Model of sustainable development of smallholders in Riau Province

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Abstract. Natural rubber has countless significant roles in human life. Rubber plants have the ability to maintain natural functions (they serve as carbon producers, conservationists of land and water, and habitats for wildlife) and they also produce many added values in terms of social and economy for rubber farmers or smallholders as well as become sources of their living and income. The price of natural rubber in the international market has significantly dropped in the last decade; leaving many rubber farmers or smallholders to live in poverty. Many programs to elevate the prosperity of rubber farmers or smallholders have been created and applied by the government of Indonesia but none of the programs has been deemed successful according to the analysis results of Multi-Dimensional Scaling (MDS), the sustainable ecological index (52.95%), technological sustainability (62.35%), economical sustainability (60.18%), social sustainability (53.62%), and institutional sustainability (20.73%). The institutional management of rubber farmers is highly expected to increase the development of rubber farmers so that each and every one of them may have high competitiveness which in turn will sustainably improve their prosperity in the future.

1. Introduction

Many programs with various strategies and schemes aimed to improve the quality of life and prosperity of rubber farmers have been applied, and one widely known scheme is the core estate and smallholder (Perkebunan Inti Rakyat or PIR), which has been in effect since 1977. This scheme in its development has been applied in the transmigration areas known as Trans Core Estate and Smallholders (Indonesian: PIR Tran), and solely related to new land clearings, meanwhile another scheme or strategy known as the available plantation land rejuvenation is known as PPKR (Indonesian: Peremajaan Kebun Karet Rakyat) or rubber plantation revitalization. The Plantation Revitalization Program is the Indonesian government's effort to accelerate the development of smallholders' rubber plantations through expansion, rejuvenation, and rehabilitation of plantation plants supported by banking credit investment and interest subsidy given by the government by involving corporations in plantation business sector as partners in the plantation development, processing, and marketing. Additionally, a new scheme called UPPB or Lump Processing and Marketing Unit was developed to create a number of good smallholders and increase the number of

qualified smallholders and rubber quality. This scheme is a business entity or a business unit formed by two or more groups of smallholders as the training venue of farming, processing, and temporary storing techniques, and smallholder's lump marketing. Despite all these efforts, the prosperity of the rubber farmers has not significantly improved. A concrete solution to improve the smallholders' prosperity must be found to create rubber business sustainability.

Based on the problem background stated above, an integrative and collaborative approach of ecological, technological, economic, social and institutional factor must be created toward plantation ecosystem of smallholders' plantation in Riau Province. The problems that have to be solved through this research are as follows:

- What are the ecological, technological, economic, social and institutional characteristics of smallholders' rubber plantation sustainability in Riau Province?
- What are significant attributes of the ecological, technological, economic, social and institutional dimension that become the factors of sustainable development arousal of smallholders in Riau Province?

The results of this research are hoped to bring about a model and strategy for empowering smallholders in order to accelerate the sustainable economic development of in villages in Riau.The research findings are going to be beneficial to all agricultural entrepreneurs as well as the government as decision makers in regards to the business of plantation development. It is highly expected that there is progress and improvement which increase the smallholders' income to improve their prosperity.

2. Literature Review

Sustainable development is a concept of development that has been widey applied in many countries in the world. It is aimed to give maximum solutions of all different interests for development. This sustainable development concept was first introduced by the World Commission on Environment and Development (WCED) in 1987 in their report entitled "Our Common Future" [1] . It is a simple yet complex concept causing the definition of sustainability to be very multidimensional and multi-interpretational, including the implementation of such concept in sustainable rubber plantation. [2] stated that there are eight strategic factors that influence the development of sustainable rubber business, those factors are: availability of technology, empowering resources, farmers training, policy support, plantation size, farmers' skills, farmers' institutionality, production and productivity. The first four strategic factors are categorized in the agribusiness system as input as they have strong influences on other factros, yet their dependency on the other factors is not as strong. Meanwhile the other four factors are connecting factors in that they have strong influences on the other factors as they have strong dependency on the other factors. Many studies have been conducted to analyze the relationship between smallholder development and their family income as reported by [3, 4, 5], Studies on the impact of the rubber plantation development on the farmers' social and economy were carried out by [6, 7, 8, 9].

Results of previous studies concluded that the majority of smallholders in various regions in Indonesia including Riau Province are poor (pre-prosperous). Nurhamlin [10] stated that the income of smallholders in Kampar, Riau Province is just Rp2.500.000 per month with average number of family members of five per household, if that is compared to the minimum wage of Riau Province in 2016 which is Rp2.266.722,53, it can be said that household income of the smallholders in Riau is categorized as low income. Results of studies conducted in other regions also showed the same condition as stated by [11] that the agricultural development in Riau Province has not yet reached poor rubber farmers. [12] who conducted a research in West Kutai Regency, Provinsi East Kalimantan Province also concluded that the average income of the rubber farmers there is only Rp14.909.608,70 a year or Rp1,187,609.50 per month or lower than the minimum wage of Riau Province in 2017. This is confirmed by the report released by the Riau Agriculture Office in 2013, that the income level of rubber farmers in 2013 was just Rp14.251.314,00 a year or Rp1.187.609,50 per month. Research result by [13] concluded that the average income of rubber tappers in Pangkal Baru village, Tempunak

Sub-District, Sintang Regency, West Kalimantan Province in a month is Rp2.800.000 with the average size of the plantation of one hectare classified as medium level.

According to [13], factors affecting the income of the rubber tappers are buyers, climate and wheather, and rubber quality. Efforts made by the rubber tappers to increase their income are by working outside the activities of rubber tapping and through intensification and extensification of agriculture such as maintenance and vertilization of rubber plants and also adding fields of tapping elsewhere. Accrodint to [14] in Sannia B. *et al*. stated that income is a form of reward for maintenance service which utilizes land, labor, and capital owned in an agricutural activity. Farmers' prosperity will improve if their income is bigger than the costs that they reduce balanced by high quality production and good rubber prices. Influence of price and productivity that fluctuate causes fluctuations in farmers' income. Price and productivity are two factors of uncertainty in an agricultural activity. According to the data issued by [15], the price of rubber at the factory door in Riau is only Rp13.000 for a kilogram of dried rubber or KKK (Indonesian: kilogram karet kering) of 100%; the price of a kilogram of rubber is inadvertenly only around Rp5.000 to Rp6.000 per kilogram among the farmers. Due to the low price, many farmers ditched their plantations and changed professions. If this continues to occur, in a long run the production of smallholders' rubber will significantly drop and will impact the continuity of rubber processing factories in Riau, which in effect will decrease the amount of non-oil and gas export to regions like Riau especially in the sub-sector of agriculture. With that consideration, a research is deemed necessary in order to find a development model for smallholders so that their prosperity can improve and rubber plantations can be sustainable.

