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Research article

The development of *jarak towo* cassava as a high economical raw material in sustainability-based food processing industry

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Abstract: Cassava was regarded as inferior food; however, with the advancement of processing technology, cassava products have a potential for higher economic value today. One type of cassava that is used as a raw material for food processing industries, restaurants, cafes, or hotels is *jarak towo* cassava. However, the supply of this agricultural product is insecure due to the long growing period before harvesting and limited land suitability for cultivating this plant. This article aims at investigating sustainability-based the development of *jarak towo* cassava as the raw material in food processing industry. A total of 60 farmers cultivating *jarak towo* cassava took part in this study as the respondents. Snowball sampling was applied to take samples from three sub-districts in Karanganyar Regency. In-depth information was also obtained from key informants, including policy-makers and experts in cassava development. The data were analyzed using the Multi-Dimensional Scaling (MDS) method. The results of the analysis show the less sustainable multidimensional status of *jarak towo* cassava development. The prioritized strategies for developing *jarak towo* cassava are determined based on the driving and leverage variables. Farmers' active participation in farmer groups and the roles of agricultural extension in *jarak towo* cassava farming become the driving variables stimulating the other nine key factors, which belong to leverage variables. Those leverage variables include land suitability, the use of pesticides, the setting of planting frequency, the use of seedlings, planting diversification, the use of fertilizers, the availability of water during the planting period, impacts on erosion, and cooperation.

Keywords: Multi Dimensional Scaling; less sustainability; key factors; driving variable

1. Introduction

Climate change is a major factor jeopardizing sustainable food production, and various efforts have been made to prevent potential food shortages in the future. One of the staple food crops potential to be developed is cassava [1,2]. The community has long known cassava as a staple food commodity, but its development has not been intensive compared to other staple food commodities such as rice, corn, and soybeans in Indonesia [3]. Cassava is merely considered as inferior food to overcome food insecurity in marginal areas, especially for the poor [4–6]. If people's income increases, cassava consumption will decrease and people will switch to other staple foods [7–9]. On the other hand, the price of cassava is fluctuating. The domestic and global markets for cassava commodities in Indonesia show progressive growth [3]. Cassava is used as food, biofuel, and animal feed [3,8–12].

Dozens of types of cassava are cultivated in East Java, Central Java, West Java and other parts of Indonesia for the plants can live in various types of soil conditions [13]. Cassava is grown in monoculture and intercropping systems with other staple crops, such as maize, rice, and others on dryland [7,10]. The same thing is found on dryland in the mountainous area of Karanganyar Regency, Central Java, Indonesia, where one typical cassava plant, namely *jarak towo*, grows in the region. The local people call it "*jarak towo*" or "*jalak towo*" because of the shapes of the flowers and leaves resembling the flowers and seeds of *jarak* (Jatropha). This plant has many branches, as shown in Figure 1. This type of cassava has a unique taste, delicious, sweet, and smooth, making it suitable to be processed into fried cassava, *gethuk* (sweet mashed cassava), or frozen food. Even though this cassava is legendary, there has not been serious attention from the government to develop this commodity, both in the production and marketing aspects.

Figure 1. *Jarak towo* cassava plant.

Cassava commodities have experienced a transformation from staple food to overcome food insecurity, food for people in rural areas, to commercial food [14,15] and a similar transformation also happens in Indonesia in recent years,. The cassava processing industry is growing rapidly along with the development in producing added value [9]. Cassava that is processed into frozen food is in great demand by consumers because it can be easily reprocessed into ready-to-eat food. Covid-19 pandemic triggers consumers' high demand for frozen food, one of which is *jarak towo* cassava frozen food. The availability of cassava is unstable and the competition with restaurants, hotels, and cafes for obtaining this raw material to be processed as one of the most favorite food is also high. These contribute to the high price of the cassava in the market, ranging between IDR 5000 until IDR 7000 per kg. The observation results show that the price of *jarak towo* cassava depends on the demand for this commodity and the negotiation between farmers and food-processing enterprises/culinary entrepreneurs sourcing this cassava as the main ingredient for their products. The price is higher if the cassava production is lower. Meanwhile, the price of *jarak towo* cassava commodity is higher than the price of other types of cassava, which reaches IDR 2500.00/kg. On the other hand, cassava production and productivity cannot be quickly increased. These are so for several reasons, among others are 1) high quality *jarak towo* cassava can be produced if planted at an altitude of ± 1,000 masl, 2) farmers have to meet their daily need of food but the plant can only be harvested after at least eight months of planting, 3) there is a competition with other commodities that are more profitable, such as garlic and cauliflower, planted on the same land, and 4) not all places are suitable for cultivating high quality *jarak towo* cassava. If a solution is not provided, these conditions will harm the business climate of *jarak towo* cassava. The unsustainable availability of cassava raw materials also occurs in the mocaf industry in Indonesia, which cannot develop due to its inefficiency [16].

