

Aloe Vera Agribusiness Development Sustainability Analysis in Bogor Regency

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How to Cite: Jompa S, Syarief R, Sutjahjo SH, Yulianto A. (2021). Aloe Vera Agribusiness Development Sustainability Analysis in Bogor Regency, *Int. J. Agr. Syst.* 9(2): 80-90

ABSTRACT

As a suburban area, Bogor Regency faces complex problems in the development of the aloe vera agribusiness. Land use conflicts, unemployment problems due to the Covid-19 pandemic, financial support and market access, post-harvest handling, and institutional support put the sustainability status of this commodity agribusiness into question. This research was conducted to assess the sustainability of aloe vera agribusiness development in Bogor Regency. Analysis of the sustainability status uses the MDS (multidimensional scaling) method, using four dimensions, namely: social, economic, institutional, and environmental. MDS analysis utilizes the Rapid Appraisal for Fisheries (RAPFISH) software. The research was conducted in five sub-districts in Bogor Regency, namely Kemang, Tajur Halang, Rancabungur, Ciampea, and Mount Sindur Districts. The results showed that, in general, aloe vera agribusiness in Bogor Regency has a sustainable status of: "moderately sustainable" (Mount Sindur and Kecamatan Kemang), "close to moderately sustainable" (Rancabungur and Ciampea), and "less sustainable" (Tajur Halang). To support the sustainability status of the aloe vera agribusiness in Bogor Regency, group land management should be undertaken, assisted by counseling from government institutions, availability of agro-industrial processing, and clarification of land status.

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Keywords:

Aloe Vera; Sustainability Status; Multidimensional Scaling; Bogor District

1. Introduction

Aloe vera is a commodity that has high economic value. Aloe vera can be used for various types of food/drinks, cosmetics and medicinal ingredients. Nutritious processed foods made from aloe vera include juice, cocktails, lunkhead, jam, jelly, nata de aloe, rainbow cake, crackers, and aloe vera skin tea. The nutritional content of aloe vera is mainly based on the minerals Zinc (Zn), Potassium (K), and Iron (Fe); Vitamins A, B1, B2, B12, C, and E; and inositol, folic acid, and choline (Arifin, 2015). Aloe vera also contains amino acids, essential fatty acids, enzymes, phytosterols, fats, antioxidants, lectins, omega-6 fatty acids, arachidonic acid, and other advantageous ingredients (AMBWellnes, 2020). Aloe vera is beneficial for health in many ways, including the fact

that it contains acemannan, alprogen, C-glycosyl chromone, bradykinase, magnesium lactate and salicylic acid (Pandey and Singh, 2016), which are beneficial for the body's immune system, have anti-allergy and anti-impression qualities, and speed up the healing process.

Indonesia's aloe vera production in 2020 reached 21.7 thousand tons, lower than ginger (179.0 thousand tons), turmeric (193.9 thousand tons), or even temulawak, which reached 26.7 thousand tons (BPS, 2020), whereas internationally, aloe vera is one of the ten best-selling plants in world trade (Destina, 2013). The development of aloe vera has great prospects. This plant can grow in areas with minimal irrigation systems, while compared to other phytopharmaceutical commodities, aloe vera has a very high land productivity, reaching 33-75 tons/ha, which is higher than ginger (about 21 tons/ha), turmeric (28 tons/ha) or galingale (31 tons /ha) (Directorate General of Horticulture, Ministry of Agriculture, 2020). However, the development of agribusiness for agricultural commodities in an area, especially in regions including suburban areas (a transition between rural and urban), such as in Bogor Regency, faces relatively complex challenges. These are not only related to social and economic conditions, but also to environmental and institutional conditions.

Social issues include land use conflict, in addition to other factors such as land management patterns, community habits, and participation in land management activities. For suburban areas, land is a commodity that has a high selling value. There are many interests for land tenure and use, because of its high economic value. Most of the land has been controlled by certain groups. On the other hand, farmers who own agricultural land generally have a low legality status relating to this land, so they are prone to having ownership shifted to capital owners.