3. Research Methods

This research uses a combination of quantitative and qualitative research which is done by utilizing the survey method with questionnaire instrument and structured interview guidelines. The research location is purposively determined based on the total sizes of the plantation areas and number of smallholder households. With that in mind, three regencies (Kuantan Singingi Regency, Kampar Regency, and Pelalawan Regency) are set up as the locations for this research.Data required is primary and secondary data. The secondary data is collected from related institutions as well as private parties and rubber associations. Meanwhile the primary data is obtained by conducting interviews with the experts and distributing questionnaires to the rubber farmer households. To ascertain the sustainability level of smallholder plantations, an analysis of *Multi-Dimensional Scaling* (MDS) was done with the help of *RapEst software* [16, 17, 18].

The result of the determination of the sustainability from each dimension is then converted to a *kite diagram* to see the sustainability *trade-off* from the management of the rubber plantations. The index value of the sustainability in each dimension is depicted in Figure 1.

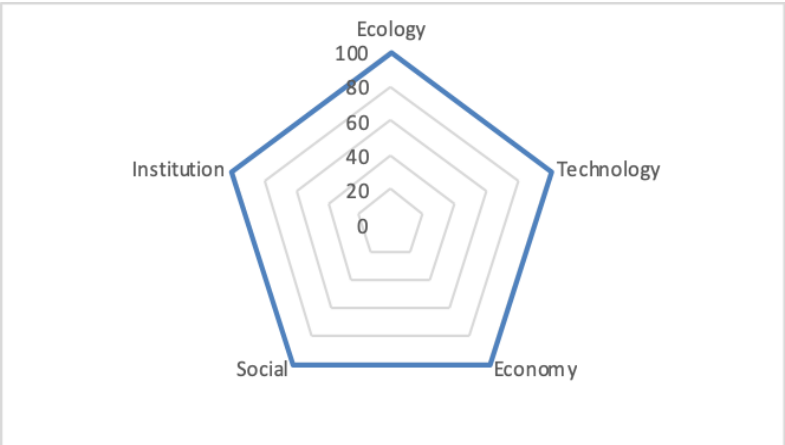

Figure 1. Illustration of sustainability index kite diagram

To learn which attribute is the most crucial in each dimension a prospective analysis is done. This prospektive analysis aims to determine the rankings of inquisitive attributes so that key attributes or *driving variables* in the management of rubber plantations are achieved in the research locations. The prospective of the *output* analysis comes up with four quadrants which are the ranks of the inquisitive attributes as seen in Figure 2 [19,20,21].

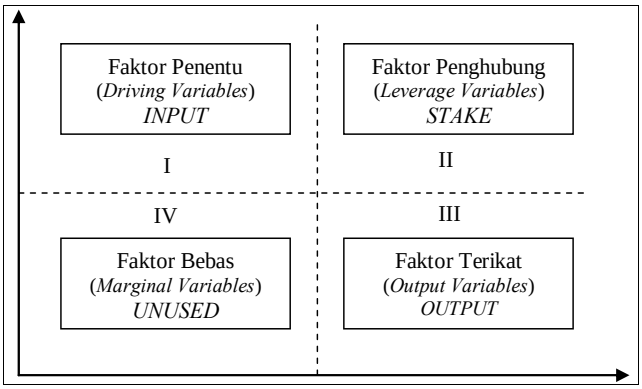

Figure 2. Graph of variable influence and dependency

4. Result and Discussion

4.1. Research results

4.1.1. Ecological Dimension. The result of the ecological parameter measurement on the smalholders' plantations shows that there are seven attributes which predictably affect the sustainability of the ecological dimension, and those attributes are: (1) rubber seed type; (2) number of rubber tapping days/rubber tapping frequency; (3) rainfalls; (4) land administrative status; (5) land area; (6) land fertility; (7) land type. The result of the *Multi-Dimensional Scaling* (MDS) analysis of the ecological dimension can be seen in Figure 3.

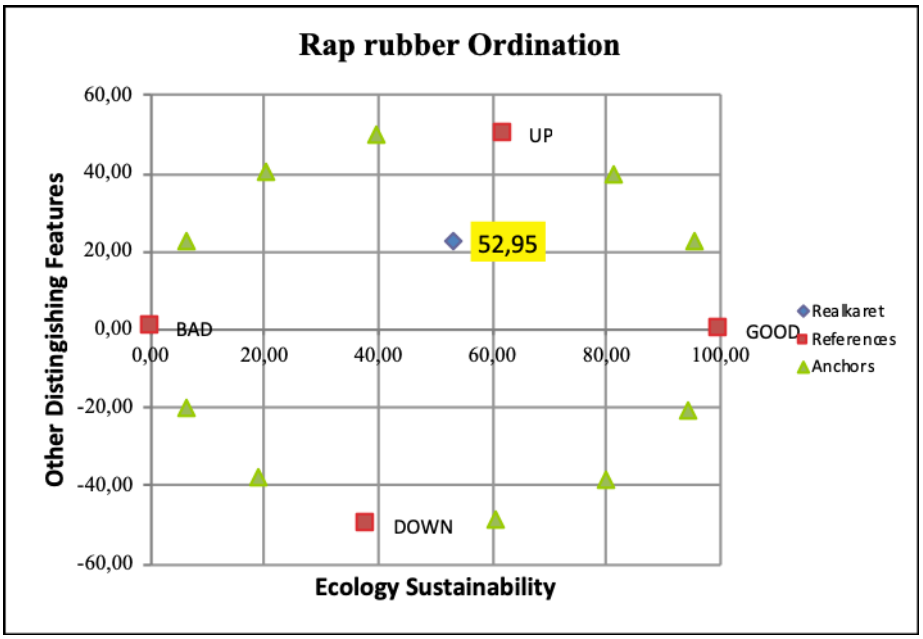

Figure 3. Index of ecology dimension sustainability of rubber plantations

The MDS analysis of the ecology dimension attributes shows an index score of 52.95 which fits in enough sustainability. Role of each attribute in the ecology dimension is then analyzed with the *leverage* analysis which is aimed to look for an attribute which is sensitive in contributing to the sustainability of the ecology dimension. The result of the *leverage* analysis is gained from the *Root Mean Square* (RMS) value of each attribute. The result of the *leverage* analysis the ecology dimension can be seen in Figure 4.