Cassava significantly contributes to the increase in income, improvement of the income distribution, source of nutrition ad food security in Java, Indonesia. As a source of carbohydrates, cassava is lower in price than rice [17]. However, unlike the other types of cassava, *jarak towo* is more expensive than corn. However, farmers have not realized that planting *jarak towo* cassava is more fruitful that cultivating other commodities. However, various obstacles as mentioned earlier make farmers reluctant to grow the plant. The planting location also determines the quantity and quality of production [18,19].

It is necessary to realize that the sustainability of *jarak towo* cultivation is the basis of the development of this type of cassava in supporting the availability of raw materials for the processing industry. The availability of cassava is closely related to the sustainability of *jarak towo* cassava cultivation, where sustainability plays an important role in supporting the environment, economy, and social condition. The development of *jarak towo* cassava is economically beneficial, environmentally friendly, as well as socially equal and acceptable, and technically appropriate. Without a sustainability study, the development of *jarak towo* cassava is not yet comprehensive in the discussion. Therefore, this article aims at investigating sustainability-based the development of *jarak towo* cassava as the raw material in the food-processing industry. The development of this commodity is an input for the local governments in making policies to increase *jarak towo* cassava production on a wider scale. The strategies are also beneficial for field extension officers and farmers to multiply the production and productivity of *jarak towo* cassava without damaging environmental quality.

2. Material and methods

2.1. Research location

Karanganyar, which is located in Central Java, Indonesia, was selected as the research location for *jarak towo* cassava is only found in this regency, with several characteristics, particularly its unique taste, as presented in Figure 1. The data regarding the land area, production, and productivity of *jarak towo* cassava have not been reported by the Central Bureau of Statistics of Karanganyar and other regencies. Since the published data have not specifically reported *jarak towo* cassava, it is necessary to dig preliminary data and information about this commodity from the people who understand this type of cassava. Based on the information gathered from field agricultural extension officers, entrepreneurs in *jarak towo* cassava processing, restaurant owners, and prominent figures, this high-quality cassava is found in three sub-districts, covering Tawangmangu, Karangpandan, and Jatiyoso (see Figure 2). Twenty farmers from each sub-district who cultivate *jarak towo* cassava with either monoculture or intercropping techniques were taken as samples. The total respondents in this study were 60 farmers. The characteristics of *jarak towo* cassava farmers as the samples of this study are presented in Table 1. Samples were taken using snowball sampling because the data of farmers and production quantity of this type of cassava had not been recorded at the village, sub-district, and regency levels. Data were gathered through in-depth interviews using questionnaires, recording, and observation. The data obtained from farmers were then cross-checked with the field extension officers and farmer group administrators understanding the cultivation of cassava.

Table 1. The characteristics of respondents regarding *jarak towo* cassava in Karanganyar Regency.

Description	Jatiyoso Sub-district	Ngargoyoso Sub-district	Tawangmangu Sub-district
Number of farmer respondents (people)	20	20	20
Average land area (m^2)	1243	625	2535
The average age of farmers (years)	43	58	54
The average education level of farmers (years)	7.8	9.2	5
Gender of farmers (male)	16	20	17
Gender of farmers (female)	4	0	3
The average number of farmer family members (people)	4	4	4
The average number of farmer family members active in *jarak towo* cassava farming (people)	2	1	2
The average years of experience in cultivating *jarak towo* cassava (years)	19	18	31

Source: Primary data analysis, 2020.

This study also explores the data from key informants, who are experts and understand the condition of *jarak towo* cassava development in the research locations. Five key informants took part in this study, including the representatives from local government (regency) and university, to evaluate the key factors in developing sustainable *jarak towo* cassava within a prospective analysis.

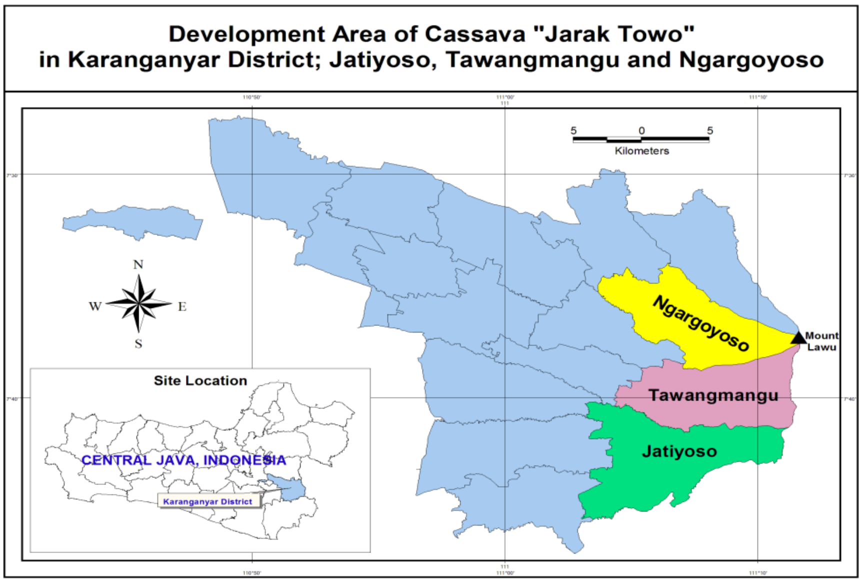

Figure 2. Area of *jarak towo* cassava development in Karanganyar Regency.

