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Sustainable Development Strategy to Alleviate Disadvantaged Regions in Indonesia

Siti Khoeriyah[1*], Aulia Hapsari Juawita[2], Marselinus Nirwan Luru[3], Emma Rahmawati[4] and Anang Dwi Purwanto[4]
1 Doctoral Program in Regional and Rural Development Planning, IPB University
2 Faculty of Economics and Business, Sebelas Maret University
3 Faculty of Landscape Architecture and Environmental Technology, Trisakti University,
4 National Research and Innovation Agency (BRIN)of Indonesia
** Corresponding Author, Email: sitikhoeriyah41@gmail.com*

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Keywords: Disadvantaged Region, Sustainability, Indonesia, RAPFISH, SDGs

Abstract: Development gaps between regions are still a problem that occurs in several countries, including Indonesia. This condition causes an area to lag behind other regions, which ultimately results in poverty and low welfare. This is not in line with the concept of sustainable development, which emphasizes "no one left behind" with the existence of areas that are still left behind. This study aims to analyze the sustainability status of the underdeveloped regions in Nusa Tenggara Timur (NTT) Province, Indonesia, from economic, social, and ecological aspects and formulate alleviation strategies. The data used in this study was collected through secondary data obtained from the Ministry of Village Development of Disadvantaged Regions and Transmigration (Kemendesa), as well as statistical data from the Central Bureau of Statistics (BPS) Indonesia. Data was analyzed using Rapid Appraisal for Fisheries (RAPFISH) to determine its sustainability status and determine the best strategy for alleviating underdeveloped areas. The results showed that the economic dimension has a bad sustainability status compared to the other two dimensions, where there are only 3 districts with good status. Meanwhile, there are 7 districts with good status in the social dimension and 11 districts with good status in the ecological dimension. On the other hand, there are underdeveloped districts that have good sustainability in two dimensions at once. The most influential attributes of sustainability in each dimension include electrification, school participation, and disasters. The strategy for alleviating disadvantaged areas is through mainstreaming intervention programs in disadvantaged districts that have good sustainability on two dimensions and have the highest scores on each dimension. In addition, alleviation optimization is carried out through development planning, which leads to the most influential attributes in each dimension of sustainability.

1. INTRODUCTION

A total of 193 countries have committed to achieving the Sustainable Development Goals (SDGs). Seventeen SDGs goals align 3 components covering economic, social, and ecological goals (Eisenmenger, Pichler et al., 2020; Zeng, Maxwell et al., 2020). SDGs also carry the mission of “no one

left behind" in development. So, the achievement of sustainable development becomes a big challenge not only for developed countries but also for developing countries (Shahzad, Radulescu et al., 2021).

The difficulty of achieving the SDG's goals is felt by various countries, including countries that are members of the BRICS (Brazil, Russia, India, China, and South Africa) characterized by environmental degradation due to economic growth and financial development (Awosusi, Adebayo et al., 2022; Chien, Anwar et al., 2021) In addition, the achievement of SDG's goals in Asian countries that are considered to be lagging in the economy still faces major problems over environmental degradation (Anwar, Sinha et al., 2022). So, measuring progress in achieving SDGs is important to know the development efforts in each country and guide policy development and implementation (Xu, Chau et al., 2020). This measurement can be seen through economic, social and ecological components.

In the economic component, the elimination of poverty is the first goal of the sustainable development goals. Through the UN Main Assembly, countries in the world agreed to achieve the first goal of the SDGs by ending poverty in every country and at every level (Han, Jin et al., 2023). There are many causes of poverty in a country. Economic crisis, unemployment, and labor migration can be triggers for poverty (Rai, Rai et al., 2021). Development in various fields, both health and economy, has been carried out in the context of poverty alleviation (Omar and Inaba, 2020; Paulson, Kamath et al., 2021).

In addition to the elimination of poverty, reducing inequality and increasing economic growth are also the focus of countries in the world. Economic globalization plays a significant role in the occurrence of gap inequality between regions. Globalization has given rise to groups of regions that are able to compete as well as groups that are unable to compete economically. Groups that are able to compete will tend to have high-income areas and vice versa (Ezcurra and Del Villar, 2021). Economic disparities between urban and rural areas occur in various countries, and in Europe this is influenced by migration and population factors (Giannakis and Bruggeman, 2020). While regional disparities in Italy and China are strongly influenced by *smart mobility*, adequate inter-regional transportation has increased economic growth, thereby reducing regional disparities in the country (Cascetta, Cartenì et al., 2020; Liu, Wan et al., 2020), in addition, efficient land use and equal access to green open space in urban areas are the causes of GDP differences and regional disparities between cities in China (He, Yu et al., 2020; Wu and Kim, 2021). Accessibility to public services, transportation, and availability of higher education facilities are sources of considerable disparity in Portugal, Japan, China, and India (Dai, Liu et al., 2022; Jain and Jehling, 2020; Otsuka, 2020; Sá Marques, Saraiva et al., 2020).

Gaps between regions also occur in Indonesia. As many as 11.5% of district areas in Indonesia are categorized as underdeveloped districts based on Indonesian Presidential Regulation No. 63 of 2020 (Perpres 63/2000). Disadvantaged areas are defined as economically deteriorating areas and limited health services (Guilluy, 2019; Xiong, Wong et al., 2020; Zhang and Xu, 2021) . In general, underdeveloped areas in Indonesia can be identified from the high percentage of poor people and the low quality of human resources. Areas with poverty percentages that are higher than the national average and human development indexes that are lower than the national average can be indicators of regional underdevelopment. The concentration and distribution of underdeveloped districts in Indonesia are still dominated

by the eastern region (Nusa Tenggara Timur, Maluku, and Papua). As many as 82.3% of underdeveloped regional districts out of the total of all disadvantaged regional districts in Indonesia are spread in the eastern region. The three provinces in Indonesia with the highest number of underdeveloped districts include the Provinces of Papua Barat, Papua, and Nusa Tenggara Timur. The country has made various efforts to overcome the problem of underdevelopment for the achievement of sustainable development goals. However, efforts to achieve the target of achieving the sustainable development goals have not been maximized.

Regional inequality in underdeveloped areas is not only the cause of high poverty, but also the cause of low economic growth and quality of life as well as the underdevelopment of community welfare. The underdeveloped condition on Nias Island, Indonesia, has brought four regions on Nias Island to become districts with underdeveloped status. Inadequate sanitation, food insecurity, and low education are in line with the high stunting rate on Nias Island. Stunting has had short-term and long-term impacts on the decline in quality of life, poverty, economic decline, and decline in the quality of human resources (Purnama, Hasibuan et al., 2023). Conditions that are not much different are also experienced by Nusa Tenggara Timur (NTT) Province, Indonesia. High poverty rates and low quality of human resources are still major problems in NTT Province. As many as 62% of NTT Province has the status of underdeveloped regional districts. The prevalence of stunting in NTT Province, which is 35.5%, is the highest contributor to the stunting rate nationally. The human development index (HDI) of NTT Province of 66.68 in 2023 is below the national HDI figure, while the poverty rate of NTT Province of 9.12 is far above the national poverty rate.

The identification of underdeveloped areas, especially in the eastern region such as NTT Province, shows that sustainable development has not been fully appropriately realized in Indonesia, this is because there are still parts of society that are left behind in development. So, this is a challenge for Indonesia in encouraging the realization of SDG's goals in Indonesia. Based on this, this study aims to analyse the sustainability status of underdeveloped areas in East Nusa Tenggara (NTT) Indonesia Province from ecological, economic and social aspects and formulate alleviation strategies. Economic, social, and ecological aspects will be able to explain the sustainability status of a region holistically. The sustainability status of an area can be used as a reference for the evaluation of development that has been carried out as well as a basis for the formulation of subsequent development policies that are more sustainable. The formulation of region-based policies through an approach to economic, social, ecological dimensions in underdeveloped areas is expected to be able to overcome development problems in underdeveloped areas (MacKinnon, Kempton et al., 2022). Proper development planning in underdeveloped areas will bring the area from being left behind, so that it can be on par with other regions.

2. METHODS

2.1 Study Location

This research was conducted in 13 districts of disadvantaged areas in NTT Province, Indonesia, based on Presidential Regulation Number 63 of 2020

concerning the Determination of Disadvantaged Areas for 2020 - 2024. These districts include Sumba Barat, Sumba Timur, Kupang, Timor Tengah Selatan, Belu, Alor, Lembata, Rote Ndao, Sumba Tengah, Sumba Barat Daya, Manggarai Timur, Sabu Raijua, and Malaka as shown in *Figure 1*.

