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Distribution of Poverty in West Kalimantan

Ummi Rahimah[1*]

[1]Program Studi Statistika Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Tanjungpura, Jl. Prof. Dr. Hadari Nawawi, Kota Pontianak, Kalimantan Barat
*Penulis Korespondensi. *e-mail*: h1091211040@student.untan.ac.id
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ABSTRACT

Poverty is a complex problem faced by various countries so poverty is a development priority. Poverty in each region is caused by various factors. Therefore, the initial step in overcoming it can be grouping regions based on their characteristics. In this study, an analysis was carried out using all provinces in Indonesia and after that, the urban districts in West Kalimantan province were grouped with urban districts from other provinces in cluster 1. The indicators used in this study were the percentage of poor people, poverty severity index, depth index poverty, human development index, expected length of schooling, average length of schooling, and adjusted per capita expenditure. This study uses k-means clustering analysis. The results of phase 1 research obtained 3 clusters of poverty levels, namely cluster 1 is a medium poverty rate of 26 provinces, cluster 2 is a high poverty rate of 5 provinces, and cluster 3 is a low poverty rate of 5 provinces. The results of phase 3 research obtained 3 clusters of poverty levels, namely Cluster 1 is a moderate poverty rate of 65 urban regencies, cluster 2 is a high poverty rate of 103 urban regencies, and Cluster 3 is a low poverty rate of 224 urban regencies.

Keywords: k-means clustering, poverty indicators, poverty level

INTRODUCTION

Poverty is a fundamental problem that is difficult for various countries to face, both developed and developing countries (Purnomo, 2021). This is because poverty is a complex problem caused by various factors. Poverty is a condition when a person is unable to meet standard needs for food, shelter, and clothing. In Indonesia, the differences that exist can lead to a comparison of the rich and the poor, so poverty is always associated with people's welfare. Indonesia, which is a UN country, is certainly required to be able to meet the targets declared in the SDGs. The goal of the SDGs is to achieve prosperity that focuses on development issues, namely the environment, economy, and society.

Development is a continuous step that aims to prosper people's lives. the goals of national development in Indonesia are stated in the preamble of the 1945 Constitution which reads "to promote public welfare, educate the nation's life, and realize justice for all Indonesian people". The high level of poverty, then the level of income in a region is low. Thus, this can cause a large number of unemployed which will hinder development in a region. One of the things that must be considered in reducing and overcoming the poverty rate is solving all the factors that cause poverty together so that it can directly lead to factors that are closely related to poverty (Annur, 2013).

The quality of life of the people described by HDI is how development results in terms of health, income, education, and others that can be accessed by the community (Febianto & Palasara, 2019). Poverty occurs as a result of various factors, one of the supporting factors for poverty is low education. Education is an alternative for a country to progress. Because education can shape the character of development and self-defense of society against a nation. Therefore, having a high educational status is

very important for every individual in developing their potential and quality so that they can compete in the world of work, where the average level of education is an important aspect and top priority in the world of work (Azizah & Kusuma, 2018). In this case, further review is needed to overcome poverty in Indonesia so that it does not cause other problems. One effort that can be done is to group regions based on high, medium, and low levels of poverty.

Grouping based on the same characteristics from various regions can be done by cluster analysis. Cluster analysis is used to place regions into the same cluster. Research that classifies poverty by region was conducted by Febianto and Palasara using 13 indicators that affect poverty with a case study in West Java province. Research by Widodo, Ermayani, Laila, and Madani classifies all provinces in Indonesia into 3 clusters, namely high, medium, and low. Although there have been many studies related to poverty indicators, only a few have applied them to classify them. In this study, researchers will involve 3 indicators of poverty and 4 indicators of the Human Development Index (IPM), namely Percentage of Poor Population (P0), Poverty Severity Index (P1), Poverty Depth Index (P2), Human Development Index (IPM), Expenditures Adjusted Per Capita, Years of School Expectation (HLS), and Average Years of Schooling (RLS). On this occasion, researchers used K-Means Clustering analysis to see the distribution of poverty levels in Indonesia, especially in the province of West Kalimantan.