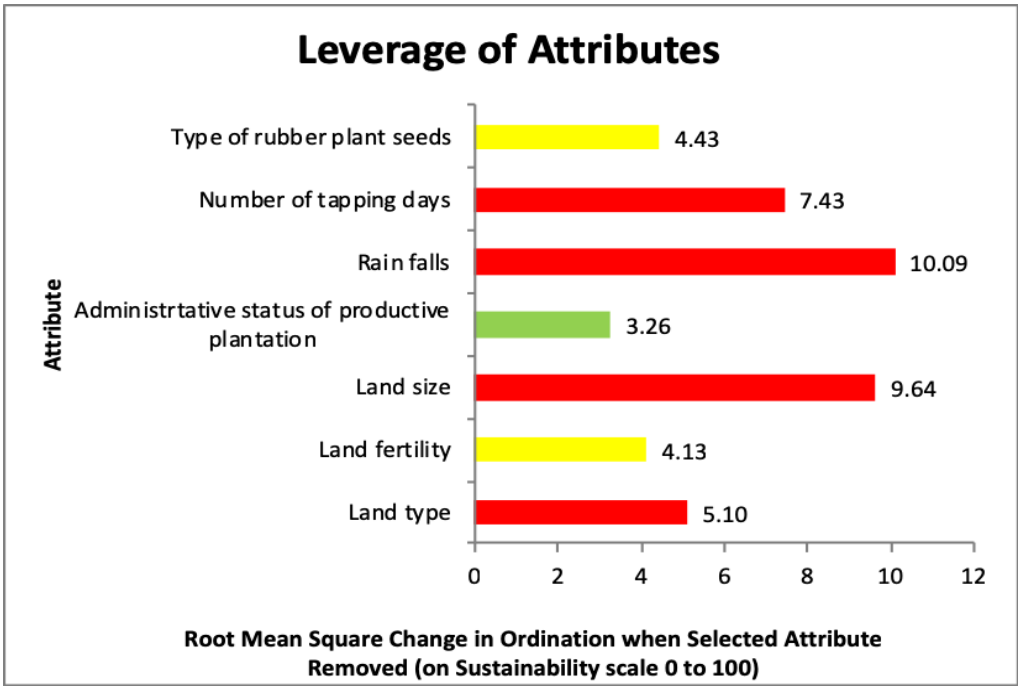

Figure 4. Role of each attribute influencing the sustainainability of ecology dimension of smallholders plantations

The determination of the sensitive attributes which influence the sustainability of the ecology dimension uses a combination of *leverage* analysis and Pareto analysis Kusbimanto [22]. The Pareto analysis was conducted by sorting/arranging the RMS values of the *leverage*analysis of the highest to the lowest value and then weighting them in percentage and then accumulating the till the maximum cumulative value limit of 75%. The percentage of the RMS value to determine the sensitive attributes in the ecology dimension can be seen in Table 1.

Table 1. Percentage of RMS Value to Determine Sensitive Attributes in Ecology Dimension

No	Attributes	RMS Value	Percentage
1	Rainfalls	10.09	22.32
2	Land Area	10.04	22.14
3	Tapping frequency	7.43	16.97
4	Land type	5.10	11.36
	Total percentage		72.80
5	Rubber seed type	4.43	10.37
6	Land fertility	4.13	9.27
7	Adm status of land deed	3.26	7.55
	Total	**21.28**	**100.00**

There are four sensitive attributes in the ecology dimension which affect the sustainability of the smallholders' plantations. They are derived from the total cumulative percentage of the RMS which is 72.80%. If another attribute is added, it shows a value over from the requirement (93.07%) and that is the maximum cumulative value limit of 75%. Those sensitive attributes are (1) rainfalls; (2) land area; (3) tapping frequency, and (4) land type. These four attributes of the ecology dimiension that are considered for the next step in the efforts to develop the sustainable development model for the rubber farmers in Riau Province.

4.1.2. Technology Dimension. The result of the technology parameter measurement mentions that there are 14 attributes that are forecast to be influential on the sustainability of the technology dimension, and those attributes are: (1) fertilization frequency of productive plantations; (2) care frequency of productive plantations; (3) pestiside frequency/pest control frequency of productive plantations; (4) behaviour of farmers regarding clean lump; (5) knowledge of clean lump; (6) knowledge of coagulant; (7) knowledge of tapping technique; (8) knowledge of care/maintenance technique of productive plantations; (9) spacing/planting time of productive plantations; (10) knowledge of spacing/planting time; (11) seed source; (12) knowledge of quality seeds; (13) terrace making, and (14) knowledge of farming. The result of the Multi Dimensional Scaling (MDS) analysis of the techology dimension can be seen in Figure 5.

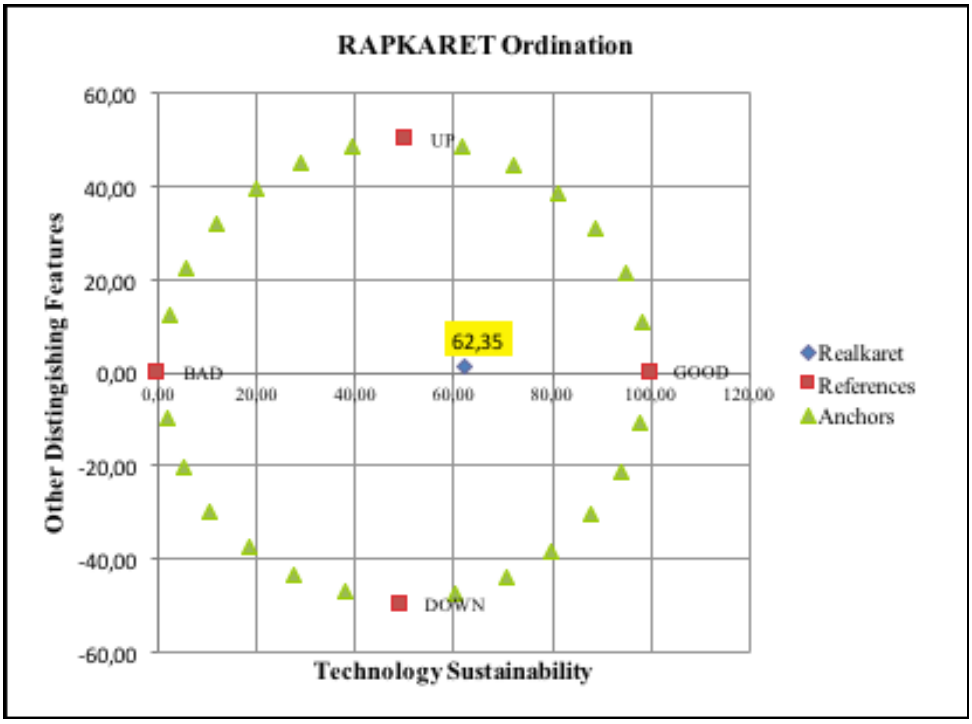

Figure 5. Technology dimension sustainability index of smallholders' plantations

The MDS analysis of the technology dimension attributes shows an index value of 62.35 and that is classified as *pretty sustainable*. The role of each attribute was then analyzed with the *leverage* analysis which was done to find any sensitive attributes contributing to the sustainability of the dimension. The result of the *leverage* analysis was gained from the *Root Mean Square* (RMS) value in each attribute which can be seen in Figure 6.