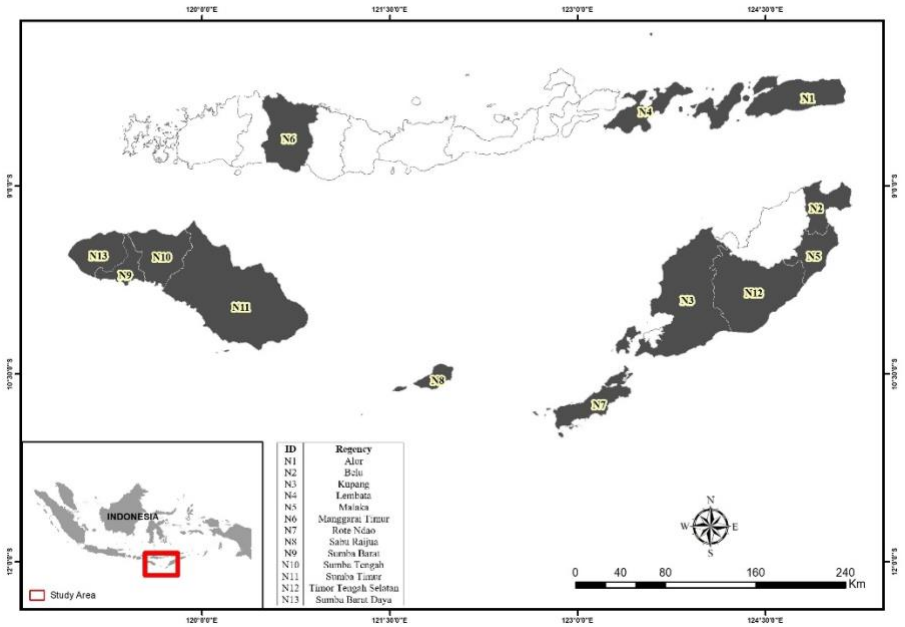

Figure 1. Study site

2.2 Data collection

The type of data used is secondary data from publication reports and information obtained from the Ministry of Village Development of Disadvantaged Regions and Transmigration (Kemendesa), as well as statistical data from the Central Bureau of Statistics (BPS) Indonesia. This study collected 18 data attributes divided into each sustainability dimension, including the economic dimension (6 attributes), the social dimension (6 attributes), and the environmental dimension (6 attributes).

2.3 Rapid Appraisal for Fisheries (RAPFISH)

Data processing in this study used the RAPFISH method. RAPFISH is a multidisciplinary assessment technique for evaluating fisheries sustainability first developed at the University of British Colombia (Pitcher and Preikshot, 2001). The use of RAPFISH then developed by using a combination of Analytical Hierarchy Process (AHP) (Fujii, 2020). In addition to fisheries, the use of RAPFISH then extends to tourism, plantations, and forest management (Abdillah, 2023; Harahab, Riniwati et al., 2021; Nashr, Putri et al., 2021; Primahardani, Mulyadi et al., 2022). The RAPFISH principle is a multi-criteria principle using the Multidimensional Scaling (MDS) algorithm. The principle of using MDS is to map one unit to another unit through scaling (Fauzi, 2022). The stages of analysis presented in *Figure 2* begin with the identification of underdevelopment problems in NTT Province. The next stage is the determination of the unit of analysis and its attributes based on the review literature and secondary data. The determination of sustainable dimensions which include economic, social, and ecological dimensions is the

third stage. Attribute data in each unit of analysis is then entered into Microsoft Excel in CSV format by taking into account the upper bond and lower bond. The data were then analyzed for ordination, leveranging, and monte carlo. The output of the analysis results is then interpreted as the basis for determining sustainability status and formulating strategies for alleviating disadvantaged districts in NTT Province.

This study used RAPFISH with R software, with technical steps for using RAPFISH / MDS as follows:

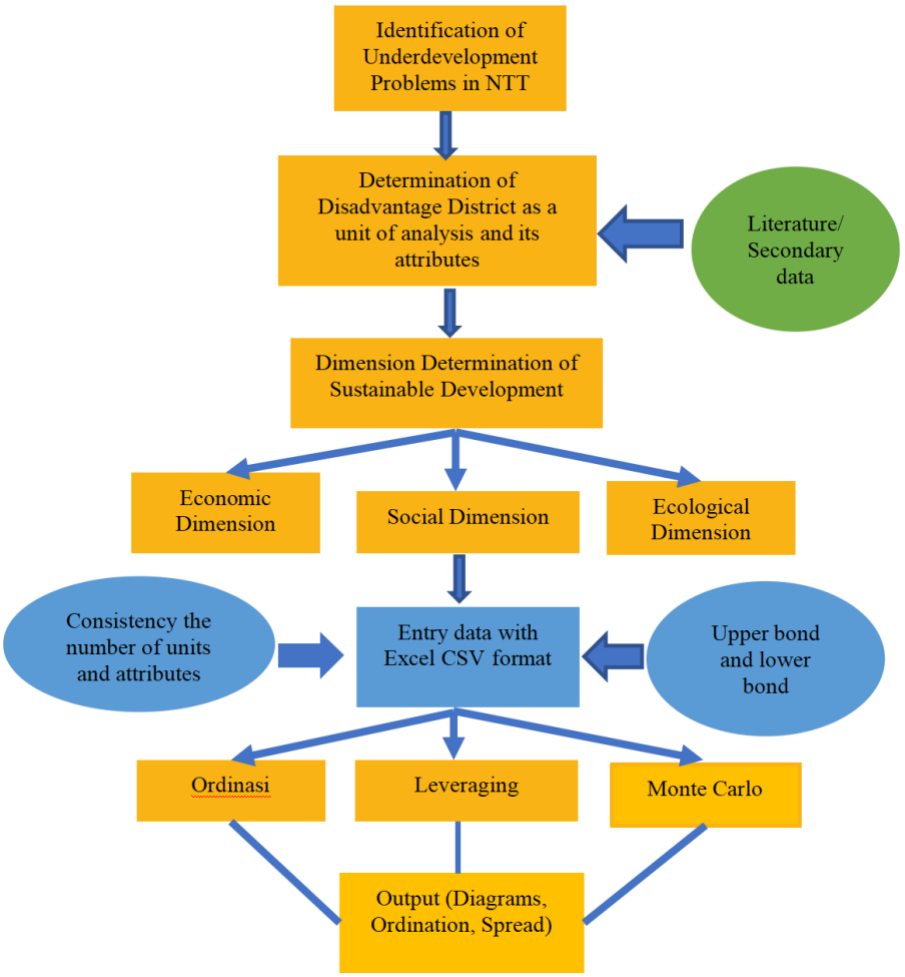

Figure 2. RAPFISH/MDS analysis stages

2.3.1 Attribute identification and determination

Attribute identification and determination Based on the thorough review and compilation of available data, 18 attributes were determined, which were divided into three dimensions that affect the sustainability status of underdeveloped districts in NTT Province, as in *Table 1*.

Table 1. Economic, Social, and Ecological Dimensions

Economic Dimension	Social Dimension	Ecological Dimension
Product domestic regional brute	Human development index	Waste management
Income per capita	School enrollment figure	Sanitation
Infrastructure	Prevalence of stunting	Forest fire
Employment	Unemployment	Decent water source
Electricity	Poverty	Disaster
Credit	Conflict	Critical land

2.3.2 Attribute scoring

The second stage of the RAPFISH analysis is attribute scoring. The determination of the score in this study is based on peer-review scoring, where the score is determined based on *a review of* scientific documentation with the determination of *thresholds*. RAPFISH scoring is *monotonic* with a minimum value of zero (0) for "*bad*" conditions and ten (10) equals "*good*" (Pitcher, Lam et al., 2013).

2.3.3 Attribute scaling

MDS in the implementation of RAPFISH plays a role in coordinating units on a "bad" *or "good" scale* through the transformation *of multidimensional statistics* (units of analysis and attributes) into low dimensions by maintaining the nature of "distance" between the analysed cases. The ALSCAL MDS algorithm will generate scores in 2 dimensions through the following formula (Kavanagh and Pitcher, 2004).

$\zeta\{S\} = D^2 + E$ 1

monotonic transformations are denoted by ζ, E denotes residual matrices (errors), and Euclidian matrices are symbolized by D

$D^2 = \sqrt{(Y_1 - Y_2)^2 + (Y_3 - Y_4)^2 + \cdots}$ 2

$D^2 = \sqrt{\sum_{i=1}^{n}(Y_i - Y_j)}$ 3

$i \neq j$

The ASCAL algorithm will perform an iteration process to initiate E, the iteration will stop when the "goodness of fit" is measured by s-stress with a value below the minimum value set (0.0005) with the formula:

$S - S - stress = (S - stress)^{\frac{1}{2}}$.....4

Stress is defined as:

$Stress = (\|E\|)/(\|\zeta\{S\}\|)$ 5

Symbol $\|\cdots\|$ represent the sum of squares of elements in the matrix

2.3.4 Ordination

Ordination in RAPFISH is placed on a two-dimensional curve with the X-axis (horizontal dimension) having significance in ordination, while the Y-axis has no effect. The Y-axis is arbitrary resulting from half the "bad" (down) and "good" (up) scores and only varies the attribute and is not related to sustainability.

2.3.5 Monte Carlo analysis

Monte Carlo analysis is performed to detect sources of error from variety. Errors in RAPFISH can occur due to inconsistencies in attribute scoring, imperfect convergence of MDS, high stress scores, and attributes used inappropriately in the analysis (Kavanagh and Pitcher, 2004).

2.3.6 Leverage analysis

Leverage analysis is used to see the change in ordinance (bad-good position) when these attributes are excluded one by one. The leverage value ranges from 2% to 6%, as measured by the change in the Root Mean Square (RMS). If the status of the attribute is output, it will reflect the status of the assessed unit. These attributes will contribute to the final result (Fauzi, 2022).

3. RESULTS

3.1 Number of pages

3.1.1 Ordination of the sustainability economic dimension

The results of the ordination on the economic dimension (*Figure 3*) show that there are only 3 dot plots located in the right quadrant (good position). 10 dot plots are in the "bad" position. Three disadvantaged districts in NTT province that are in good economic dimension include Kupang District, Timor Tengah Selatan, and Sumba Timur, while 10 other districts are in bad sustainability status. The highest level of sustainability of the economic dimension in NTT Province is in the Kupang District.

