

CLUSTERING OF CITIES AND REGENCIES IN WEST NUSA TENGGARA BASED ON WELFARE INDICATORS: A HIERARCHICAL AGGLOMERATIVE APPROACH

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Abstract

Community welfare is a primary development goal emphasized in the Sustainable Development Goals (SDGs) and Indonesia's RPJPN. However, disparities in welfare persist in regions such as West Nusa Tenggara (NTB), which consistently ranks below the national average in indicators such as poverty, education, and health. This condition underscores the need for data-driven approaches to understand regional characteristics and develop more targeted policies. This study aims to clustering Cities/Regencies in West Nusa Tenggara (NTB) Province based on people's welfare indicators. These indicators are indicators of people's welfare that represent aspects of population, health, education, employment, level and pattern of consumption, poverty and housing. The objects of observation are all Cities/Regencies in the province of NTB consisting of 10 Cities/Regencies, namely Bima City, Central Lombok Regency, East Lombok Regency, North Lombok Regency, West Lombok Regency, Mataram City, Sumbawa Regency, West Sumbawa Regency, Dompu Regency and Bima Regency. The data collection method used is the documentation method, which is obtained from the publication of Central Statistics Agency of NTB for 2022. The data analysis technique used in this study is quantitative data analysis using cluster analysis. The cluster analysis method used is the agglomerative hierarchical technique consisting of average linkage, single linkage, complete linkage, centroid, median and wards method. Based on the analysis that has been carried out, it is known that the grouping of Cities/Regencies in the NTB Province showed various clusters of each method. The optimal group is obtained by using Davies-Bouldin Index value consists of 5 clusters using average linkage, single linkage, centroid and median method; six Regencies joined in cluster 1 which are West Lombok, Central Lombok, East Lombok, Sumbawa, Dompu and Bima, West Sumbawa Regency in cluster 2, North Lombok Regency in cluster 3, Mataram City in cluster 4 and Bima City in cluster 5. The grouping results are expected to be input to the Government to plan strategic programs according to the different characteristics of each cluster to improve the welfare of the people of NTB.

Keywords: Clustering; Welfare; Indicator; Cluster Analysis; Agglomerative Hierarchical

1. INTRODUCTION

The welfare of the people is an important thing to be achieved by every country. In 2015, 193 countries, members of the United Nations (UN) including Indonesia, devoted their commitment to improve the welfare of the global community as a goal set out in the Sustainable Development Goals (SDGs) or also known as the 2030 Agenda. This mission is in line with the mandate of the 1945 Constitution as stated in the opening of the fourth paragraph of the Constitution that welfare is one of the main goals of the Indonesian nation.

In order to work on this matter, the Indonesian government has launched various programs as outlined in the National Long-Term Development

Plan (RPJPN). These programs are the nation's efforts carried out in various aspects of development for the sake of improving people's welfare. These efforts are then widely applied to the level of local government at the provincial, city/regency and village levels throughout Indonesia.

Since welfare is continually evolving to meet the requirements of the community, its definition is somewhat fluid. Welfare is a state of society where people can meet their material and spiritual requirements (Roestam, 1993). Social welfare is a prerequisite for meeting people' material, spiritual, and social requirements so they can live well and grow as individuals and fulfill their social

roles, according to the 2019 Constitution on societal Welfare No. 11.

Identification of people's welfare conditions in all regions in Indonesia is carried out by the Government through the Central Statistics Agency (BPS) by collecting data and publishing data containing information on people's welfare. However, because people's welfare data is so complex and multidimensional which consists of many aspects of people's lives, statistical analysis is needed to facilitate the analysis. Considering the complexity of these data, one of the analysis methods that can be conducted is by classifying the City/Regency based on the similarity of characteristics of the people's welfare. This is expected to be able to facilitate the government in formulating plans and making policies to improve people's welfare.

Furthermore, ensuring the welfare of people is a national development objective that necessitates the coordination of planning strategies at both the national and regional levels. This is in line with Law Number 11 of 2019, which declares that social welfare implementation is the responsibility of the national and local governments. This indicates that the attainment of an increase in national welfare is supported by the welfare of the people in the regions. Therefore, in order to accelerate the improvement of welfare in the region and to give points for raising the welfare rate nationwide, regions with welfare levels below the national people's welfare rate must be encouraged.

