International Journal of Advances in Scientific Research and Engineering (ijasre)

E-ISSN : 2454-8006

DOI: 10.31695/IJASRE.2023.9.5.7

Volume 9, Issue 5
May - 2023

Ward Hierarchical Clustering: Indonesia's Green Economy Implementation Performance based on Environmental Quality towards Sustainable Development Goals

Fitri Agustina[1] and **Helynda Mulya Arga Retha**[2]

Department of Industrial Engineering[1] and Department of Mathematics[2]

Universitas Trunojoyo Madura[1] and Institut Pertanian Bogor[2]

Bangkalan[1] and Bogor[2]

Indonesia

ABSTRACT

Environmental issues have recently emerged as an essential topic of discussion on a global scale. Actions to protect and preserve the environment should be addressed, which causes several problems such as water and air pollution, soil degradation, forest destruction, and diversion of agricultural land. Economic goals are given higher priority than other goals, such as environmental and community goals, in national development strategies and programs. The "green economy" concept is a solution to the sustainable concept to overcome the above challenges. Thus, this paper attempts to build a sustainable economic model based on research from various scientific sources. The indicators presented in this paper can help advise regional policymakers to continue progressing and developing according to the Sustainable Development Goals (SDGs) pillars. This study uses the Ward Hierarchical Clustering method. The first cluster is the provinces of Aceh, North Sumatra, and West Sumatra, which also interpret that the performance of implementing a green economy in related areas based on environmental quality is very good. The second cluster is East Java, South Sumatra, and South Sulawesi, which indicates that the performance of the implementation of a green economy in related areas based on environmental quality is quite good. Then the third cluster is West Java, which interprets that the performance of implementing a green economy in related areas based on environmental quality still needs attention from the local government. It is known that 97.06% of Indonesia's territory has implemented a green economy in related areas based on very good environmental quality.

Key Words*:* Green economy, Environmental issues, Ward hierarchical clustering, SDG.

I. INTRODUCTION

Environmental issues have recently emerged as a major topic of discussion on a global scale. This is closely related to the awareness that human actions contribute to the phenomena of natural change, which are the root causes of many catastrophic events. The effects of pollution, global warming, and climate change patterns are becoming more dire and frightening nowadays. Global warming and climate change are escalating as a result of widespread environmental degradation in many countries, including Indonesia.

Indonesia has the largest economy in Southeast Asia, a vast population of productive age, and abundant natural resources ranging from biological, animal, to diverse mineral and mining products [1]. Indonesia, as a coastal country, offers significant potential for marine resources such as marine biota, offshore oil mining, and iron sands. Indonesia has the third largest forest resources in the world, spreading from western to eastern Indonesia. Furthermore, biodiversity in forests is vital for environmental sustainability and balance. In addition, the government of Indonesia has a substantial goals to become a more competitive and high-income country by 2045.

The development is often done solely for economic gain, without taking environmental sustainability factors into account, as a result there is an increase periodically in CO_2 shown in Figure 1.