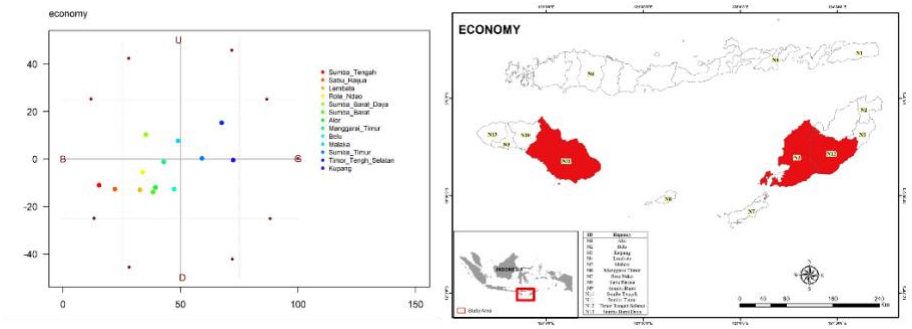

Figure 3. Result of economic dimension sustainability ordination

3.1.2 Ordination of the sustainability social dimension

The results of sustainability ordination on the social dimension (*Figure 4*) show that there are 7 underdeveloped districts in NTT Province are in "good" sustainability status, while 6 other districts are in the left quadrant which means they are in "bad" sustainability status. Sumba Tengah, Sumba Barat, and Sabu Raijua Districts are underdeveloped districts that have the best sustainability status in NTT Province in the social aspect.

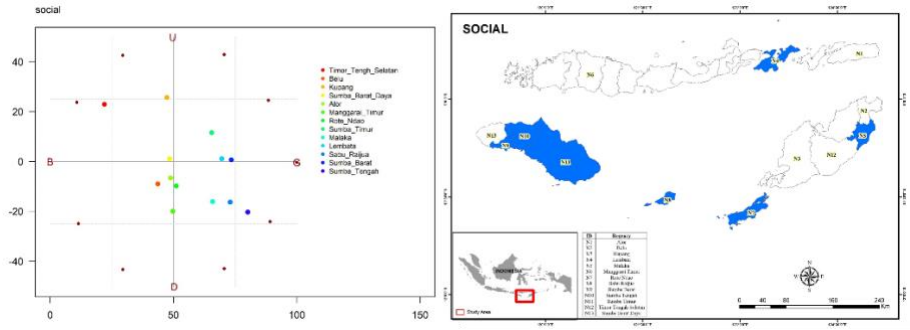

Figure 4. Result of social dimension sustainability ordination

3.1.3 Ordination of the sustainability ecological dimension

Figure 5 present the results of the ordination of sustainability of the ecological dimension. Sumba Timur and Kupang Districts have a "bad" sustainability status from an ecological dimension, while 11 other districts have a "good" sustainability status. Malaka is the district with the best sustainability status, while Sumba Timur District has the worst sustainability structure from the ecological dimension.

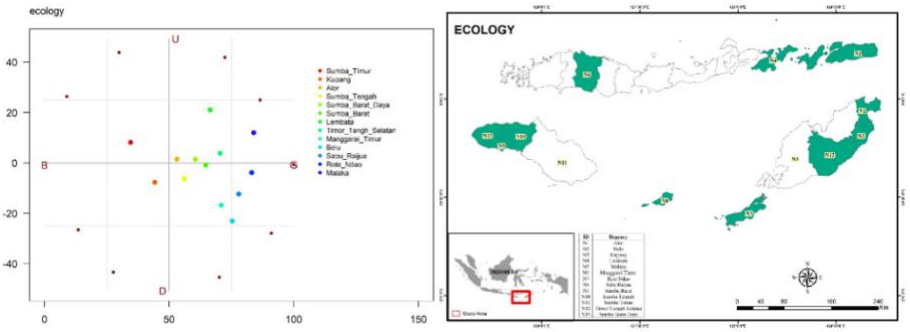

Figure 5. Result of ecological dimension sustainability ordination

3.1.4 Combined dimension sustainability ordination

The results of the ordination on the three dimensions found that there are disadvantage regions that have "good" sustainability ordination on two dimensions (*Figure 6*). 7 underdeveloped districts in NTT Province (Sumba Tengah, Sabu Raijua, Lembata, Rote Ndao, Malaka, Sumba Barat, Timor Tengah Selatan) are districts that have a "good" sustainability status from the social and environmental dimensions. Meanwhile, Sumba Timur is a district with a "good" sustainability status based on economic and social dimensions.

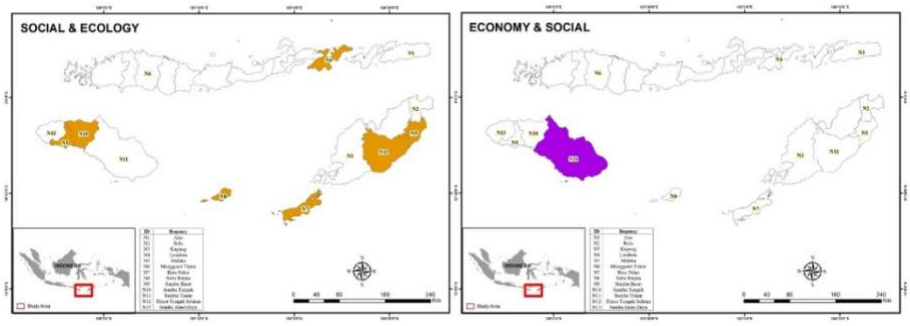

Figure 6. Combined dimension ordination result

3.2 Monte Carlo simulation

RAPFSIH R provides two types of Monte Carlo analysis. In the uniform distribution type (Uniform MC), each score on the attribute has the same chance in testing the error and diversity of attribute scores, while in the triangular distribution type (Triangular MC), the score on the attribute has values such as triangles, namely the minimum, most likely, and maximum values. In *Figure 7* the economic dimension has a triangular and uniform distribution, while the social and ecological dimensions have a uniform distribution. Kupang, Sabu Raijua, Sumba Barat, and Alor districts have a distribution of points that tend to cluster around the initial score on the economic dimension. This shows a slight disturbance in this unit, while 9 other districts have a spread point spread relatively wide, indicating a significant disturbance in the district.

The districts of Lembata and Sumba Tengah have a distribution of points that are grouped in the initial score on the social dimension, while 11 other districts have a distribution of points that spread out showing significant disturbances in the 11 districts related to the social dimension. In the ecological dimension, it can be seen that all underdeveloped districts in NTT Province have a spread of points, this shows a significant disturbance in underdeveloped districts in NTT Province from the ecological dimension.

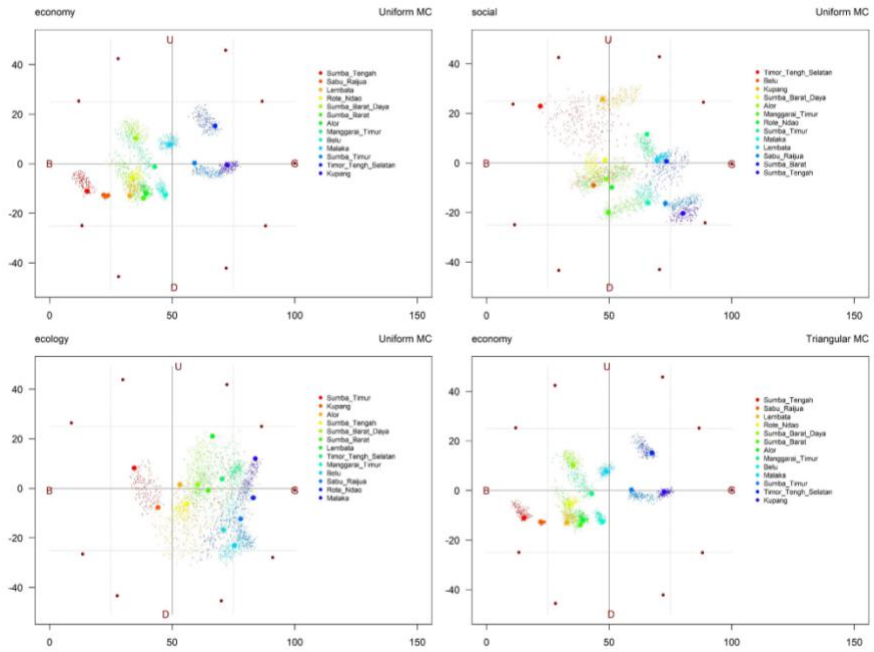

Figure 7. Monte carlo analysis results of economic, social, and ecological dimension

3.3 Leverage analysis result

Changes in ordinance due to the removal of attributes one after another can be seen from leveraging; in other words, leverage shows sensitivity. The length of each "bar" indicates the magnitude of the influence of the attribute in the ordination of bad-good. *Figure 8* shows that electrification is the most influential attribute in coordinating the sustainability of disadvantaged districts in NTT Province based on the economic dimension. If the electrification attribute is removed, then the difference in the position of sustainability ordination will change by more than 6%. Meanwhile, in the

social dimension, the school participation attribute is the most influential in the coordination of the sustainability of disadvantaged districts in NTT Province. If the school participation attribute is removed, then the difference in the position of sustainability ordination will change by 6%. The disaster attribute is the most influential in the coordination of sustainability of underdeveloped districts in NTT Province on the ecological dimension. If the disaster attribute is omitted, then the difference in the position of sustainability ordination will change by 10%.

