Analysis of the Sustainable Status of Post Disaster Crop Production in Sigi Regency, Central Sulawesi Province

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Submission date: 20-Dec-2021 11:14AM (UTC+0700)
Submission ID: 1871951123
File name: Crop_Production_in_Sigi_Regency,_Central_Sulawesi_Province.docx (1.23M)
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To cite this article: Muksin *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **672** 012031

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Analysis of the Sustainable Status of Post Disaster Crop Production in Sigi Regency, Central Sulawesi Province

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Abstract. Sigi regency is the main rice supplier for Central Sulawesi Community. Yet the condition of paddy commodity sector in period 2012-2017 faces a decline in harvested area by 5.3%/year. In the conditions after the natural disaster in 2018, it is more decreased, due to the condition of agricultural land which tends to be damaged and bumpy. The study discusses the status of the sustainability of crop production in Sigi Regency using Multi-Dimensional Scaling analysis. The results of the analysis show that the status of sustainability is "moderately sustainable" with a composite value of 59.44. Policy intervention is conducted based on the main leverage factors. In moderate intervention, the status value was increased by 15% and the result was still 'quite sustainable'. Meanwhile, the optimistic intervention was increased by 28% and the result was "sustainable". The policy strategy for increasing the sustainability of crops includes the main leverage factors, such as: 1) The management pattern of paddy fields is changed to a corporate farming, 2) Protecting poor farmers by increasing and optimizing timely and targeted assistance, 3) Increasing environmental counseling and marketing, 4) Increasing the extension program on the importance of health infrastructure, and 5) Maintaining an optimal extension center.

1. Introduction

Sigi Regency is a central area that has been supplying rice for the needs of the Central Sulawesi People. Besides rice, there are also other commodities such as shallots, sweet corn, tomatoes, chilies and coconut. So far, Sigi Regency has been able to give a contribution to the Provincial Government to support the food self-sufficiency program. However, in 2012-2015, the harvested area of paddy commodities in agricultural sector of Sigi regency decreased by 5,3% per year, and plantation sector, especially coconut decreased by 1,4% per year [1]. In the post-natural disaster condition in 2018, it is expected to decline.

After the earthquake, tsunami, and liquefaction, the condition of agricultural land tends to be damaged, bumpy, and muddy. Surely, it made agricultural activities stop because some agricultural land could not be replanted so that many farmers lost their jobs. According to [2] it can increase the level of poverty, therefore to prevent it, expand employment in the agricultural sector, increase the agro-industry sector, and stabilize prices are needed. Regarding the problems mentioned, various programs have been done, such as clearing agricultural land, building irrigation wells, and planting tomato, shallot, corn, and

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chili seeds. Besides, there are also economic aids in the form of distribution of agricultural and fishery assistance to farmers and fishermen and their families. Overall, these aids are classified as short-term economic assistance and need to be gradually increased towards holistic and long-term development, so that the implementation of post-natural disaster agricultural sector development programs should lead to sustainable development.

The sustainable development approach is essentially a development activity that combines economic, social, environmental, infrastructure, and technology as well as legal and institutional dimensions [3]. Research that combines these dimensions has been conducted in various fields / sub-sectors, including the food sector [4], the forestry sub-sector [5], and the agricultural sector [6] and [7]. Integrated agricultural sector management can be used as a strategy to build potential of the agricultural sector that faces a decline. Therefore, the social, economic, ecological, infrastructure, and technological as well as legal and institutional dimensions can be integrated into the process of increasing the sustainability of the agricultural sector.

To overcome the management of agricultural resources that increasingly threaten these aspects of sustainability, this research tries to find a solution by formulating a policy scenario for the sustainable development of the agricultural sector. The role of the agricultural sector is very dominant compared to other sectors in the formation of GRDP of Sigi Regency in 2017 was 44.28%, this indicates that the amount of products produced from the agricultural sector is higher than other sectors [8]. The purpose of this research is 1) knowing the condition of the sustainable status of the agricultural sector in Sigi Regency after the natural disaster, and 2) formulating a scenario for the sustainable development of the agricultural sector in Sigi Regency. Based on these objectives, the stages of the research method were designed as follows: 1) detecting the level of sustainability using Multidimensional Scaling (MDS) analysis and 2) building a strategic scenario for the sustainable management model of the agricultural sector based on leverage factors.