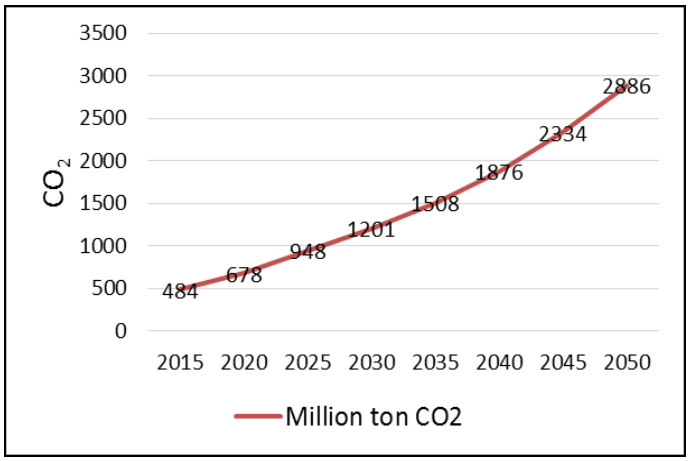

Figure 1. The amount of CO_2 emission

The quality of the human environment can degrade or decline as a result of natural catastrophes, human social and economic activities, and other factors. The preservation of the constructed environment, the social environment, and the natural environment is hampered by these varied activities. The average degree of awareness of environmental care in Indonesian society was 81.61%, according to a survey on environmental care behavior carried out by the Central Bureau of Statistics in 2013. The government's performance in carrying out Law No. 32/2009 [2] concerning Environmental Protection and Management must be examined whether it has been implemented effectively or not. However, if environmental degradation continues to spread and pervade every layer of the earth, the benefits of this resource's enormous potential will be lost. According to [3], the average quantity of carbon dioxide (CO_2) in the earth's atmosphere in 2025 is 948 Mt and it will increase in the following years. Increasing carbon dioxide (CO_2) emissions, over exploitation of natural resources, has been increasing energy consumption, and the urge for greater economic development all contribute to environmental degradation [4].

In addition, some movements to protect and preserve the environment are unfortunately often neglected, which causes several problems such as water and air pollution, soil degradation, forest degradation and diversion of agricultural land. For example, oil palm development in West Papua (Manokwari), West Kalimantan (Kubu Raya), and Papua (Boven Digoel) has led to deforestation, resulting in significant secondary external impacts such as water pollution, soil erosion, and air pollution. In addition, it also results in economic and social impacts [5]. In the long term, these factors reduce the productivity of natural resources and the environment, which in turn leads to the formation of poverty and other structural problems in areas where the population is highly dependent on these factors for survival. However, Indonesia is committed to reduce emissions from deforestation and forest degradation [6]. The cliché question is how to solve it incorporated with economic problems?

In Indonesia, Economic goals are given higher priority than other goals, such as environmental and community goals, in national development strategies and programs [7]. According to [8] to achieve its goal of increasing human welfare, development must be based on Sustainable Development Goals (SDGs). The report of the World Commission on Environment and Development (WCED) in 1987 [9] entitled Our Common Future, sustainable development is made not only for now and here, but also for the future.

The concept of a "green economy" appeared as a result of increased awareness of nature conservation in commercial and development efforts. As a growing country which is rich in natural resources yet prone to environmental disasters, Indonesia should promptly establish an economic strategy that prioritizes not only growth but also environmental sustainability and prosperity [10].

The idea of a green economy is currently experiencing development with intensification of sustainable development. The green economy concept is a concept that supports sustainable development and poverty alleviation, and is currently being developed[11]. Many efforts to make the process of economic growth run by utilizing more effective, clean and resilient resources while maintaining the same level of economic growth is the main concept of "Green Economy" [12]. One of the sub-fields under the “Green Economy” scope is the study of efforts to achieve sustainable development through green economic growth.

The concept of sustainable development is analyzed in more detail, several studies confirmed the influence of the green economy on aspects of environmental, economic and social objectives. Since 1972 the UN conference had discussed the main issue, namely the environment. [13] Illustrates that Indonesia has taken into account the importance of sustainable development. This is reflected in the picture of sustainable development in Indonesia. Implementation of the Law No. 32/2009 is the government's legal basis in efforts to preserve the environment. Moreover, the law aims to improve the environmental quality of the community's socio-economic activities and realize the ideals of a green economy that is more environmentally friendly[13].

"Sustainable development includes three main pillars, namely economic, social and environmental". Economic, social and environmental activities are said to cause a decrease and increase in environmental quality. Therefore the author wants to know the

DOI: 10.31695/IJASRE.2023.9.5.7

condition of the provinces of Indonesia in terms of the SDGs main pillars to see how Indonesia's performance is in implementing the environmental quality-based Indonesian green economy which answers all SDGs main pillars for the success of the G20 [14].

1.1 Problem Identification

According to Law No. 23 of 1997[15], "the environment is a spatial unit containing all objects, power, circumstances, and living things, including humans and their behavior, that affect the continuity of life and the welfare of humans and other living things.". The Ministry of Environment established an index (IKLH) for calculating environmental quality based on a combination of composite indexes that represent how much the quality of water, air, and forests is in Indonesia with the release of the 2009 Environmental Quality Index (EQI) [2]. Several variables in the agriculture, mining, manufacturing, construction, and transportation sectors have a positive and statistically significant relationship with the environmental quality index (EQI) [16]. In order to cluster, it took some quantitative data. This paper aimed to analyze Indonesia's green economy implementation performance based on environmental quality with some supporting data from credible sources such as the Central Bureau of Statistics Indonesia.