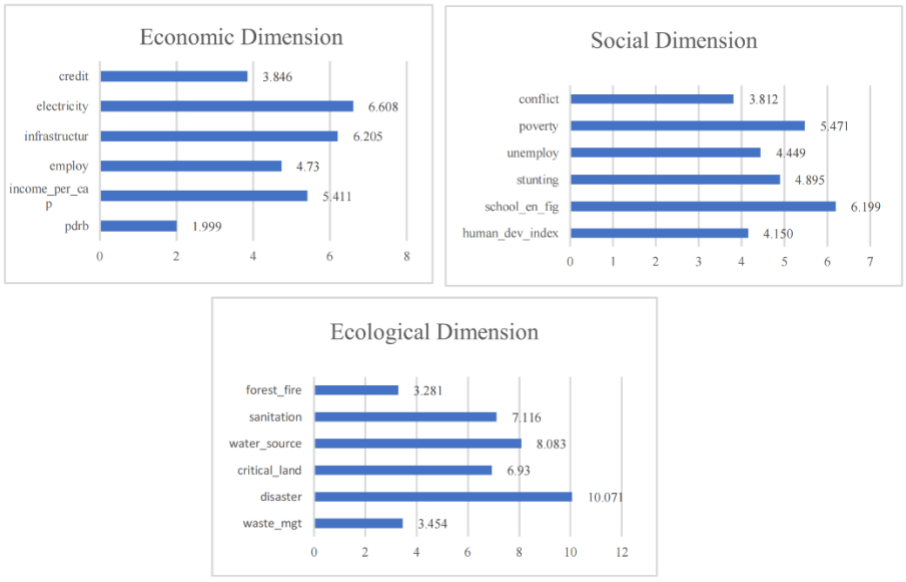

Figure 8. Result of leverage analysis of economic, social, and ecological

3.4 Kite and radar diagram

The kite and radar charts in *Figure 9* show the districts of disadvantaged areas that have the highest and lowest scores from each dimension. Kupang District has a score of 72.37, the highest in the economic dimension, while Sumba Tengah District has the lowest score, with a score of 15.34. In the social dimension, Sumba Tengah District has the highest score with a value of 80.11 and Timor Tengah Selatan District has the lowest score with a value of 21.98. Malaka District has the highest score on the ecological dimension with a value of 83.9, and Sumba Timur District has the lowest score with a value of 34.51.

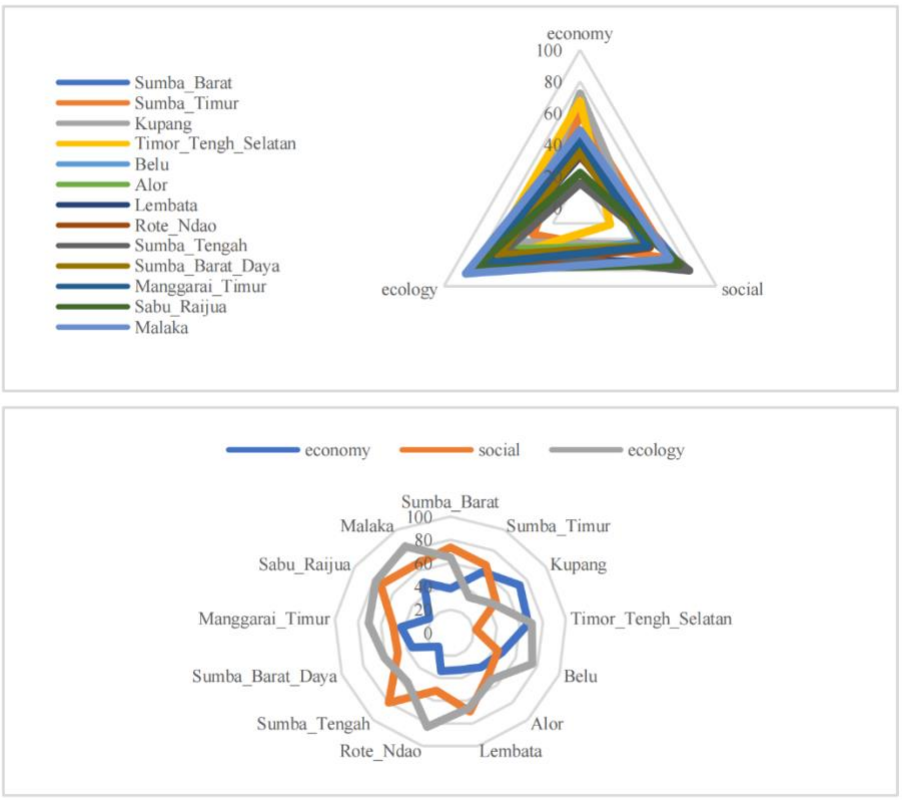

Figure 9. Kite and radar diagram

4. DISCUSSION

The difference in sustainability status of each underdeveloped district in NTT Province shows diversity in each dimension. The economic dimension is a dimension with a low sustainability status compared to the other two dimensions. It can be seen that there are only 3 districts that are in good sustainability status, this needs special attention to be addressed. Where the electrification attribute is the most influential attribute on the sustainability ordinance of this dimension. This result is in line with Sugiharti, Purwono et al. (2022), who stated that one of the factors causing chronic poverty is the limitation of most households in access to electrification (Sugiharti, Purwono et al., 2022). Most areas of NTT Province currently still have limited access to electricity in some households, besides that per capita income is still low and GDP of 3.05% which is still below the national average.

Based on the social dimension, there are still 6 districts in bad sustainability status. Where the school participation attribute is the most influential attribute on the sustainability ordinance of this dimension. The low human development index in NTT Province triggers a low social dimension. In the end, this has an impact on various aspects such as high poverty, unemployment, and stunting rates. Therefore, there is a need for intervention in supporting the improvement of the human development index in NTT Province, especially in underdeveloped areas. This is because a good human development index will have a significant negative influence on poverty (Lestari, Rahayu et al., 2022).

In the ecological dimension, most of the underdeveloped districts in NTT Province are in good sustainability status. This shows that these underdeveloped areas are still quite good environmental conditions in the

region. Nevertheless, the high level of disaster is still a threat to the sustainability of the ecological dimension. Throughout 2018-2022, BPS data states that floods are the most common in NTT Province with 122 events. Landslides and tornadoes ranked second with 63 and 56 incidents respectively. Drought also occurred in almost all districts in NTT Province throughout 2018-2022, while tidal waves or abrasion disasters and forest and land fires are still a threat in several districts in NTT Province. In addition to disasters, inadequate sanitation and decent water sources for residents are still problems in the ecological dimension. This is in line with the general condition of Indonesian society. The difficulty of access to good sanitation is still experienced by the Indonesian people, almost 2 out of 5 households in Indonesia do not have access to proper sanitation (Irianti and Prasetyoputra, 2021).

Based on the results of the sustainability analysis, it turned out that several underdeveloped districts had "good" sustainability in two dimensions of the three dimensions tested. Disadvantaged districts that fall into this category can be prioritized in programs to accelerate the alleviation of disadvantaged areas in NTT Province. So, strategies that can be carried out in alleviating disadvantaged areas in NTT Province (*Figure 10*) based on sustainability analysis, including formulating planning policies for disadvantaged area alleviation programs, are prioritized to districts that already have "good" sustainability in two dimensions and have the highest scores in each dimension. So, it is hoped that the complete dimension of sustainability achieved will be able to affect the progress of the region. This is in line with Zhou, Yu et al. (2023) who stated that economic, social, ecological, and infrastructure factors have an important role in the resilience process in disadvantaged areas. In comparison, the two dimensions that can be prioritized are the economic and social dimensions of sustainability. This is because socioeconomic growth has a negative impact on poverty (Erlando, Riyanto et al., 2020). Based on sustainability criteria, the disadvantaged areas that are prioritized to be accelerated in alleviation are Malaka District.