The welfare of the people at the regional level can be seen based on indicators that are able to accurately describe the condition of the people's welfare. Welfare can be measured by looking at the quality of life of the community from several aspects, namely in terms of material, physical, mental and spiritual aspects (Bintaro, 1989). Meanwhile, in the publication of the Central Statistics Agency for West Nusa Tenggara (NTB), there are several aspects that can be used as indicators to see the condition of the people's welfare, namely from the aspects of population, poverty, education, employment, consumption levels and patterns, health, housing and other social aspects (BPS, 2022). The population aspect can be represented by population density variable as used in research conducted by (Yulianto & Hidayatullah, 2014) and (Belinda et al., 2019). The health aspect is represented by the life expectancy variable as used in research conducted by (Yulianto & Hidayatullah, 2014), (Belinda et al., 2019) and (Tenriawaru, 2018). The education aspect is represented by the average length of

school variable as used in research conducted by (Ramdhani et al., 2015), (Belinda et al., 2019) and (Wahyuni & Wulandari, 2022).

The employment aspect can be represented by the unemployment rate variable as used in research (Ramdhani et al., 2015), (Belinda et al., 2019) and (Wahyuni & Wulandari, 2022). Aspects of levels and patterns of consumption are represented by the average expenditure per capita variable as used in research (Yulianto & Hidayatullah, 2014) and (Tenriawaru, 2018). The poverty aspect is represented by the percentage of poor people variable as in research conducted by (Yulianto & Hidayatullah, 2014), (Belinda et al., 2019) and (Wahyuni & Wulandari, 2022). The housing aspect is represented by percentage of households that have access to proper sanitation as used in research conducted by (Ramdhani et al., 2015) and (Wahyuni & Wulandari, 2022).

One aspect that can describe the condition of people's welfare is the aspect of poverty. Based on BPS data, the percentage of poor people in Indonesia from 2012 to the present tends to fluctuate. In 2017 - 2019 the percentage of the indigent people decreased from 10,12% to 9,22% before finally rising again to touch 10,19% in 2020. If look at this national achievement figure, there are still some areas where the percentage of poor people is well above the national figure. One of them is the Province of West Nusa Tenggara (NTB) which has a percentage of the poor in 2020 at 13,97%.

NTB Province is a province located in eastern Indonesia with a population of 5.560 million people in 2023. Based on BPS data, the percentage of poor people in NTB in 2012 was 18,02% and gradually declined to 13,97% in 2020. Although the poverty rate tends to decrease in the 2012-2020 period, the achievement of the poverty rate in NTB in 2020 is still far above the national achievement rate and is included in the top eight provinces with the highest percentage of poor people along with Maluku, NTT, Papua, West Papua, and several other areas. The percentage of poor people at NTB increase to 14,14% in 2021, decrease to 13,68% in 2022 and increase to 13,85 in 2023.

Apart from the aspect of poverty, other indicators that can be used to identify the condition of the people's welfare are aspects of education and health. In terms of education, the average length of school for people aged more than 15 years in NTB, although it has increased every year since 2015, still occupies the lowest 3 position nationally after Papua and West Kalimantan Provinces with a figure of 8,08 in 2020 and 8,1 in 2021. Meanwhile

in 2022 and 2023 changed to the lowest 4 position nationally with the average length of school 8,31 and 8,39. In the health aspect, the life expectancy of the NTB community in 2020 is in the 5th lowest position nationally with a life expectancy of 66.51 years. This figure is far below the national figure of 71.47 years.

The less optimal achievements mentioned above indicate that development programs for improving welfare carried out by the government have not been implemented evenly. Meanwhile, one of the conditions for the success of development programs launched in an area depends on the distribution and accuracy of the implementation of these programs. Therefore, identification and classification based on the characteristics of the people's welfare in an area is needed so that the government can correctly determine the programs, policies and development strategies needed by the region. This research is also important to do considering that there is no research that focuses on studying the classification or clustering of all Cities/Regencies in NTB based on people's welfare to realize the goal of improving people's welfare in NTB and increasing people's welfare nationally.