2.2. Data analysis

The data analysis in this study was divided into two stages; the first stage was analyzing the sustainability and the second stage was conducting a progressive analysis. Analysis of sustainability was performed using the Multi-Dimensional Scaling (MDS) method. In this method, an ordination technique called Rapid Appraisal for the development of *jarak towo* cassava (RAP-DJATO) was applied, a modification of RAP-FISH [20,21]. The ordination technique used the parameters measured with a scaling technique [22].

Table 2. Attributes used in Rapid Appraisal for *jarak towo* cassava development (RAP-DJATO).

Attributes	Class	
	Good	Bad
Environmental dimension		
1. Availability of *jarak towo* cassava seedlings during the planting period	3	0
2. Availability of water during the planting period	3	0
3. Water conservation	3	0
4. Land suitability	3	0
5. Land conservation	2	0
6. Plant diversification	3	0
7. Use of fertilizers	3	0
8. Agricultural waste utilization	3	0
9. Use of pesticides	2	0
10. The setting of planting regulation	2	0
11. Use of seedlings	2	0
12. Impact on erosion	2	0

Continued on next page

Attributes		Class	
		Good	Bad
Economic dimension			
1.	Status of land use	3	0
2.	The income per year compared to planting other types of commodities	2	0
3.	The fluctuating price of *jarak towo* cassava	2	0
4.	*Jarak towo* cassava productivity	2	0
5.	Farming feasibility	2	0
6.	Price risk	2	0
7	Production risk	2	0
Social dimension			
1.	Agricultural extension	3	0
2.	Participation of family members in managing *jarak towo* cassava farming	2	0
3.	Adoption of Good Agricultural Practices of *jarak towo* cassava	2	0
4.	The intensity of counseling and training on sustainable cultivation technology and post-harvest of *jarak towo* cassava	3	0
5.	Farmers' active participation in farmer groups	3	0
6.	Cooperation in *jarak towo* cassava farming	1	0
7.	Cultivation of *jarak towo* cassava as livelihood	3	0
8.	Role of field agricultural extension officers in *jarak towo* cassava farming	3	0
9.	Role of farmer groups in *jarak towo* cassava farming	3	0
10.	Conflict incidence in *jarak towo* cassava farming	3	0
11.	Government assistance in *jarak towo* cassava farming	2	0

The RAP-DJATO analysis includes the following stages: First, the researchers determined the dimensions and attributes. As presented in Table 2, three dimensions of sustainability with 30 attributes, consisting of 12 attributes of environmental dimension, 7 attributes of economic dimension, and 11 attributes of the social dimension, were used. Those attributes were modified from those obtained in previous studies on the sustainability status of farming and the observation results of the research areas. Second, each attribute was assessed on an ordinal scale (scoring) based on the sustainability criteria for each dimension. Attributes in each dimension were classified based on the criteria, either "good" or "bad", using the concept as proposed by Fisheries Centre (2002) [23]. Each attribute in a good condition was scored 3 (or 2, depending on the range defined for each attribute), while the worst one was scored 0. Third, the RAP-DJATO ordination was analyzed to determine the ordination and stress values. Fourth, the index and status of the sustainability of *jarak towo* cassava development were evaluated, either at a multidimensional or dimensional level (Table 3). Estimator score for each dimension was expressed on a scale of 0 (bad) or 100 (good), which is the index value. The index value of sustainability in data analysis was grouped into four levels of sustainability status. Fifth, the attributes sensitive to the sustainability of leverage analysis were determined. Finally, the uncertainty analyzed with Monte Carlo was checked and taken into account. The next stage was a prospective analysis where attributes sensitive to sustainability were used as the bases for the analysis. This analysis was performed to determine the key sustainability factors, which were then used to formulate the policy priorities to improve sustainability.

Table 3. The sustainability status of *jarak towo* development.

Index value	Sustainability status
0 < Index ≤ 25	Not sustainable
25 < Index ≤ 50	Less sustainable
50 < Index ≤ 75	Quite sustainable
75 < Index ≤ 100	Sustainable

Source: [24].

A prospective analysis was performed to determine the level of influence and dependence among the factors in the sustainable *jarak towo* cassava development. The factors used in the prospective analysis were all leverage attributes having the highest Root Mean Square (RMS) values up to half of the value of each sustainability dimension. All of these attributes were the key factors. The software used for analysis was exsimpro software (link https://exsimpro.com/).