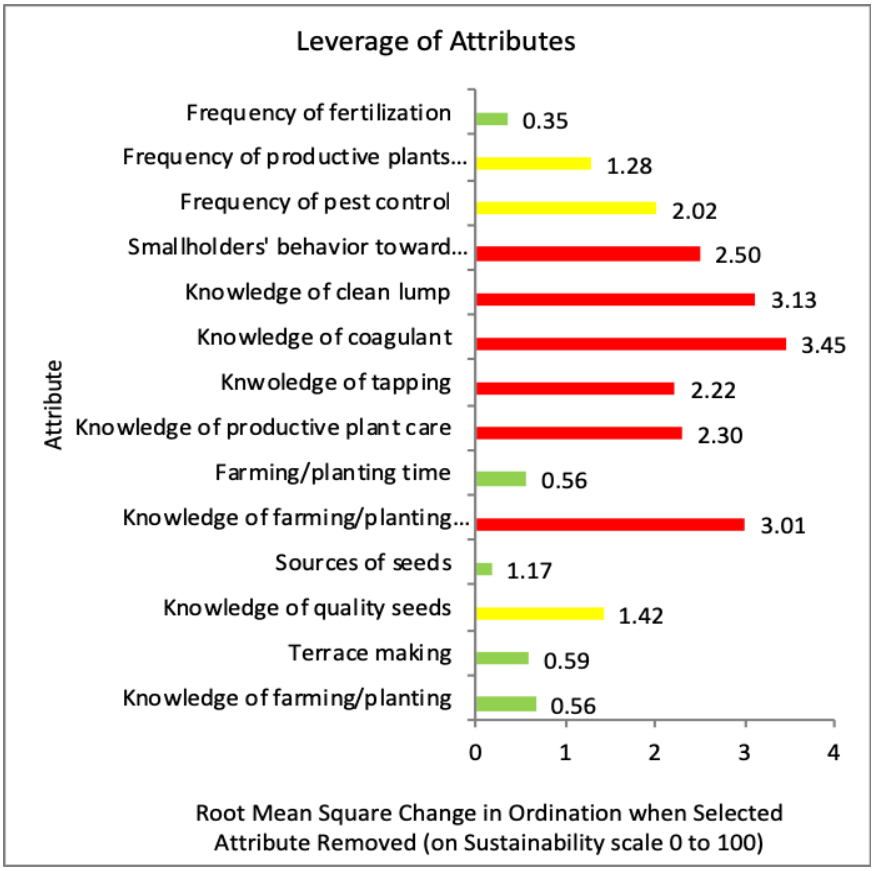

Figure 6. Role of each attribute influencing smallholders' plantation sustainability in technology dimension

The determination of the sensitive attributes that influence the sustainability of the technology dimension uses a combination of *leverage* and Pareto analysis [22] The Pareto analysis was conducted by sorting the RMS value, a result of *leverage* analysis, from the biggest to the lowest, and then weighting in percentage was done and they were then accumulated to the maximum cumulative value limit of 75%. The percentage of the RMS value used to determine the sensitive attributes in the ecology dimension can be seen in Table 2. Six sensitive attributes were found in the technology dimension influencing the sustainability of the smallholders' plantations. Those attributes were retrieved from the total percentage of the RMS cumulative which is 70.20%. If another attribute is added, it will be over limit (78.74%), overthe maximum cumulative value limit of 75%. The six sensitive attributes are (1) knowledge of coagulant; (2) knowledge of clean lump; (3) knowledge of spacing/planting time; (4) behavior of farmers regarding clean lump; (5) knowledge of productive plantation care, and (6) knowledge of tapping technique. These six attributes were the consideration for the next step in creating the model.

Table 2. The RMS value percentage to determine sensitive attributes in technology dimension

No	Technology Attributes	RMS Value	Percentage
1	Knowledge of solidification material	3.45	14.58
2	Knowledge of clean lump	3.13	13.23
3	Knowledge of spacing/planting time	3.01	12.72
4	Smallholders' behavior regarding clean lump	2.50	10.57

No	Technology Attributes	RMS Value	Percentage
5	Knowledge of care productive plants	2.30	9.72
6	Knowledge oftapping technique	2.22	9.38
	Total		**70.20**
7	Frequency of pest control of productive plantations	2.02	8.54
8	Knowledge of quality seeds	1.42	6.00
9	Frequency of care of productive plantations	1.28	5.41
10	Knowledge of gardening/farming	0.66	2.79
11	Terrace making	0.59	2.49
12	Spacing/planting time of productive plantations	0.56	2.37
13	Frequency of fertilization of productive plantations	0.35	1.48
14	Source of seeds	0.17	0.72
	Total	**23.66**	**100.00**

4.1.3. Economy Dimension. The result of the calculation of the economy parameters shows that there are 12 attributes that are assumed to be able to influence the sustainability of the economy dimension, and they are: (1) perception of rubber price; (2) perception of nine basic needs adequacy; (3) access to price information; (4) access to capital; (5) access to transportation; (6) access to clean water; (7) obstacles in selling agricultural products; (8) access to market; (9) *marketable right*; (10) debt; (11) saving, and (12) household income. The result of the *Multi-Dimensional Scaling* (MDS) analysis in the economy dimension can be seen in Figure 7.

The MDS analysis of the economy dimension attributes shows an index value of 60.08 which is classified as *good* (*pretty sustainable*). The role of each attribute in this dimension was then analyzed with the *leverage* analysis which was done to search for any sensitive attributes contributing to the the ecology dimension's sustainability. The result of the *leverage* analysis was taken from the *Root Mean Square* (RMS) value in each attribute. The result of the *leverage* analysis in the ecology dimension can be seen in Figure 8. The determination of the sensitive attributes influencing the sustainability of the economy dimension uses a combination of the *leverage* and Pareto analysis (Kusbimanto *et al*. [24] The latter analysis was performed by sorting the RMS values as the results of the *leverage* analysis from the biggest to the smallest and then were weighted in percentage and accumulated to the maximum accumulative value limit of 75%. The percentage of the RMS value to determine the sensitive attributes in the economy dimension can be seen in Table 3.

There are six sensitive attributes found in the economy dimension influlencing the sustainability of the smallholders' plantations. They were gained from the total cumulative percentage of the RMS which is 67.29%. If another attribute is added, it will be over limit (75.59%), which is the maximum accumulative value limit of 75%. Those six sensitive attributes are (1) access to clean water; (2) access to transportation; (3) debt; (4) obstacles in marketing agricultural products; (5) perception of nine basic needs adequacy, and (6) access to rubber price information. They were considered for the next step in creating the model.

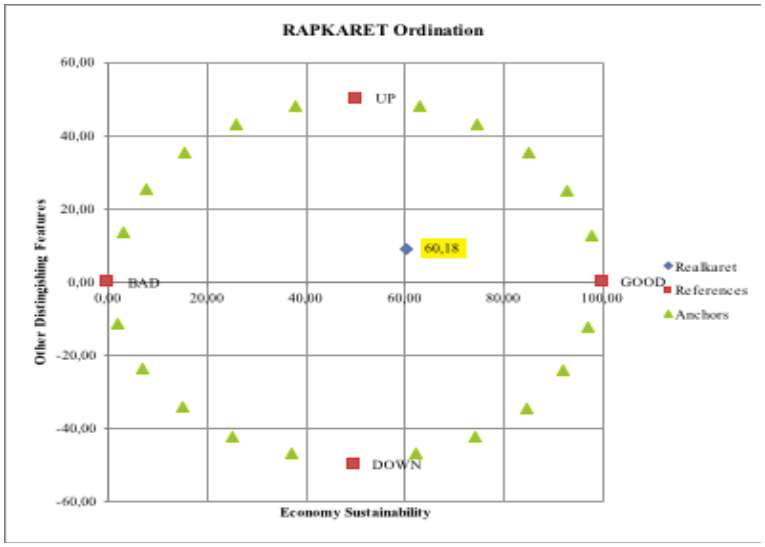

Figure 7. Smallholders' Plantations Sustainability Index

Table 3. Percentage of RMS value to determine sensitive attributesin economy dimension