With the outbreak of the Covid-19 pandemic, there were layoffs and a reduction in working hours for employees, which caused employee income to drop sharply and led to increased unemployment (PWC, 2020). For the affected suburban areas, the use of the land around them is a promising alternative. However, some of the land, which is owned by the company/capital owner, is not utilized because the owners have difficulty in sourcing funding. Cultivating land without a permit, meanwhile, can lead to future land conflicts.

From an economic perspective, aloe vera cultivators are generally lower-middle class people, so they have limited access and market reach, financial support, bargaining power, and business feasibility, as well as facing various other problems. This situation makes it very difficult for cultivators/farmers to act independently, requiring support from other institutions. Institutional support is also not necessarily able to help, because government institutions and finance that should be able to provide support are not necessarily in optimal condition themselves. On the other hand, environmental factors such as land fertility, post-harvest handling, and by-products – if not handled seriously – can make an aloe vera agribusiness sub-optimal. With these various problems, it is necessary to analyze the sustainability of the aloe vera agribusiness, so that the development of the aloe vera agribusiness in Bogor Regency can be achieved sustainably and run optimally.

2. Materials and Methods

To determine the sustainability of the aloe vera agribusiness in Bogor Regency, research was conducted in several aloe vera producing areas in Bogor Regency, including:

Kemang District, Tajur Halang District, Ciampea District, Rancabungur District, and Gunung Sindur District. The data obtained from the five sub-districts are data regarding the responses of aloe vera farmers related to the social, economic, institutional, and environmental dimensions that affect the aloe vera agribusiness.

Research on the sustainability status of the aloe vera agribusiness in Bogor Regency was carried out through the following stages: (1) determining the dimensions used, (2) determining attributes and scoring for each attribute of each dimension, (3) data searching process, and (4) data processing and data analysis. The determination of dimensions is adjusted to the objectives of the research and/or program. The dimensions that are widely used by researchers include: economic, ecological, and social (Graha, 2017; Pratama & Iswandi, 2018); environmental, economic, social, and institutional (Hidajat, Sitorus, Rustiadi, & Machfud, 2013; Kuvaini, Hidayat, Kusmana, & Basuni, 2019; Rosadi, 2018); economic, socio-cultural, ecological-environmental, infrastructure, and institutional (Chaidir & Murtini, 2014); ecological, economic, social, technological, and institutional (Bursamin, Utama, & Barchia, 2015; Nurmalina, 2008; Susanto, Rusdiyanto, & Sumartono, 2012); ecological, economic, technological, social, and ethical (Suryana, Wiryawan, Monintja, & Wiyono, 2012); ecological, economic, social, infrastructure and technological; legal and institutional (Bakeri, Yanuar, Riani, & Sutjahjo, 2016); individual characteristics, family characteristics, business profile, partnership, and access and control (Hikmah, Yulisti, & Nasution, 2017); and inputs, processes, and outputs (Mahida & Handayani, 2019). From these various studies, the social, economic, environmental, and institutional dimensions are the most widely used. Therefore, this study uses these four dimensions.

From each dimension, attributes are then arranged according to the needs of aloe vera agribusiness development in Bogor Regency. Attributes are compiled by considering several aspects to support the sustainability of this aloe vera agri-industry activity. The attributes for the social, economic, environmental, and institutional dimensions are shown in Table 1.

Table 1. Dimensions and attributes used in the analysis of the sustainability of the aloe vera agribusiness development in Bogor Regency

Dimensions	Attributes
Social	Participation of family members in managing land, Formal education, Land management patterns, Frequency of conflicts in the agricultural sector, Frequency of counseling and training, Habits of mutual cooperation
Economy	Financial support, Transaction mechanisms, Farmer's bargaining power, Marketing access, Market reach, Aloe vera productivity, Farming feasibility, Aloe vera processed products
Environment	Land fertility, Post-harvest land conditions, Handling of crop residues, Land conversion, Utilization of by-products
Institutions	Financial institutions, Farmers' groups, Extension centers, Inter-sectoral policies, Compliance with government assistance

Each attribute is scored from “bad” to “good”. The determination of the score is based on the scientific judgment of the researcher. The determination of the score for each attribute is carried out using various techniques, namely: for attributes whose data is available in numerical form, documentation data is used, while for attributes whose data were in the form of perceptions or views, interviews with respondents and field visits were carried out to determine the exact condition of these attributes.