This paper is the author's attempt to build a sustainable economic model based on research from various scientific sources. The authors have several dimensions to describe the environmental quality. Which are: opportunity and policy economy, socio-economic and characteristics growth, natural assets, productivity source power and the endogen variable which is bad quality environment life (Y). We analyzed how some of these variables affect the quality of the environment. These dimensions were created from the calculation of Gross Domestic Product (GDB), and the Central Bureau of Statistics divided the economy into seventeen sectors beginning in 2010.

Agriculture, mining, manufacturing, power and gas, as well as water and waste management, are the key economic sectors in Indonesia that are intimately tied to the environment. While social activities like births, deaths, migration between regions, and initiatives to improve the quality of the human being himself are activities that are intimately tied to the growth of a region. A share of government spending for environmental purposes is donated as a result of the government's status as a welfare-seeking party.

It is hoped that the indicators presented in this paper can help regional policy makers to continue in progressing and developing the environment regulation according to the SDG's pillars. Similar to the OECD's proposed green growth measurement methodology, the proposed indicators aim to provide a comprehensive picture of the state of the economy and society, encompassing five types of indicators: resource productivity, natural assets, environmental quality, economic opportunity and policy, and socio-economic context and growth characteristics. This framework becomes a reference in this study so that the data variables were obtained in Table 1.

Table 1. Sustainable economic model

Variable	Dimensions
Constant GRDP	Opportunity and Policy Economy
Human Development Index	Socio-Economic Context and Characteristics Growth
Rate Growth Resident	
Density Resident	
Forest Area	Natural Assets
Fish Production	
% Adequate Water Consumption	Productivity Source Power
Consumption Electrical Energy	
% Access Service sanitation Viable and Sustainable	
Air Pollution	Bad Quality Environment Life (Y)
Soil Pollution	
Water Pollution	

DOI: 10.31695/IJASRE.2023.9.5.7

The Central Bureau of Statistics, the Ministry of Finance and the Ministry of Environment have secondary quantitative data used in this study, which were collected from their respective publications and websites (www.bps.go.id). Since there are still several factors that have not been published, the authors used the latest information available for each of these factors.

Referring to the conceptualization of research above, the four hypotheses in this study were formulated as follows:

1. The increase of opportunity and the policy economy will diminish the bad quality of environmental life (H_1).
2. The increase of socio-economic context and expected growth will diminish the bad quality of environmental life (H_2).
3. The more natural assets will diminish the bad quality of environmental life (H_3).
4. The increase of the productivity of source power will enhance the bad quality of environmental life (H_4).

The hypothesis (H_1) explains that if there is an indication of an increase in the value of the opportunity and policy economy, interpreted as an increase in the constant GRDP value, it will diminish the bad quality of environmental life or increase the quality of environmental life. This statement also applies to the next hypothesis (H_2). Suppose there is an indication of an increase in the value of the context's socio-economic and characteristic growth, which is interpreted as an increase in the value of the human development index, resident growth rate, and resident density so it will diminish the bad quality of environmental life or enhance the quality of environmental life. In addition, natural assets which is interpreted as the increase or stability of the value of forest area and fish production will diminish the bad quality of environmental life or increase the quality of environmental life (H_3). Finally, increasing the productivity of source power, interpreted as an increase in the value of adequate water consumption, electrical energy consumption, and access to viable and sustainable sources, will enhance the bad quality of environmental life or diminish the quality of environmental life (H_4).

The next stage is to identify the framework-related metrics for the bad quality of environmental life idea. This stage had been done to make the research process easier within its quantitative constraints.