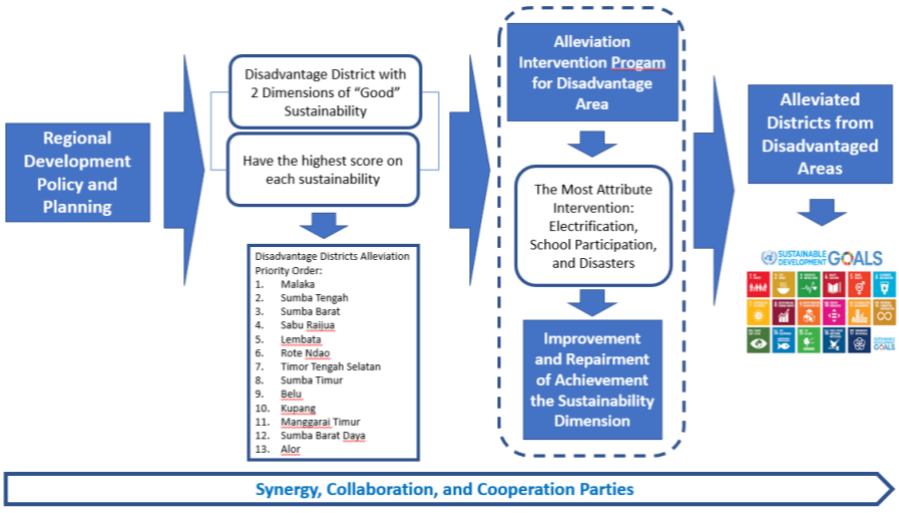

Figure 10. Strategy to accelerate the alleviation of disadvantaged areas in NTT Province

Furthermore, sustainable development planning for the alleviation of disadvantaged districts in NTT Province is directed to optimally support attributes that have a strong influence on sustainability in each dimension. Optimization can be done through development planning that focuses on

sustainability attributes that have a strong impact, for example economic development can be done by expanding electrification in areas that are still not reached by electricity. Then, improving the quality of human resources can be done by increasing the high school enrolment rate in the school-age population. In addition, the need to increase public understanding of disaster mitigation and the construction of early warning system (EWS) facilities can be carried out as disaster preparedness efforts. Proper development planning in accordance with the needs and conditions of the local area is expected to be able to encourage underdeveloped districts to alleviate from their lagging behind. Of course, this will not be achieved without the support of various parties who synergize, collaborate, and work together. The strategy to accelerate the alleviation of disadvantaged districts through policies and intervention programs directed at achieving the sustainability dimension, in addition to supporting alleviation, will also encourage the achievement of SDGs goals. Formulation of region-based policies by utilizing local potential is what underdeveloped regions need, so that the achievement of sustainable development goals can be achieved by increasing resilience and reducing vulnerability (Li, Deng et al., 2021; MacKinnon, Kempton et al., 2022).

5. CONCLUSION

Regional inequality and poverty are still problems in most districts of NTT Province, where 13 districts are still underdeveloped. Through the analysis of sustainability status, sustainability status dimensions can be mapped from the economic, social, and ecological dimensions of each underdeveloped regional district in NTT Province. The economic dimension is a dimension with low sustainability status compared to the other two dimensions, where there are only 3 districts with good status in this dimension. Meanwhile, there are 7 districts with good status in the social dimension and 11 districts with good status in the ecological dimension. On the other hand, there are underdeveloped districts that have good sustainability in two dimensions at once. The most influential attributes of sustainability in each dimension include electrification, school participation and disasters. The strategy for alleviating disadvantaged areas is through mainstreaming intervention programs in disadvantaged districts that have good sustainability on two dimensions and have the highest scores on each dimension. In addition, alleviation optimization is carried out through development planning, which leads to the most influential attributes in each dimension of sustainability.

AUTHOR CONTRIBUTIONS

Conceptualization, S.K., E.R and A.D.P methodology, S.K., A.H.J and M.N.L.; software, A.H.J and M.N.L.; investigation, M.N.L.; resources, S.K.; data curation, A.H.J; writing—original draft preparation, S.K., E.R and A.D.P; writing—review and editing, S.K., E.R and A.D.P. All authors have read and agreed to the published version of the manuscript.

ETHICS DECLARATION

The authors declare that they have no conflicts of interest regarding the publication of the paper.

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Sustainable Development Strategy to Alleviate Disadvantaged Regions in Indonesia

Siti Khoeriyah[1*], Aulia Hapsari Juawita[2], Marselinus Nirwan Luru[3], Emma Rahmawati[4] and Anang Dwi Purwanto[4]
1 Doctoral Program in Regional and Rural Development Planning, IPB University
2 Faculty of Economics and Business, Sebelas Maret University
3 Faculty of Landscape Architecture and Environmental Technology, Trisakti University,
4 National Research and Innovation Agency (BRIN)of Indonesia
** Corresponding Author, Email: sitikhoeriyah41@gmail.com*

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Abstract: Development gaps between regions are still a problem that occurs in several countries, including Indonesia. This condition causes an area to lag behind other regions, which ultimately results in poverty and low welfare. This is not in line with the concept of sustainable development, which emphasizes "no one left behind" with the existence of areas that are still left behind. This study aims to analyze the sustainability status of the underdeveloped regions in Nusa Tenggara Timur (NTT) Province, Indonesia, from economic, social, and ecological aspects and formulate alleviation strategies. The data used in this study was collected through secondary data obtained from the Ministry of Village Development of Disadvantaged Regions and Transmigration (Kemendesa), as well as statistical data from the Central Bureau of Statistics (BPS) Indonesia. Data was analyzed using Rapid Appraisal for Fisheries (RAPFISH) to determine its sustainability status and determine the best strategy for alleviating underdeveloped areas. The results showed that the economic dimension has a bad sustainability status compared to the other two dimensions, where there are only 3 districts with good status. Meanwhile, there are 7 districts with good status in the social dimension and 11 districts with good status in the ecological dimension. On the other hand, there are underdeveloped districts that have good sustainability in two dimensions at once. The most influential attributes of sustainability in each dimension include electrification, school participation, and disasters. The strategy for alleviating disadvantaged areas is through mainstreaming intervention programs in disadvantaged districts that have good sustainability on two dimensions and have the highest scores on each dimension. In addition, alleviation optimization is carried out through development planning, which leads to the most influential attributes in each dimension of sustainability.

1. INTRODUCTION

A total of 193 countries have committed to achieving the Sustainable Development Goals (SDGs). Seventeen SDGs goals align 3 components covering economic, social, and ecological goals (Eisenmenger, Pichler et al., 2020; Zeng, Maxwell et al., 2020). SDGs also carry the mission of "no one

left behind" in development. So, the achievement of sustainable development becomes a big challenge not only for developed countries but also for developing countries (Shahzad, Radulescu et al., 2021).

The difficulty of achieving the SDG's goals is felt by various countries, including countries that are members of the BRICS (Brazil, Russia, India, China, and South Africa) characterized by environmental degradation due to economic growth and financial development (Awosusi, Adebayo et al., 2022; Chien, Anwar et al., 2021) In addition, the achievement of SDG's goals in Asian countries that are considered to be lagging in the economy still faces major problems over environmental degradation (Anwar, Sinha et al., 2022). So, measuring progress in achieving SDGs is important to know the development efforts in each country and guide policy development and implementation (Xu, Chau et al., 2020). This measurement can be seen through economic, social and ecological components.

In the economic component, the elimination of poverty is the first goal of the sustainable development goals. Through the UN Main Assembly, countries in the world agreed to achieve the first goal of the SDGs by ending poverty in every country and at every level (Han, Jin et al., 2023). There are many causes of poverty in a country. Economic crisis, unemployment, and labor migration can be triggers for poverty (Rai, Rai et al., 2021). Development in various fields, both health and economy, has been carried out in the context of poverty alleviation (Omar and Inaba, 2020; Paulson, Kamath et al., 2021).

In addition to the elimination of poverty, reducing inequality and increasing economic growth are also the focus of countries in the world. Economic globalization plays a significant role in the occurrence of gap inequality between regions. Globalization has given rise to groups of regions that are able to compete as well as groups that are unable to compete economically. Groups that are able to compete will tend to have high income areas and vice versa (Ezcurra and Del Villar, 2021). Economic disparities between urban and rural areas occur in various countries, and in Europe this is influenced by migration and population factors (Giannakis and Bruggeman, 2020). While regional disparities in Italy and China are strongly influenced by *smart mobility*, adequate inter-regional transportation has increased economic growth, thereby reducing regional disparities in the country (Cascetta, Cartenì et al., 2020; Liu, Wan et al., 2020), in addition, efficient land use and equal access to green open space in urban areas are the causes of GDP differences and regional disparities between cities in China (He, Yu et al., 2020; Wu and Kim, 2021). Accessibility to public services, transportation, and availability of higher education facilities are sources of considerable disparity in Portugal, Japan, China, and India (Dai, Liu et al., 2022; Jain and Jehling, 2020; Otsuka, 2020; Sá Marques, Saraiva et al., 2020).

Gaps between regions also occur in Indonesia. As many as 11.5% of district areas in Indonesia are categorized as underdeveloped districts based on Indonesian Presidential Regulation No. 63 of 2020 (Perpres 63/2000). Disadvantaged areas are defined as economically deteriorating areas and limited health services (Guilluy, 2019; Xiong, Wong et al., 2020; Zhang and Xu, 2021) . In general, underdeveloped areas in Indonesia can be identified from the high percentage of poor people and the low quality of human resources. Areas with poverty percentages that are higher than the national average and human development indexes that are lower than the national average can be indicators of regional underdevelopment. The concentration and distribution of underdeveloped districts in Indonesia are still dominated

by the eastern region (Nusa Tenggara Timur, Maluku, and Papua). As many as 82.3% of underdeveloped regional districts out of the total of all disadvantaged regional districts in Indonesia are spread in the eastern region. The three provinces in Indonesia with the highest number of underdeveloped districts include the Provinces of Papua Barat, Papua, and Nusa Tenggara Timur. The country has made various efforts to overcome the problem of underdevelopment in the achievement of sustainable development goals. However, efforts to achieve the target of achieving the sustainable development goals have not been maximized.