Each attribute for each dimension was then searched for both primary and secondary data. Secondary data were obtained from the Central Statistics Agency (BPS) of Bogor Regency, institutional reports, and literature, while primary data were obtained directly from aloe vera agribusiness actors in Bogor Regency, through field visits and interviews. The data were then analyzed using the Multi-dimensional Scaling (MDS) method and the Rapid Appraisal for Fisheries (RAPFISH) software.

The results of the MDS analysis are expressed in three outputs, namely: ordination, leveraging, and kite diagrams (Rosadi, 2018). Ordination is a mapping in the size of bad and good, with an index range from 0 (bad) to 100 (good). The closer to the good position, the more sustainable the area is said to be. For convenience, the index is divided into four categories, namely: between 0 and 25, it is categorized as “unsustainable”; between 25 and 50, it is categorized as “less sustainable”; between 50 and 75, it is categorized as “fairly sustainable”; and between 75 and 100, it is categorized as “sustainable”.

Leveraging provides an overview of the sensitive attributes for changing the sustainability score. This leverage is measured by standard error through the root mean square. Visually, the larger (prominent) leverage image shows the attributes that are sensitive to changing the sustainability score. Meanwhile, the kite diagram depicts the sustainability status in an integrated manner between various dimensions. Kite diagrams or radar diagrams measure the closeness of the analysis distance to zero. The farther from zero, the higher the sustainability.

3. Results and Discussion

The sustainability of the aloe vera agribusiness development in Bogor Regency was analyzed using four dimensions: social, economic, environmental, and institutional. Data were collected from primary and secondary data. Data were analyzed by MDS method and RAPFISH software. The results of the analysis were as follows.

3.1 Sustainability Analysis for the Social Dimension

From the analysis of the social dimension (output ordination), it appears that the sustainability index of aloe vera agribusiness development in Bogor Regency ranges from 40 - 70, or is between “less sustainable” and “fairly sustainable” (Figure 1a). For sustainability in each sub-district, it appears that the sustainability index for the social dimension in Gunung Sindur District is the highest, with a value of 70.02 (quite sustainable), while two other sub-districts fall into the same category: Kemang District (60.86) and District Rancabungur (55,50). Meanwhile, two other sub-districts are categorized as “less sustainable”, namely: Tajur Halang District (43.22) and Ciampea District (42.56).

Based on output leverage, of the six attributes on the social dimension, there are three relatively dominant attributes, namely (a) Land Management Form; (b) Conflicts in Land Management and (c) Extension and Training Activities (Figure 1b). The form of land management that is mostly carried out by aloe vera agribusiness actors is self-

management, with some actors involve farmer groups. This means that farmers work on the land individually or in a group, but do not involve an external company. Land management in the five sub-districts in Bogor Regency is relatively unrestrained, because there is almost no conflict between farmers, either with other farmers, farmer groups, migrants, or others. Meanwhile, for Extension and Training Activities, there is almost no involvement from the Department of Food Crops, Horticulture and Plantation of Bogor Regency - or from agricultural supervisors from the central government - to provide guidance to aloe vera farmers.

