

IDM Clustering: Study of Village Potential Development Efforts in the Developing Category

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Abstract: Bogor Regency has a Development Village Index (IDM), which is a composite index formed based on the Social Resilience Index (IKS), Economic Resilience Index (IKE) and Ecological Resilience Index (IKL) [1]. The IDM indicator set was developed based on the concept that in order to lead to an advanced and independent village, a sustainable development framework is needed where social, economic and ecological aspects become complementary forces and maintain the village's potential and ability to prosper village life. Based on 416 villages in Bogor Regency (40 sub-districts), 180 villages are in the Developing category, 188 are in the Advanced category and 48 villages are classified as Independent villages [2]. This research focuses on a comprehensive study on developing a sustainable development model to encourage 180 villages with developing status, to move up to an advanced level. This model can later be used as a reference in developing village development planning in Bogor Regency. The research method used is quantitative with the clustering method of data mining, and qualitative through the approach of literature studies, field surveys, FGDs and in-depth interviews. This research is a form of advanced implementation of the results of the research conducted by the Head of the Applied Team which focuses on IKS in the informal sector Health BPJS sector [3; 4; 5; 6; and 7].

The results of the research resulted in a mapping of 180 villages with developing categories into 5 clusters. This cluster grouping then describes the results of the IDM analysis based on its 3 dimensions. Furthermore, results were obtained which outlined the respective strengths and weaknesses in each cluster, which were then used as the basis for recommendations for villages that had the potential to be encouraged to become developed villages. Efforts to encourage these villages to become developed villages by taking into account the superior dimensions found in each village. So that later this development pattern will be presented in a proposed model of research results.

Keywords: Developing Village, Developed Village, Sustainable Development, IDM, Bogor Regency

Introduction

Village development is an effort to improve the quality of life and community welfare. The measurement of village development is carried out by the Ministry of Villages with the Ministry of Village Regulations, Development of Disadvantaged Regions, and Transmigration. The measurement of development by the Ministry of Villages in Permendes No. 2 of 2016 about Indeks Desa Membangun (IDM) [8]. IDM captures the development of village independence based on the implementation of the Village Law with the support of village funds and village assistants. IDM directs the accuracy of interventions in policies with the right correlation of development interventions from the government in accordance with community participation which is correlated with the characteristics of the village area, namely typology and social capital. According to [9], the position of social capital also plays a positive role in the political dimension because it encourages participation.

Policies and activities for development and empowerment of rural communities must produce equity and justice, be based on and strengthen local and cultural values, and be environmentally friendly by managing the potential of natural resources in a good and sustainable manner. Based on this context, social, economic and ecological resilience work as a dimension that strengthens the process and achievement of development goals and empowerment of rural communities. According to [10], that social capital in rural areas is one of the means that can be used by rural communities to increase their role in various activities, especially in agriculture and plantations. Various means of existing social capital have actually provided a medium for village communities to join in thinking about increasing welfare.

The position of social capital also plays a positive role in the political dimension because it encourages participation, accessibility and freedom of society which are also principles in the paradigm of sustainable inclusive development [11]. The term social capital first appeared in writing [12] in the context of improving people's living conditions through community involvement, goodwill, and other social attributes in neighbors. In

this work, the main characteristics of social capital appear, namely bringing internal and external benefits. This social capital includes the availability of social facilities such as sports facilities, meeting halls, and others. The last indicator in social resilience is Settlements. The availability of settlements for the community is important to create a healthy society.

Bogor Regency as one of the largest provincial areas in Java (West Java) has 416 villages in 40 sub-districts. In 2021, 180 villages are in the developing category, 188 villages are in the advanced category and 48 villages are in the independent status. Unlike the previous year, where there were still 4 underdeveloped village categories in 2020 [2]. Improving the IDM category of villages in Bogor Regency in 2021 is a good achievement, and calls for continuous improvement in the development of these villages in the future. This study comprehensively examines the potential for improvement and development of various variables and indicators in 180 villages with the category of developing into developed villages. The results of this study will produce a recommendation model in the form of a development strategy for the 180 villages,

Methodology

This study uses a quantitative approach using the concept of big data analysis through the clustering method. Data was collected through the Regional Apparatus Organization (ODP) and BPS Bogor Regency for 180 villages in Bogor Regency and through secondary data processing. The steps taken as the stages of implementing the activity are as follows:

1. Data Collection

The data and information used are primary data and secondary data obtained from Regional Apparatus Organizations/Agencies/Institutions in the Bogor Regency Government, which are then compiled or arranged according to the sequence of data grouping.