No	Economy Attributes	RMS Value	Percentage
1	Access to clean water	3.70	15.49
2	Access to transportation	3.46	14.49
3	Debt	2.81	11.77
4	Obstacles in marketing agricultural products	2.06	8.63
5	Perception of nine basic needs adequacy	2.05	8.58
6	Access to rubber price information	1.99	8.33
	Total		**67.29**
7	Access to market	1.98	8.29
8	Access to capital	1.86	7.79
9	Household income	1.79	7.50
10	Marketable rights	1.47	6.16
11	Perception of rubber price	0.63	264
12	Savings	0.08	0.34
	Total	**23.88**	**100.00**

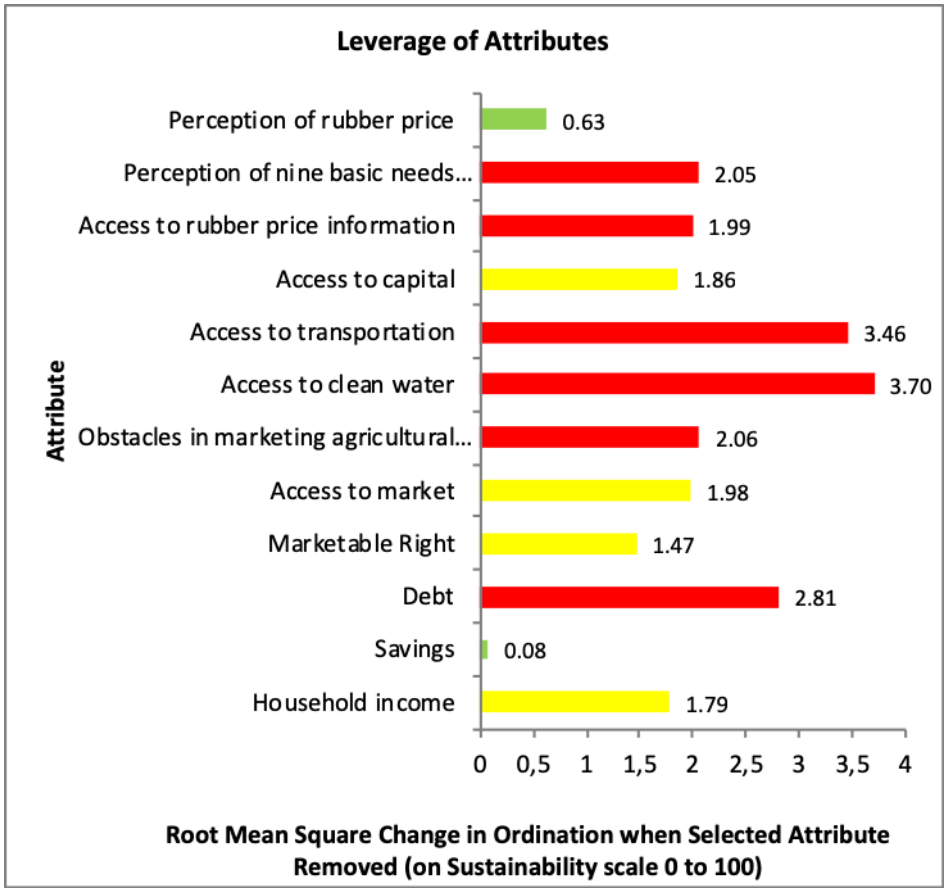

Figure 8. Role of each attribute influencing sustainability of smallholders plantations in economy dimension

4.1.4. Social Dimension. The result of the social parameter calculation results in 10 attributes that are thought of being influential on the sustainability of the social dimension, and those attributes are: (1) social relationship pattern in society; (2) relationship pattern of farmers and proprietors; (3) employment rate; (4) local wisdom and knowledge; (5) population density; (6) rate of social conflict; (7) economical facilities/infrastructures; (8) educational facilities; (9) social facilities; (10) society participaton rate. The *Multi-Dimensional Scaling* (MDS) analysis result in the economy dimension can be seen in Figure 9.

The MDS analysis of the attributes in the social dimension shows an index value of 53.62 and it is classified as (pretty sustainable). The role of each attribute in the economy dimension was then analyzed with the *leverage* analysis which was aimed to find out all the sensitive attributes contributing to the sustainability of the ecology dimension. The result of the *leverage* analysis was gained from the *Root Mean Square* (RMS) value in each attribute. The result of the *leverage* analysis in the ecology dimension can be seen in Figure 10.

The determination of the sensitive attributes influencing the sustainability of the social dimension uses a combination of the *leverage* analysis and the Pareto analysis [22] The Pareto analysis was done by sorting the RMS value of the *leverage*analysis result from the highest to the lowest and then weighting was done in percentage and then accumulated until the maximum cumulative value limit of 75%. The percentage of the RMS value to determine the sensitive attributes in the social dimension can be seen in Table 4.