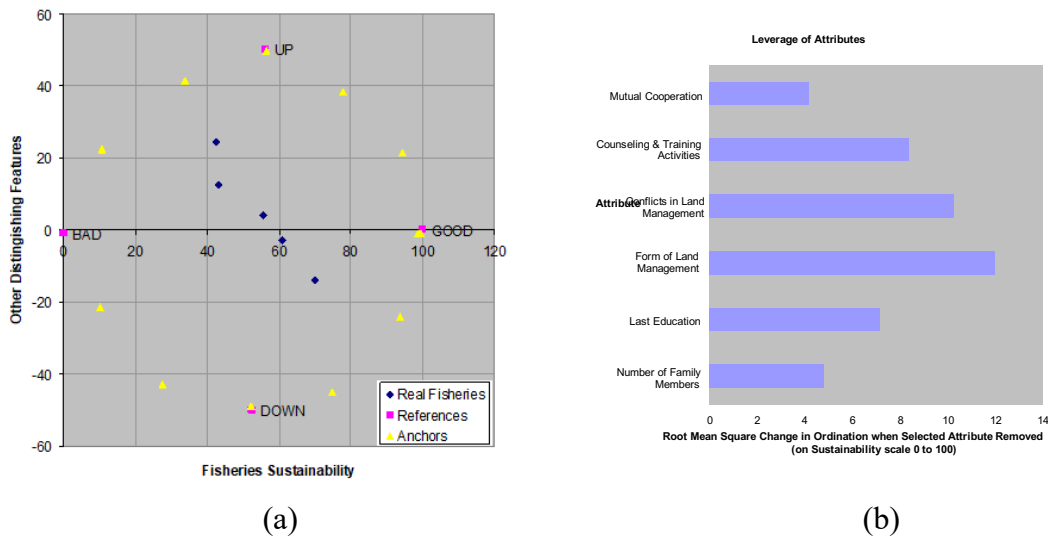


Figure 1. Sustainability index (a) and sensitive and dominant attributes (b) in the development of the aloe vera agribusiness in Bogor Regency for the social dimension

3.2 Sustainability Analysis for the Economic Dimension

The results of the analysis of the economic dimension indicate that the sustainability index of the aloe vera agribusiness development in Bogor Regency ranges from 41 to 47, except for Ciampea District with 61 (Figure 2a). This index shows that the sustainability of the aloe vera agribusiness development in Bogor Regency is generally considered "less sustainable". The exception to this is Ciampea, which is categorized as "fairly sustainable". The sustainability index in each sub-district indicates that in the economic dimension, it will be a challenge to implement the sustainable development of aloe vera in Bogor Regency.

Based on the output leverage, three of the six economic attributes are relatively dominant, namely (a) Land Ownership Status; (b) Amount of Aloe Vera Production Each Harvest and (c) Harvest Sales Method (Figure 2b). For Land Ownership Status, most of the farmers do not own the land, instead cultivating the land by renting it from the land owner. The amount of Aloe Vera Production Each Harvest is mostly more than 20 tons/ha/year. This shows that the productivity of aloe vera in Bogor Regency is very high. Meanwhile, based on the Harvest Sales Method, most of the farmers sell their aloe vera to middlemen, with only a few selling through cooperatives.

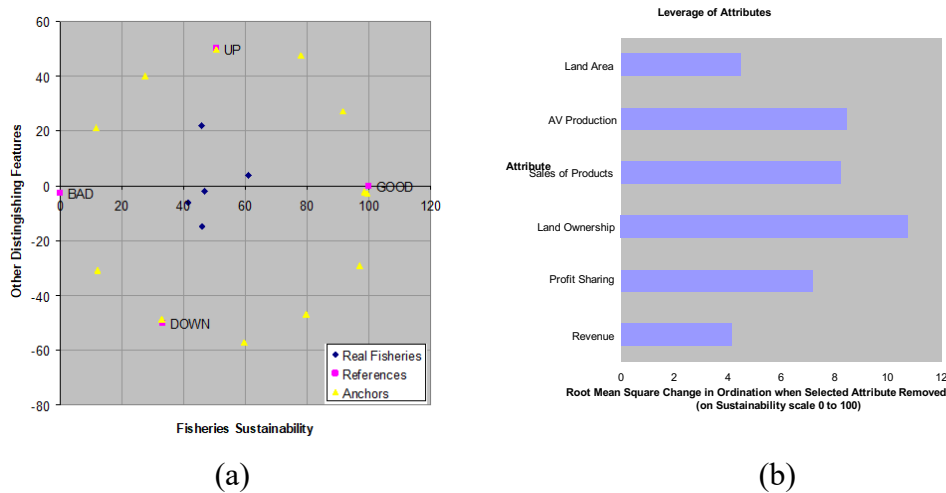


Figure 2. Sustainability index (a) and sensitive and dominant attributes (b) in the development of the aloe vera agribusiness in Bogor Regency for the economic dimension