The results of the prospective analysis are presented in a diagram divided into four quadrants, namely: 1) the first quadrant containing the driving variables having strong influence and low inter-factor dependence; 2) the second quadrant containing leverage variables with a strong influence and high dependence between factors; 3) the third quadrant containing the dependent factors (output variables) giving a small effect and high dependence between factors and; and 4) the fourth quadrant containing marginal variables with a small effect and low inter-factor dependence [25] (see Figure 3).

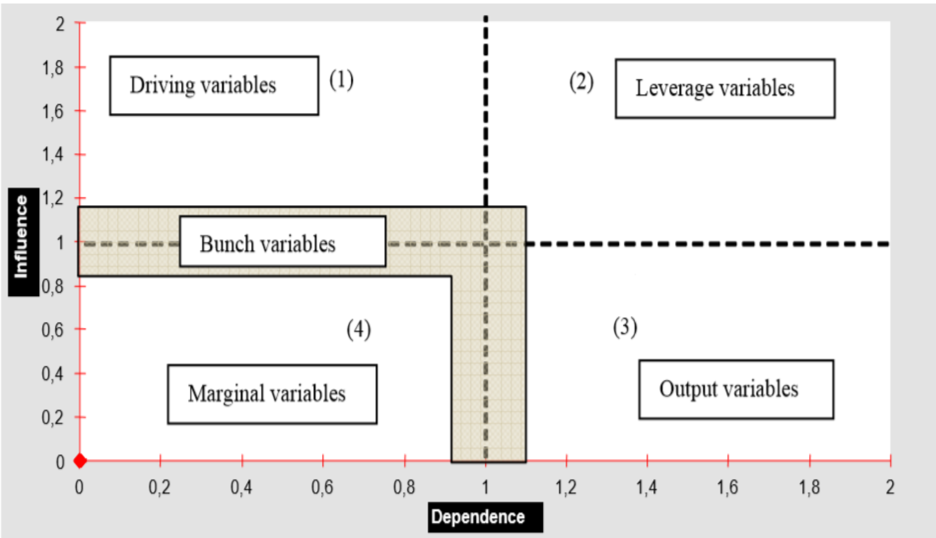

Figure 3. The level of influence and dependency between factors in the system.
Source: [25].

3. Results and discussion

3.1. Multidimensional sustainability

Sustainability analysis using the RAP-DJATO approach yielded in a sustainability index for the environmental dimension of 44.03, the economic dimension of 56.29, and the social dimension of 43.29 (Diagrams 1, 2, and 3). The economic dimension was quite sustainable, while the environmental and social dimensions were less sustainable. The multidimensional sustainability index was known to be 47.87, where the status was perceived as less sustainable.

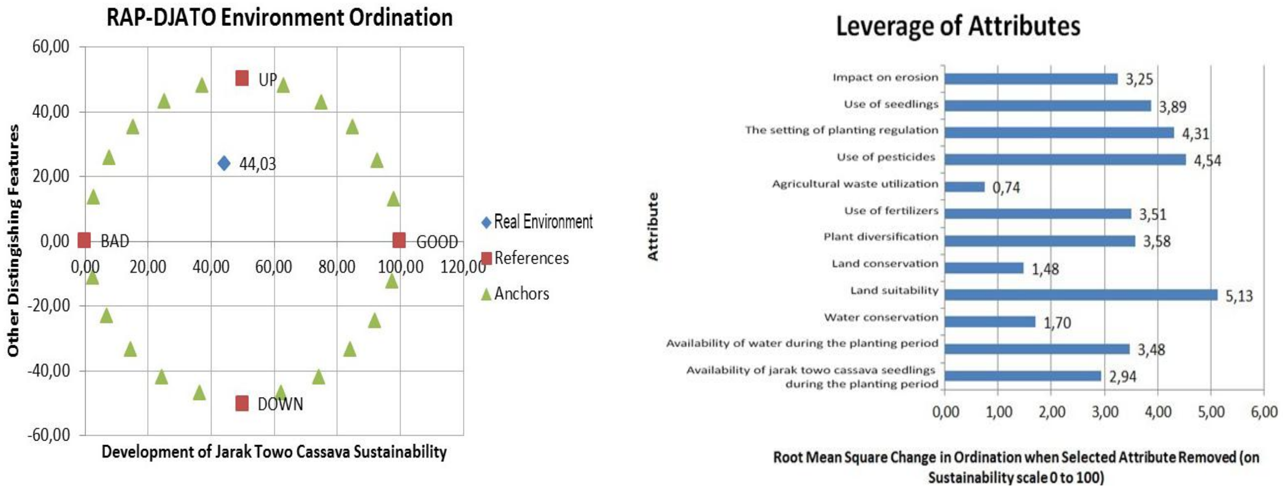

Diagram 1. Environmental dimension.