2. Literature Review

2.1. Sustainable Agriculture as an Integrated Viewpoint Approach

The sustainable agriculture approach is a perspective that integrates social, economic, and environmental aspects in synergy. The concept of a sustainable economy is based on efforts to maximize income by maintaining a reserve of resources that can generate a profit. Efficient use of scarce sources is a must for facing uncertainties. Meanwhile, the concept of sustainable social orientation is human-oriented and the relationship between social stability and cultural systems, including efforts to reduce damage by social conflicts. The main focus of the social aspect is long term and sustainable equity, preservation of cultures, and enhancement of local knowledge. The sustainable environmental aspect prioritizes efforts to maintain environmental system stability with a focus on maintaining the survival of each subsystem. According to [9], sustainable agriculture is the best and integrated solution for the problems of soil conditions that get worse, pollution, farmer debt, and health problems due to intensive use of pesticides. The sustainable agricultural pattern, in this case, consists of 1) Using of mixed farming systems, with the most complementary crops such as long beans and chilies, 2) reducing the use of chemical fertilizers and pesticides, and 3) applying the knowledge that is taken from training and improving production system management.

The three mentioned aspects are related to one another. The interconnectedness of economic and social aspects refers to economic growth that is evenly distributed across all social levels in society and prevents economic disparities and social stratification. The relational link between economic and environmental aspects is intended so that economic activities do not have an impact on negative externalities on the environment. Environmental aspects should be involved in every action and decision related to economic aspects. As for the relational link between social and environmental aspects, it tends to improve the quality of life equally and increase society's participation in environmental conservation.

2.2. Multidimensional Scaling (MDS) is an Effective Measurement Tool for Analyzing the Sustainability of the Agricultural Sector

MDS is a statistical analysis to determine the similarity and dissimilarity of variables that are depicted in geometric space. [10] Furthermore, MDS analysis was used to assess each attribute on an ordinal scale based on the sustainable criteria of each dimension. Ordination analysis based on the MDS method, is used to compile an index and status of the current state of sustainability, both in general and in each dimension.

The score value of each attribute on each dimension is analyzed in a multi-dimensional manner to determine one or more points that reflect the position of the sustainable development of the agricultural sector under study relative to two reference points, namely the "bad" point (bad) and the "good" point (good). The sustainable index value has a range of 0% -100% using a scale developed by the University of Columbia, Canada as illustrated in Figure 1.

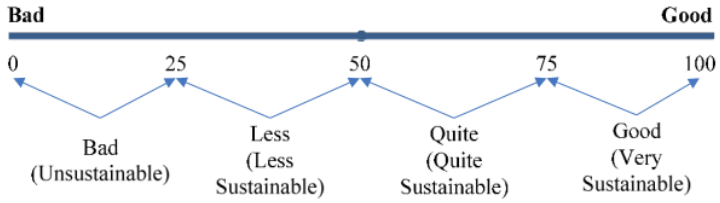

Figure 1 Two Points of Reference for Bad and Good

Furthermore, the Ordination Analysis is intended to facilitate the visualization of this position. This analysis can also be used for only one dimension including all the attributes of that dimension. The analysis results will reflect the extent to which the status of the dimension is sustainable. If the analysis each dimension has been conducted, the comparative analysis of the inter-dimensional sustainability can be visualized in the form of a kite diagram.

Evaluation of the effect of random errors in the process of estimating the value ordination of resource functions in the agricultural sector, using the Monte Carlo analysis, that is useful for learning several things, such as: 1. The error effect of attribute score making that is caused by the imperfect understanding of research location or misunderstanding to attribute or how the score attribute makes.; 2. The effect of the variation in scoring due to differences in opinion or judgment by different researchers; 3. Stability of the iteration of the MDS analysis process; 4. Errors in data entry or missing data; 5. The high "stress" value resulting from the sustainable analysis, the "stress" value can be accepted if <25% [11].

MDS analysis with the Rapfish tool has shown better usability and is continuing to be developed. Research [12] indicates that the Rapfish which is described in this paper has show better usability in comparing the sustainable status of fisheries, and also gives evaluation to the potential impact of alternative policies on that status. This includes and systematizes a much broader range of evaluations an conventional assessments. Additional Rapfish analyzes are in development especially on the use of new evaluation aspects, such as energy consumption. The recent update concerning more for formal uncertainty analyzes, which reflect a different opinion in attribute scoring and Monte Carlo simulation using from input of attribute score range, are in development.