Studies on the classification of an area based on welfare indicators have been carried out by several previous researchers including (Ramdhani et al., 2015) who conducted research with the aim to investigate the results of grouping provinces in Indonesia. Additionally, research on regional classification at the City/Regency level was conducted by (Yulianto & Hidayatullah, 2014) which aimed to determine the grouping of Cities/Regencies in Central Java Province using average linkage. Besides, (Latuhimallo et al., 2021) conducted a study that aimed to group Cities/Regencies in Maluku Province, (Tenriawaru, 2018) conducted research aimed at generating clustering information for Cities/Regencies in Southeast Sulawesi Province using K-Means method. Based on previous studies, it is known that there had been no studies that addressed the condition and classification of Cities/Regencies in NTB, so this research is important to do considering that there is no research that focuses on this matter. Therefore, this study aims to classify 10 Cities/Regencies in NTB Province based on indicators of people's welfare.

2. METHODOLOGY

Data and Variables

The data used in this research is secondary data sourced from the Central Statistics Agency of NTB in the form of data on people's welfare indicators. The objects of observation are all Cities/Regencies in the province of NTB consisting of 10 Cities/Regencies, namely Bima City, Central Lombok Regency, East Lombok Regency, North Lombok Regency, West Lombok Regency, Mataram City, Sumbawa Regency, West Sumbawa Regency, Dompu Regency and Bima Regency.

The variables used are indicators of people's welfare that represent aspects of population, health, education, employment, consumption levels and patterns, poverty and housing that have been determined in a publication by Central Statistics Agency of NTB (BPS, 2022). Those seven indicators are represented by the following variables.

Table 1. Variables

Symbol	Variable
X ₁	Population Density
X ₂	Life Expectancy
X ₃	Average Length of School
X ₄	Unemployment Rate
X ₅	Average Expenditure Per capita
X ₆	Percentage of Poor Population
X ₇	Percentage of Households that Have Access to Proper Sanitation

Data Collection Techniques

Data collection techniques that will be used in this research are documentation and literature study. The documentation technique is done by looking at the documents from Central Statistics Agency of NTB. This technique is used to obtain data on people's welfare indicators from all cities and regencies in the province of NTB. While the literature study technique is carried out and used with the aim of determining, collecting and analyzing reading sources that are in accordance with the problem in the research.

Data Analysis Techniques

The data analysis that used in this research is quantitative data analysis techniques. Quantitative data analysis was carried out to analyze the welfare indicator data in NTB Province in order to identify the welfare conditions of the people and classify the Cities/Regencies in NTB based on their welfare conditions. The statistical method used is

descriptive statistics to identify/describe the condition of the welfare of the community and cluster analysis to classify the Cities/Regencies. The stages that will be carried out in data analysis are as follows:

- a) Collect datasets from Cities/Regencies in NTB Province according to the predetermined variables
- b) Performing descriptive statistical analysis of the data on people's welfare indicators
- c) Classifying Cities/Regencies in NTB Province using cluster analysis using the agglomerative method consisting of average linkage, single linkage, complete linkage, centroid, median and wards method and the Euclidean distance measure with the following steps:
 - 1) Standardize data
 - 2) Determine and calculate the size of the distance between data
 - 3) Creating Clusters/Clustering
 - 4) Interpret cluster results
- d) Summarizing the results of data analysis

Multivariate Analysis

Multivariate analysis is a type of statistical analysis used to analyses multivariate data. Multivariate data is data that consists of two or more observations/objects with several characteristics/variables (Wijaya & Budiman, 2016). Multivariate analysis consists of two methods, dependency and interdependency. Dependency method is used if in the analysis there are two types of variables, namely independent and dependent variables. In this type of method, the variables are interdependent. While in the Interdependency method, the existing variables are not interdependent with each other. This means that all variables are independent variables (Santoso, 2018). Multivariate data with n objects and p variables can be presented as follows (Astutik et al., 2018):

$$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1q} \\ x_{21} & x_{22} & \dots & x_{2q} \\ \vdots & \vdots & \ddots & \vdots \\ x_{p1} & x_{p2} & \dots & x_{pq} \end{bmatrix}$$

where $i=1,2,\dots,p$ and $j=1,2,\dots,q$.