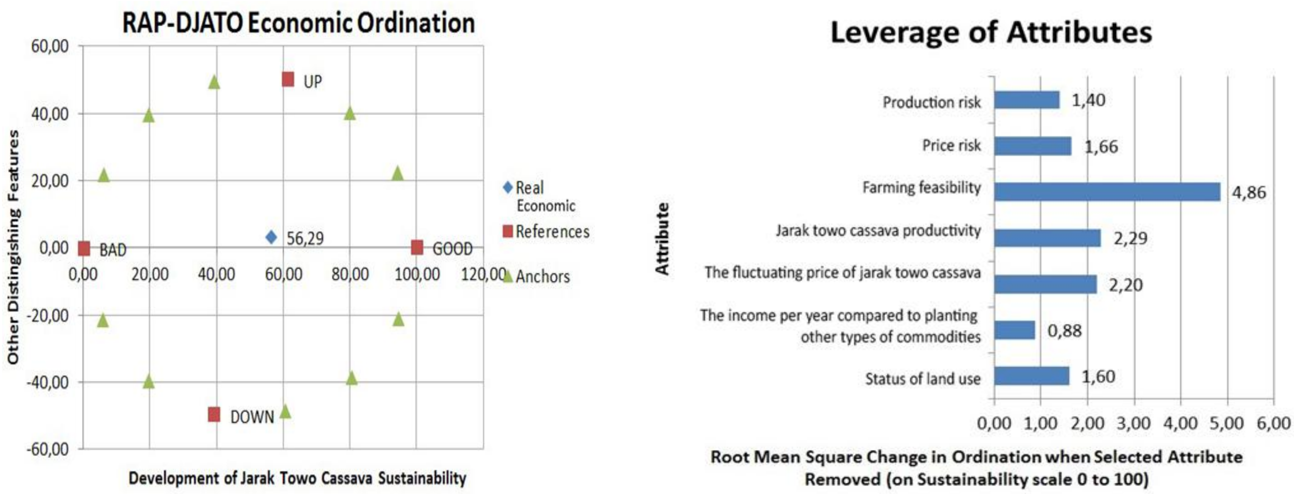

Diagram 2. Economic dimension.

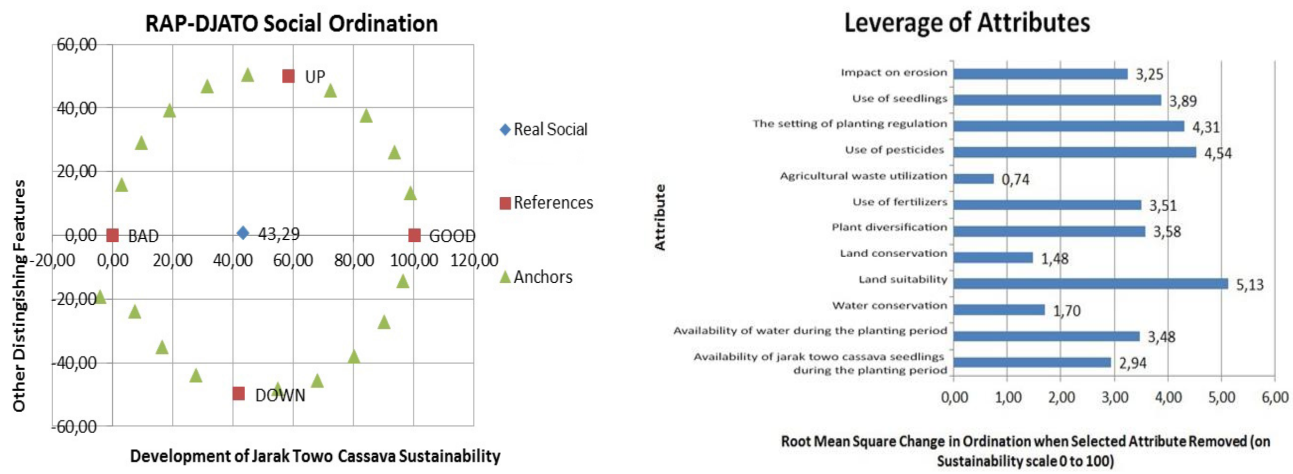

Diagram 3. Social dimension.

Figure 4. Sustainability is seen from the dimensions of the environment, economic and social.
Source: Outputs of RAP-DJATO analysis, 2020.

Diagram 1 shows that the environmental dimension was less sustainable. This indicates that the attributes in the environmental dimension do not support the development of *jarak towo* cassava at the research locations. The implementation of Good Agricultural Practice (GAP) in the cultivation of *jarak towo* was not carried out properly by the farmers in the study areas. On the other hand, one way to increase cassava production is by applying GAP [26]. Based on the study of Prudencio & Al-Hassan [4], it is known that cassava production has a negative relationship with soil quality, has a positive relationship with the risk of production failure, and is negatively related to the use of modern inputs. The age of cassava for harvesting will determine the production and selling price of the commodity. Harvesting cassava at a young age will cause low production and starch content [10]. Farmers have applied land and water conservation to increase sustainable production [27].

