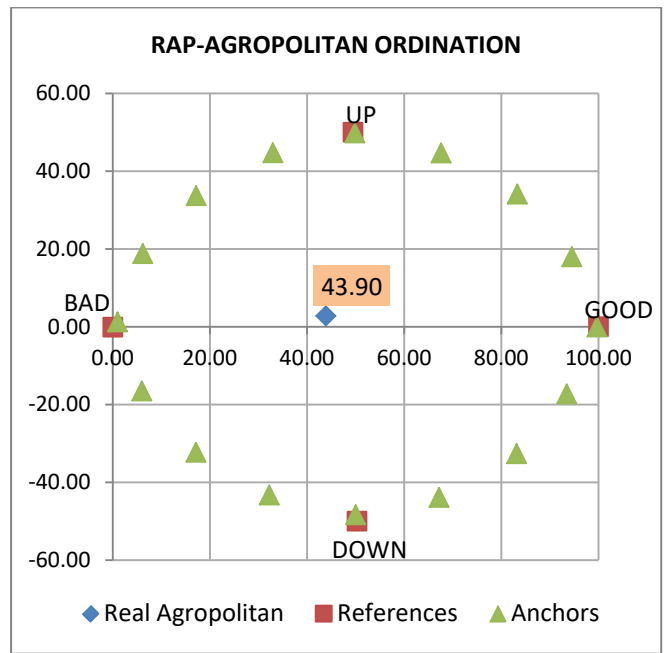


Figure 1: ecology sustainability ordination

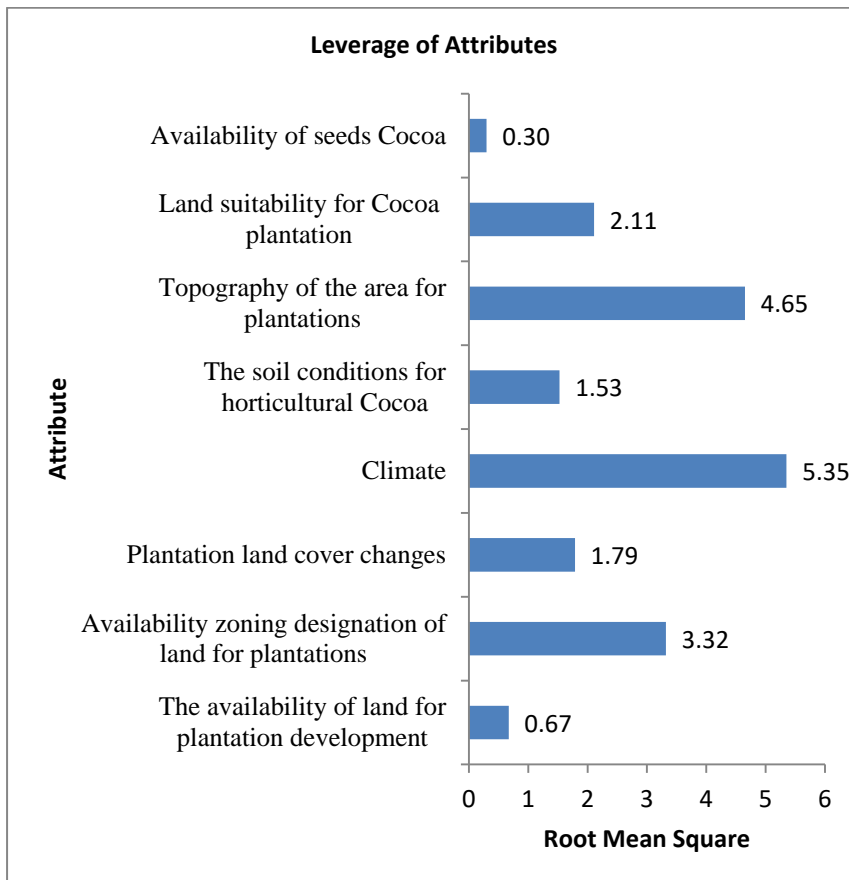


Figure 2: leverage attribute of ecological sustainability

The results of leverage analysis obtained three (3) attributes i.e; climate (RMS=5.35), topography (RMS=4.65) and the availability of land zoning for plantation (RMS=3.32). [10] states that the RMS value indicates the magnitude of the role of each attribute to the sensitivity of the sustainability status.