Several types of analysis in the dependency and interdependency method include multiple regression, canonical correlation and discriminant analysis in the dependency method; factor analysis, multidimensional scaling and cluster analysis in the interdependency method (Wijaya & Budiman, 2016).

Cluster Analysis

One multivariate analysis method for classifying things according to how similar their properties are is cluster analysis. The features of objects in one cluster are the same or very comparable to those of objects in other clusters (Widayat, 2018). There is at least one member in each cluster, and each member may only be a part of one cluster. The two main categories of cluster analysis methods are the hierarchical approach and the non-hierarchical method. The hierarchical method is a cluster analysis technique that uses a step-by-step or hierarchical approach to classify objects. With this approach, the current algorithm will automatically generate the number of clusters. Unlike the hierarchical approach, the non-hierarchical approach involves the researcher first deciding how many clusters to establish, after which the items join the designated clusters (Nugroho, 2008).

The most popular approach is the hierarchical one. The hierarchical approach consists of two steps: the agglomerative and divisive methods. According to the divisive technique, every item is initially united in a single cluster. According to (Hennig et al., 2016), the objects that have the highest dissimilarity values are then progressively divided into several clusters until each object creates its own cluster in which the objects with the highest dissimilarity values are not in the same cluster. The agglomerative approach, also known as the merging method, makes the assumption that every item was initially a cluster. Additionally, the most similar objects progressively combine to create additional clusters, eventually forming a single, sizable cluster that includes all of the objects (Hennig et al., 2016). The single linkage technique, the complete linkage method, the average linkage method, the wards method, the centroid method, and the median method are the steps involved in the merging process (Nugroho, 2008).

A measure of distance is required when classifying objects using cluster analysis in order to ascertain how similar the objects under study are to one another. The Euclidean distance is the most widely used unit of measurement for distance. The following definition applies to the distance from the p variable (or between the i-th and j-th clusters of the objects under study) (Kassambara, 2017):

$$d_{euc}(x, y) = \sqrt{\sum_{i=1}^n (x_i - y_i)^2} \tag{1}$$

where:

$d_{euc}(x, y)$: The distance between x and y

n : Number of cluster variables

x_i : data from object x

y_i : data from object y

The above Euclidean distance can also be written as:

$$d_{euc}(x, y) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \dots + (x_n - y_n)^2} \quad (2)$$

3. RESULT AND DISCUSSION

The welfare of the people of the Cities/Regencies in the NTB Province

The welfare of the people of NTB Province can be identified from various variables including 7 welfare indicators that have been determined by Central Statistics Agency (BPS) namely population density, life expectancy, average length of school, unemployment rate, average expenditure per capita, percentage of poor population and percentage of households that have access to proper sanitation. In the population density, Mataram City has the highest population density among the ten Cities/Regencies in NTB, while Sumbawa is in the lowest order. Meanwhile, for the life expectancy variable, from all Cities/Regencies in NTB, Mataram City has the highest life expectancy and East Lombok Regency has the lowest life expectancy. For the variable percentage of poor people, North Lombok Regency has the highest percentage of poor people and Mataram City has the lowest. The City/Regency with the highest and lowest data for each variable of people's welfare can be seen in Table 2.

Table 2. City/Regency with the Lowest and Highest Variable Values

Variable	Lowest		Highest	
	Value	City/Regency	Value	City/Regency
X ₁	72	Sumbawa	8427	Mataram City
X ₂	66,16	East Lombok	71,88	Mataram City
X ₃	6,04	North Lombok	10,65	Bima City
X ₄	1,58	Bima	5,52	West Sumbawa
X ₅	852323	North Lombok	1882229	Mataram City
X ₆	8,65	Mataram City	27,04	North Lombok
X ₇	74,1	West Lombok	92,93	West Sumbawa

The condition of the welfare of the people of

NTB can also be identified by looking at the average value of the variable. Cities/Regencies which are below and above the average value of the variable can be seen in figure 1.