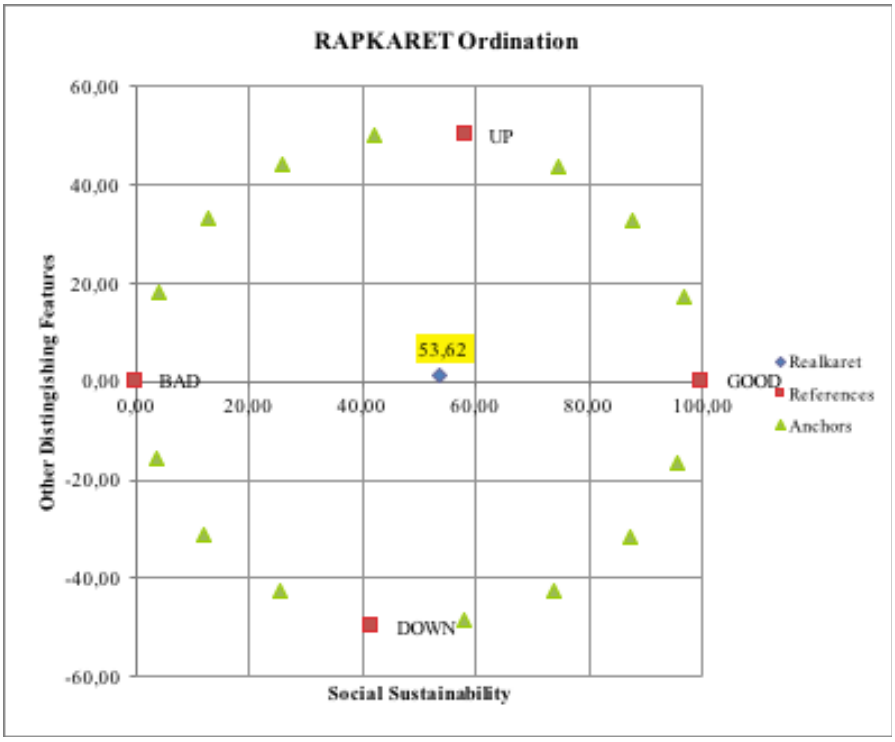

Figure 9. Smallholders' plantation sustainability index in social dimension

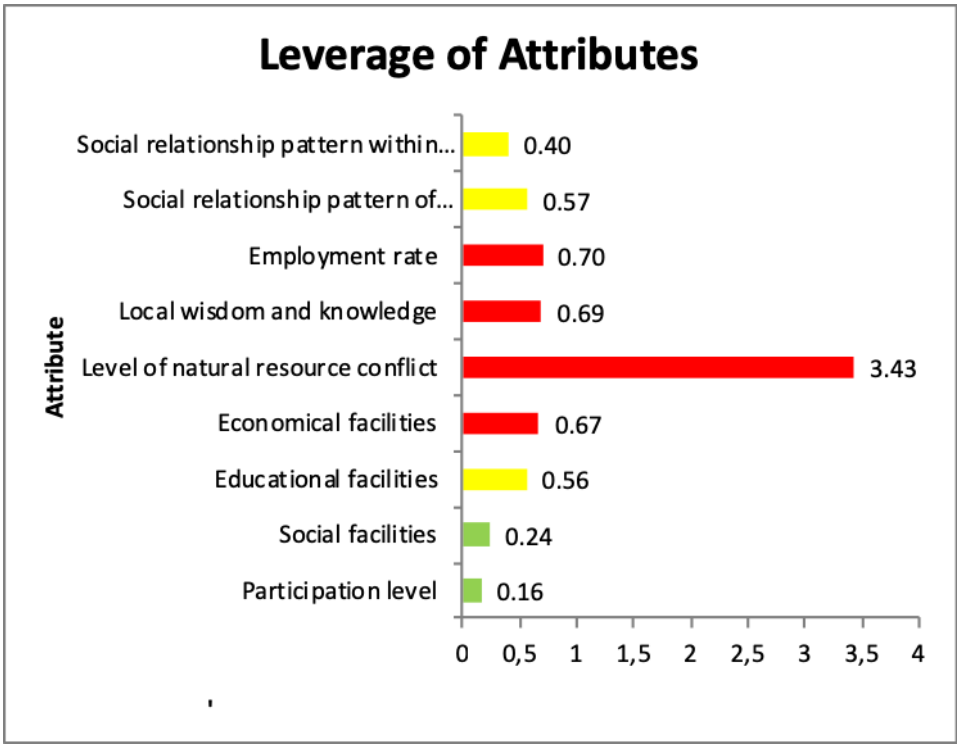

Figure 10. Role of each attribute influencing smallholders plantation sustainability in social dimension

Table 4. Percentage of RMS value to determine sensitive attributes in social dimension

No	Atribut Sosial	Nilai RMS	Percentage
1	Conflict rate	3.43	46.23
2	Employment rate	0.70	9.43
3	Local wisdom and knowledge	0.69	9.30
4	Economic facilities	0.67	9.03
	Total		**73.99**
5	Social relationship of farmers and proprietors	0.57	7.68
6	Health facilities	0.56	7.55
7	Social relation within society	0.40	5.39
8	Social facilities	0.24	3.23
9	Participation rate	0.16	2.16
	Total	**7.42**	**100.00**

There are four sensitive attributes found in the social dimension influencing the sustainability of the smallholder plantations. These four sensitive attributes were found from the total percentage of the RMS cumulative which is 73.99%. If another attribute is added, it will be over the limit (82.67%) as the maximum cumulative value limit is 75%. Those sensitive attributes are (1) conflict rate in society; (2) employment rate; (3) local wisdom and knowledge, and (4) economic facilities. These social dimension attributes were then considered for the next step in creating the model.

4.1.5. Institutional Dimension. The result of the institutional parameter calculation produced 8 attributes which are presumed to be influential on the sustainability of the institutional dimension, and those 8 attributes are: (1) role of plant breeding institution; (2) role of government institution in empowering the smallholders; (3) role of the *tauke* or proprietors; (4) role of auction market; (5) role of UPPB; (6) role of agro-cooperative; (7) role of farmers groups; and (8) regulation completeness. The result of the *Multi-Dimensional Scaling* (MDS) analysis in the economy dimension can be seen in Figure 11.

The MDS analysis of the institutional dimension attributes shows an index value of 20.73 which is classified as *bad* (*unsustainable*). The role of each attribute in the institutional dimension was then analyzed by using the *leverage* analysis to find out which of the attributes are sensitive and contribute to the sustainability of the ecology dimension. The result of the *leverage* analysis was gained from the *Root Mean Square* (RMS) value in each attribute. The result of the *leverage* analysis in the institutional dimension can be seen in Figure 12.

The determination of the sensitive attributes influencing the sustainability of the institutional dimension uses a combination of the *leverage* analysis and the Pareto analysis. The Pareto analysis was done by sorting the RMS value of the *leverage* analysis result from the highest to the lowest value and then weighting was done in percentage and it was accumulated until the maximum cumulative value limit of 75%. The percentage of the RMS value to determine the sensitive attributes in institutional dimension can be seen in Table 5.

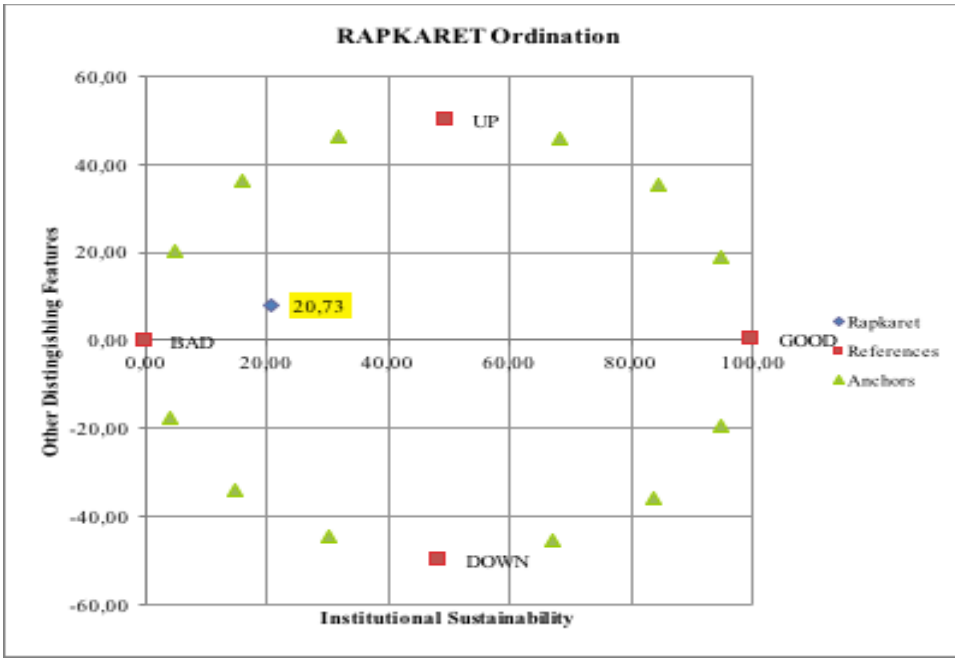

Figure 11. Smallholders' plantation sustainability index in institutional dimension