3.3 Sustainability Analysis for the Environmental Dimension

In contrast to the economic dimension, the results of the analysis on the environmental dimension show that the sustainability index of the aloe vera agribusiness development in Bogor Regency is quite high, ranging from 72 to 78, between “fairly sustainable” and “sustainable” (Figure 3a). In relation to each sub-district, the sustainability index for the environmental dimension in Rancabungur District is the highest, with a value of 78.32 (sustainable). Two other sub-districts in the “sustainable” category are Kemang District (76.54) and Gunung Sindur District (75.58). The other two sub-districts are categorized as “fairly sustainable”, namely Tajur Halang District (72.71) and Ciampea District (72.80).

From the output leverage, two of the five attributes for the environmental dimension are relatively dominant, namely (a); Post-Harvest Land Conditions and (b) Post-Harvest Waste Management Patterns (Figure 3b). Post-harvest land in the aloe vera agribusiness in Bogor Regency is extremely easy to handle. By doing a little weeding, farmers can immediately plant aloe vera, without needing to spend a lot of money on reprocessing. Likewise, for the Post-Harvest Waste Handling Pattern, farmers are able to use leftover waste to become fertilizer, without any special handling requirements. This indicates that the aloe vera agribusiness for farmers in Bogor Regency is very easy within the environmental dimension.

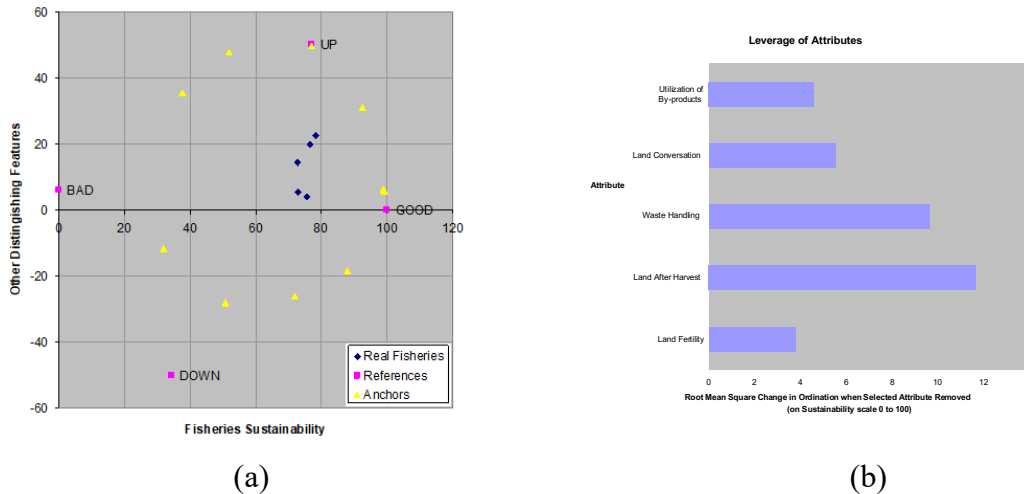


Figure 3. Sustainability index (a) and sensitive and dominant attributes (b) in the development of the aloe vera agribusiness in Bogor Regency for environmental dimensions

3.4 Sustainability Analysis for the Institutional Dimension

From the output leverage, two of the five attributes for the environmental dimension are relatively dominant, namely (a); Post-Harvest Land Conditions and (b) Post-

The results of the analysis of the institutional dimensions show that the sustainability index of aloe vera agribusiness development in Bogor Regency has a very wide range – from 10 to 72 – with a category range from “unsustainable” to “fairly sustainable” (Figure 4a). For the sustainability index in each sub-district, Gunung Sindur District is the only one categorized as "fairly sustainable" for the institutional dimension, with a value of 72.46. Two other sub-districts with “less sustainable” scores are Kemang District (42.39) and Ciampea District (27.95). Two other sub-districts are categorized as “unsustainable”, namely Tajur Halang District (21.04) and Rancabungur District (10.69).

