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SUSTAINABILITY ANALYSIS OF CIBODAS BIOSPHERE RESERVE MANAGEMENT

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Abstrak. This study aims to formulate the sustainable management of the Cibodas Biosphere Reserve through the function of the Biosphere Reserve approach. Sustainable development in the Cibodas Biosphere Reserve requires sustainable analysis to become material for supporting periodic reviews document of the Cibodas Biosphere Reserve Management and the Indonesian Man and Biosphere Programme National Committee. The method uses the Multidimensional Scaling (MDS) method with the stages of determining the attributes in each dimension. Which are: ecological dimensions (carbon stock, environmental services, sustainability of natural resources and ecosystems, and reduction of disasters), economic dimensions (poverty reduction, strengthening of the community economy, opportunities employment and branding) and the social culture dimensions (access to SDA, sustainable development education, health services / services, as well as science and technology, and innovation). Based on the results of the Rap Analysis, Leverage Analysis and, Monte Carlo, both in the ecological, economic and socio-cultural dimensions, the CBC sustainability index (IK) value is above 75.01 on a scale of 0-100. So, it can be concluded that the management of Cibodas Biosphere Reserve is currently very sustainable.

Keywords: sustainable analysis; biosphere reserves; multidimensional scaling

I. INTRODUCTION

Biosphere Reserve is an area management concept consisting of various types of ecosystems including terrestrial ecosystem types, inland waters, coastal ecosystems and marine ecosystems or includes a combination of more than one ecosystem that is internationally recognized as part of the UNESCO (United States) Man and Biosphere (MAB) program **[1]**. Nation, Scientific and Culture Organization) which have benefits for applying the concept of sustainable development (Seville Strategy in Purwanto **[2]**). UNESCO's MAB program has a mission to promote and demonstrate the balance of the relationship between humans and nature with an approach [1]. Indonesia as a member of UNESCO's MAB is obliged to run the MAB program in Indonesia. The main focus of the MAB Program in Indonesia is to build and develop biosphere reserves as a vehicle to demonstrate sustainable development in the region by creating a balance of ecological and economic interests supported by science, technology and innovation (Purwanto **[3]**; Monk **[4]**) . The Biosphere Reserve has 3 main functions, namely the function of conservation of biological and cultural diversity, the function of sustainable economic development and the function of logistical support such as research, development, education, monitoring and evaluation. In order to achieve these three functions and facilitate their management, the management of the biosphere reserve area is made up of a zoning system covering the core area, buffer zone and transition area (Purwanto **[5]**).

The successful management of biosphere reserves as a vehicle for sustainable development needs to be supported by various efforts, such as efforts to balance conservation and economic interests supported by the development of science, technology, and innovation. Its implementation is through strengthening program planning and implementation, multi-stakeholder management, institutional strengthening, legal aspects, sustainable funding and others. Biosphere reserves are ideal areas to test and demonstrate approaches to sustainable development at local and regional levels. The landscape ecosystem approach has implications not only for the types of ecosystems found in the biosphere reserve area, but also for the parties who own or control these ecosystem types. Biosphere Reserves contribute to preserving cultural values and at the same time conserving biodiversity. Therefore, the purpose of managing biological resources is to manage and use them continuously. For that we must have a mindset that this biodiversity must still exist among us (Purwanto **[5]**) and still be useful for us.

The status of the Biosphere Reserve is valid for 10 years and is determined by the results of a “periodic review” assessed by the IACBR and determined at the UNESCO MAB International Coordinating Council (ICC) Session. The periodic review of the biosphere reserve includes an assessment of the zoning system and 3 functions of the biosphere reserve, namely the conservation of biodiversity and culture, sustainable economic development and

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logistical support activities as well as the integration of these three functions in implementing sustainable regional development (Purwanto **[6]**).

Actually the management of a biosphere reserve is based on the principle of "multi stakeholder management", considering the variety of landscapes and stakeholders. So that in the preparation of the management plan for the Biosphere Reserve itself, stakeholders must be involved. The preparation of this management plan becomes an integrated management guideline and determines the direction of development of the Biosphere Reserve area as a vehicle for sustainable development.

