Sustainability Of Sugar Cane Farming In The Province East Java Indonesia

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ABSTRACT

The sustainability of sugar cane farming is a problem and a question at the moment. In order to determine the sustainability of sugarcane farming carried out by farmers, research was conducted on the sustainability of sugarcane farming in terms of the 5 dimensions of ecology, economics, socio-cultural, technological and institutional. The research was carried out using the MDS (Multi Dimension Scaling) method, which will obtain a sugarcane farming sustainability index value. Research locations in 4 locations Sidoarjo Regency, Tulungagung, Ngawi, Situbodo. Data was taken from 120 samples, 30 samples from each district. The results of the MDS-Rapfish analysis showed that sugarcane farming in East Java was quite sustainable with an index of 52.73%. Sustainability index for Sidoarjo Regency 67.12%, Tulungagung 52.98%, Ngawi 44.63%, Situbondo 56.23%.

Keywords: Sustainability, Sugarcane Farming, Sugarcane Farmer Business

INTRODUCTION

Sustainable Development Goals (SDGs) are a set of goals set by the United Nations (UN) to overcome various global challenges and achieve sustainable development. Sustainable Development Goals (SDGs) have been a central issue since 2016. The SDGs, which contain 17 Goals and 169 Targets, are a global action plan for the next 15 years (valid from 2016 to 2030), to end poverty, reduce inequality and protect the environment. SDGs apply to all countries (universally), so that all countries without exception, developed countries have a moral obligation to achieve the SDGs goals and targets. The agricultural sector has an important role in achieving several SDGs goals. In Indonesia, the agricultural sector is one of the main pillars supporting national economic development. In reality, the agricultural sector is not only a provider of food for 273 million people, but also a provider of employment opportunities and a source of household income, especially for people living in rural areas. In

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sustainable agricultural development, the implementation of policies, programs and activities always pays attention to harmony between social, economic and environmental aspects. The social dimension pays attention to the rights and interests of farmers, including small scale farmers and agribusiness actors to improve welfare. The economic dimension is related to increasing productivity and profitability with the principles of efficiency and competitiveness. The environmental dimension is related to the use of resources that apply the principles of environmental sustainability and sustainability, so that they can be passed on to the next generation with higher production capacity.

Sugar cane is one of the commodities whose sustainability is maintained and developed because it is a valuable need for many people. Sugarcane, as a raw material for making sugar, has so far not been able to meet people's needs. Every year it always imports. The development of sugar cane production in East Java for 10 years (2012 – 2021) shows a trend of decreasing sugar cane area and production. Sugarcane commodity income must compete with income from rice and corn crops. Sometimes in various locations, sugar cane plants cannot compete with rice and corn plants. The sustainability of sugar cane farming is a problem in the sugar self-sufficiency program. In order to determine the sustainability of sugarcane farming carried out by farmers, research was conducted on the sustainability of sugarcane farming in terms of the 5 dimensions of ecology, economics, socio-cultural, technological and institutional.

MATERIALS AND METHODS

The research was carried out using the MDS (Multi Dimension Scaling) method, through analysis on computer applications. The research was carried out in 4 locations in the districts of Sidoarjo, Tulungagung, Ngawi, Situbodo, on a sample of 120 farmers, 30 samples from each district.

RESULTS AND DISCUSSION

The results of the analysis are presented in the following order; (1) Ordinate of sustainability of sugarcane farming, (2) Index of sustainability of sugarcane farming, (3) Kite diagram, (4) Attributes of levers of sustainability of sugarcane farming.

Ordinate for the sustainability of sugarcane farming

The results of the analysis are presented in the following order; (1) Ordinate of sustainability of sugarcane farming, (2) Index of sustainability of sugarcane farming, (3) Kite diagram, (4) Attributes of levers of sustainability of sugarcane farming. The sustainable position of the farm is visualized on the ordinate, through the horizontal and vertical axes with a rotation process. The position of sustainability is on the horizontal axis with the sustainability index value given a score of 0% (bad) and 100% (good). If the system being studied has a sustainability index value greater than or equal to 50%, then the system is said to be sustainable; conversely, the system will not be sustainable if the index value is <50%. Kavanagh (1991) states that the index for each dimension is categorized as follows: index value 0-25.00% (unsustainable category) - index value 25.01-50.00% (less sustainable category) - index value 50.01- 75.00 % (fairly sustainable category) and - index value 75.01-100 % (sustainable category).