2. RESEARCH METHOD

This study was conducted throughout Indonesia covering the provinces of Aceh, North Sumatra, West Sumatra, Riau, Jambi, South Sumatra, Bengkulu, Lampung, Bangka Belitung islands, Riau islands, DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, Banten, Bali, West Nusa Tenggara, East Nusa Tenggara, West Kalimantan, Central Kalimantan. Moreover, North Kalimantan is now part of a new province, the authors had to combine several studies previously with East Kalimantan.

The study uses the Ward Hierarchical Clustering method and uses software r. The author uses correlation analysis to analyze the correlation between the quality of environmental life with the variables. Cluster analysis using the ward method is a clustering approach that aims to group data to minimize internal variance. The number of clusters is determined based on the ward method dendrogram. The measure used is the variable Sum Square Error (SSE). The clustering stages using the ward method are as follows [17]:

2.1 Ward Hierarchical Clustering's Step

The Ward technique is employed because it can minimize the sum of squares (SSE), it makes this technique to be the best way for cluster analysis utilizing the hierarchical method. The internal cluster variance of the clusters should be as low as possible using the variance approach. The Ward approach, which computes the average for each cluster, is the most popular variance estimation technique. Next, determine the Euclidean distance between each object and its average value before calculating any other distances. Two clusters with a growing "sum of squares in the cluster" are combined at each stage [22]. By merging objects into clusters, information is lost, leading to the construction of clusters according to Ward's technique. The sum of the squared deviations from the cluster mean for each observation is used to calculate it. The objective function is error sum of squares (SSE). If two items have the least possible function, they will be combined. This method has the following stages [18]:

1. The first stage begins with paying attention to N groups of subjects with one subject in each group. Sum Square Error (SSE) will be equal to zero for the initial stage because each observation will form a cluster. Equation (1) is given to calculate SSE.
2. The first group is formed by selecting two out of N groups. The combination will produce a Sum Square Error on the objective function value.
3. Pay attention again to group N –1 in determining two groups that can reduce goals. Therefore, N groups are reduced to N – 1, then to N – 2, and finally a group is formed.

DOI: 10.31695/IJASRE.2023.9.5.7

$$SSE = \sum_{j=1}^{p}\left(\sum_{i=1}^{n} X_{ij}^{2} - \frac{1}{n}\left(\sum_{i=1}^{n} X_{ij}\right)^{2}\right) \quad (1)$$

Description:

X_{ij} : value of the ij variable

P: number of variables measured

N: number of objects in the formed cluster

2.2 Flow charts

[22] illustrates the categorization process used to cluster the data in this cluster analysis and shown in Figure 2.