2. Processing and Tabulation

The data and information that has been collected is processed and tabulated into several tabulations according to categories and indicators in IDM.

3. Data Analysis

Processed data and information are tabulated so that data analysis can be carried out in a better and more in-depth manner.

The analytical method used in the research on the sustainable development model: 180 villages to developed villages in Bogor Regency include:

1. Descriptive statistics

Descriptive statistics are statistical analyzes that provide a general description of the characteristics of each research variable. These data and information are presented in the form of cross-tabulations and graphics.

2. Clustered Data Mining

This analysis is directed at processing data and information using the concept of big data with data mining methods. [5; 13] says that "data mining is the process of finding meaningful new correlations, patterns, and trends by sifting through large amounts of data stored in repositories, using technological pattern reasons as well as statistical and mathematical techniques. There are many data mining techniques that can be used, including K-Means clustering, Hierarchical clustering, DBS can be used if the main goal is to classify data that is unknown to the target class, and if the target data is known, algorithms such as Naïve Bayes, Decision Tree can be used, and Artificial Neural Networks. There are several other things related to data mining, including statistics, machine learning, data visualization, and database management.

According to [14: 15] "K-means clustering is a popular method used to obtain a description of a set of data by revealing the tendency of each individual data to group with other data individuals. The tendency for this grouping is based on the similarity of the individual characteristics of the existing data. The basic idea of this technique is to find the center of each possible data group and then group each individual data into one of these groups based on their distance. The closer the individual data distance, let's say X1 to one of the centers of the existing groups, say A, the clearer it is that X1 is a member of a group centered in A and the clearer it is that X1 is not a member of any of the other groups (illustration can be seen on Figure 1.) This shows that d1A, namely the distance from X1 to A, has the highest value. Gets small when compared to d1C and d1B.

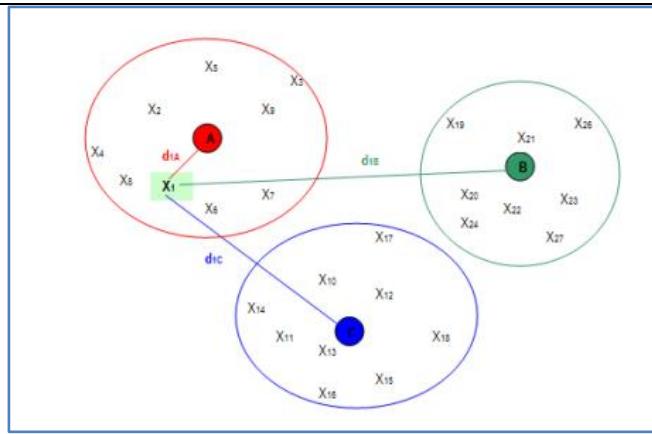


Figure 1 Illustration of Determining Group Membership Based on Distance

Data and information are needed to determine what policy directions will be taken in the development planning of a region. Therefore, a sharp analysis is needed and leads to the most appropriate policies in increasing the status of villages from developing to developed villages. As for each indicator in the Developing Village Index, it becomes the basis for the analysis that will be carried out [16; 17]. Based on the available IDM data, a comparison will be made by conducting a survey by sampling to see the reality and cross-checking process in the village based on these indicators. Then the data is processed and analyzed with existing methods.

Results and Discussions

1. Descriptive Statistical Analysis

This study is based on secondary data processing with the latest data year, namely 2021. The use of the latest year's data is based on the latest updated categories of 416 villages in Bogor Regency. In 2021 it can be seen clearly that the categorization of villages is only in 3 (three) categories, namely: developing (180 villages), advanced (188 villages) and independent (48 villages). It is different when seen in the previous year (2020), that the categorization of villages in Bogor Regency is still divided into 4 categories, namely developing (252 villages), developed (131 villages) and independent (29 villages) and there are still categories of underdeveloped villages as many as 4 villages [2].