The number of poor people in West Kalimantan in the last 5 years is 350 thousand people. Even though there has been an insignificant decrease, such as in 2021 the poverty rate in West Kalimantan is at the value of 7.15%, and in 2022 the poverty rate in West Kalimantan is at a value of 6.73%, this means that there has been a decrease in the poverty rate by 0. 42%. The purpose of this study is to determine the condition of the poverty rate in the districts/cities of West Kalimantan based on the factors that influence it, to know the clustering of poverty levels, and to know the poverty characteristics of each cluster. It is hoped that this research can become a reference for the West Kalimantan provincial government in overcoming poverty in urban districts in West Kalimantan.

METHODOLOGY

The data used in this study is secondary data from the Indonesian Central Bureau of Statistics and the Central Bureau of Statistics of West Kalimantan Province. The data used are the Percentage of Poor Population (P0), Poverty Severity Index (P1), Poverty Depth Index (P2), Human Development Index (IPM), adjusted per capita spending, Expected Years of Schooling (HLS), and Average Years of School (RLS) from 34 provinces in Indonesia and 14 districts/cities in West Kalimantan in 2022. Data on the depth index and poverty severity index are used to determine the severity of poverty in grouping provinces and districts cities into 3 groups, namely groups with high poverty rates, medium, and low.

Table 1. Operational definition of research variables

No	Variable	Operational Definition of Variables
1	Percentage of Poor Population	$$P_{\infty} = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - y_i}{z}\right]^{\infty}$$
2	Poverty Severity Index	$$P_2 = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - y_i}{z}\right]^{2}$$ Dengan: P_2 = Poverty severity index; z = Poverty line; y_i = The average monthly per capita expenditure of the population is below the poverty line $y_i < z$

No	Variable	Operational Definition of Variables
		q = the number of people living below the poverty line n = Total population
3	Poverty Depth Index	$$P_1 = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - y_1}{z}\right]$$ description: P_1 = Poverty depth index
4	Human Development Index	$$IPM = \sqrt[3]{I_{kesehatan} \times I_{pendidikan} \times I_{pengeluaran}} \times 100$$
5	Adjusted Per Capita Spending	$$I_{pengeluaran} = \frac{\ln(pengeluaran) - ln(pengeluaran_{min})}{ln(pengeluaran_{maks}) - ln(pengeluaran_{min})}$$
6	Expected Years of Schooling	$$HLS_a^t = FK \times \sum_{i=a}^{n}\frac{E_i^t}{P_i^t}$$ description: HLS_a^t = Expected length of school at age a in year t E_{di}^t = Number of the population aged who attended school in year t i = Age (a, a+1, …, n) FK = Correction factor
7	Average Years of School	$$RLS = \frac{1}{n} \times \sum_{i=1}^{n} x_i$$ description: RLS = The average length of schooling for the population is 25 years and over x_i = The length of school for the population n = Total population aged 25 years and over

Source: Badan Pusat Statistik Indonesia (2023)

In conducting research, it is important to find out whether the independent variables used have a relationship with other independent variables. To find out this, a multicollinearity test was carried out. Multicollinearity is a condition where the independent variables have a linear relationship in multiple regression.

Table 2. Research variables before the multicollinearity test were carried out

X1	Percentage of the poor population
X2	Poverty severity index
X3	Poverty depth index
X4	Human development index
X5	Expected years of schooling
X6	Average years of school
X7	Adjusted per capita spending

After conducting a multicollinearity test with a 95% confidence level, the results show that the variables X2, X3, and X4 have symptoms of multicollinearity. Thus, indicators of the poverty severity index, poverty depth index, and human development index must be excluded. In Table 3 it can be seen the variables used in this study after the multicollinearity test was carried out.

Table 3. Research variables after the multicollinearity test were carried out

X1	Percentage of the poor population
X2	Expected years of schooling
X3	Average years of school
X4	Adjusted per capita spending

In this study, researchers grouped variables based on the information contained in the data explaining the relationship between variables, this was done to maximize similarities between members of one group and minimize similarities between classes, this process is called clustering (Darmansah & Wardani, 2020). Researchers will use cluster analysis, more precisely the analysis of k-means clustering. K-means clustering is a partitioning method that is often used because this method is efficient and can be used in various applications due to its simplicity and can achieve fast convergence (W. Xu and Y. Peng, 2015). In this method, to get optimal results from the specified amount there is a repetition process. The stages in the K-means clustering analysis method are as follows (Feng et al, 2019):