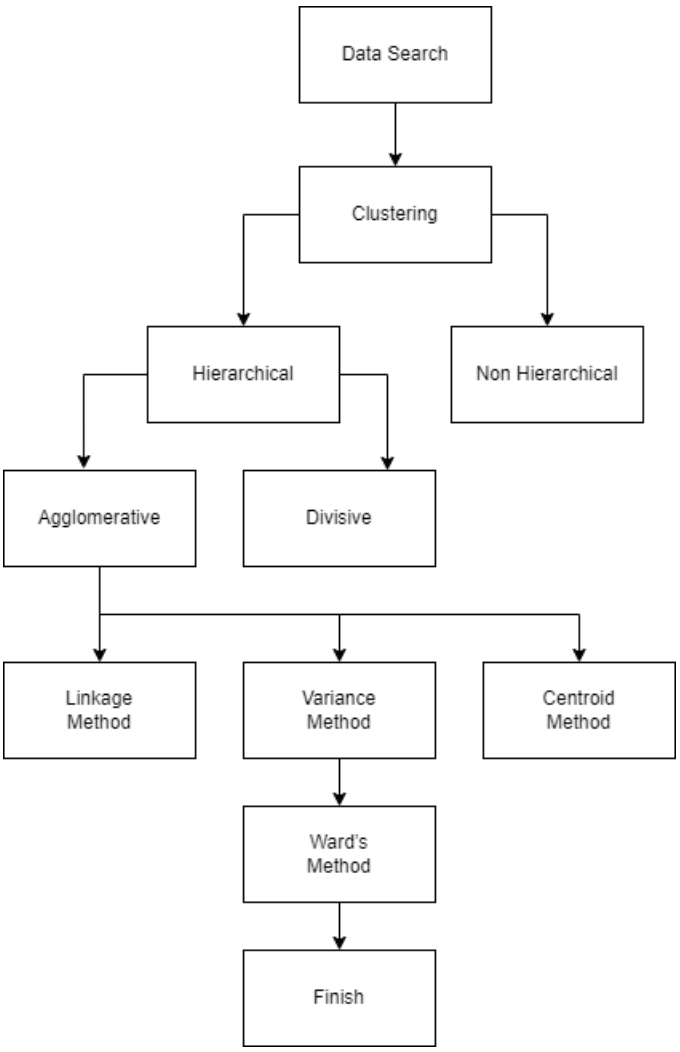

Figure 2. Flow diagram of Ward's method

2.3 Correlation Analysis

One way to evaluate how closely two variables are related is by computing their correlation[19]. The range of the correlation coefficient ranges from -1 to 1, with a perfect negative correlation at r = -1 indicating a negligibly small effect of variable X on variable Y, and a perfect positive correlation at r = 1 indicating a highly significant effect of variable X on variable Y[20]. A correlation coefficient of zero indicates that the two variables being analyzed are unrelated. Equation (2) describes correlation formulation (r).

DOI: 10.31695/IJASRE.2023.9.5.7

$$r = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{(n\sum(X)^2 - (\sum X^2))\left((n\sum(Y)^2 - (\sum Y^2)\right)}} \quad (2)$$

Description:

X: value of the variables

Y: value of the Quality Environment Life

N: number of objects

3.RESULTS AND DISCUSSION

Based on the Ward Hierarchical Clustering method, the first clusters are the provinces of Aceh, North Sumatra, and West Sumatra, other than those who interpret the performance of implementing a green economy in related areas based on environmental quality as very good. The second cluster is East Java, South Sumatra, and South Sulawesi, which results that the performance of implementing the green economy based on environmental quality is quite good. Finally, the third cluster is the rest of the first and second clusters, namely West Java, which indicates that the performance of implementing green economy in related areas based on environmental quality still needs attention from the local government. This is because the clustering results have a lower average than the results of other clusters as shown in the following Figure 3 and Table 2.

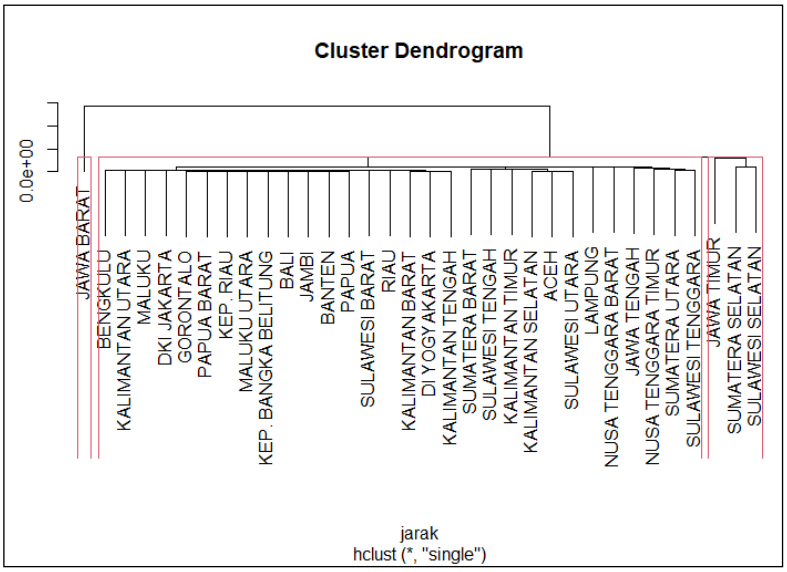

Figure 3. Results cluster dendogram

Table 2. Sustainable economic model

	Clusters 1	Clusters 2	Clusters 3
	Province other	Java, South Sulawesi and South Sumatra	West Java
Constant GRDP	68,356.2	59,062.3	45,299.6
Human Development Index (HDI)	71.3	71.5	72.5
Rate Growth Resident	1.8	1.0	1.5
Density Resident	759.4	381.3	1,379.0
Forest Area	3,814,834.7	2,484,746.7	816,603.0