Regional inequality in underdeveloped areas is not only the cause of high poverty, but also the cause of low economic growth and quality of life as well as the underdevelopment of community welfare. The underdeveloped condition on Nias Island, Indonesia, has brought four regions on Nias Island to become districts with underdeveloped status. Inadequate sanitation, food insecurity, and low education are in line with the high stunting rate on Nias Island. Stunting has had short-term and long-term impacts on the decline in quality of life, poverty, economic decline, and decline in the quality of human resources (Purnama, Hasibuan et al., 2023). Conditions that are not much different are also experienced by Nusa Tenggara Timur (NTT) Province, Indonesia. High poverty rates and low quality of human resources are still major problems in NTT Province. As many as 62% of NTT Province has the status of underdeveloped regional districts. The prevalence of stunting in NTT Province, which is 35.5%, is the highest contributor to the stunting rate nationally. The human development index (HDI) of NTT Province of 66.68 in 2023 is below the national HDI figure, while the poverty rate of NTT Province of 9.12 is far above the national poverty rate.

The identification of underdeveloped areas, especially in the eastern region such as NTT Province, shows that sustainable development has not been fully appropriately realized in Indonesia, this is because there are still parts of society that are left behind in development. So, this is a challenge for Indonesia in encouraging the realization of SDG's goals in Indonesia. Based on this, this study aims to analyse the sustainability status of underdeveloped areas in East Nusa Tenggara (NTT) Indonesia Province from ecological, economic and social aspects and formulate alleviation strategies. Economic, social, and ecological aspects will be able to explain the sustainability status of a region holistically. The sustainability status of an area can be used as a reference for the evaluation of development that has been carried out as well as a basis for the formulation of subsequent development policies that are more sustainable. The formulation of region-based policies through an approach to economic, social, ecological dimensions in underdeveloped areas is expected to be able to overcome development problems in underdeveloped areas (MacKinnon, Kempton et al., 2022). Proper development planning in underdeveloped areas will bring the area from being left behind, so that it can be on par with other regions.

2. METHODS

2.1 Study Location

This research was conducted in 13 districts of disadvantaged areas in NTT Province, Indonesia, based on Presidential Regulation Number 63 of 2020

concerning the Determination of Disadvantaged Areas for 2020 - 2024. These districts include Sumba Barat, Sumba Timur, Kupang, Timor Tengah Selatan, Belu, Alor, Lembata, Rote Ndao, Sumba Tengah, Sumba Barat Daya, Manggarai Timur, Sabu Raijua, and Malaka as shown in *Figure 1*.

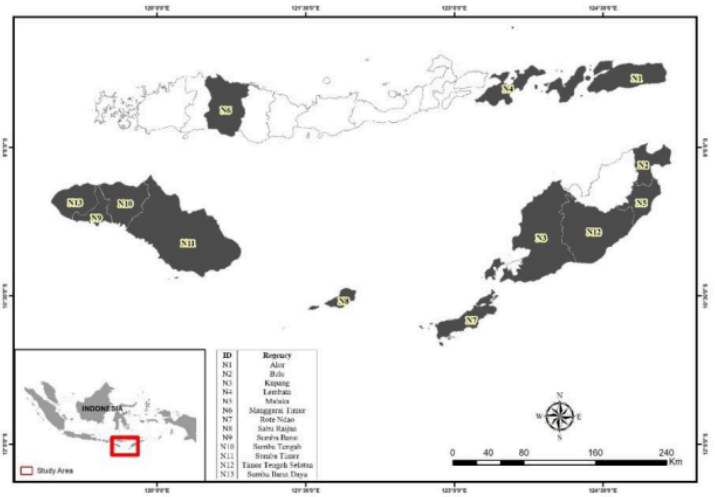

Figure 1. Study site

2.2 Data collection

The type of data used is secondary data from publication reports and information obtained from the Ministry of Village Development of Disadvantaged Regions and Transmigration (Kemendesa), as well as statistical data from the Central Bureau of Statistics (BPS) Indonesia. This study collected 18 data attributes divided into each sustainability dimension, including the economic dimension (6 attributes), the social dimension (6 attributes), and the environmental dimension (6 attributes).

2.3 Rapid Appraisal for Fisheries (RAPFISH)

Data processing in this study used the RAPFISH method. RAPFISH is a multidisciplinary assessment technique for evaluating fisheries sustainability first developed at the University of British Colombia (Pitcher and Preikshot, 2001). The use of RAPFISH then developed by using a combination of Analytical Hierarchy Process (AHP) (Fujii, 2020). In addition to fisheries, the use of RAPFISH then extends to tourism, plantations, and forest management (Abdillah, 2023; Harahab, Riniwati et al., 2021; Nashr, Putri et al., 2021; Primahardani, Mulyadi et al., 2022). The RAPFISH principle is a multi-criteria principle using the Multidimensional Scaling (MDS) algorithm. The principle of using MDS is to map one unit to another unit through scaling (Fauzi, 2022). The stages of analysis presented in *Figure 2* begin with the identification of underdevelopment problems in NTT Province. The next stage is the determination of the unit of analysis and its attributes based on the review literature and secondary data. The determination of sustainable dimensions which include economic, social, and ecological dimensions is the

third stage. Attribute data in each unit of analysis is then entered into Microsoft Excel in CSV format by taking into account the upper bond and lower bond. The data were then analyzed for ordination, leveranging, and monte carlo. The output of the analysis results is then interpreted as the basis for determining sustainability status and formulating strategies for alleviating disadvantaged districts in NTT Province.

This study used RAPFISH with R software, with technical steps for using RAPFISH / MDS as follows:

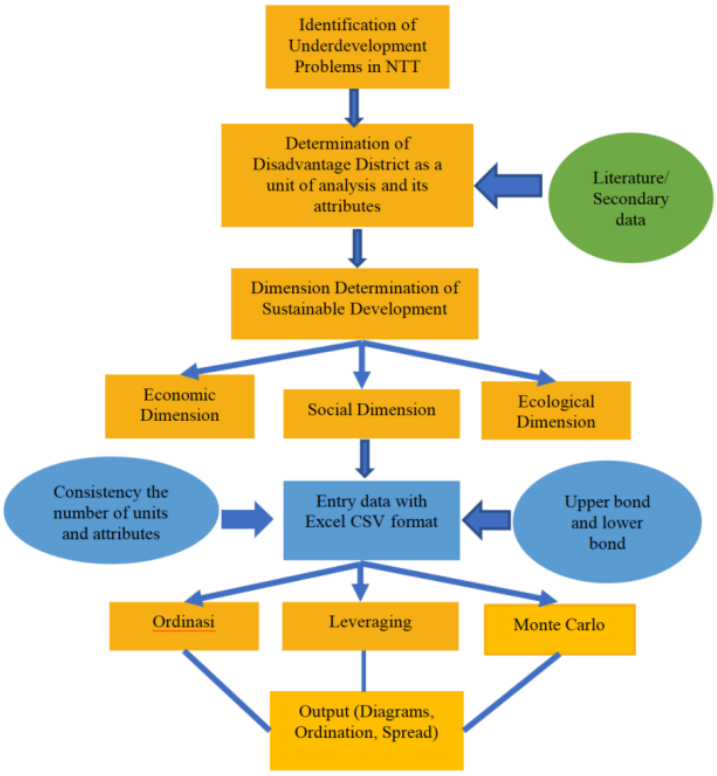

Figure 2. RAPFISH/MDS analysis stages

2.3.1 Attribute identification and determination

Attribute identification and determination Based on the thorough review and compilation of available data, 18 attributes were determined, which were divided into three dimensions that affect the sustainability status of underdeveloped districts in NTT Province, as in *Table 1*.

Table 1. Economic, Social, and Ecological Dimensions

Economic Dimension	Social Dimension	Ecological Dimension
Product domestic regional brute	Human development index	Waste management
Income per capita	School enrollment figure	Sanitation
Infrastructure	Prevalence of stunting	Forest fire
Employment	Unemployment	Decent water source
Electricity	Poverty	Disaster
Credit	Conflict	Critical land

2.3.2 Attribute scoring

The second stage of the RAPFISH analysis is attribute scoring. The determination of the score in this study is based on peer-review scoring, where the score is determined based on *a review of* scientific documentation with the determination of *thresholds*. RAPFISH scoring is *monotonic* with a minimum value of zero (0) for "*bad*" conditions and ten (10) equals "*good*" (Pitcher, Lam et al., 2013).

2.3.3 Attribute scaling

MDS in the implementation of RAPFISH plays a role in coordinating units on a "bad" *or "good" scale* through the transformation *of multidimensional statistics* (units of analysis and attributes) into low dimensions by maintaining the nature of "distance" between the analysed cases. The ALSCAL MDS algorithm will generate scores in 2 dimensions through the following formula (Kavanagh and Pitcher, 2004).

$\zeta\{S\} = D^2 + E$ ……..1

monotonic transformations are denoted by ζ, E denotes residual matrices (errors), and Euclidian matrices are symbolized by D

$D^2 = \sqrt{(Y_1 - Y_2)^2 + (Y_3 - Y_4)^2 + \cdots}$ ……..2

$D^2 = \sqrt{\sum_{i=1}^{n}(Y_i - Y_j)}$ ……..3

$i \neq j$

The ASCAL algorithm will perform an iteration process to initiate E, the iteration will stop when the "goodness of fit" is measured by s-stress with a value below the minimum value set (0.0005) with the formula:

$S - S - stress = (S - stress)^{\frac{1}{2}}$……..4

Stress is defined as:

Stress=(‖E ‖)/(‖ ζ{S} ‖) ……..5

Symbol ‖ ⋯ ‖ represent the sum of squares of elements in the matrix

2.3.4 Ordination

Ordination in RAPFISH is placed on a two-dimensional curve with the X-axis (horizontal dimension) having significance in ordination, while the Y-axis has no effect. The Y-axis is arbitrary resulting from half the "bad" (down) and "good" (up) scores and only varies the attribute and is not related to sustainability.