This study identifies the potential and problems faced by the parties in applying the CB concept in developing the CBC area. The results of this study are expected to support the periodic review activities carried out every 10 years which will be carried out in 2023.

In order to see the condition of sustainable development in the Cibodas Biosphere Reserve, it is necessary to analyze the sustainability of the management of the Cibodas Biosphere Reserve, which will then be used as material to carry out periodic reviews by the joint manager of the Indonesian MAB Program National Committee. It is hoped that this method of analysis for the sustainability of the management of the Cibodas Biosphere Reserve can be adopted by other biosphere reserves in Indonesia.

II. RESEARCH METHODS

The analytical method used for the analysis of the sustainability of the management of the Cibodas biosphere reserve uses the Multidimensional Scaling (MDS) method. Multidimensional scaling is an analytical technique used to determine the sustainability of development in a multi-criteria (Kavanagh and Pitcher **[7]**). The analysis is carried out through several stages, namely: (1) determining the attributes of sustainable agricultural development based on agro-industry development which includes four dimensions, namely: environmental, economic, social, and institutional (2) assessment of each attribute on an ordinal scale based on the sustainability criteria of each dimension, and (3) preparation of the index and sustainability status.

The dimensions used in the analysis of the sustainability of the management of the Cibodas Biosphere Reserve are complemented by attributes that are used to assess the condition of the area in the past. The attributes are spread in four dimensions, namely the ecological dimension, the economic dimension, and the socio-cultural dimension. Each attribute in each dimension is given a score based on the scientific judgment of the scorer. The output of the MDS analysis is an index that can be displayed in three indicators, namely Ordination, Leveraging, and Kite Diagrams. Ordination is the placement (mapping) of commodities that are analyzed in terms of bad and good which are then strengthened by anchors. The closer to the good position, the system is said to be sustainable.

Output in the form of Leveraging is an output that provides an overview of the attributes considered sensitive to changing the sustainability score. This leverage is measured by standard error through the root mean square. Visually, the larger (prominent) leverage image shows the attributes that are sensitive to changing the sustainability score. The third output display is in the form of a kite diagram that describes the sustainability status in an integrated manner between various dimensions. This kite diagram is also often called a radar diagram where the closer the analysis distance to the zero point, the lower the sustainability. On the other hand, the further away from the zero point, the higher the sustainability **[8]**.

Assessment using the MDS method is carried out through quantifying the attributes that affect sustainability by scoring **[9]**. Following are the stages of the MDS analysis. Determining the attributes of the management of the Cibodas Biosphere Reserve a. Assessment of each attribute on an ordinal scale based on the sustainability criteria of each dimension. b. Sustainability index and status

Meanwhile, the dimensions of the MDS analysis in the sustainable analysis of the management of the Cibodas Biosphere Reserve are the ecological dimension (carbon stock, environmental services, natural resource and ecosystem sustainability and disaster reduction), the economic dimension (poverty reduction, community economic strengthening, job opportunities and branding) and social and cultural dimensions (access to natural resources, sustainable development education, health services/services, as well as science and technology and innovation). This study uses key informants and respondents as primary data sources. Key informants are stakeholders or parties who have the potential to provide information about the object of research and are considered representative. Sampling for experts (key informants) was taken by purposive sampling. According to Sugiyono **[10]**, purposive sampling is a sampling method with certain considerations, for example the respondent is considered to have knowledge and information about what the researcher expects or the respondent has a position or position to make it easier for researchers to explore an object. According to Thamrin **[11][12][13]**, there are several considerations in determining key informants/experts who will be respondents, these criteria include: 1. Having competent experience in accordance with the field being studied; 2. Has a reputation, position/position within his competence with the field being studied; 3. Has high credibility, is willing and or is in the location being studied; 4. Objective recognition of professional abilities possessed by the academic environment and the wider community. Furthermore, in this study, respondents who can represent and understand the problems studied are the coordination and communication forum for the management of the Cibodas Biosphere Reserve, the Gunung Gede Pangrango National Park Center, BAPPEDA, community groups, Cianjur Regency,

Sukabumi and Bogor. The number of stakeholder respondents was taken as many as 30 people, each of which has a function and position in accordance with the needs of the researcher.