DOI: 10.31695/IJASRE.2023.9.5.7

Fish production	372,192,485.2	1,545,976,572.0	3,078,847,121.2
Air Pollution	128.4	411.7	556.0
Soil Pollution	36.8	88.7	129.0
Water Pollution	252.2	633.3	1,217.0
% Adequate Water Consumption Drink	87.1	91.1	93.0
Consumption energy electricity	5,056.7	27,611.8	41,063.3
% Access service sanitation feasible and sustainable	65.9	69.7	58.7

This table defines that the cluster 3 area is quite good in terms of HDI, total fish production, and consumption of potable water, however, it is still not optimal in implementing green economy in other parts such as GRDP performance, high population density, narrow forest area, air pollution, high soil pollution, high water pollution, high electricity consumption, and the percentage of access to sanitation services. The feasibility and sustainability are quite low. This can be seen through the following Figure 4.

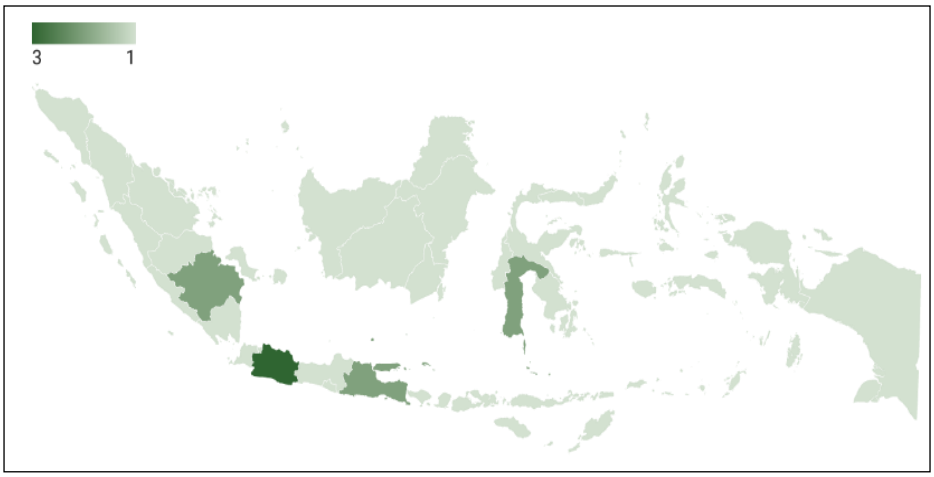

Figure 4. Results mapping clustering

It is known that 97.06% of Indonesia's territory has had the performance of implementing a green economy in related areas based on very good environmental quality, this indicates that the implementation of the law No. 32/2009 [15], which is the legal basis for the government in an effort to preserve the environment, is implemented quite well when viewed from the Ward Hierarchical Clustering model. The author realizes that this paper still has some limitations, one of which is the insufficient number of variables to interpret a green economy performance, so the author hopes that there will be other novelties in future research.

Correlation analysis was also conducted to determine how much the influence of the variable has on the endogenous variable, namely bad quality environment life (Y). Table 3 represents the results of correlation values in each dimension.

Table 3. Correlation results for each dimension

Correlation	Dimensions
-0.194	Opportunity and Policy Economy
-0.044	Context Socio-Economic and Characteristics Growth

DOI: 10.31695/IJASRE.2023.9.5.7

0.681	Natural Assets
0.780	Productivity Source Power

Based on Table 3, the correlation's result of opportunity and policy economy's variable is -0.194, which means that the greater will diminish the bad quality environment life (H_1 accepted) in other words, it will enhance the quality environment life. The correlation of the socio-economic context and growth characteristics variable is -0.044, which means that the greater number will diminish the bad quality environment life (H_2 accepted) in other words, enhance the quality environment life. The correlation of natural assets is 0.681, which means that the greater number will enhance the bad quality environment life (H_3 is rejected). In other words, it will diminish the quality of the environment life. The correlation's result of the productivity source power is 0.780, which means that the greater number will enhance bad quality environment life (H_4 is rejected). Moreover, there should be a negative correlation because the productivity of the source power is related to energy saving. The next step is the analysis between variables and the results that are shown in Table 4.