3.2. Economy Sustainable

The economic dimension is describe economic conditions and communities in the region. The economy aspect is very important related to sustainability of economics. Some attributes/indicators of economy sustainability on Agropolitan program, consist of; income, income of alternative non-farm, asset ownership, access to capital, marketable right, marketing of products, access to resources, the value of SLQ and DLQ, the contribution to revenue and growth of the plantation subsector. Graph ordinated economic dimension, as follows:

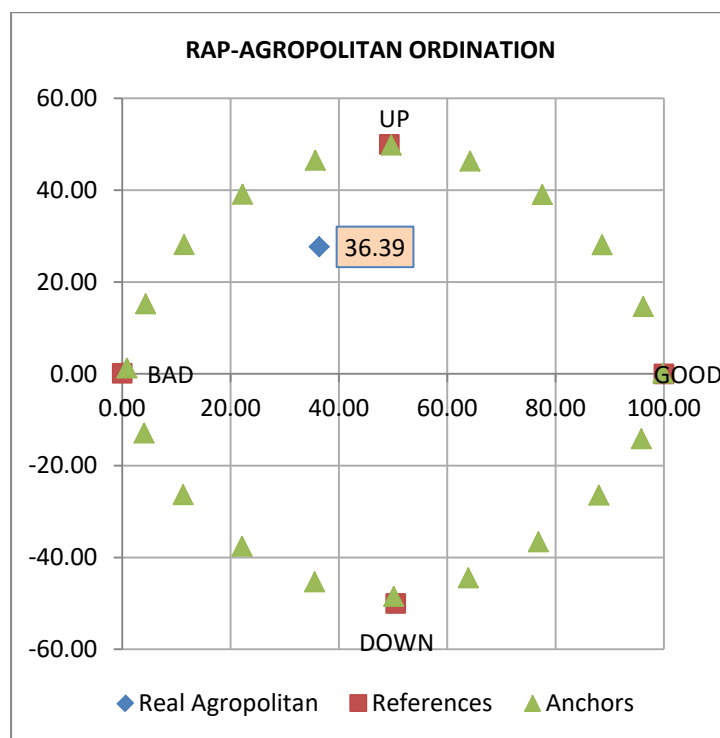


Figure 3: economy sustainability ordination

The analysis results of Rap-Agropolitan for economy dimension (economics sustainability) ordinate value obtained 36.39% or classified as less sustainable. Rap-Agropolitan analysis results are acceptable given the results of the validation test values obtained Monte Carlo is 38.30%, that shows the difference a very small is 1.91% or less than 2.0%.

These values indicate that the effect of error is relatively small. Thus, the model Rap-Agropolitan for ecological dimension is adequate as the estimate value of sustainability index. According to [10], that Monte Carlo analysis can be used as a method to evaluate the impact of random error in statistical analysis conducted on all dimensions.

The same thing also expressed [9] that the Monte Carlo analysis can be an indicator of 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.

Value ordinated describe that the sustainability of Agropolitan program relatively less sustainable in terms of economy aspects. Based on Rap-Agropolitan analysis obtained that leverage attribute of economy sustainability is marketable right and access to capital.