For output leverage, three of the seven attributes of the institutional dimension are relatively dominant, namely (a) Availability of the Aloe Vera Processing Industry; (b) The Role of Agricultural Extension Officers, and (c) Appropriateness of Government Assistance (Figure 4b). Until now, the Availability of the Aloe Vera Processing Industry to produce processed products (drugs, cosmetics, food, beverages, and others) does not yet exist on a large enough scale, despite the fact that this is crucial for agribusiness activities. Until now, the role of Agricultural Extension Officers has been non-existent, even though aloe vera agribusiness actors need agricultural extension to increase the productivity of the aloe they produce. Likewise, in terms of the suitability of government assistance, until now aloe vera agribusiness actors in Bogor Regency feel that they have not received significant assistance from the government to support their activities.

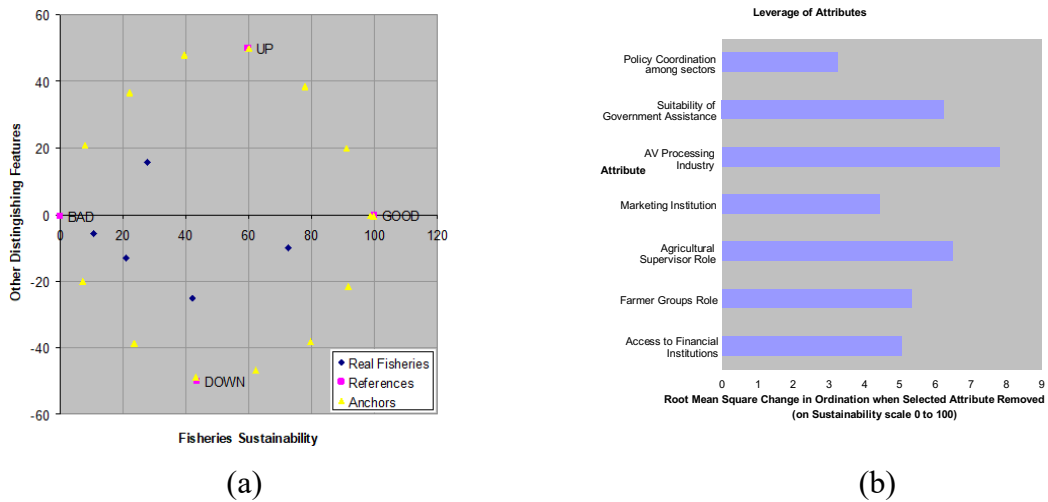


Figure 4. Sustainability index (a) and sensitive and dominant attributes (b) in the development of the aloe vera agribusiness in Bogor Regency for institutional dimensions

3.5 Fourth-Dimensional Sustainability Analysis

The ordinated output of the four dimensions (social, economic, environmental, and institutional) for the five sub-districts in Bogor Regency (Ciampea, Kemang, Tajur Halang, Rancabungur, and Gunung Sindur) was used to create a kite diagram to compare each sub-district in terms of its level of sustainability for all four dimensions (Figure 5). The figure shows that the sustainability index of aloe vera agribusiness development in Bogor Regency varies widely. Only two sub-districts in aggregate from the four dimensions are approaching “sustainable” status, namely Gunung Sindur District and Kemang District. Rancabungur and Ciampea sub-districts are approaching “quite sustainable” status, while Tajur Halang is relatively “less sustainable”.

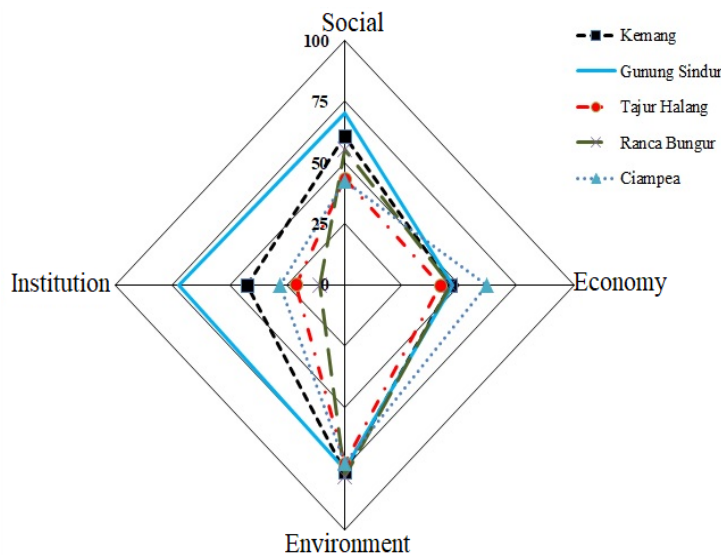


Figure 5. Status of aloe vera agribusiness sustainability in Bogor Regency in five sub-districts, based on four dimensions