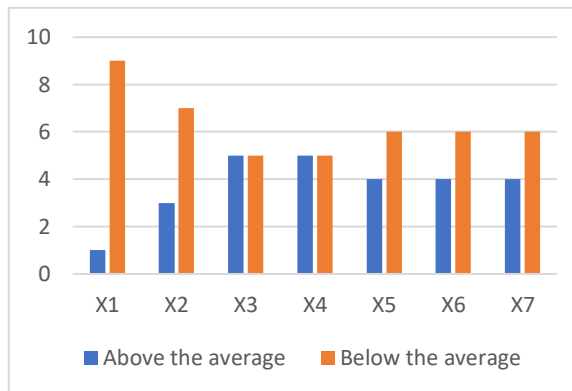


Figure 1. Composition of the Cities/Regencies that are Above and Below the Variable Average

Based on Figure 1, it can be seen that on the 2 indicators of the welfare of the people of NTB, the number of Cities/Regencies that are above and below the average value of the variables is the same, which are 5 Cities/Regencies respectively. Meanwhile, on the other 5 indicator variables of people's welfare, there are more Cities/Regencies that are below the average value of the variables.

Clustering of Cities/Regencies in the NTB Province

Cluster analysis was carried out to classify 10 Cities/Regencies in NTB which are Mataram City, Bima City, West Lombok Regency, Central Lombok Regency, East Lombok Regency, North Lombok Regency, Sumbawa Regency, West Sumbawa Regency, Dompu Regency and Bima Regency based on 7 welfare indicators that have been set by BPS. Clustering used agglomerative hierarchical technique consisting of average linkage, single linkage, complete linkage, centroid, median and wards method. The formation of clusters starts from two or more variables that are most similar to form one cluster. The process of merging the object using *average linkage* can be seen from figure 2.

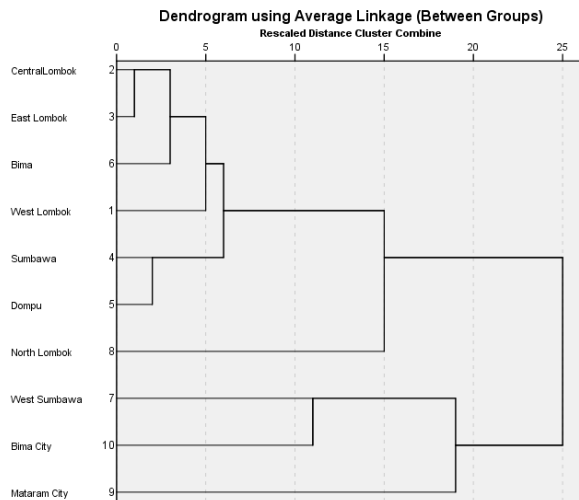


Figure 2. Dendrogram of grouping Cities/Regencies in NTB using Average Linkage Method

Figure 2 shows the merging process that occurs in the City/Regency people's welfare data in NTB. The stages of cluster formation start from the two variables that are closest in distance. In Stage 1, there is a merger of two Cities/Regencies with the closest distance from the entire combination of the existing 10 Cities/Regencies. So that in stage 1, Central Lombok Regency and East Lombok Regency merged into one cluster. And so on until all cities and regencies merging. The results of the cluster analysis of 10 Cities/Regencies in NTB based on people's welfare indicators using agglomerative method can be seen in Table 3 and 4.

Table 3. Members of The Cluster Formed; 2 – 4 cluster

Cities/Regencies	2 Clusters					3 Clusters					4 Clusters							
	A	S	CP	CT	M	W	A	S	CP	CT	M	W	A	S	CP	CT	M	W
West Lombok	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Central Lombok	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
East Lombok	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sumbawa	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dompu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bima	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
West Sumbawa	2	1	2	1	1	2	2	1	2	2	2	2	2	1	2	2	2	2
North Lombok	1	1	1	1	1	1	1	1	1	1	1	1	3	2	3	1	1	3

a	2	2	2	2	2	2	2	3	3	3	3	3	3	3	4	3	4	3	3	4
y	2	1	2	1	1	2	2	1	2	2	2	2	2	2	4	2	4	4	4	2