Table 4. Correlation results for each variable

	Variable	Dimensions
-0.19382	Constant GRDP	Opportunity And Policy Economy
-0.00444	Human Development Index (HDI)	Context Socio-Economic and Characteristics Growth
-0.41639	Rate Growth Resident	
-0.0435	Density Resident	
0.005031	Forest Area	Natural Assets
0.679756	Fish Production	
0.095574	% Adequate Water Consumption	Productivity Source Power
0.779945	Consumption Electrical Energy	
-0.10276	% Access Service sanitation Viable and Sustainable	

Based on Table 4, the correlation of the opportunity and policy economy correlation which is interpreted with the constant GRDP variable is -0.194, which means that getting bigger number will reduce the poor environmental quality, in other words increasing environmental quality. The second dimension is socio-economic context and growth characteristics, the correlation variable for the human development index (HDI) is -0.00444, the correlation variable for population growth rate is -0.41639, the population density correlation variable is -0.0435, which means that the Human Development Index (HDI) variable is getting bigger will reduce the bad quality of the environment, in other words, it will increase the quality of the environment. The third dimension is natural assets, the correlation variable for forest areas is 0.005031, the correlation variable for fish production is 0.67975, which means that only the forest area variable which is getting bigger will reduce the poor environmental quality, in other words it will increase the quality of the environment. The last dimension is the productivity of source power, the correlation variable % consumption of adequate water is 0.095574, consumption of electrical energy is 0.779945, % access to adequate and sustainable sanitation services is -0.10276, which means that all variables that are getting bigger and it will reduce the quality of the bad environment. In other words, it will increase the quality of the environment. The greater the variable of electric energy consumption will increase the poor quality of the environment. However, it all depends on low or high correlation.

This study suggests the government of Indonesia to start focusing on SDG's, especially in cluster 3 by taking into account indicators that are considered quite helpful in improving environmental quality, such as seeking solutions to increase constant GRDP, forest area, Human Development Index (HDI), fish production, % adequate water consumption, and % access to adequate and sustainable sanitation services such as reducing the consumption of electrical energy. In addition, the existence of local cultural wisdom originating from traditional knowledge, such as the Mentawai tribe, the slopes of Mount Merapi community, and the Balinese in Indonesia has the potential to be developed, adapted, and modified for handling global environmental issues in other regions [21].

DOI: 10.31695/IJASRE.2023.9.5.7

5.CONCLUSION

Sustainable development led to the development of the green economy concept. The author models a measurement framework for green growth as proposed by the OECD, which includes five types of indicators such as: Resources Productivity, Natural Assets, The Quality of the Environment, Opportunities and Economic Policy, and Socio-Economic Context and Growth Characteristics. Based on the Ward Hierarchical Clustering method, the performance of the West Java region's Green Economy implementation based on Environmental Quality still needs more attention from the local government. The cluster 3 area is quite good in terms of HDI, total fish production, and consumption of potable water. Based on the dimensional correlation analysis, Opportunity And Policy Economy is accepted and Socio-Economic Context and Growth Characteristics is also accepted because there is an increase in the dimensions of the Quality Environment of Life. In the correlation between the variables, Constant GRDP, Human Development Index Forest Area, Fish Production, % Adequate Water Consumption, and % Viable And Sustainable Sanitation Service Access, and Electrical Energy Consumption are quite good in increasing the Quality Environment Life. This result suggests the government of Indonesia to start focusing on SDG's, especially on cluster 3 by considering indicators that are considered quite helpful in increasing the Quality Environment Life.

ACKNOWLEDGMENT

The authors would like to thank their colleagues at Universitas Trunojoyo Madura and IPB. The data has been supplied by BPS and the Indonesian Ministry of Environment via the official website.

REFERENCES

[1] Gerard A, Persoon, and Merlijn van Weerd, "Biodiversity and Natural Resource Management in Insular Southeast Asia," *Island Studies Journal*, vol. 1, no. 1, pp. 81–108, 2006.

[2] Ministry of Environment., *Law of the Republic of Indonesia Number 32 of 2009 concerning Environmental Protection and Management*.