2.3.5 Monte Carlo analysis

Monte Carlo analysis is performed to detect sources of error from variety. Errors in RAPFISH can occur due to inconsistencies in attribute scoring, imperfect convergence of MDS, high stress scores, and attributes used inappropriately in the analysis (Kavanagh and Pitcher, 2004).

2.3.6 Leverage analysis

Leverage analysis is used to see the change in ordinance (bad-good position) when these attributes are excluded one by one. The leverage value ranges from 2% to 6%, as measured by the change in the Root Mean Square (RMS). If the status of the attribute is output, it will reflect the status of the assessed unit. These attributes will contribute to the final result (Fauzi, 2022).

3. RESULTS

3.1 Number of pages

3.1.1 Ordination of the sustainability economic dimension

The results of the ordination on the economic dimension (*Figure 3*) show that there are only 3 dot plots located in the right quadrant (good position). 10 dot plots are in the "bad" position. Three disadvantaged districts in NTT province that are in good economic dimension include Kupang District, Timor Tengah Selatan, and Sumba Timur, while 10 other districts are in bad sustainability status. The highest level of sustainability of the economic dimension in NTT Province is in the Kupang District.

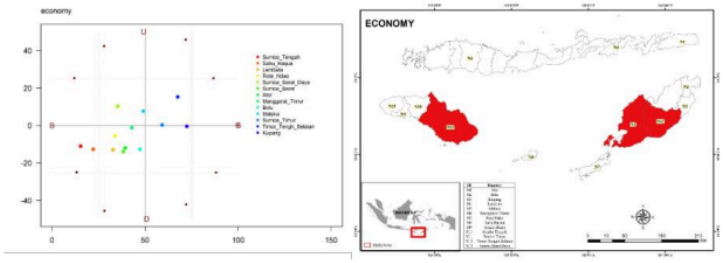

Figure 3. Result of economic dimension sustainability ordination

3.1.2 Ordination of the sustainability social dimension

The results of sustainability ordination on the social dimension (*Figure 4*) show that there are 7 underdeveloped districts in NTT Province are in "good" sustainability status, while 6 other districts are in the left quadrant which means they are in "bad" sustainability status. Sumba Tengah, Sumba Barat, and Sabu Raijua Districts are underdeveloped districts that have the best sustainability status in NTT Province in the social aspect.

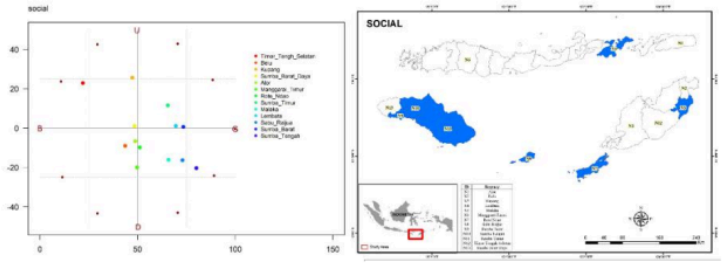

Figure 4. Result of social dimension sustainability ordination

3.1.3 Ordination of the sustainability ecological dimension

Figure 5 present the results of the ordination of sustainability of the ecological dimension. Sumba Timur and Kupang Districts have a "bad" sustainability status from an ecological dimension, while 11 other districts have a "good" sustainability status. Malaka is the district with the best sustainability status, while Sumba Timur District has the worst sustainability structure from the ecological dimension.

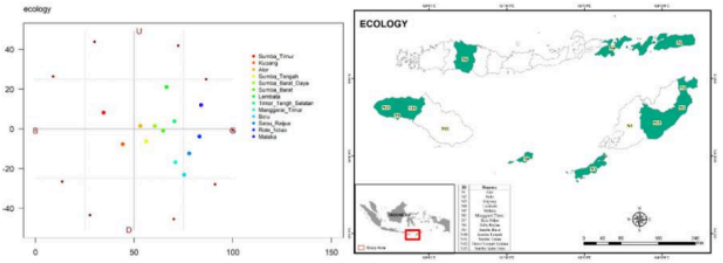

Figure 5. Result of ecological dimension sustainability ordination

3.1.4 Combined dimension sustainability ordination

The results of the ordination on the three dimensions found that there are disadvantage regions that have "good" sustainability ordination on two dimensions (*Figure 6*). 7 underdeveloped districts in NTT Province (Sumba Tengah, Sabu Raijua, Lembata, Rote Ndao, Malaka, Sumba Barat, Timor Tengah Selatan) are districts that have a "good" sustainability status from the social and environmental dimensions. Meanwhile, Sumba Timur is a district with a "good" sustainability status based on economic and social dimensions.

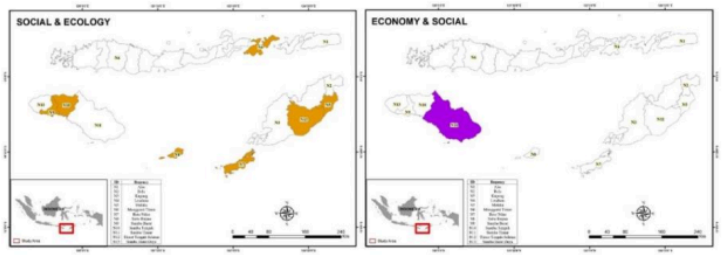

Figure 6. Combined dimension ordination result

3.2 Monte Carlo simulation

RAPFSIH R provides two types of Monte Carlo analysis. In the uniform distribution type (Uniform MC), each score on the attribute has the same chance in testing the error and diversity of attribute scores, while in the triangular distribution type (Triangular MC), the score on the attribute has values such as triangles, namely the minimum, most likely, and maximum values. In *Figure 7* the economic dimension has a triangular and uniform distribution, while the social and ecological dimensions have a uniform distribution. Kupang, Sabu Raijua, Sumba Barat, and Alor districts have a distribution of points that tend to cluster around the initial score on the economic dimension. This shows a slight disturbance in this unit, while 9 other districts have a spread point spread relatively wide, indicating a significant disturbance in the district.

The districts of Lembata and Sumba Tengah have a distribution of points that are grouped in the initial score on the social dimension, while 11 other districts have a distribution of points that spread out showing significant disturbances in the 11 districts related to the social dimension. In the ecological dimension, it can be seen that all underdeveloped districts in NTT Province have a spread of points, this shows a significant disturbance in underdeveloped districts in NTT Province from the ecological dimension.

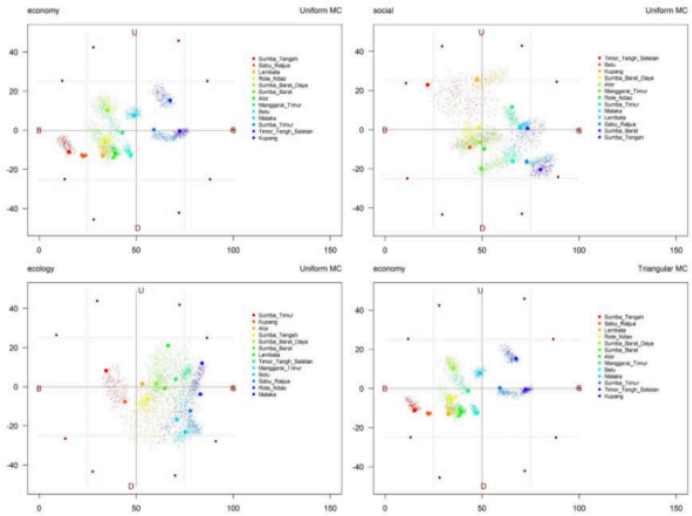

Figure 7. Monte carlo analysis results of economic, social, and ecological dimension

3.3 Leverage analysis result

Changes in ordinance due to the removal of attributes one after another can be seen from leveraging; in other words, leverage shows sensitivity. The length of each "bar" indicates the magnitude of the influence of the attribute in the ordination of bad-good. *Figure 8* shows that electrification is the most influential attribute in coordinating the sustainability of disadvantaged districts in NTT Province based on the economic dimension. If the electrification attribute is removed, then the difference in the position of sustainability ordination will change by more than 6%. Meanwhile, in the

social dimension, the school participation attribute is the most influential in the coordination of the sustainability of disadvantaged districts in NTT Province. If the school participation attribute is removed, then the difference in the position of sustainability ordination will change by 6%. The disaster attribute is the most influential in the coordination of sustainability of underdeveloped districts in NTT Province on the ecological dimension. If the disaster attribute is omitted, then the difference in the position of sustainability ordination will change by 10%.