In Figure 1 below it can be seen that the ecological ordinate position of Sidoarjo district is in the area > 60, which falls into the criteria of being quite sustainable. Likewise, Tulungagung and Situbondo Regencies are in areas 50 – 60, in areas that are quite sustainable. Meanwhile, Ngawi district is in position 40 - 50 which is the less sustainable category.

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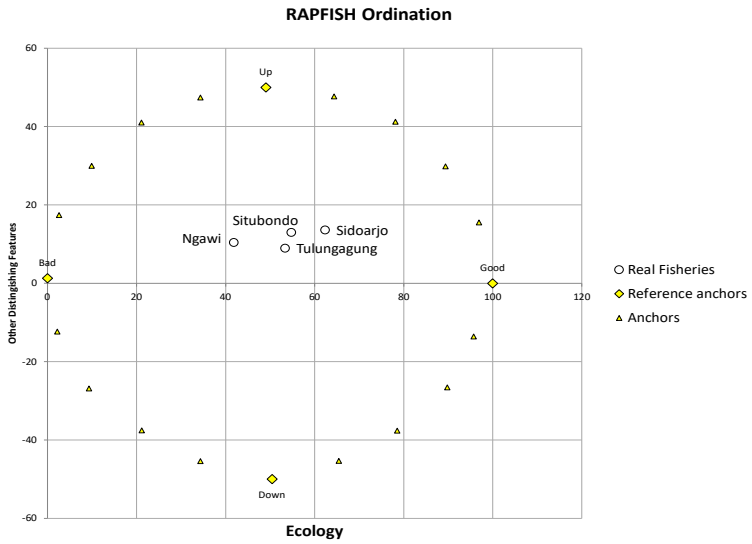
Figure 1. Ecological Ordinate for Sugarcane Farming Sustainability



As for Figure 2, it shows that the economic ordinate position of Situbondo, Tulungagung, Sidoarjo districts is in the area > 60, which is considered quite sustainable. Ngawi Regency, in area 50 – 60, is in a fairly sustainable area, as follows:

Figure 2. Economic Ordinate of Sugarcane Farming Sustainability

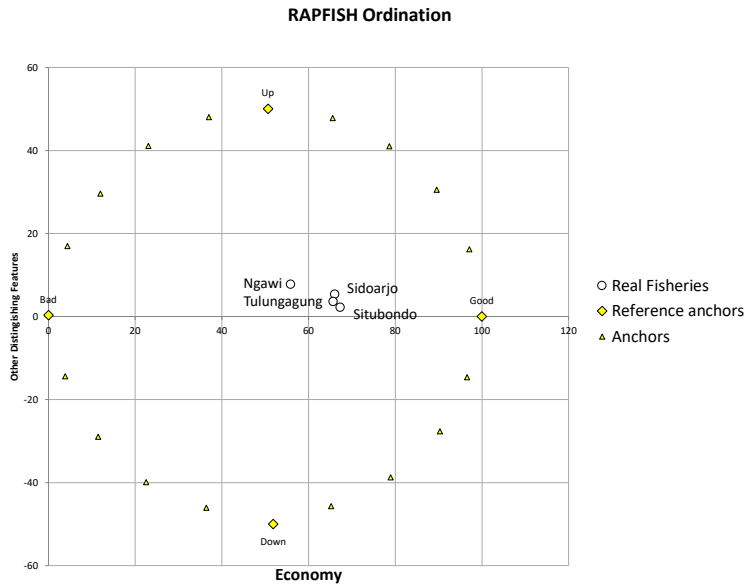


Figure 3 shows that the socio-cultural ordinate position of Situbondo district is in the area > 60, which is considered quite sustainable. Likewise, Tulungagung, Situbondo and Ngawi regencies are included in fairly sustainable areas in positions 50 – 60, as follows:

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Figure 3. Socio-Cultural Ordinate for Sustainability of Sugarcane Farming