[3] International Energy Agency, *CO2 emissions from fuel combustion: overview*. 2017.

[4] Syed tauseef hassan, bushra batoo, muhammad sadiq, and bangzhu zhu, "How do green energy investment, economic policy uncertainty, and natural resources affect greenhouse gas emissions? A markov-switching equilibrium approach.," *Environ Impact Assess Rev*, vol. 97, 2002.

[5] K. Obidzinski, A. R, H. Komarudin, and A. Andrianto, "Environmental and social impacts of oil palm plantations and their implications for biofuel production in Indonesia," *Ecology and Society*, vol. 25, no. 1, p. 25, 2012.

[6] Rajiani I and Pypłacz P, "National Culture as Modality in Managing the Carbon Economy in Southeast Asia," *Polish Journal Of Management Studies*, vol. 18, no. 1, 2018.

[7] Oana Forestier and Rakhyun E. Kim, "Cherry-picking the Sustainable Development Goals: Goa lprioritization by national governments and implications for global governance," *Sustainable Development*, vol. 28, pp. 1269–1278, 2020.

[8] P. Pradhan, L. Costa, D. Rybski, W. Lucht, and J. P. Kropp, "A Systematic Study of Sustainable Development Goal (SDG) Interactions," *Earths Future*, vol. 5, pp. 1169–1179, 2017.

[9] "World Commission on Environment and Development (WCED)," vol. 17, 1987.

[10] Olivia Bina, "The green economy and sustainable development: an uneasy balance," *Environ Plann C Gov Policy*, vol. 31, pp. 1023–1047, 2013.

[11] Eleonore Loiseau *et al.*, "Green economy and related concepts: An overview," *J Clean Prod*, vol. 139, pp. 361–371, 2016.

[12] A. Lavell *et al.*, "Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. In Managing the risks of extreme events and disasters to advance climate change adaptation: Special report of the intergovernmental panel on climate change," *Cambridge University Press*, pp. 25–64, 2012.

[13] Asif Raihan, Monirul Islam Pavel, Dewan Ahmed Muhtasim, Sadia Farhana, Omar Faruk, and Arindrajit Paul, "The role of renewable energy use, technological innovation, and forest cover toward green development: Evidence from Indonesia," *Innovation and Green Development*, vol. 2, 2023.

DOI: 10.31695/IJASRE.2023.9.5.7

[14] UNEP (United Nations Environment Programme), *Life Cycle Management: A Business Guide to Sustainability*. 2007.

[15] Ministry of Environment., *Law of the Republic of Indonesia No. 23 of 1997 concerning Environmental Management*.

[16] Izzatul Ummi, Rusdarti, and Heri Yanto, "Relationship of the GRDP Sectors with Environmental Quality Index in Indonesia 2012-2017," *Journal of Economic Education*, vol. 8, no. 2, pp. 152–158, 2019.

[17] Fionn Murtagh and Pierre Legendre, "Ward's Hierarchical Clustering Method: Clustering Criterion and Agglomerative Algorithm.," *J Classif*, vol. 31, no. 3, pp. 274–295, 2014.

[18] F. Murtagh and P. Contreras, "Algorithms for hierarchical clustering: an overview," *Wiley Interdiscip Rev Data Min Knowl Discov*, vol. 2, no. 1, pp. 86–97, 2011.

[19] Senthilnathan and Samithamby, "Usefulness of Correlation Analysis," *SSRN*, 2019.

[20] NJ Gogtay and UM Thatte, "Principles of Correlation Analysis," *Journal of The Association of Physicians of India*, vol. 65, 2017.

[21] Syafwan Rozi and Zulfan Taufik, "Adaptation of Religion and Local Wisdom in Global Environmental Issues in Indonesia.," *Religious: Jurnal Studi Agama-Agama dan Lintas Budaya*, vol. 3, no. 2, pp. 191–203, 2020.

[22] Bilson Simamora. (2005). Analisis Multivariat Pemasaran Edisi Pertama. Jakarta: PT. Gramedia Pustaka Utama.

DOI: 10.31695/IJASRE.2023.9.5.7