Diagram 2 presents that the economic dimension was quite sustainable. Some facts underlying this status include the price of *jarak towo* cassava that is higher than that of other varieties of cassava, the stable price, and the income received by farmers that is higher than the income of growing other food crop commodities. This is so for the cost of cultivating cassava is lower than that of planting other food commodities [1,14]. At the research locations, buyers guarantee the sale and price certainty [28], so that the high demand for commodities is not followed by an increase in production. The development of *jarak towo* cassava processing industry in the surrounding area has made the processed cassava have greater profitability and added value. The profitability and added value will be even greater when the processing applies mechanization because it is more efficient [8,29,30].

Diagram 3 demonstrates that the social dimension was less sustainable. The relationship among farmers in farmer groups, the role of farmer groups, the role of field agricultural extension officers, group participation, and other attributes in the social dimension do not support the sustainability of *jarak towo* cassava development. On the other hand, increasing cassava production is pursued by improving the role of field agricultural extension officers, government assistance, and the adoption of good agricultural practice [26,31]. According to Nasir & Qori'ah [28], the sustainability of cassava production is achieved by optimizing the role of farmer groups.

3.2. Sensitivity analysis

Sensitivity analysis was used to determine the leverage of sensitive attributes affecting the development of sustainability-based *jarak towo* cassava. The greater the value of the RMS leverage is, the more sensitive the role of these attributes will be in the development of *jarak towo* cassava. Pitcher & Preikshot [32] stated that the attribute chosen as the main leverage factor is the attribute that has the highest RMS value up to half of the value of each of the sustainability dimensions (Diagrams 1, 2, and 3). The RMS values of the three dimensions of sustainability are presented in Table 4. The attributes in Table 4 are the key factors in developing sustainability-based *jarak towo* cassava used as the bases for prospective analysis.

Table 4. Attributes sensitive to the development of sustainability-based *jarak towo* cassava.

Attribute code	Attribute	RMS value
A1	Land suitability	5.13
A2	Use of pesticides	4.54
A3	The setting of planting frequency	4.31
A4	Use of seedlings	3.89
A5	Planting diversification	3.58
A6	Use of fertilizers	3.51
A7	Availability of water during the planting period	3.48
A8	Impact on erosion	3.25
A9	Farming feasibility	4.86
A10	Cooperation	5.63
A11	Active participation of farmers in farmer groups	4.64
A12	Role of field agricultural extension officers in *jarak towo* cassava farming	4.08

Sources: Outputs of RAP-DJATO analysis, 2020.

3.3. Accuracy of analysis (goodness of fit)

The goodness of fit in MDS is reflected in the S-Stress value calculated based on the S-Stress and R^2 values. In RAP-FISH approach, a good model is indicated by a stress value of less than 0.25 or S-Stress < 0.25 [22]. Based on the analysis, it is known the S-Stress value < 0.25 and R^2 > 0.94, close to 1, which means that the RAP-DJATO *approach* is a good model. Monte Carlo analysis using the RAP-DJATO approach is to estimate the random error rate in the model resulting from MDS analysis on all dimensions with a 95% confidence level. The smaller the difference in value between the results of the MDS analysis and the Monte Carlo analysis is, the better the Monte Carlo model resulting from the RAP-DJATO approach will be (Table 5).

Table 5. Differences in the value of the RAP-DJATO analysis and the value of Monte Carlo analysis.

Sustainability dimension	MDS	Monte Carlo	Difference
Environmental	44.03	44.39	0.36
Economic	56.29	55.45	0.84
Social	43.29	43.54	0.25

Sources: Outputs of RAP-DJATO analysis, 2020.

The test results show a difference between the MDS value and the Monte Carlo value in the environmental and social dimensions of less than 0.5, except for the economic dimension. In general, the resulted MDS analysis model is sufficient to predict the sustainable development of *jarak towo* cassava. The difference in value that is greater than 0.5 in the economic dimension may be due to the differences in opinion and/or assessment between researchers and respondents when obtaining the data and information [21].

3.4. Development of jarak towo cassava

Key factors are sensitive attributes that have an RMS value of more than half of each dimension of sustainability. The key factors as the policy strategists in developing sustainable-based *jarak towo* cassava include attributes A1 to A12 (Table 4). The sensitive attributes were then analyzed prospectively as displayed in Diagram 4. Based on the locations of the sensitive attributes as presented in the diagram, the key factors were obtained for prioritizing the management to develop *jarak towo* cassava. The first quadrant contains the key factors for the active participation of farmers in farmer groups and the role of agricultural extension in *jarak towo* cassava farming. This quadrant contains the driving variables, which have a strong influence but a less strong dependence so that they can be categorized as strong variables in the system [25]. These two key factors have a strong influence on the development of *jarak towo* cassava and are not significantly influenced by other factors in the system (independent variables). The two factors influence other factors in stimulating the development of *jarak towo* cassava.