Table 4. Members of The Cluster Formed; 5 – 6 cluster

Cities/Regencies	5 Clusters					6 Clusters							
	A	S	CP	CT	M	W	A	S	CP	CT	M	W	
West Lombok	1	1	1	1	1	1	1	1	1	1	1	1	1
Central Lombok	1	1	1	1	1	1	1	1	1	1	2	2	1
East Lombok	1	1	1	1	1	1	1	1	1	1	2	2	1
Sumbawa	1	1	2	1	1	2	2	2	2	2	2	2	2
Dompu	1	1	2	1	1	2	2	2	2	2	2	2	2
Bima	1	1	1	1	1	1	1	1	1	1	2	2	1
West Sumbawa	2	2	3	2	2	3	3	3	3	3	3	3	3
North Lombok	3	3	4	3	3	4	4	4	4	4	4	4	4
Mataram City	4	4	5	4	4	5	5	5	5	5	5	5	5
Bima City	5	5	3	5	5	3	6	6	6	6	6	6	6

Table 3 and 4 show the grouping of Cities/Regencies in NTB based on people's welfare indicators consisting of 2, 3, 4 5 and 6 clusters using Average Linkage (A), Single Linkage (S), Complete Linkage (CP), centroid (CT), Median (M) and Wards (W) method. Determining the number of optimal cluster can be identified by looking at the Davies Bouldin Index (DBI) value. The cluster with the minimum DBI value is the optimal cluster. The DBI value for each number of clusters can be seen in Table 5.

Table 5. DBI Value of Each Cluster

Method	Number of Clusters	DBI	Method	Number of Clusters	DBI
Average	2 clusters	0,805897	Centroid	2 clusters	0,362083

Linkage	3 cluster	0,616782	Median	3 cluster	0,616782
	4 cluster	0,548017		4 cluster	0,342991
	5 cluster	0,321884		5 cluster	0,321884
	6 cluster	0,477648		6 cluster	0,384398
	2 cluster	0,362083		2 cluster	0,362083
Single Linkage	3 cluster	0,449597	Wards	3 cluster	0,616782
	4 cluster	0,397769		4 cluster	0,342991
	5 cluster	0,321884		5 cluster	0,321884
	6 cluster	0,477648		6 cluster	0,384398
	2 cluster	0,805897		2 cluster	0,805897
Complete Linkage	3 cluster	0,616782		3 cluster	0,616782
	4 cluster	0,548017		4 cluster	0,548017
	5 cluster	0,678839		5 cluster	0,678839
	6 cluster	0,477648		6 cluster	0,477648

Based on Table 5, the minimum DBI value was obtained to average linkage, single linkage, centroid and median method with DBI value is 0,321884 when the Cities/Regencies in NTB were grouped into 5 clusters with each member of the cluster as shown in Table 6.

Table 6. Cities/Regencies Member of Each Cluster

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
West Lombok Central Lombok East Lombok Sumbawa Dompu Bima	West Sumbawa	North Lombok	Mataram City	Bima City

There are 6 Cities/Regencies that have joined

into cluster 1, namely West Lombok, Central Lombok, East Lombok, Sumbawa, Dompu and Bima. While just 1 City/Regency in another Cluster. West Sumbawa Regency in cluster 2, North Lombok Regency in cluster 3, Mataram City in cluster 4 and Bima City in cluster 5. The distribution of the Cities/Regencies Groupings can be seen on the map shown in Figure 3, the color on the map shows the groups of each cluster.



Figure 3. Map of Cities/Regencies in NTB Based on People's Welfare Indicators

Interpretation of the formed Cluster

Interpretation of cluster results uses the cluster average value of each cluster as below:

Table 7. Average of Each Cluster

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
X ₁	435,333	87	283	8427	827
X ₂	66,825	68,31	67,36	71,88	70,5
X ₃	7,366667	8,72	6,04	9,54	10,65
X ₄	2,738333	5,52	1,75	5,19	3,56
X ₅	1081080	1503034	852323	1882229	1718519
X ₆	14,11333	13,54	27,04	8,65	8,88
X ₇	81,75833	92,93	79,23	91,63	90,68

Based on the Table 7, the Cities/Regencies in cluster 1 when compared to other clusters have: (a) Life expectancy value is the lowest, (b) percentage of poor population is the second highest, (c) population density is the third highest, and (d) the other variables are the fourth highest. Meanwhile, the Cities/Regencies in cluster 2 when compared to other clusters have: (a) unemployment rate and percentage of households that have access to proper sanitation values are the highest, (b) population density is the lowest, and (c) the other variables are the third highest. The Cities/Regencies in cluster 3 when compared to

other clusters have: (a) percentage of poor population value is the highest, (b) population density and life expectancy are the second highest, and (c) the other variables are the lowest.