Figure 2 Comparison of Bogor Regency IDM data for 2020 - 2021

Furthermore, the descriptive analysis of the data focused on 180 villages with the IDM categorization of developing villages (data for 2021) as the target focus of this study. The categorization of village IDM sizes in this study follows: Classification of Village Status in Permendesa PDT Trans Number 2 Tahun 2016 about Indeks Desa Membangun [8], as follows :

Table 1. Village Category Criteria

1) Independent Village	: (>) 0.8155
2) Developed Village	: (\leq) 0.8155 and (>) 0.7072
3) Developing Village	: (\leq) 0.7072 and (>) 0.5989
4) Underdeveloped Village	: (\leq) 0.5989 and (>) 0.4907
5) Very Underdeveloped Village	: (\leq) 0.4907

2. Data Mining Analysis with the K-Means Clustering Method

Table 2 below is the summary resultoutputcomputation of the results of data mining analysis for 180 villages using the methodK-Means Clustering, by utilizing the applicationR-Studio software.

Table 2. OutputComputation of Processed ResultsK-Means Clustering

Subdistrict	Village	IDM_2021
Min. :3.00	Min. : 1.00	Min. :0.5994
1st Qu. :14.75	1st Qu.: 45.75	1st Qu. :0.6480
Median : 20.00	Median : 90.50	Median : 0.6702
Means : 20.91	Means : 90.50	Mean : 0.6661
3rd Qu. :29.00	3rd Qu.:135.25	3rd Qu. :0.6910
Max. :39.00	Max. :180.00	Max. :0.7071

The results of this data summary provide an overview related to the secondary data that is entered and processed into the applicationR-Studio software. In brief, the main interpretations of the summary are:

- a. The total number of sub-districts is 39 sub-districts.
- b. The number of villages that have the category of "Developing Village" in Bogor Regency is 180 out of 416 villages.
- c. The IDM score is based on the developing village category in 2021, namely:
 - 1) The lowest IDM value of developing villages is 0.5994
 - 2) The average IDM value of developing villages is 0.6661
 - 3) The highest IDM value for developing villages is 0.7071

3. Clustering Analysis

The following is the result of processed data obtained from the output of the R-Studio software application for 180 village data, for data mining analysis using theK-Means Clustering.

Table 3. Distribution ResultsClustersand Average Grades

Clusters	Subdistrict	Village	IDM_2021
1	32.178571	147.82143	0.6381786
2	14.518519	55.55556	0.6246963
3	33.806452	153.48387	0.6889645
4	7.941176	21.73529	0.6726118
5	19.216667	85.90000	0.6822533

Resultscluster outputfrom the applicationR-Studio softwareabove is the average value of the calculation.Based on the clustering results above, it shows that the village categories based on the IDM 180 developing villages are as follows:

- a. **Clusters 1**has an average IDM of 0.6381786 in 28 villages
- b. **Clusters 2**has an average IDM of 0.6246963 in 27 villages
- c. **Clusters 3**has a cluster that has the highest average IDM among other developing village clusters namely 0.6889645 as many as 31 villages
- d. **Clusters 4**has an average IDM of 0.6726118 in 34 villages
- e. **Clusters 5**has an average IDM of 0.6822533 in 60 villages

Table 4 below shows the clustering results which explain the highest village IDM among 180 other developing villages.

Table 4. Summary of Clustering Results from IDM Processed 180 Villages

Clusters	IDM_2021	Subdistrict	Village
1	0.6633	Dramaga	Sinarsari
2	0.6521	Rumpin	Leuwi Batu
3	0.7071	Tanjungsari	Sirnasari
		Sukajaya	Harkatjaya
4	0.7065	Bojong Gede	Rawalong
5	0.7049	Long Parrot	Gorowong

4. Strengths and Weaknesses of Clusters 1-5 for 180 Developing Villages

The following table shows various advantages that can be mapped based on the 3 dimensions of IDM that are measured. Each village cluster shows quite significant differences in the different attributes of excellence it has. These superior attributes become the basic foundation for stakeholders to build villages and improve the welfare of the related village communities. As found [18; 19] in his research that Potential in this paper is power, strength, ability and ability that has the possibility to be developed. So village potential is the power, strength, ability and ability possessed by a village which has the possibility to be developed in order to improve the welfare of the community. Broadly speaking, village potential can be divided into two; First is the physical potential in the form of land, water, climate, geographical environment, livestock, and human resources. The second is the non-physical potential in the form of the community with its patterns and interactions, social institutions, educational institutions, and village social organizations, as well as village officials and pamong.