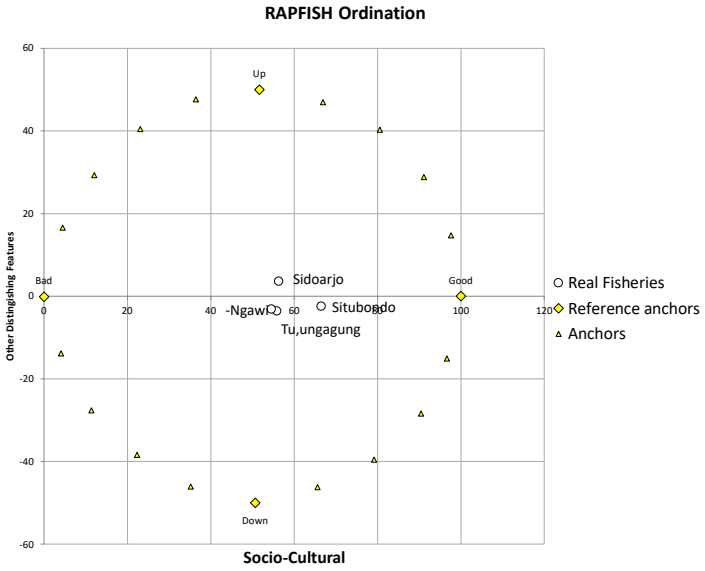

Figure 4. Technology Ordinate for Sugarcane Farming Sustainability

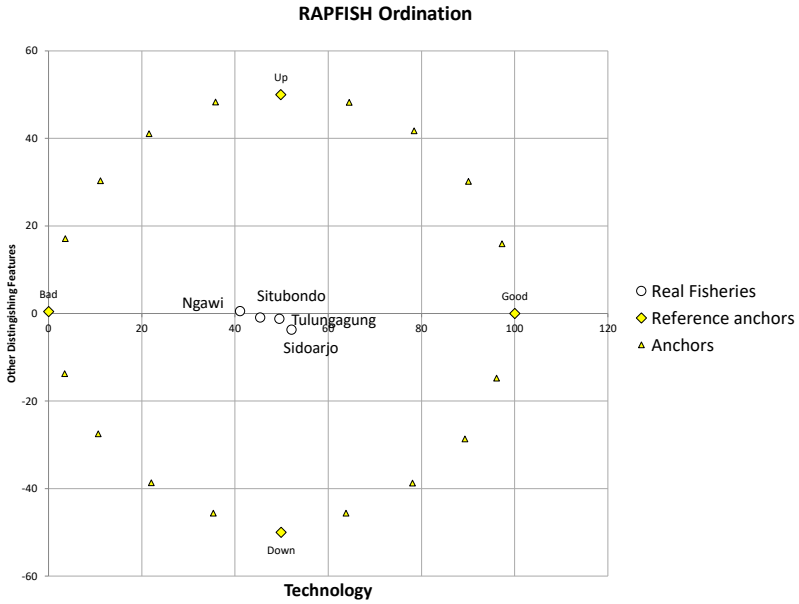

Figure 4 shows that the technological ordinate position of Sidoarjo district is in the 50 - 60 area, which is considered quite sustainable. Tulungagung Regency, Situbondo, Ngawi, is in the 40 – 50 area in the less sustainable criteria as follows:

Figure 5. Institutional Ordinate for Sustainability of Sugarcane Farming

Figure 5 shows that the institutional ordinate position of Sidoarjo, Situbondo, Tulungagung, Ngawi districts is in the 40 – 50 area in the less sustainable criteria, as follows:

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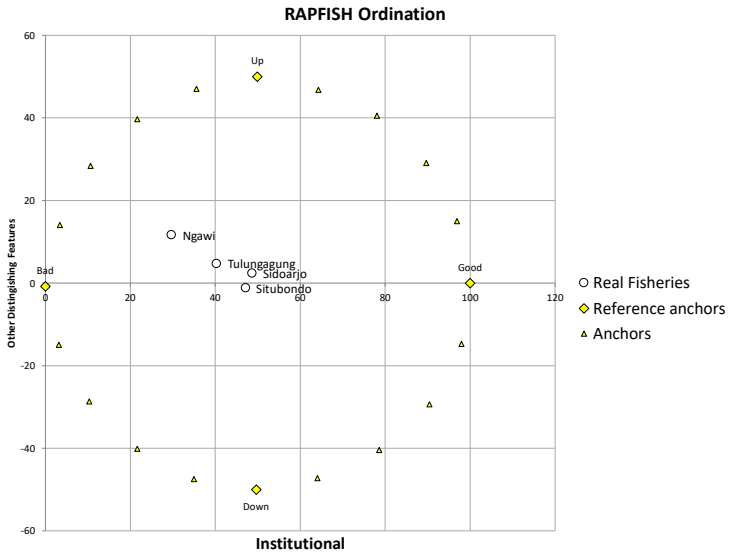