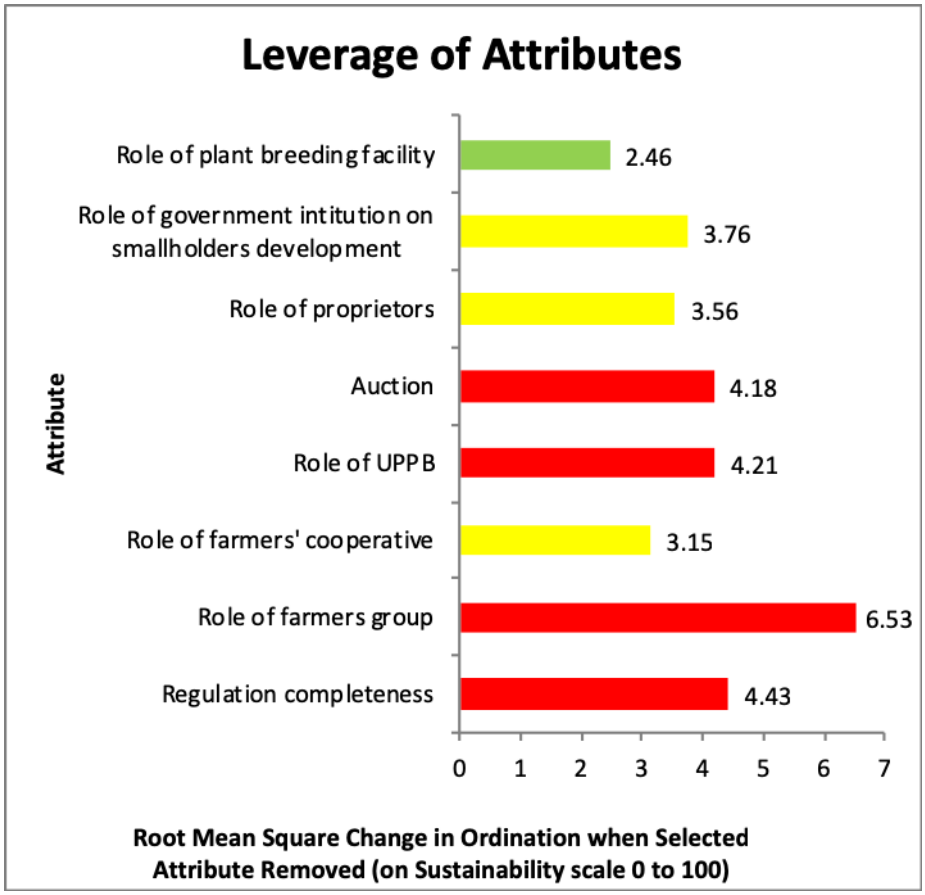

Figure 12. Role of each attribute influencing smallholders plantation sustainability in institutional dimension

Table 5. Percentage of RMS Value To Determine Sensitive Attributes In Institutional Dimension

No	Institutional Attributes	RMS Value	Percentage
1	Role of farmer group	6.53	20.23
2	Regulation completeness	4.43	13.72
3	Role of UPPB	4.21	13.04
4	Auction	4.18	12.95
5	Role of government institutions on smallholders' development	3.76	11.65
	Total		**71.59**
6	Role of proprietors	3.56	11.03
7	Role of farmers cooperative	3.15	9.76
8	Role of plant breeding facility	2.46	7.62
	Total	**32.28**	**100.00**

In the institutional dimension five sensitive attributes were found influencing the smallholders' plantation sustainability. They were taken from the RMS total percentage cumulative which is 71.59%. if another attribute is added, it will be over limit (82,63%), which is over the maximum cumulative value limit of 75%. Those five attributes are (1) role of farmer group; (2) completeness of regulations; (3) role of UPPB; (4) auction/bid market, and (5) role of government institution in smallholder development. These attributes were considered for the next step to create the model.

4.1.6. Level of Smallholders Plantations Sustainability. The partial analysis of the smallholders' plantation sustainability for each dimension where five dimensions have sustainability value in between 52.95 and 60.35 except for the institutional dimension which is only 20.73. Meanwhile the average stress value is 15% and the Determination Coefficient value (R^2) can be seen in Table 6.

Table 6. Sustainability value, pressure value, and determination coefficient value (R^2)

Dimension	**Sustainability Value (%)**	**Pressure Value (%)**	**Determination Coefficient Value (R^2)**
Ecology	52.95	13.73	94.60
Technology	62.35	13.10	95.47
Economy	60.18	13.64	95.30
Social	53.62	15.40	94.55
Institutional	20.73	13.75	95.25
Smallholders' rubber	53.73	12.90	95.77

Source: MDS Process

Table 6 shows that the sustainability index of the smallholders' rubber plantations in multi dimensions is categorized as **pretty sustainable** with a value of 53.73 or> 50%. The pressure value on the model is just 12.90% or <20%. Meanwhile the determination coefficient value (R^2) reaches 95.77% which means that only 4.23% that can not be explained by the model. As a whole, the result of the MDS analysis on five dimensions of smallholders' rubber plantations can be seen in Figure 13.

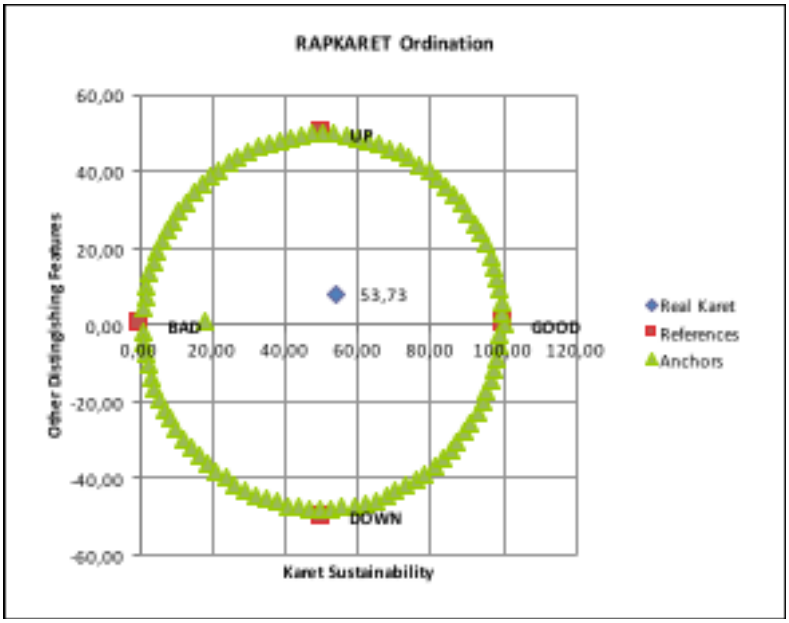

Figure 13. Index of multi dimensional sustainability of smallholders' rubber plantations

Even though the sustainability index of the smallholders' rubber plantations is categorized as *pretty sustainable*, by taking the five dimensions into account, the sustainability value of the institution dimension is considered *less sustainable* as seen in the *kite diagram* in Figure 14.