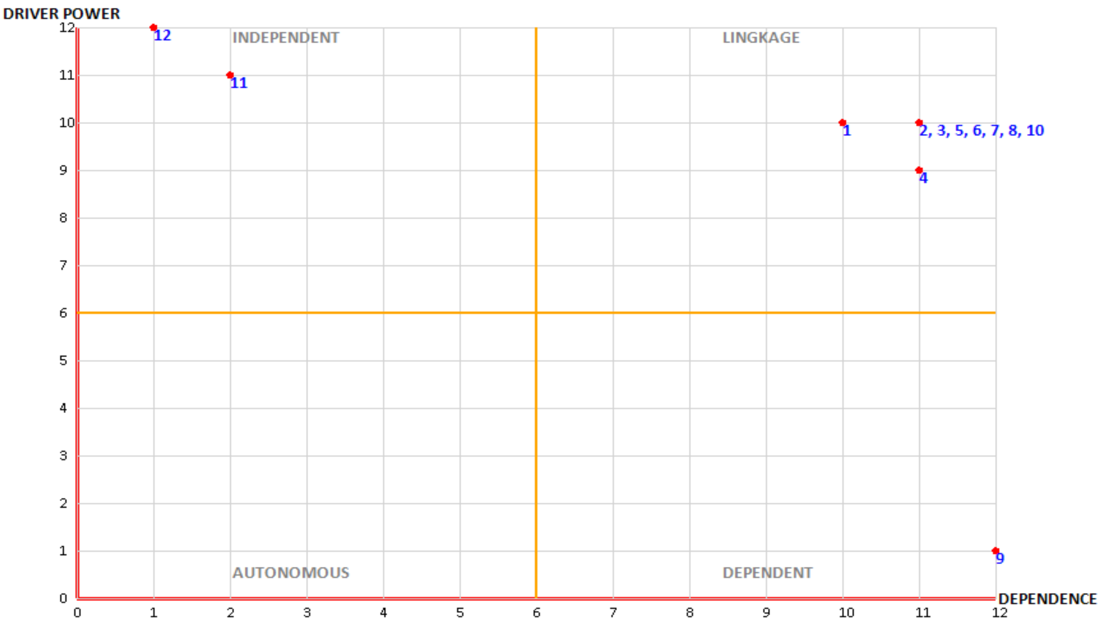

Figure 5. Prospective analysis of sustainable-based *jarak towo* development.

Source: Outputs of prospective analysis, 2020.

The second quadrant contains the key factors of land suitability, use of pesticides, planting frequency setting, use of seedlings, crop diversification, use of fertilizers, water availability during the planting period, impact on erosion, and cooperation. In the second quadrant, there are leverage variables, which have a strong influence and a strong dependency [25]. These nine factors have very strong effects and high dependence on the system in developing *jarak towo* cassava. Meanwhile, the third quadrant contains the key factors of business feasibility, which are highly dependent on other key factors. By applying the key factors in cassava development, it is expected that the availability of cassava as a raw material for the processing industry, both in quantity and quality, is guaranteed.

Based on the relationship between the influence and dependence among key factors, priority strategies for developing *jarak towo* cassava based on sustainability is then developed as follows:

a. Active participation of farmers in farmer groups

The role of farmer groups in marketing and farming is highly dependent on the active role of group members in supporting farmer group activities. Collective actions of farmer group members are the major assets affecting both marketing and farming in a rapidly changing competitive climate [33]. Farmer group is a forum that transfers knowledge, skills, technology, and information to its members. The development of collaborative networks with partners is beneficial for the members [34]. Farmers' active participation in farmer groups is the driving power for other key factors. Thus, the participation of farmers is vital to increase by improving the institutional capacity building of farmer groups and their members.

b. Role of field agricultural extension officers in *jarak towo* cassava farming

The field agricultural extension officers have only focused on providing counseling or training to farmers who cultivate rice, corn, and vegetables. Cassava is not a commodity that receives major attention, even though *jarak towo* cassava has a relatively high commercial value compared to other staple crop commodities. The field agricultural extension officers are the drivers of other key factors. For that reason, to increase quantity and quality of production, the role of officers in disseminating and adopting GAP-based cassava cultivation technology is very important in increasing production and farmers' income [35]. Farmer empowerment begins to focus on GAP-based cassava cultivation technology.

c. Land suitability

Land suitability for *jarak towo* cultivation is necessary to be achieved by mapping the land suitability [19], including the micro-climate that influences the quality of produced cassava. This is conducted by the Department of Agriculture. The results of the land suitability mapping are disseminated by field agricultural extension officers to farmers planting cassava in the areas suitable for developing *jarak towo* cassava.