3. Material and method

The research was conducted at a food plant production center in Sigi Regency with a purposive sampling consisting of 12 sources from government, practitioners, and farmers. The sample in this study is a source that can provide reliable information about the existing dimensions. The sample is determined with certain considerations, such as the person who is considered the most knowledgeable about the expected information or influential people, so that it makes researchers easier to get the information needed.

3.1. Research Stage

1. Analyze the condition of the sustainable status of the agricultural sector.
2. Identify the attributes of leverage as the basis for determining the solution to the problem.
3. Develop strategic scenarios for the development of sustainable agricultural sector policies.

3.2. Research Methods

1. Detecting the level of sustainability uses Multidimensional Scaling (MDS) analysis. Through the MDS method, the sustainable index value of each dimension (economic, social and cultural, ecological, legal and institutional and infrastructure and technology) can be visualized in the form of a kite diagram.
2. After the MDS analysis and the sustainable index, an analysis of the leverage attributes is conducted to determine the attributes that contribute to the sustainable value. This leverage analysis is used to see changes in attributes in the output of the MDS analysis. The effect of each attribute is seen in the form of change in root mean square (RMS) [13].
3. The final stage is to build a strategic scenario for a sustainable agricultural sector management model. This scenario is a combination of key variables that may occur in the future. In this study, scenarios are grouped into three scenario clusters, such as the pessimistic, moderate, and optimistic scenarios.

4. Result and discussion

4.1. Data Collecting

Data collection was conducted through in-depth interviews and observations. The data was collected using a questionnaire with stakeholders from the Sigi Regency Government, practitioners, and farmers. The data obtained is then finalized by academic experts to determine the final answers from the sources.

4.2. Data Processing

Research data processing was conducted in Multi-dimensional Scaling (MDS) format with the help of a Rap-fish device which was modified into Rap-food. The results of data processing can be seen in Table 1.

Tabel 1 Sustainable Index Data Processing Result of Crops

DIMENTION	WEIHGT	DIMENTION STATUS	MONTE-CARLO	DELTA	RSQ	STRESS
Social	0,251	73,23	71,34	1,89	0,946	0,134
Economic	0,180	52,48	52,05	0,43	0,952	0,137
Enviroment	0,189	55,35	54,87	0,48	0,952	0,137
Infrastructure dan Technology	0,181	52,84	52,839	0,001	0,949	0,131
Legal and Institutional	0,199	58,27	57,57	0,7	0,946	0,131

On the Table 1 is shown the difference between processing data of dimension status and monte carlo is not more than 5 %. It means error impact that affects overall processes analysis of MDS method is categorized as small. RSQ value can be accepted because every dimension is more than 0,6. It shows that model can be accepted for describing the sustainable status of post-disaster crop production in Sigi regency. It is also supported by stress value, while the stress value that is occurred close by 0 in every dimension. It shows that the model obtained can be stated as perfect. So that, it can be used in applying sustainable status of post-disaster crop production in Sigi regency.

4.3. Data Analysis

The results of data analysis based on data processing using Rapfish are presented in the form of a kite diagram. Based on the conditions of the key factors and possible future changes in the management of sustainable vannamei commodities, the kite diagram develops as shown in Figure 4.1.

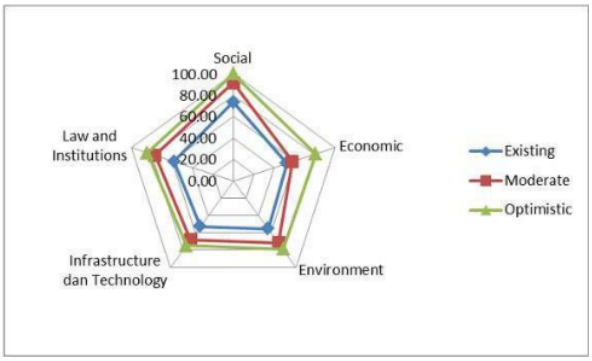

Figure 2 Kite Diagrams for Sustainability Index in Existing, Moderate and Optimistic Scenarios

Sustainable index for all dimensions are grouped as 'quite sustainability' with different values, are social dimension 73,23, economic dimension 52,48, environmental dimension 55,35, technology and infrastructure dimension 52,48, and legal and institutional dimension 58,27. Likewise, sustainable status data analysis of multidimensional is 59,44 (quite sustainability).