The Cities/Regencies in cluster 4 when compared to other clusters have: (a) population density, life expectancy and average expenditure per capita values are the highest, (b) percentage of poor population value is the lowest, and (c) the other variables are the second highest. Meanwhile, The Cities/Regencies in cluster 5 when compared to other clusters have: (a) average length of school value is the highest, (b) population density, life expectancy and average expenditure per capita values are the second highest, (c) unemployment rate and percentage of households that have access to proper sanitation are the third highest, and (d) percentage of poor population is the fourth highest. The grouping results show the difference characteristic of each cluster. This result is expected to provide an overview of the conditions and similarities or differences of each City/Regency in NTB.

This study produced a clustering of cities/districts in NTB Province based on indicators of community welfare using the agglomerative hierarchical method. The clustering results show five groups with different welfare characteristics, which can guide the government in designing specific and data-based policies. This research is in line with several previous studies, including research by (Ramdhani et al., 2015), (Yulianto & Hidayatullah, 2014), (Latuhimallo et al., 2021), (Tenriawaru, 2018), as well as additional studies by (Dakhi & Ningsi, 2024), (Musa & Fallo, 2023), (Dini & Fauzan, 2020), (Chelvin Pratama, n.d.) and (Prasetya Subakti & Kholijah, n.d.) which applied the cluster approach to identify the needs and characteristics of areas based on welfare or economic indicators.

(Yulianto & Hidayatullah, 2014), who used the average linkage method in Central Java Province, also indicated that geographically close regions can have very different welfare characteristics. This is relevant to the findings in NTB, where significant differences were observed between Mataram City (Cluster 4) which has a high level of per capita expenditure and North Lombok (Cluster 3) which has the highest percentage of poverty.

(Ramdhani et al., 2015) used the K-Means method to cluster provinces in Indonesia based on public welfare indicators, and found that the clustering results can help in identifying areas that require specific policy interventions, especially in the poverty alleviation and health sectors. Their

findings support the results of this study in NTB, where clustering revealed specific regional needs, such as the need for policies focused on improving health and reducing poverty in Cluster 3 (North Lombok District).

Research by (Tenriawaru, 2018) in Southeast Sulawesi and (Salsabila et al, 2022) in East Java support the finding that clustering helps the government design more effective policies and allocate resources appropriately. In the context of NTB, clustering is expected to provide guidance in setting priorities for development programs, such as improving access to sanitation in Cluster 2 and focusing on education in Cluster 1. Meanwhile, Cluster 4 (Mataram City) requires policies that support economic stability and improvements in living standards that have already been achieved.

In addition, the theory of regional classification or grouping according to similar characteristics (Wijaya & Budiman, 2016) also underpins the use of cluster analysis in this study. Grouping regions based on similar indicators helps the government to identify the development needs of each region in detail, so that policies designed can be better suited to local needs. Thus, this study reinforces the importance of clustering in data-driven development planning that is tailored to local characteristics. This approach is expected to provide tangible benefits for the improvement of community welfare in NTB. So this regional welfare mapping highlights the necessity for ongoing data-driven approaches to enhance the welfare of NTB's communities comprehensively and equitably.

4. CONCLUSION

In general, the welfare status of the residents of the ten cities and regions in the province of NTB was lower than the average value of the variables. Furthermore, according to the cluster analysis, the best way to group ten cities/regions in NTB based on people's welfare indicators is to create five clusters. Six regencies joined cluster 1, which includes West Lombok, Central Lombok, East Lombok, Sumbawa, Dompu, and Bima; North Lombok Regency joined cluster 3; Mataram City joined cluster 4; and Bima City joined cluster 5. It is anticipated that the NTB government would use the conditions and the grouping of cities and regions based on this measure of people's wellbeing to design strategic programs that will enhance the welfare of the people living in NTB.

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