Kite diagram of sugarcane farming sustainability

As the name suggests, a multidimensional scaling kite diagram is a kite-shaped diagram, combining sustainability indices into a radar image. In the diagram the resulting cross-sectional area, connecting all dimensions, shows the overall sustainability index. Fisheries that have the largest area are districts that have a high sustainability index. Apart from seeing more clearly the sustainability index of each fishery, you can also see the dimensions of each fishery, its ordinate position and its sustainability index value.

Figure 6. Kite diagram of sugarcane farming sustainability

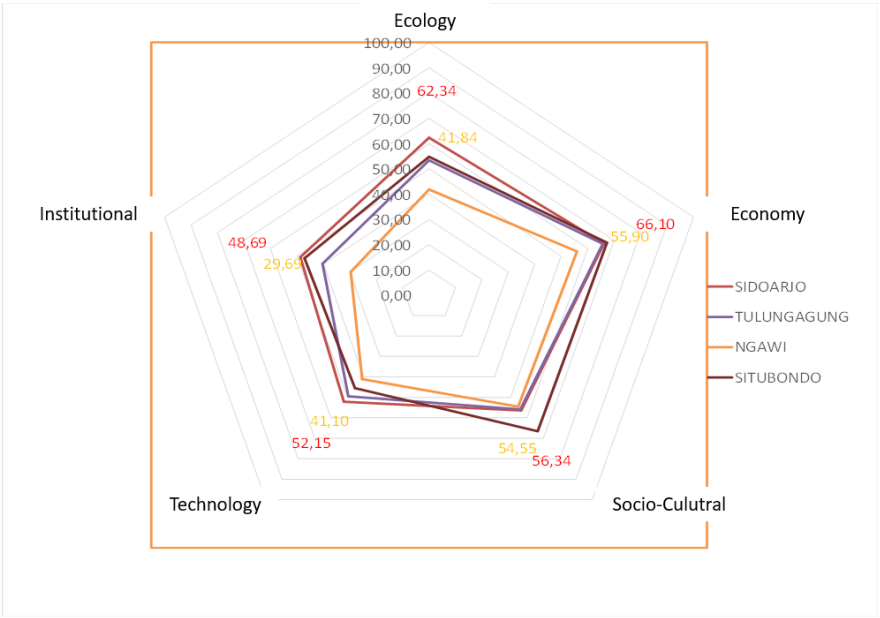

Figure 6 shows that Sidoarjo district has the largest area, among all other districts. Occupies the ordinate position of ecology 62.34, economy 66.10, socio-culture 56.34, technology 52.15, institutional 48.69. Meanwhile, Ngawi district has the narrowest area at the ecological ordinate position 41.84, economic 55.90, socio-cultural 54.55, technological 41.10, institutional 29.69. The size of the kite area indicates the level of sustainability. Sidoarjo Regency has the highest

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sustainability index value of 57.12 with fairly sustainable criteria, then Situbondo Regency with a score of 56.23 is quite sustainable, Tulungagung Regency is 52.96 is quite sustainable, and Ngawi Regency is 44.62 with less sustainable criteria.