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III. RESULTS AND DISCUSSION

The results of Rap Analysis both on the ecological, economic and socio-cultural dimensions produce a sustainability index (IK) value of CBC above 75.01 on a scale of 0-100, overall including the good category and very sustainable because the value is in the range of 75.01-100, 00.

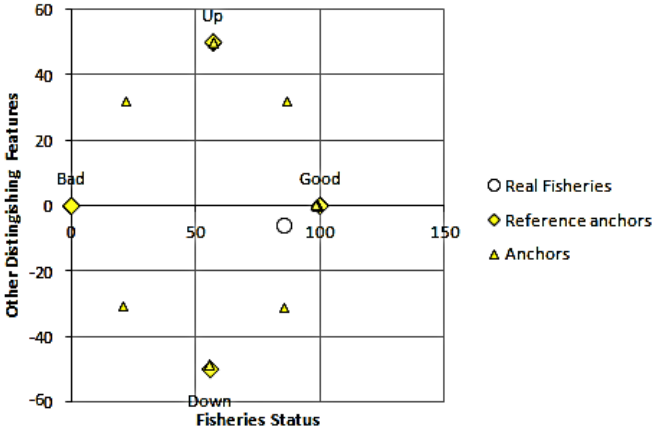

Figure 1. Status of Biosphere Reserve Sustainability Based on Economic Dimension

The IK CBC value in each dimension is the ecological dimension of 89.45784, the economic dimension is 85.85605 and the socio-cultural dimension is 76.27469. The IK CBC values from the three dimensions were obtained based on an assessment of 12 attributes, namely 4 attributes on the ecological dimension (reduced disaster, sustainability of natural resources and ecosystems, environmental services and carbon stock), 4 attributes on the economic dimension (branding, employment, people's economy, access to on natural resources) and 4 attributes on the socio-cultural dimension (science and technology and innovation, health services, education for sustainable development, poverty).

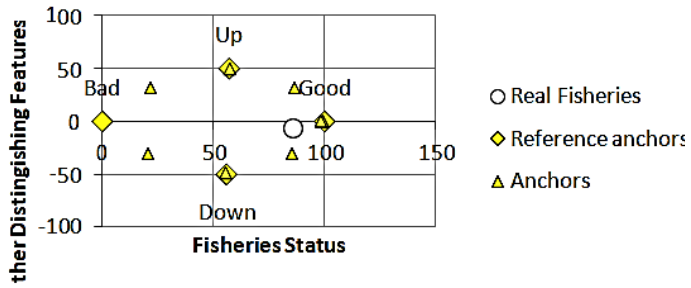

Figure 2 Status of Biosphere Reserve Sustainability Based on Economic Dimension

In the rapfish ordonation image, both in the ecological, economic and socio-cultural dimensions (figures 1, 2 and 3) the circle symbol is an anchor or boundary, where in the three images the circle symbol approaches the maximum index value (100) . This shows that the value of the three dimensions analyzed shows a good value (good).

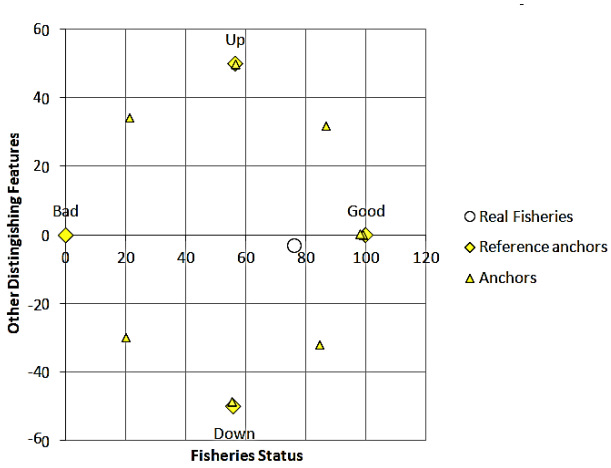

Figure 3. Status of Biosphere Reserve Sustainability Based on Socio-Cultural Dimension

It is known that the ecological dimension has the highest sustainability index compared to the economic and socio-cultural dimensions. This implies that the multidimensional ecological dimensions contribute highly to the sustainability of the management of the Cibodas Biosphere Reserve. This is because the focus of management is the preservation of the core zone of the Cibodas Biosphere Reserve which is a conservation area under the management of the Gunung Gede Pangrango National Park Center, where the condition of the ecosystem is not disturbed so that its function as an area to preserve biodiversity, monitor ecosystems and conduct research can be achieved. Thus the function of the application of the Cibodas biosphere reserve to contribute to the conservation of landscapes, ecosystems, species and germplasm can be realized.