4.4. Social Dimension.

Social dimension is good enough from sustainable status by value 73,23 (picture 4.2) Leverage factor that affects this dimension is rice filed processing pattern by value 11,09 and community development by value 6,57. Both factors are important because they have an important role to determine the sustainability of crop agriculture in the future.

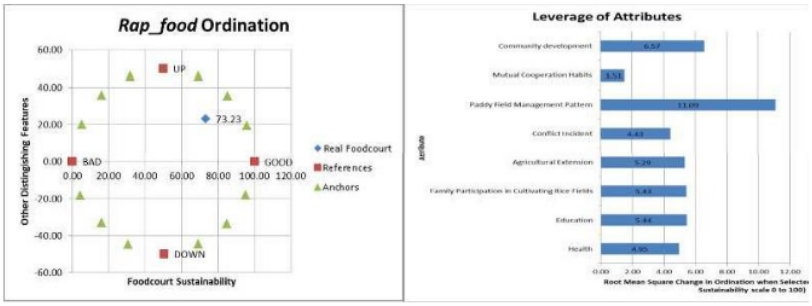

Figure 3 Sustainable Status and Leverage Attribute of a Social Dimension

Rice field processing pattern is important for crop agricultural value in long term to control the use of agricultural field resources optimally, maximize crop harvest production, and maintain the field well.

Yet, in Sigi Regency, all farmers use rice field processing patterns individually. It shows that the harvest production is not maximum.

4.5. Economic Dimension.

The analysis result of sustainable economic dimension status is still quite sustainability by value 52,48%, yet this sustainability needs to be maintained by seeing the leverage factor because of value range to the change close by 50. Sustainable status and economic dimension leverage attribute is shown in picture 4.3.

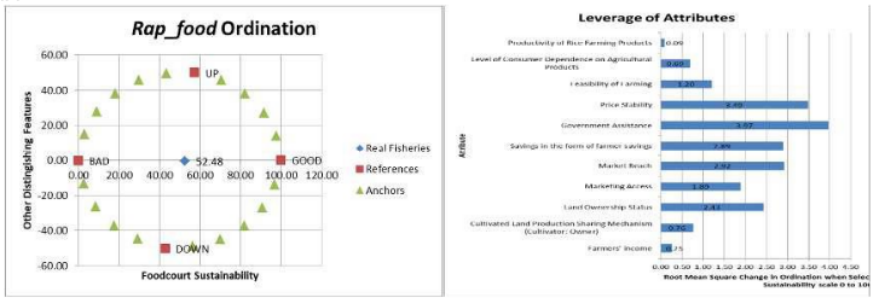

Figure 4 Sustainable Status and Leverage Attribute of Economic Dimension

Economic Dimension is significantly affected by government assistance factor by value 3,97 and stability value 3,49. Therefore, from economic aspect, both factors are important because they determine the sustainability of crop agriculture in the future. Government assistance factor is important because the existence of poor farmers is high and farmer income doesn't cover the production cost. It is caused by the declining agricultural field. The good assistance that can be given is the fulfillment of timely and targeted assistance and also input production assistance (Saprodi) is needed.

4.6. Environmental Dimension.

The status value of environmental dimension sustainability is 55, 35 grouped by quite sustainability criteria, this value needs to be maintained by seeing the leverage attribute because it is susceptible to change and value close by 50. Sustainable status value is better than social dimension (Figure 5)

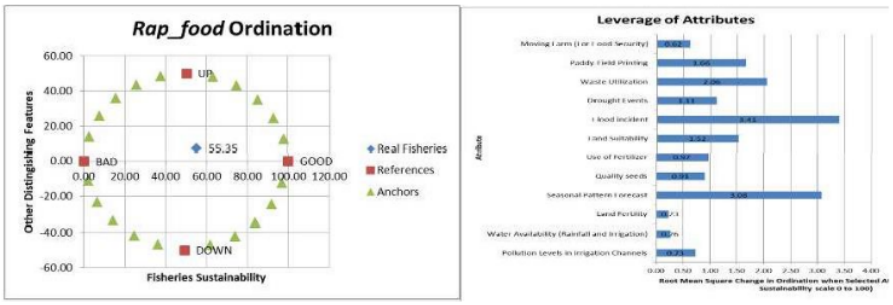

Figure 5 Sustainable Status and Leverage Attribute of Environment Dimension

Flood in Sigi regency is usually happened, it causes most of agricultural production is crop failure. Flood is caused by illegal logging and housing development more expand. The solution is to give counseling to avoid flood in rainy seasons and productive seed that is appropriate for post-flood field or location.