Sugarcane farming sustainability index

The farming sustainability index is an instrument used to measure farming sustainability, in units of % (percent). The results of the analysis of the sustainability index in 4 districts in the ecological, economic, socio-cultural, technological, institutional dimensions, obtained the sustainability index for sugarcane farming in East Java as shown in the following table:

Table 1. Sugarcane Farming Sustainability Index

Fisheries	Sustainable Index					
	Ecology (%)	Economy (%)	Socio-cultural (%)	Technology (%)	Institutional (%)	Average (%)
Sidoarjo	62,34	66,10	56,34	52,15	48,69	57,12
Tulungagung	53,36	65,73	55,84	49.52	40,34	52,96
Ngawi	41,84	55,90	54.55	41,10	29,69	44,62
Situbondo	54,76	67,32	66,49	45,46	47,14	56,23
Rerata	53,07	63,76	58,31	47,05	41,46	52,73*

Note: 0 – 25 % = Not sustainable; 25.1 – 50 % = Less sustainable 50.1 – 75 % = Sufficiently sustainable; 75.1 – 100 = Sustainable *East Java average

Attributes of levers of desire for sugarcane farming

Leverage attributes are attributes that play a role in increasing the highest root mean square compared to other attributes on the same dimension. Leveraging attributes are defined as attributes that are sensitive to interventions that can be carried out on these attributes to increase their sustainability. In other words, if these sensitive attributes are intervened with appropriate activities, it will increase the sustainability index. The results of the leverage analysis from the ecological, economic, socio-cultural, technological and institutional dimensions are described as follows:

Figure 7. Lever Attributes in the Ecological Dimension

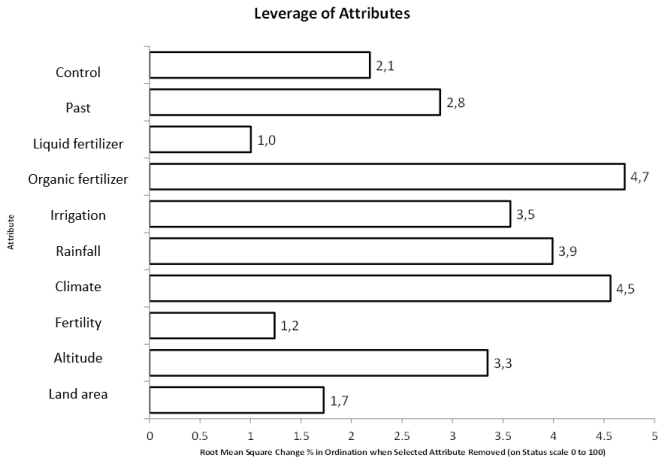

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Figure 7 shows that the results of the leverage analysis in the ecological dimension, it was found that the leverage factors were organic fertilizer, climate suitability, irrigation. If these lever attributes are intervened, the ecological sustainability index of 53.07 will increase. (1) The attribute of organic fertilizer is the main leverage factor because research results show that no or rarely do farmers use organic fertilizer to grow sugar cane. According to Andyana (2012), organic fertilizer is the result of the decomposition of organic materials which are broken down (broken down) by microbes, the final result of which can provide the nutrients needed by plants for their growth and development. (2) The results of the leverage analysis show that climate suitability is a lever factor that is sensitive to changes in sustainability. Sugarcane plants that grow in appropriate climate zones will increase the sustainability of sugarcane farming. (3) Irrigation is a leverage factor because sugar cane plants need quite a lot of water, especially at the beginning of growth until the vegetative period stops. Water is needed to fill the stem, so that it enlarges and grows to its maximum height as long as there is water.