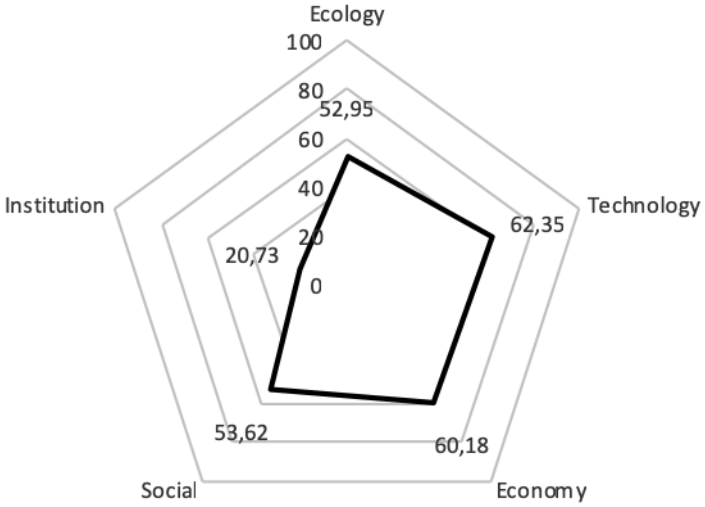

Figure 14. Five-Dimension Analysis of Smallholders' Rubber Sustainability

4.2. Discussion

4.2.1. Key Attributes of Sustainability of Smallholders Rubber Plantations in Riau. The key attributes that influence the sustainability of smallholders' plantations in Riau are considered from the development of the farmers based on the *leverage* analysis as seen in Table 7.

Table 7. Recap of key attributes influencing sustainability of smallholder rubber plantation in Riau

No	Dimension	Attributes	*Leverage*	*MDS*
1	Ecology	Rainfalls (HH	10.09	52.95
		Land size (LLK)	10.04	
		Tapping frequency (JHS)	7.43	
		Land type (JL)	5.10	
2	Technology	Knowledge ofbahan pembeku (PP)	3.45	62.35
		Knowledge ofclean smallholder's lump (PBB)	3.13	
		Knowledge ofspacing/planting time (PJT)	3.01	
		Behavior of farmers regarding clean smallholder's lump (PPBB)	2.50	
		Knowledge of PRODUCTIVE PLANTS maintenance (PPTM)	2.30	
		Knowledge oftapping techniques (PTP)	2.22	
3	Economy	Access to clean water (AAB)	3.70	60.18
		Accessto transportation (AT)	3.46	
		Debt (Ht)	2.81	
		Obstacles in Marketing Rubber (HPK)	2.06	
		Perception of food kecukupan pangan (PKP)	2.05	
		Access to rubber price information (AIHK)	1.99	
4	Social	Level of resource conflict (TKS)	3.43	53.62
		Level of labor recruitment (PTK)	0.70	
		Local wisdom and knowledge (KPL)	0.69	
		Economic facilities (FE)	0.67	
5	Institutional	Role of farmers groups (PKT)	6.53	20.73
		Regulation completeness (KA)	4.43	
		Role of UPPB (PUPPB)	4.21	
		Auction market (PL)	4.18	
		Role of government toward rubber farmers (PIP)	3.76	

There are 25 attributes identified as influential attributes on the ecology, technology, economy, social, and institutional dimension and those 25 attributes clearly affect the sustainability of the smallholders' rubber plantation in Riau. The next procedure was to determine the key attributes out of those 25 attributes which will be put into consideration in deciding the steps to create a development model for for farmers to achieve sustainable rubber business in Riau. The perpective analysis method was used to determine the key attributes.

4.2.2. Perspective Analysis. The Prospective Analysis (AP) was then conducted which was aimed to determine the positioning of the driving attributes so that the key attributes of the *driving variables* in carrying out the development of smallholders in the framework of the sustainable rubber plantation management could be found. The perspective analysis *output* was gained in the form of four quadrants which are the positioning of the driving attributes as seen in Figure 15.

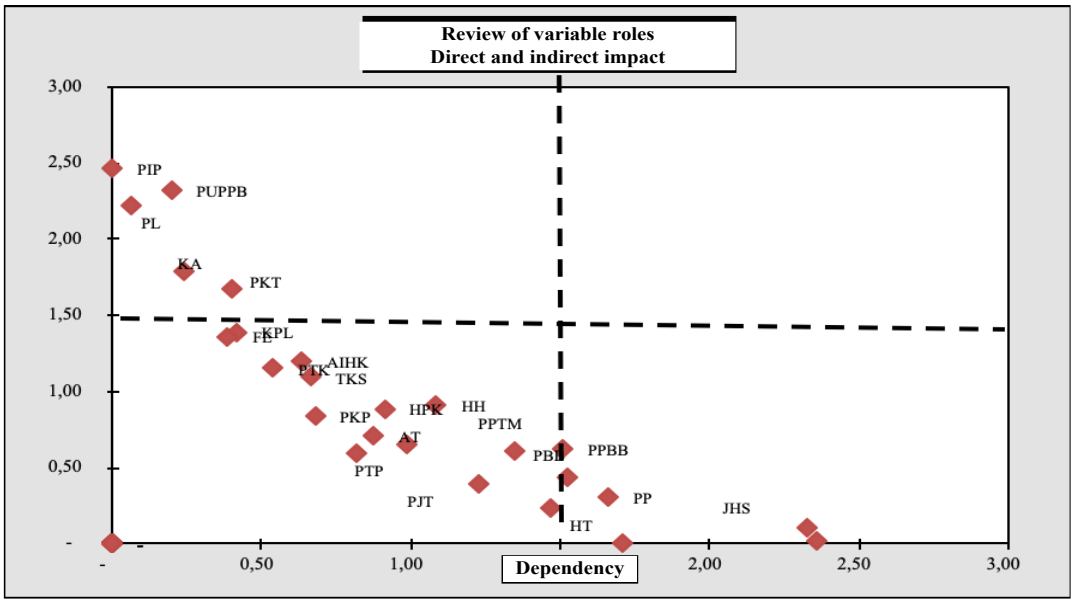

Figure 15. Graph of variable influence and dependency

Based on the participative prospective analysis, there is an indication that the five factors below determine the sustainability of the smallholder development and their correct order can be seen in Figure 15.

- Improvement of the role of the government
- Improvement of the role of UPPB
- Improvement of the role of Rubber Auction Market
- Improvement of regulation completeness
- Development of agricultural groups

5. Conclusions

From the analysis result and discussion of the previous parts, it can be concluded that:

- Based on the Multidimensional Scaling (MDS) method as a whole the smallholders' plantations are categorized as **pretty sustainable** with an index value of 53.73. Of the five dimensions, the institutional dimension is the only unsustainable dimension with an index value of 20.73 and the technology dimension is the most sustainable one. Therefore, to create sustainable smallholders' plantations good institutional management is a must.
- Based on the *leverage* analysis, there are twenty five driving attributes of the fifty attributes that influence the sustainability of the smallholders plantations, and based on the participative prospective analysis, of the twenty five driving attributes there are five which are categorized as *driving variable*s i.e. improvement of the role of the government institution, improvement of UPPB, improvement of the rubber bid/auction market, improvement of the completeness of the regulations and development of the farmer groups.

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