4.7. Technology and Infrastructure Dimension

Sustainable status of infrastructure and technology dimension include in enough category by value 52,84, yet this dimension needs to be maintained by seeing leverage factor because the values close by 50 or susceptible to change (picture 4.5)

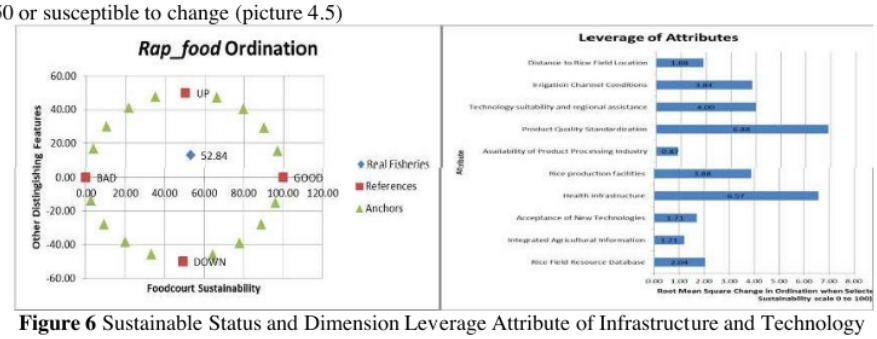

Figure 6 Sustainable Status and Dimension Leverage Attribute of Infrastructure and Technology

Dimension leverage attribute of infrastructure and technology is a standardization of quality product-related Good Agriculture Practice that has not been applied. Only a few farmers know about GAP, so that evaluation is needed for any agricultural improvement programs especially GAP (formulating GAP, Applying GAP, and giving certification to agriculture product) which the purpose is to give product improvement and other activities. GAP also has a purpose to improve innovation of plantation technology that can increase production, such as the use of quality seed that can be adjusted with climate conditions, also increase the GAP knowledge. According to [14] and [15] the application of GAP needs to be strengthened by the application of a quality management system at the level of the production process. With a quality production process, a quality product will be produced.

4.8. Legal and Institutional Dimension.

The sustainable status value of Legal and institutional dimension are categorized 'quite sustainability' by value 58,7, likewise infrastructure dimension and technology, this dimension needs to be maintained by seeing the leverage factor because the value is close by 50 or susceptible to change (Picture 4.6)

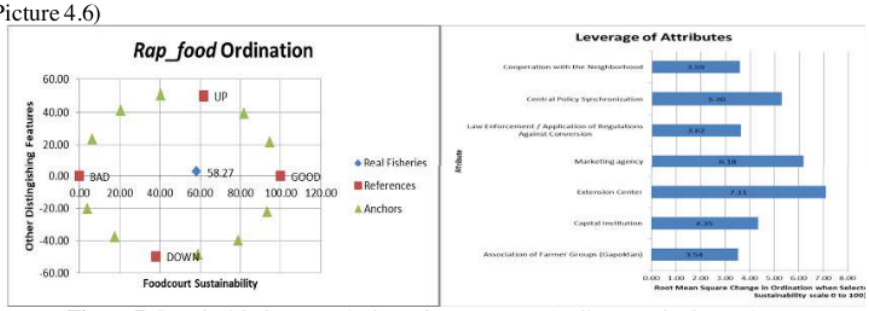

Figure 7 Sustainable Status and Dimension Leverage Attribute Institution and Law

Dimension leverage attribute of Legal and Institutional are extension programs, where agricultural extension in Sigi Regency that so far optimally work are needed to keep operate and develop more in the future.

5. Conclusion

The crop agricultural condition after earthquake and liquefaction in Sigi Regency is in 'quite sustainability' category. Multidimensional scaling shows that estimating leverage attributes is needed, such as: rice field processing pattern, government assistance, avoid flood, standardization of quality product, and extension program. The solution that can be taken based on leverage attribute is: conducting field processing in a group, increasing government assistance especially the fulfillment of timely and targeted saprodi assistance, giving knowledge to avoid flood in rainy seasons, applying GAP, and maintaining agricultural extension to keep operating.

6. Acknowledgments

The authors acknowledge the financial support from DRPM KEMENRISTEKDIKTI, Jakarta, Indonesia and the author also thanks to the Center for Research and Community Service at the Politeknik Negeri Jember for facilitating international seminars.

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