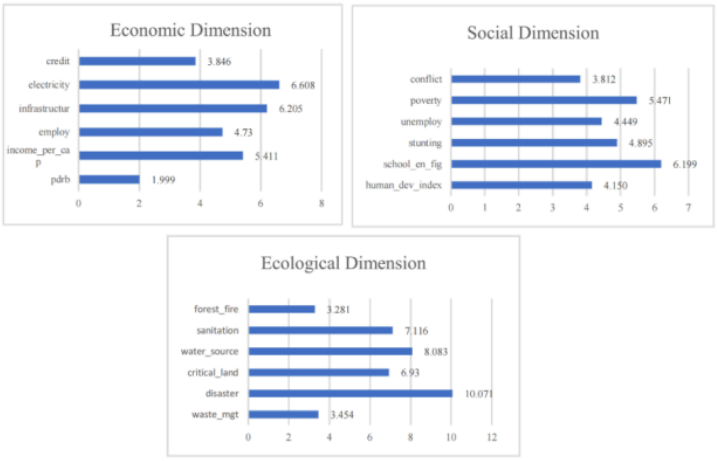

Figure 8. Result of leverage analysis of economic, social, and ecological

3.4 Kite and radar diagram

The kite and radar charts in *Figure 9* show the districts of disadvantaged areas that have the highest and lowest scores from each dimension. Kupang District has a score of 72.37, the highest in the economic dimension, while Sumba Tengah District has the lowest score, with a score of 15.34. In the social dimension, Sumba Tengah District has the highest score with a value of 80.11 and Timor Tengah Selatan District has the lowest score with a value of 21.98. Malaka District has the highest score on the ecological dimension with a value of 83.9, and Sumba Timur District has the lowest score with a value of 34.51.

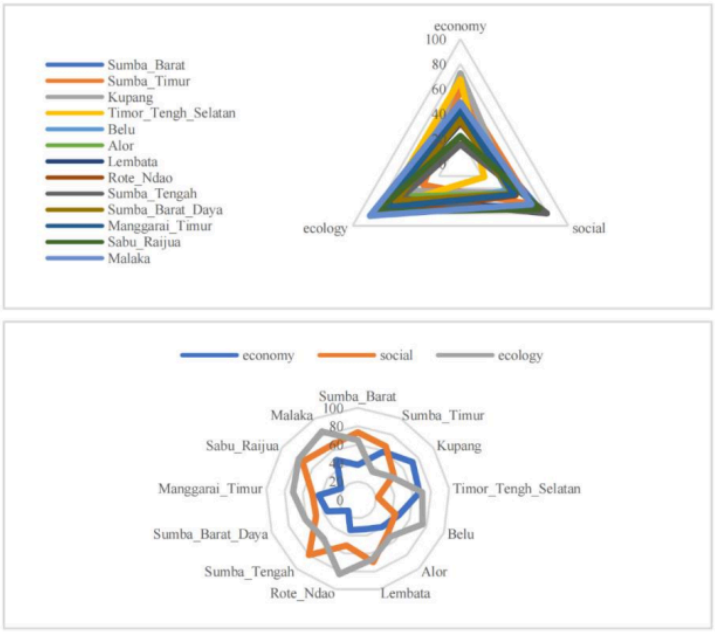

Figure 9. Kite and radar diagram

4. DISCUSSION

The difference in sustainability status of each underdeveloped district in NTT Province shows diversity in each dimension. The economic dimension is a dimension with a low sustainability status compared to the other two dimensions. It can be seen that there are only 3 districts that are in good sustainability status, this needs special attention to be addressed. Where the electrification attribute is the most influential attribute on the sustainability ordinance of this dimension. This result is in line with Sugiharti, Purwono et al. (2022), who stated that one of the factors causing chronic poverty is the limitation of most households in access to electrification (Sugiharti, Purwono et al., 2022). Most areas of NTT Province currently still have limited access to electricity in some households, besides that per capita income is still low and GDP of 3.05% which is still below the national average.

Based on the social dimension, there are still 6 districts in bad sustainability status. Where the school participation attribute is the most influential attribute on the sustainability ordinance of this dimension. The low human development index in NTT Province triggers a low social dimension. In the end, this has an impact on various aspects such as high poverty, unemployment, and stunting rates. Therefore, there is a need for intervention in supporting the improvement of the human development index in NTT Province, especially in underdeveloped areas. This is because a good human development index will have a significant negative influence on poverty (Lestari, Rahayu et al., 2022).

In the ecological dimension, most of the underdeveloped districts in NTT Province are in good sustainability status. This shows that these underdeveloped areas are still quite good environmental conditions in the

region. Nevertheless, the high level of disaster is still a threat to the sustainability of the ecological dimension. Throughout 2018-2022, BPS data states that floods are the most common in NTT Province with 122 events. Landslides and tornadoes ranked second with 63 and 56 incidents respectively. Drought also occurred in almost all districts in NTT Province throughout 2018-2022, while tidal waves or abrasion disasters and forest and land fires are still a threat in several districts in NTT Province. In addition to disasters, inadequate sanitation and decent water sources for residents are still problems in the ecological dimension. This is in line with the general condition of Indonesian society. The difficulty of access to good sanitation is still experienced by the Indonesian people, almost 2 out of 5 households in Indonesia do not have access to proper sanitation (Irianti and Prasetyoputra, 2021).

Based on the results of the sustainability analysis, it turned out that several underdeveloped districts had "good" sustainability in two dimensions of the three dimensions tested. Disadvantaged districts that fall into this category can be prioritized in programs to accelerate the alleviation of disadvantaged areas in NTT Province. So, strategies that can be carried out in alleviating disadvantaged areas in NTT Province (*Figure 10*) based on sustainability analysis, including formulating planning policies for disadvantaged area alleviation programs, are prioritized to districts that already have "good" sustainability in two dimensions and have the highest scores in each dimension. So, it is hoped that the complete dimension of sustainability achieved will be able to affect the progress of the region. This is in line with Zhou, Yu et al. (2023) who stated that economic, social, ecological, and infrastructure factors have an important role in the resilience process in disadvantaged areas. In comparison, the two dimensions that can be prioritized are the economic and soc24 dimensions of sustainability. This is because socioeconomic growth has a negative impact on poverty (Erlando, Riyanto et al., 2020). Based on sustainability criteria, the disadvantaged areas that are prioritized to be accelerated in alleviation are Malaka District.

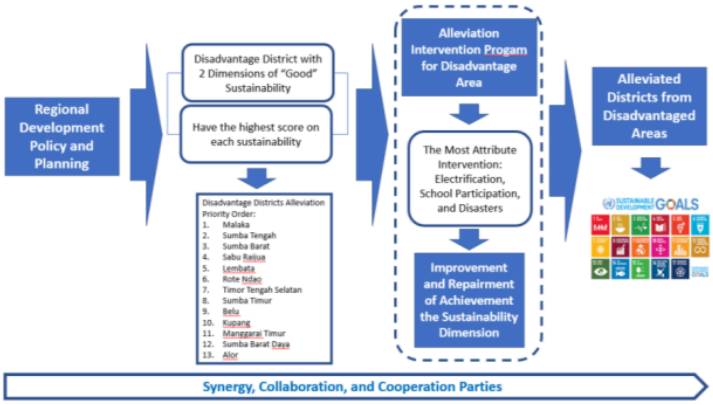

Figure 10. Strategy to accelerate the alleviation of disadvantaged areas in NTT Province

Furthermore, sustainable development planning for the alleviation of disadvantaged districts in NTT Province is directed to optimally support attributes that have a strong influence on sustainability in each dimension. Optimization can be done through development planning that focuses on

sustainability attributes that have a strong impact, for example economic development can be done by expanding electrification in areas that are still not reached by electricity. Then, improving the quality of human resources can be done by increasing the high school enrolment rate in the school-age population. In addition, the need to increase public understanding of disaster mitigation and the construction of early warning system (EWS) facilities can be carried out as disaster preparedness efforts. Proper development planning in accordance with the needs and conditions of the local area is expected to be able to encourage underdeveloped districts to alleviate from their lagging behind. Of course, this will not be achieved without the support of various parties who synergize, collaborate, and work together. The strategy to accelerate the alleviation of disadvantaged districts through policies and intervention programs directed at achieving the sustainability dimension, in addition to supporting alleviation, will also encourage the achievement of SDGs goals. Formulation of region-based policies by utilizing local potential is what underdeveloped regions need, so that the achievement of sustainable development goals can be achieved by increasing resilience and reducing vulnerability (Li, Deng et al., 2021; MacKinnon, Kempton et al., 2022).

5. CONCLUSION

Regional inequality and poverty are still problems in most districts of NTT Province, where 13 districts are still underdeveloped. Through the analysis of sustainability status, sustainability status dimensions can be mapped from the economic, social, and ecological dimensions of each underdeveloped regional district in NTT Province. The economic dimension is a dimension with low sustainability status compared to the other two dimensions, where there are only 3 districts with good status in this dimension. Meanwhile, there are 7 districts with good status in the social dimension and 11 districts with good status in the ecological dimension. On the other hand, there are underdeveloped districts that have good sustainability in two dimensions at once. The most influential attributes of sustainability in each dimension include electrification, school participation and disasters. The strategy for alleviating disadvantaged areas is through mainstreaming intervention programs in disadvantaged districts that have good sustainability on two dimensions and have the highest scores on each dimension. In addition, alleviation optimization is carried out through development planning, which leads to the most influential attributes in each dimension of sustainability.

AUTHOR CONTRIBUTIONS

Conceptualization, S.K., E.R and A.D.P methodology, S.K., A.H.J and M.N.L.; software, A.H.J and M.N.L.; investigation, M.N.L.; resources, S.K.; data curation, A.H.J; writing—original draft preparation, S.K., E.R and A.D.P; writing—review and editing, S.K., E.R and A.D.P. All authors have read and agreed to the published version of the manuscript.

ETHICS DECLARATION

The authors declare that they have no conflicts of interest regarding the publication of the paper.

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