Leverage analysis aims to see the sensitive attributes that contribute to the sustainability index value of the Cibodas Biosphere Reserve in each dimension.

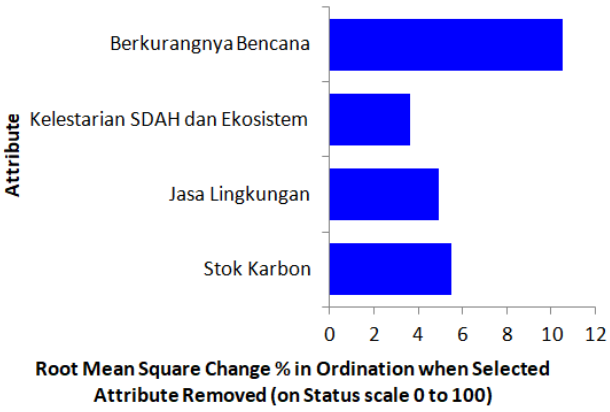

Figure 4. Sensitive Ecological Attributes Affecting CBC Sustainability

From the results of the analysis of Leverage Attributes of the sustainability of the Cibodas Biosphere

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Reserve, the ecological dimensions as shown in Figure 4.4, it is known that from the 4 attributes analyzed there is 1 dominant or sensitive attribute in influencing the sustainability of the Cibodas Biosphere Reserve, namely the reduction of disasters.

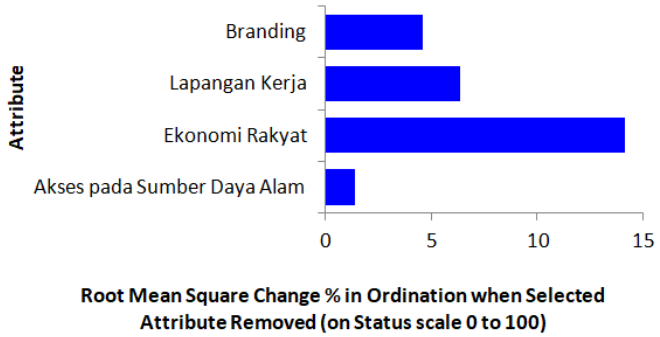

Figure 5 Sensitive Economic Attributes Affecting CBC Sustainability

People's economic attributes are very influential on the sustainability of the Cibodas Biosphere Reserve because the welfare of the community has an impact on the sustainability of the conservation area as the core zone of the Cibodas Biosphere Reserve, meaning that if the welfare of the community increases, the dependence on natural resources in the core zone will be lower, so as to minimize negative interactions that are disturbing and threaten the sustainability of the core zone of the Cibodas Biosphere Reserve.

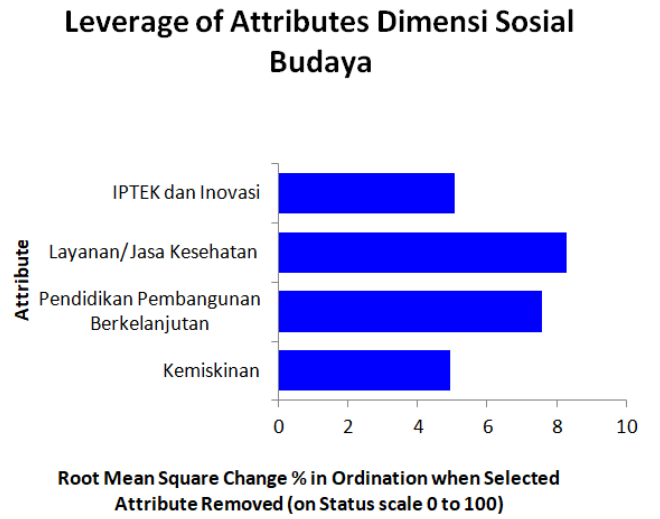

Figure 6. Sensitive Socio-Economic Attributes Affecting CBC Sustainability

Attributes of Science and Technology and Innovation and Poverty also affect the socio-cultural dimension. That the development of science and technology can create new innovations in managing natural resources in a sustainable manner, this can develop alternative incomes that have an impact on increasing the community's economy, so that resource exploitation can be minimized because people do not have direct dependence on natural resources.