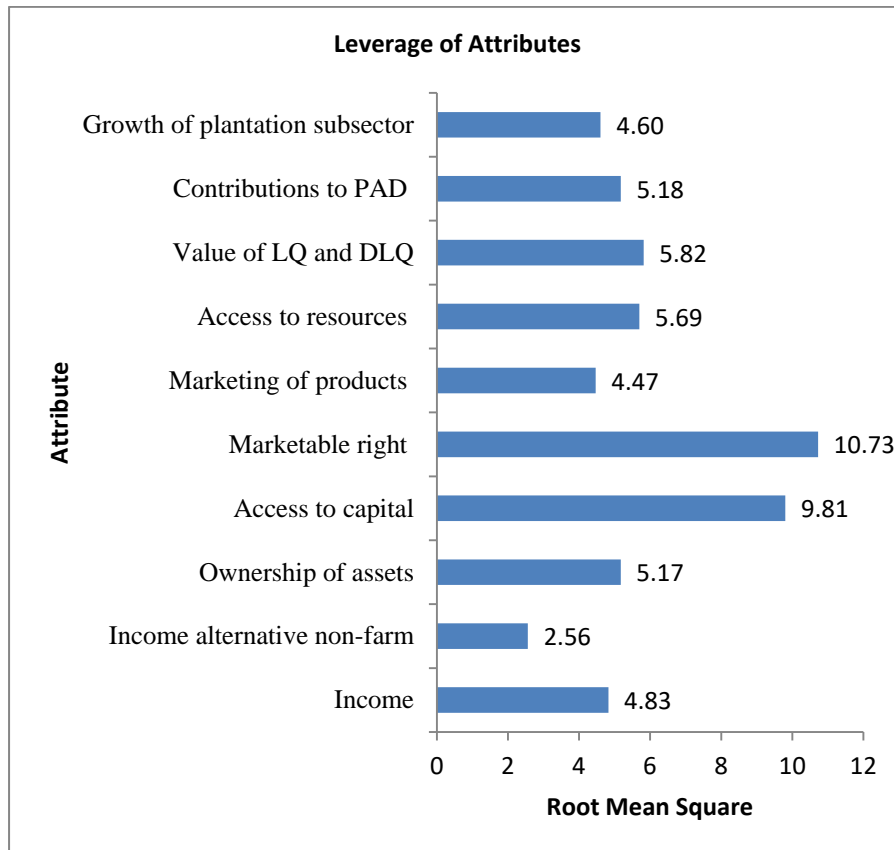


Figure 4: leverage attribute of economy sustainability

The results of leverage analysis obtained two (2) attributes, i.e; marketable right (RMS=10.73) and access to capital (RMS=9.81). [10] states that the RMS value indicates the magnitude of the role of each attribute to the sensitivity of the sustainability status.

3.3. Social Sustainable

The social dimension is describe social conditions on the potential development program based main commodities in Bantaeng.

The social aspect is characterized in the eight (8) attributes, consist of; the level of community participation, environmental knowledge, education levels, potential conflicts, the growth of household planters (RTP), local knowledge /local wisdom, the pattern of public relations, and patterns of cooperation in plantation activities.

Graph ordinated social dimension, as follows:

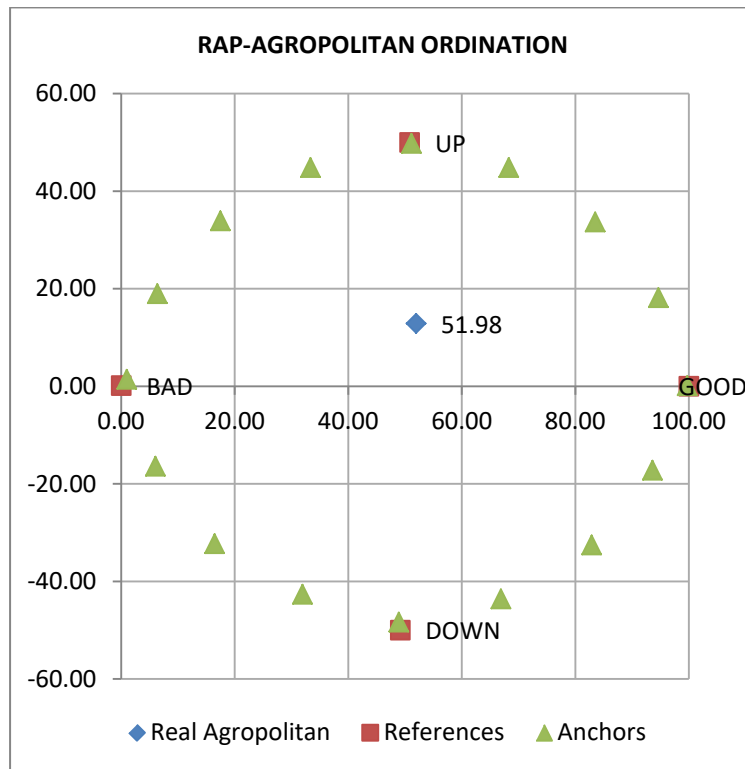


Figure 5: social sustainability ordination

The analysis results of Rap-Agropolitan for social dimension (social sustainability) ordinate value obtained 51.98% or classified as quite sustainable. Rap-Agropolitan analysis results are acceptable given the results of the validation test values obtained Monte Carlo is 52.07%, that shows the difference a very small is 0.09% or less than 0.1%. These values indicate that the effect of error is relatively small. Thus, the model Rap-Agropolitan for ecological dimension is adequate as the estimate value of sustainability index. According to [10], that Monte Carlo analysis can be used as a method to evaluate the impact of random error in statistical analysis conducted on all dimensions. The same thing also expressed [9] that the Monte Carlo analysis can be an indicator of 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. Value ordinated describe that the sustainability of Agropolitan program relatively quite sustainable in terms of social aspects. Based on Rap-Agropolitan analysis obtained that leverage attribute of social sustainability is growth of domestic planters, local wisdom, environmental knowledge, and the pattern of public relations. More details as follows:

The results of leverage analysis obtained four (4) attributes, i.e; growth of households planters (RMS=7.02), local knowledge (RMS=5.06), environmental knowledge (RMS=5.01) and the pattern of public relations (RMS=4.74). [10] states that the RMS value indicates the magnitude of the role of each attribute to the sensitivity of the sustainability status.

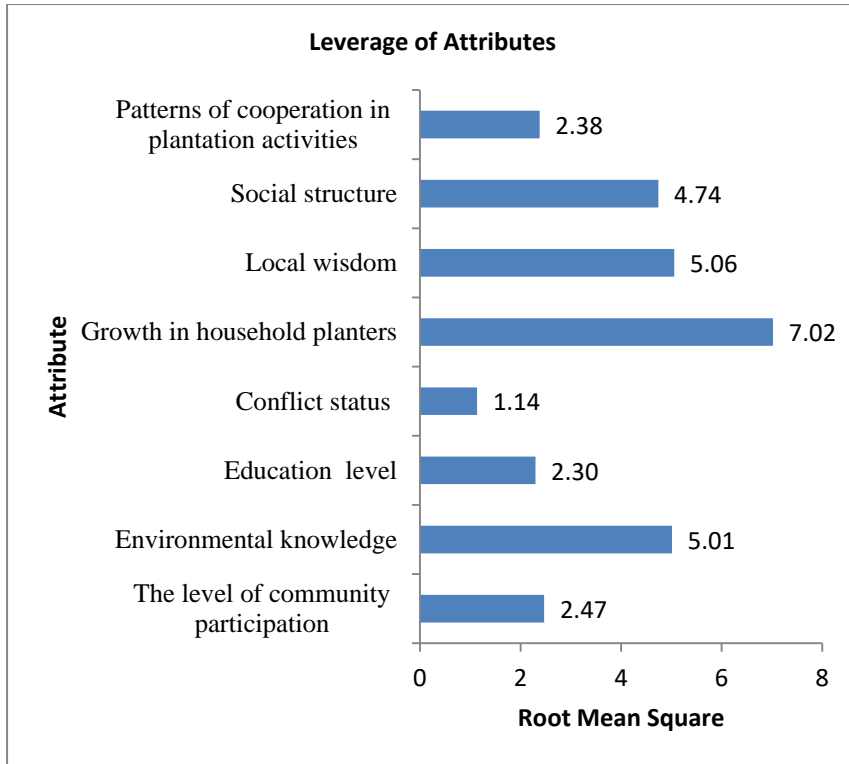


Figure 6: leverage attribute of social sustainability

3.4. Technology Sustainable

The technology dimensions is describe technological aspects of the sustainability program based main commodities in Bantaeng. Plantation activities both on a large scale and small scale (household), strongly influenced by the use of appropriate technology. It is intended to improve the efficiency of the workforce and increasing the effectiveness of business. Graph ordinated technological dimension, as follows:

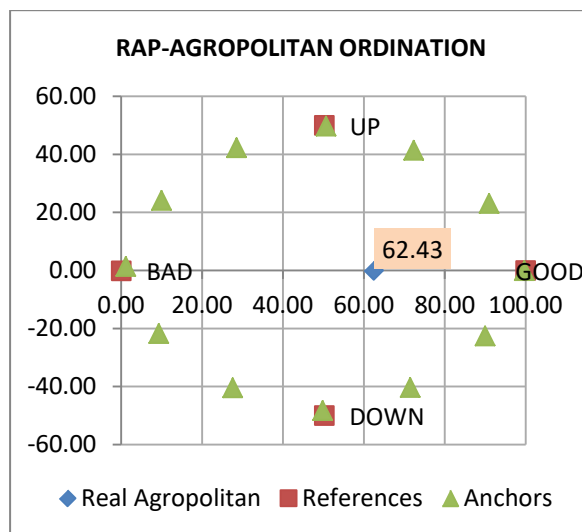


Figure 7: technology sustainability ordination

The analysis results of Rap-Agropolitan for technology dimension (technology sustainability) ordinate value obtained 62.43% or classified as quite sustainable. Rap-Agropolitan analysis results are acceptable given the results of the validation test values obtained Monte Carlo is 61.92%, that shows the difference a very small is 0.51% or less than 1.0%. These values indicate that the effect of error is relatively small. Thus, the model Rap-Agropolitan for ecological dimension is adequate as the estimate value of sustainability index. According to [10], that Monte Carlo analysis can be used as a method to evaluate the impact of random error in statistical analysis conducted on all dimensions. The same thing also expressed [9] that the Monte Carlo analysis can be an indicator of 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. Value ordinated describe that the sustainability of Agropolitan program relatively quite sustainable in terms of technology aspects. Based on Rap-Agropolitan analysis obtained that leverage attribute of technology sustainability is a technology marketing, harvesting and post harvest technology, technology of planting and maintenance and pest and disease management. More details as follows:

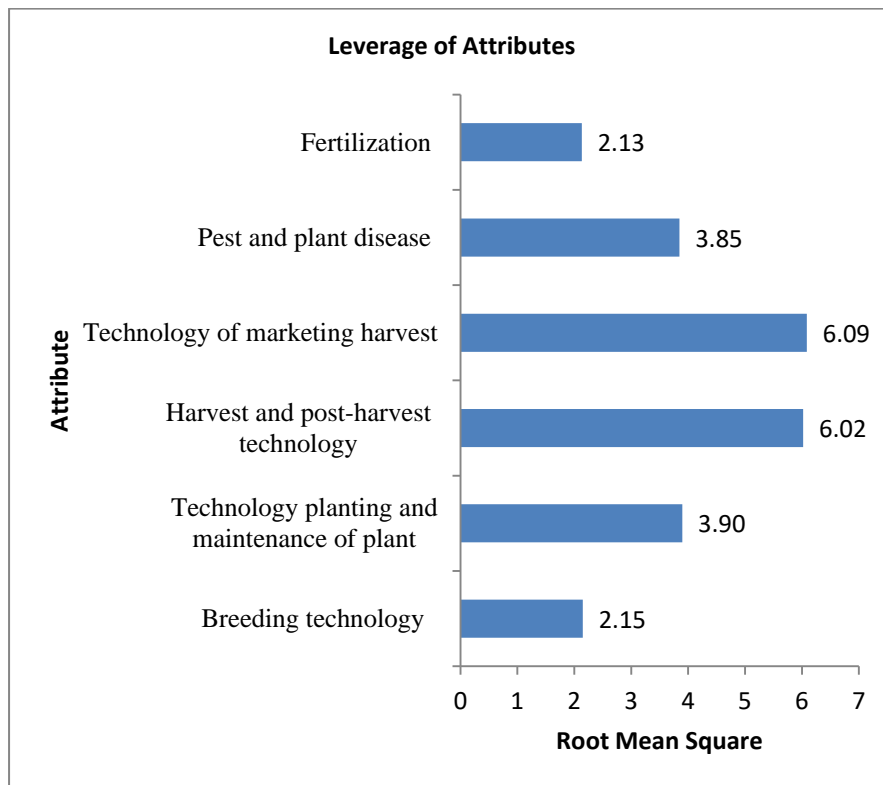


Figure 8: leverage attribute of technology sustainability

The results of leverage analysis obtained four (4) attributes, i.e; marketing technology (RMS=6.09), harvesting and post-harvest technology (RMS=6.02), planting and maintenance of plant technology (RMS=3.90), and treatment of pests and plant diseases (RMS=3.85). [10] states that the RMS value indicates the magnitude of the role of each attribute to the sensitivity of the sustainability status.

3.3. Institutional Sustainable

The institutional dimension illustrates how the role/influence of institutional sustainability of potential development of agricultural commodity-based agropolitan featured in Bantaeng. Attributes include institutional sustainability; the existence of the planters, the existence of extension agencies, policy synchronization between local and central government, the level of synergy with policies and institutions, microfinance institutions, the existence of public institutions, the existence of the research program and community service as well as the existence of the farm. Graph ordinated institutional dimension, as follows:

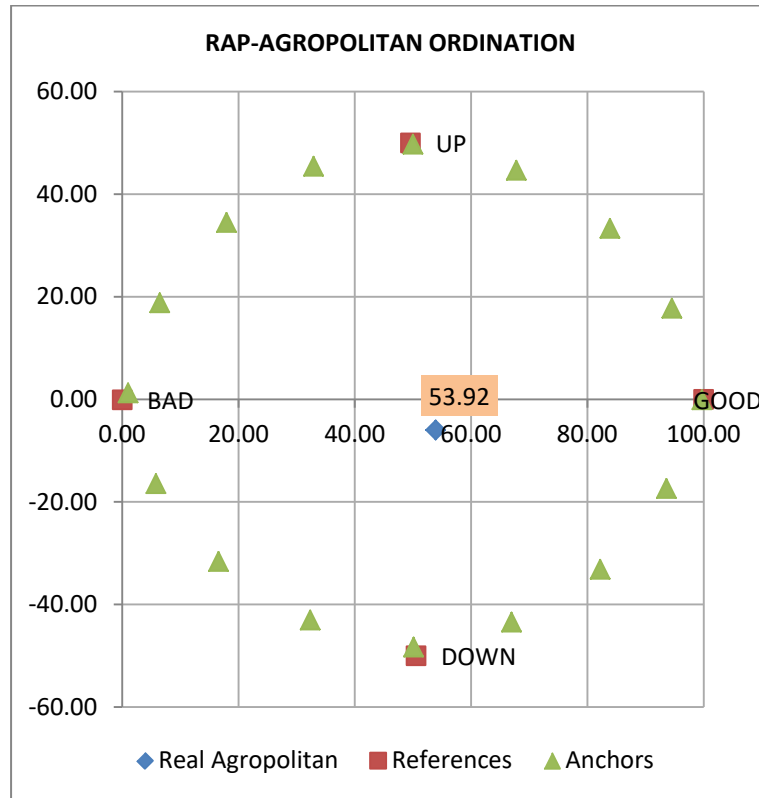


Figure 9: institutional sustainability ordination

The analysis results of Rap-Agropolitan for institutional dimension (institutional sustainability) ordinate value obtained 53.92% or classified as quite sustainable. Rap-Agropolitan analysis results are acceptable given the results of the validation test values obtained Monte Carlo is 54.02%, that shows the difference a very small is 0.10% or less than 1.0%. These values indicate that the effect of error is relatively small. Thus, the model Rap-Agropolitan for ecological dimension is adequate as the estimate value of sustainability index. According to [10], that Monte Carlo analysis can be used as a method to evaluate the impact of random error in statistical analysis conducted on all dimensions. The same thing also expressed [9] that the Monte Carlo analysis can be an indicator of 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. Value ordinated describe that the sustainability of Agropolitan program relatively quite sustainable in terms of institutional aspects. Based on Rap-Agropolitan analysis obtained that leverage attribute of institutional sustainability is synergy with policies and institutional, synchronization between local and central government and research program and community service. More details as follows:

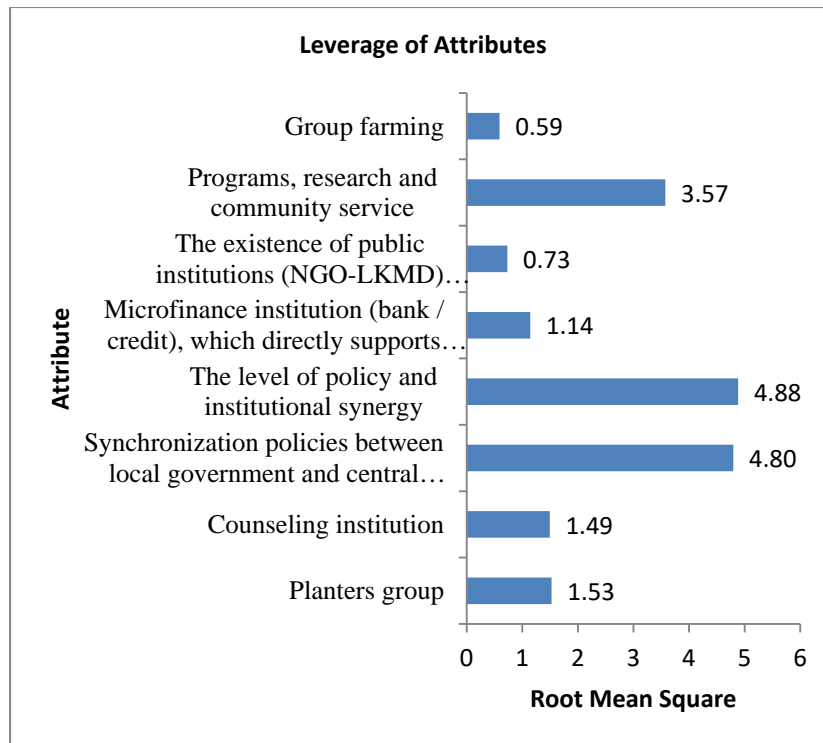


Figure 10: leverage attribute of institutional sustainability

The results of leverage analysis obtained three (3) attributes, i.e; synergy with policies and institutional level (RMS=4.88), policy synchronization between local and central government (RMS=4.80) and keberadaan research programs and community service (RMS=3.57). [10] states that the RMS value indicates the magnitude of the role of each attribute to the sensitivity of the sustainability status.

4. Conclusion

Based on the results of analysis and discussion obtained conclusions that sustainability level of Agropolitan program is generally categorized quite sustainable with ordinate values of the ecological dimension (43.90%), the economic dimension (36.39%), the sociol dimension (51.98%), the tecnology dimension (62.43%) and the institutional dimension (53.92%), and also there are 16 (sixteen) attributes used as leverage attribute of Agropolitan program sustainability, consist of; ecological dimension (climate, topography and availability of land zoning for the plantation), the economic dimension (marketable rights and access to capital), social dimension (growth domestic planters, local knowledge, knowledge of the environment and the pattern of public relations), technology dimension (technology of marketing product, harvesting and post-harvest technology, technology of cultivate and maintenance, pests and plant diseases), institutional dimension (synergy between policies and institutional, synchronization between local and central government as well as research program and community service).

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