This has provided a positive outcome for the Bogor Regency government in encouraging villages that have good values of excellence to be encouraged and developed into villages with an advanced category. Through this method it is expected to be able to develop the superior economic potential of the Village/Sub-District which is adapted to the typological characteristics of the Village.

Table 5. Advantages of Clusters 1-5 for 180 Developing Villages

	SUPERIORITY				
	Clusters 1	Clusters 2	Clusters 3	Clusters 4	Clusters 5
Economic Dimension	<ul style="list-style-type: none"> The average number of micro-small businesses is 36 and the highest number is 317 micro-small businesses. The average number of medium-sized businesses in this cluster is 7 and there are at most 64 medium-sized businesses. 	<ul style="list-style-type: none"> The average number of micro-small businesses is 59, with the highest number being 1146 micro-small businesses. The average number of medium-sized businesses in this cluster is 2, with the largest number having 14 medium-sized businesses. 	<ul style="list-style-type: none"> Small micro businesses have an average of 117 with the highest number, namely 1273 small micro businesses. The average number of medium-sized businesses in this cluster is 6, with the largest number having 115 medium-sized businesses. The road surface quality is average in good condition. 	<ul style="list-style-type: none"> The average number of micro-small businesses is 61 with the largest number being 450 micro-small businesses. The average number of medium businesses in this cluster is 3 with the largest number having 25 medium businesses. The road surface quality is average in good condition. 	<ul style="list-style-type: none"> The average number of micro-small businesses is 57, with the highest number being 1,292 micro-small businesses. The average number of medium-sized businesses in this cluster is 3, with the largest number having 45 medium-sized businesses.

Social Dimension	Home ownership based on the highest number of family heads is 3375.	Home ownership based on the highest number of family heads is 5,000 households.	Home ownership based on the highest number of family heads is 15,000 households.	Home ownership based on the highest number of family heads is 9862 households.	Home ownership based on the highest number of family heads is 15,000 households.
Ecological Dimension	There are no environmental problems such as the absence of water pollution and river waste.	<ul style="list-style-type: none"> • There are no environmental problems such as the absence of water pollution and river waste. So it does not cause health problems. • On average there is no change in agricultural sector land. 	<ul style="list-style-type: none"> • There are no environmental problems, it is known that on average the village does not have water pollution and river waste. So it does not cause health problems. • On average, there is no land change to the non-agricultural sector. 	<ul style="list-style-type: none"> • There are no environmental problems such as the absence of water pollution and river waste. No health problems. • On average there is no change in agricultural sector land. 	<ul style="list-style-type: none"> • There are no environmental problems such as the absence of water pollution and river waste. So it does not cause health problems. • On average there is no change in agricultural sector land.

Furthermore, Table 6. below shows various weaknesses that can be mapped based on the 3 dimensions of IDM that are measured. Each village cluster shows significant differences in the different attributes of the weaknesses it has. [20; 21] explains that rural development is basically related to the maturity of thought and hard work of the villagers. This can be realized through the practical actions of villagers in increasing the potential of their community, self-education, self-help and collaboration with other parties. Pedesan development must be carried out through a comprehensive innovation mechanism, not just certain sectors. In essence, innovation is very important for economic growth and development of rural areas, one of which is by creating new opportunities to open businesses in rural areas.

Table 6. Weaknesses of Clusters 1-5 for 180 Developing Villages

	WEAKNESS				
	Clusters 1	Clusters 2	Clusters 3	Clusters 4	Clusters 5
Economic Dimension	<ul style="list-style-type: none"> • The average village in this cluster does not have economic support facilities such as unavailability of hotels, government commercial banks and private banks. • Average road surface quality in moderately damaged condition. 	<ul style="list-style-type: none"> • The average village in this cluster does not have economic support facilities such as unavailability of hotels, government commercial banks and private banks. • Average road surface quality in moderately damaged condition. 	The average village in this cluster does not have economic support facilities such as unavailability of hotels, government commercial banks and private banks.	The average village in this cluster does not have economic support facilities such as unavailability of hotels, government commercial banks and private banks.	<ul style="list-style-type: none"> • The average village in this cluster does not have economic support facilities such as unavailability of hotels, government commercial banks and private banks. • Average road surface quality in moderately damaged condition.