3.6 Validation Using Monte Carlo Analysis

A Monte Carlo analysis was used to test the level of confidence in the total index value of aloe vera agribusiness development sustainability in Bogor Regency. In the MDS analysis using the RAPFISH tool, some errors may arise, so Monte Carlo analysis validates results by measuring any differences that arise. Several types of errors may affect results, including the effect of scoring errors on each attribute in each dimension, variations in scoring, understanding of attributes by respondents, errors in data entry, stability of the MDS analysis process, and stress values that are too high. The results of the Monte Carlo analysis can be seen in Table 2, indicating that the value of aloe vera agribusiness development in Bogor Regency for five sub-districts at a 95% confidence interval does not experience much difference between the results of the MDS and the Monte Carlo analysis. The table shows that the percentage difference between MDS results and Monte Carlo results is relatively small (less than 5%). A small difference value indicates a minimal occurrence of errors in the input score.

Table 2. Results of multidimensional Monte Carlo analysis for RAPFISH Value with 95% Confidence Interval

District	MDS	Monte Carlo	Different	Stress	R ²
Kemang	53,10696	52,89528	0,212	0,1261237	0,9483311
Gunung Sindur	63,80745	62,61031	1,197		
Tajur Halang	41,60354	43,15554	1,552		
Ranca Bungur	45,87471	46,08075	0,206		
Ciampea	52,74861	52,52751	0,221		

The Monte Carlo Scatter Plot derived from RAPFISH ensures the robustness of the previous results, showing that on replicates up to 25, scores that are concentrated in each sub-district do not reflect any significant perturbation. This verifies the low uncertainty of this model.

4. Conclusion

The aloe vera agribusiness sustainability index in Bogor Regency generally has a category ranging from "less sustainable" to "moderately sustainable". Two sub-districts are close in aggregate to "sustainable", namely Gunung Sindur District and Kemang District. Those that are close to "fairly sustainable" are Rancabungur Sub-district, and Ciampea Sub-district, while Tajur Halang District's status is "less sustainable".

Based on the social dimension, the three sub-districts with an index of "moderately sustainable" are Gunung Sindur, Kemang and Rancabungur, while the two sub-districts with an index of "less sustainable" are Tajur Halang and Ciampea. Sustainability sensitive attributes are: (a) Land Management Form, (b) Conflicts in Land Management, and (c) Extension and Training Activities.

Based on the economic dimension, the one sub-district with a "fairly sustainable" index is Ciampea District, while the four sub-districts with a "less sustainable" index are Kemang, Gunung Sindur, Tajur Halang, and Rancabungur Districts. Sustainability

sensitive attributes are: (a) Land Ownership Status, (b) Amount of Aloe Vera Production Each Harvest, and (c) Harvest Sales Method.

Based on environmental dimensions, the three sub-districts with a “sustainable” index are Rancabungur, Kemang, Gunung Sindur, while the two sub-districts with a “moderately sustainable” index are Tajur Halang and Ciampea. Sustainability sensitive attributes are: a) Post-Harvest Land Conditions, and (b) Post-Harvest Waste Management Patterns.

Based on the institutional dimension, the three sub-districts with a “sustainable” index are Rancabungur, Kemang, Gunung Sindur, while the two sub-districts with a “moderately sustainable” index are Tajur Halang and Ciampea. Sustainability sensitive attributes are: (a) Availability of Aloe Vera Processing Industry, (b) the role of agricultural extension workers, and (c) the suitability of government assistance.

Acknowledgements

Special thanks to IPB University for the administrative support in the conduct of this study.

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