Figure 8. Lever Attributes in the Economic Dimension

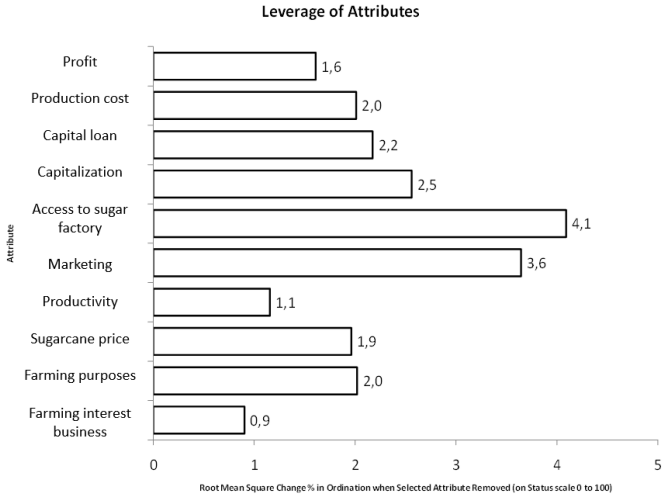

Figure 8 shows that the results of the leverage analysis in the economic dimension show that the leverage factors are farmers' access to import sugar cane into sugar factories, ease of marketing, and capital. If these lever attributes are intervened, the economic sustainability index of 63.76 will increase. (1) Farmers' access attributes to import sugar cane into the sugar factory are suspected to be substandard. The reality on the ground is the main leverage factor because only farmers who carry out partnership cooperation have good access to get sugar cane into the sugar factory. Other farmers can still do so, through trusted people, brokers, sugar cane entrepreneurs, farmer groups, community leaders who are widely known by the Sugar Factory. (2) Sugarcane marketing is a lever for the smooth process of sugarcane getting to the market (cutting and transporting system), as well as price setting by the government and real prices in the field. (3) Capital attributes are also a lever for sustainability in the economic dimension. As the definition of capital is the availability of funds, assets as the parent/principal that can be used for business, it plays a vital role in sugar cane farming.

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Figure 9. Leverage attributes in the socio-cultural dimension

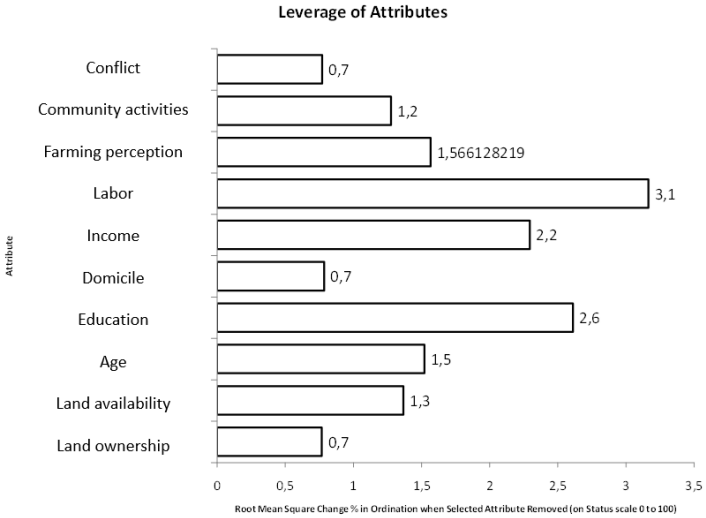

Figure 9 shows that the results of the socio-cultural dimension leverage analysis show that the levers are labor, education and farmer income. If these lever attributes are intervened, the socio-cultural sustainability index of 58.31 will increase. (1) The labor attribute which is a leverage factor is an indication that sugar cane cultivation requires specific labor, having certain skills. (2) The farmer's education factor is a lever for the socio-cultural dimension because it is implied that educational background determines the lack of social skills. According to Rahmawati (2012), social skills are the ability to interact in a social context in a specific way that is acceptable to society. These include participating, collaborating, accepting differences, following rules, respecting yourself and others, being polite, complying with local cultural ethics, and so on. (3) Factors that leverage farmers' income in the socio-cultural dimension, relating that income determines farmers' welfare. Income that cannot improve the welfare of farmers will hamper social dynamics.

Figure 10. Lever Attributes in the Technology Dimension

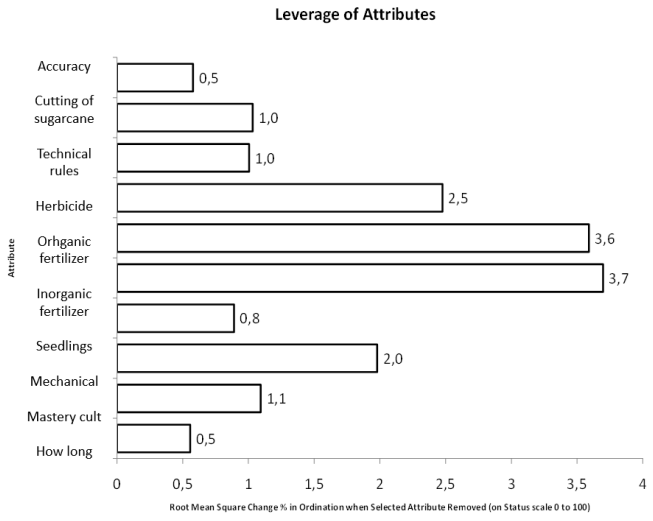

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Figure 10 shows that the results of the technology dimension leverage analysis show that the leverage factors are inorganic fertilizers, organic fertilizers, pesticides. If the leverage attribute is intervened, the technology sustainability index of 47.05 (less sustainable) will increase. (1) Inorganic fertilizer is part of the technological elements that are important for plant growth, so that they are able to provide production in accordance with their potential. (2) Organic fertilizer is a lever for increasing the sustainability index. This is in accordance with the role of organic fertilizer as a soil fertilizer. (3) Farmers usually use herbicides to control weeds. The application is easy and requires relatively cheaper costs compared to weeding by labor.