d. Use of pesticides

The use of pesticides in cassava cultivation is relatively small compared to the use of pesticides when farming other staple food crops [36]. The same thing happened in the research area. Pesticides are important to be used in controlling pests and diseases of cassava, especially mealybugs attacking leaves and rats eating young tubers. Integrated Pest Management (IPM) is pivotal in increasing the quantity and quality of cassava production [37,38].

e. The setting of planting frequency

Cassava farmers have limited cultivation skills, technology, and management of cassava farming [35]. On the other hand, uncertain natural conditions make it difficult for farmers to predict the initial planting period of cassava, which affects the planting frequency. Good quantity and quality cassava can be yielded when it is harvested at the age of 10–12 months [10], but due to an urgent condition, cassava is harvested at the age of 6–7 months so the quantity and quality of production are low. The best frequency of planting cassava is once a year to yield optimal production and income for farmers.

f. Use of seedlings

Superior variety seedlings contribute to higher profitability than local varieties of cassava [7,15]. Based on indigenous knowledge, farmers select *jarak towo* cassava stems to be used for seedlings [39]. However, the selected items will be exchanged with the stems selected by other farmers. The method of planting cassava stems obtained from the previous harvest on the same land will result in a decrease in the quality of cassava.

This variety of cassava has not been registered to the Ministry of Agriculture so that a superior variety of seedlings has not been legally marketed. The government must test the quality of seedlings and varieties to produce superior seedling of *jarak towo* cassava. The superior tested seedlings are expected to yield high production, shorten harvest period, and uniform tuber sizes [40]. The productivity of *jarak towo* cassava is currently between 18 and 20 tons per ha, which is lower than the national productivity.

g. Planting diversification

In general, farmers have traditionally applied planting diversification in cassava cultivation. The diversification aims to increase income, improve food security, decrease market risk, and reduce the degradation of agricultural land [41]. Hence, farmers in the research areas have to pay more attention to the types of plants that will be intercropped with *jarak towo* cassava to meet the purpose of diversification.

h. Use of fertilizers

Farmers rarely use both organic and non-organic fertilizers in cassava farming because the cassava plant is generally an intercropping plant. The same thing is also applied by other farmers [42]. The use of fertilizers can increase production efficiency [31,43]. The use of organic fertilizer/animal manure is highly important to improve soil fertility.

i. Availability of water during the planting period

Water is needed during the planting period so that its adequate availability is significant, particularly during the vegetative growth. Cassava is commonly cultivated on dryland so that water availability is one of the limiting factors. To ensure the availability of water, it is necessary to apply a drip irrigation system, build reservoirs [44] and make other water conservation efforts.

j. Impact on erosion

The research locations are agricultural lands situated in mountainous and hilly areas. The areas are at a high risk of erosion due to seasonal crop cultivation. *Jarak towo* cassava farming may contribute to erosion because of the harvesting method, which is by uprooting the plants. To minimize the impact on erosion, farmers improve planting patterns with ground covering crops and grass on terraces [45].

k. Cooperation

Cooperation is one of the local wisdom held by farmers inherited by their ancestors. This type of cooperation is also one of the social capitals in farming [46]. However, cooperation has been gradually and increasingly practiced by farmers in farming management. However, the transition of subsystem farming to commercial farming has made this local wisdom increasingly eroded by time. The habit needs to be revitalized in *jarak* towo cassava farming to reduce labor costs. It will also strengthen the social condition, which will support the farmer group institutions.

l. Feasibility of farming

Low production due to the limited cultivation technology and transportation contributes to the slow development of cassava [2]. Cassava production has a negative relationship with market access [4]. Cassava growers are technically inefficient, implying there should be an effort to improve the technical efficiency based on the present farmer resources and available technology. It is necessary to optimize farmer resources, which include age, education, planting experience, number of family members, and gender, in the development of *jarak towo* cassava farming because the resources have significant effects on the level of technical efficiency [47].

In addition to the improvement of technical efficiency, the feasibility of *jarak towo* cassava farming is increased by multiplying the farming scale [7,15]. The need for an increasing farming scale is supported by a banking financing scheme [29,48]. Feasibility in terms of price is implemented by opening a centralized market for *jarak towo* cassava by restructuring its marketing and forming cooperatives at farmer and entrepreneur levels [49].

4. Conclusion

The sustainability-based development of *jarak towo* cassava is carried out by implementing all key factors that lever sustainability. Farmers' active participation in farmer groups and the role of agricultural extension officers in *jarak towo* cassava farming are the driving variables, which will stimulate the leverage variables. Leverage variables cover land suitability, the use of pesticides, the setting of planting frequency, the use of seedlings, planting diversification, the use of fertilizers, the availability of water during the planting period, impact on erosion, and cooperation. The highlighted strategies for developing *jarak towo* cassava are determined based on the driving and leverage variables. The availability of *jarak towo* cassava is important to ensure the readiness of raw material for the processing industry by implementing strategies for the key factors.

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Conflict of interest

The authors declare no conflict of interest.

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