The Monte Carlo analysis aims to test the level of confidence in the total index value of the sustainability of the Cibodas biosphere reserve in each dimension from several influences, including the effect of scoring errors on each attribute in each dimension, procedural errors or understanding of attributes and variations in scoring, data entry errors, MDS analysis process stability and stress values are too high.

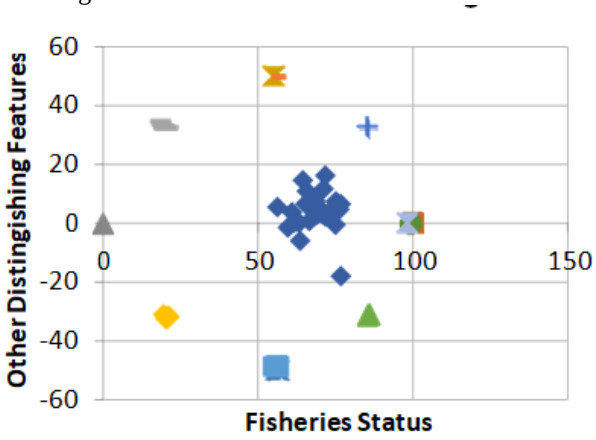

Figure 7. Monte Carlo Analysis of Social and Cultural Dimensions

The results of the monte carlo simulation for the ecological dimension show an average result of 75.28% as shown in Figure 7 which, when compared with the results of the ordinance on the ecological dimension of 89.45%, does not appear to have a significant difference. The results of the Monte Carlo simulation for the economic dimension show an average result of 73.40% as shown in Figure 8 which, when compared with the ordinated results of the economic dimension of 85.85%, does not appear to have a significant difference. The results of the Monte Carlo simulation for the socio-cultural dimension show an average result of 70.62% as shown in Figure 9 which, when compared with the results of the ordination on the socio-cultural dimension of 76.27%, does not appear to have a significant difference.

IV. CONCLUSION

Based on the results of the study, it can be concluded as follows The results of the Rap Analysis on the ecological, economic and socio-cultural dimensions resulted in a CBC sustainability index (IK) above 75.01 on a scale of 0-100. The results of the analysis of Leverage Attributes of the sustainability of the Cibodas Biosphere Reserve in the ecological dimension, there is one dominant or sensitive attribute in influencing the sustainability of the Cibodas Biosphere Reserve, namely the reduction of disasters. Thus, these attributes need attention and need to be managed and monitored properly so that the value of this dimension index can continue to increase every year. The results of the analysis of leverage on the economic dimension, there is one

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sensitive attribute that affects the value of the sustainability index of the Cibodas Biosphere Reserve in the economic dimension, namely the people's economy. Therefore, for the sustainability of the Cibodas Biosphere Reserve, the economic dimension needs to be considered carefully. Attributes of the socio-cultural dimension that affect the sustainability of the Cibodas Biosphere Reserve, namely services / health and education for sustainable development. The results of the Monte Carlo analysis show that the sustainability index value of the Cibodas Biosphere Reserve does not experience much difference between the results of the MDS and the Monte Carlo analysis and in the replicates up to 25 scores that are concentrated in each dimension appear to be clustered, which means that the determination of the scoring on each attribute has been appropriate. Based on the results of the analysis on the kite, the ecological, economic and socio-cultural dimension diagram shows that all dimensions show a high sustainability index, this means that it is in accordance with the theory of the concept of sustainability which includes 3 main pillars, namely sustainability. economic, environmental and social sustainability. Thus, it can be concluded that the current management of the Cibodas Biosphere Reserve is very sustainable.

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