Social Dimension	<ul style="list-style-type: none"> Regarding access to sanitation, the average resident throws garbage into the pit/burns it because the average TPS is not available. The average village in cluster 1 does not have a source of information either in the form of a website or other forms of information. 	<ul style="list-style-type: none"> Regarding access to sanitation, the average resident throws garbage into the pit/burns it because the average TPS is not available. On average, villages in this cluster do not have a website but do have print media (banners, billboards, banners and newspapers) as a source of information. 	<ul style="list-style-type: none"> Regarding access to sanitation, the average resident throws garbage into the pit/burns it because the average TPS is not available. The average village in this cluster does not have a source of information. 	<ul style="list-style-type: none"> Regarding access to sanitation, the average resident throws garbage into the pit/burns it because the average TPS is not available. On average, villages in this cluster do not have a website or other sources of information.
Ecological Dimension	<ul style="list-style-type: none"> There is a change in land use and the agricultural sector to non-agriculture. Does not have facilities for disaster mitigation, such as the absence of safety equipment and disaster evacuation routes. 	<p>Does not have facilities for disaster mitigation, such as the absence of safety equipment and disaster evacuation routes.</p>	<p>Does not have facilities for disaster mitigation, such as the absence of safety equipment and disaster evacuation routes.</p>	<ul style="list-style-type: none"> Interestingly, even though they don't have environmental problems, 19/34 villages in this cluster state that there is an impact of pollution, namely causing mild health problems. Does not have facilities for disaster mitigation, such as the absence of safety equipment and disaster evacuation routes.

In line with the development of the Indonesian economy which is based on the people's economy, district/city governments must carry out community-based economic development. Economic development, especially in rural areas in order to raise the standard, degree, dignity, dignity of rural communities as an effort to realize poverty alleviation programs, improve the quality of rural human resources and infrastructure development to support the mobility of goods and rural-urban residents. In an effort to spur development in terms of economic and social aspects in underdeveloped areas, rural development programs must prioritize these three aspects [22; 23; 24]. In line with this, the Bogor Regency government must immediately formulate rules and policies to encourage villages in clusters that have superior attributes to develop, and improve the attributes that are still weak. So that the target of creating and improving the economy of a good society can be realized. Improvement efforts and policies will later be directed only to the 180 villages mapped in the 5 clusters resulting from this study.

Conclusion

Based on the results of this study, it can be concluded that the mapping of 180 villages in Bogor Regency for 2021 data resulted in 5 optimal clusters which became the basis for mapping various villages for calculating their IDM values. The explanation is: cluster 1 consists of 28 villages with an average value of IDM =

0.6381786; cluster 2 consists of 27 villages with an average IDM = 0.6246963; cluster 3 contains 31 villages with an average value of IDM = 0.6889645; cluster 4 contains 34 villages with an average value of IDM = 0.6726118; and finally cluster 5 with 60 villages in it has an average value of IDM = 0.6822533. Furthermore, Sirnasari Village and Harkatjaya Village are the villages that have the highest IDM score and are in cluster 3.

The results of the clustering then produce a mapping of the attributes of the IDM dimensions (economic dimension, social dimension and ecological dimension) for all villages in the clusters. This mapping describes the various advantages of the attributes in each IDM dimension for each cluster. Furthermore, this mapping also displays the various weaknesses that exist in each village cluster for each attribute in the IDM dimension studied. These findings can provide outcomes for stakeholders, in this case the Bogor Regency Government, to encourage villages with good superior attribute values to be able to carry out regional development so that they can enter the developed village category. Furthermore, for villages that have dominant attributes with weak values, to carry out regional development treatments, taking into account the 3 dimensions of the existing IDM. This self-improvement effort must of course be in supporting, controlling and monitoring the Bogor Regency government.

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