Figure 11. Lever Attributes in the Institutional Dimension

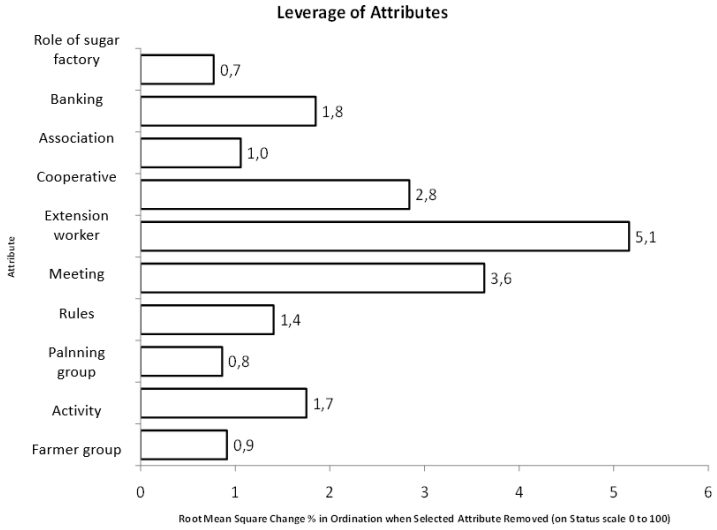

Figure 11 shows that the results of the institutional dimension leverage analysis show that the leverage factors are instructors, group meetings and the existence of cooperative institutions. If the lever attribute is intervened, the technology sustainability index of 41.46 (less sustainable) will increase. (1) Extension agents are government employees assigned to provide assistance to farmers. Providing counseling about farming, discussing in groups, providing examples of cultivation according to technical standards, visiting farmers' land, etc. (2) Group meetings serve as a vehicle for joint learning between farmers, becoming a rehearsal space so that the group becomes active and dynamic. (3) The role of cooperatives is very important in bridging farmers in accessing production inputs, providing capital, counseling, and as a forum for togetherness in accessing markets to sugar factories.

Monte Carlo Simulation

Monte Carlo simulation is a technique of predicting the likely outcomes of uncertain events. Rapfish output is assessed from Monte Carlo analysis, Stress values, and Coefficient of Determination (R2) values. The sustainability value output is said to be good if (1) the difference between the sustainability index and Monte Carlo values is < 1, (2) the Stress value is < 0.25, (3) the R2 value is > or equal to 95%, so that the quality of the MDS analysis can be accounted for. The conclusion is that the sustainability of sugar cane output modeling through

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Multi Dimensional Scaling - Rapfish can be used to represent conditions regarding the sustainability of sugar cane farming in East Java, as in the following table:

Table 2. Difference in Monte Carlo vs MDS

Difference Monte Carlo vs MDS						
No	Fishers	Ecology	Economy	Socio-Cultural	Technology	Intitutional
1	Sidoarjo	0,1	0,7	0,1	0,1	0,1
2	Tulungagung	0,1	0,6	0,2	0,2	0,1
3	Ngawi	0,3	0,3	0,1	0,3	0,9
4	Situbondo	0,3	0,4	0,1	0,2	0,1
Kebaik-modelan						
1	Stress Value	0,153	0,159	0,158	0,166	0,151
2	RSQ Value	0,952	0,947	0,945	0,945	0,950

CONCLUSIONS AND SUGGESTION

The results of the MDS-Rapfish analysis showed that sugarcane farming in East Java was quite sustainable with an index of 52.73. Sustainability index for Sidoarjo Regency 67.12, Tulungagung Regency 52.98, Ngawi Regency 44.63, Situbondo Regency 56.23.

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