1. set the initial centroid randomly;menetapkan *centroid* awal secara acak;
2. to form a temporary cluster, find the distance of each element in the dataset using the centroid. The distance used is the Euclidean distance with the equation:

$$\boldsymbol{d(O_1^m, C_l)} = \sqrt{\sum_{j=1}^{d} (\boldsymbol{C_{lj} - O_{lj}^m})^2}$$

Description :
$\boldsymbol{d(O_1^m, C_l)}$: distance
$\boldsymbol{C_l}$: *cluster l, l*: 1, 2, …, *l*
$\boldsymbol{O_1^m}$: the mth observation data in the cluster *l, m:* 1, 2, …, N

3. cluster by looking at the shortest distance;
4. find the new centroid of each cluster with the equation:

$$\boldsymbol{C_l} = \frac{\boldsymbol{1}}{\boldsymbol{k_l}} \sum_{\boldsymbol{m=1}}^{\boldsymbol{k_l}} \boldsymbol{O_l^m}$$

Description :
$\boldsymbol{k_l}$: many members in the cluster *l*

5. to get the best cluster results, repeat steps 2 to 4 with the criteria:

$$\boldsymbol{f(O, C)} = \sum_{\boldsymbol{l=1}}^{\boldsymbol{k}} \sum_{\boldsymbol{m=1}}^{\boldsymbol{k_l}} [\boldsymbol{d(O_1^m, C_l)}]^2$$

Optimum cluster results can also be seen from the minimum mean-square error value with the equation:

$$\boldsymbol{S^* = \arg\min(f(O, C))}$$

In this study, two stages of grouping were carried out using k-means analysis. The first analysis aims to determine the poverty level classification of West Kalimantan province at the national level. After that, a second analysis will be continued with the same stage where the second stage aims to determine the poverty level grouping of regencies and cities in West Kalimantan along with regencies and cities from the province resulting from the first analysis..

RESULT AND DISCUSSION

The first step in this research is to carry out a descriptive analysis of each variable in 2022 for all provinces in Indonesia, which is shown in Table 3. This table explains the state of the data to be used, namely there is a lot of data, minimum and maximum values, average values, and standard deviation. This research covers 34 provinces in Indonesia.

Table 4. Description of poverty indicator variables in 34 provinces in Indonesia in 2022

	N	Minimum	Maximum	Mean	Std. Deviation
Percentage of Poor Population	34	4.45	26.56	10.24	5.25
HLS	34	11.14	15.65	13.24	.74
RLS	34	7.02	11.31	8.84	.92
Adjusted Per Capita Spending	34	7146.00	18927.00	11079.56	2246.73
Valid N (listwise)	34				

Table 4 explains that the average percentage of poor people in Indonesia is 10.24% with the smallest percentage of 4.45% in the Bangka Belitung Islands province and the largest percentage of 26.56% in the Papua province. The average expected length of schooling in each province in Indonesia is 13.24%. Papua is a province that has the lowest average length of schooling per capita spending. Meanwhile, DKI province is the province that has the highest average length of schooling and per capita expenditure.

After describing the data, it is continued by grouping the poverty rate data into 3 groups with indicators of the percentage of poor people, expected length of schooling, average length of schooling, and per capita expenditure using k-means cluster analysis. The final grouping results from the cluster analysis of provincial poverty levels in Indonesia are shown in Table 5.

Table 5. Final Cluster Center

	Cluster		
	1	2	3
Zscore: Percentage of Poor Population	-.20362	1.66586	-.68847
Zscore: HLS	.21978	-1.02840	-.02653
Zscore: RLS	-.05006	-1.17782	1.41809
Zscore: Adjusted Per Capita Spending	-.14488	-1.00153	1.69698

Table 6. Results of Clustering poverty indicators in 34 provinces in Indonesia using the K-means method

Cluster	Number of Members	Cluster Members	Identification
1	24	Aceh, Sumatera Utara, Sumatera Barat, Riau, Jambi, Sumatera Selatan, Bengkulu, Kep. Bangka Belitung, Jawa Barat, Jawa Tengah, Jawa Timur, Banten, Nusa Tenggara Barat, Kalimantan Barat,	This cluster has the percentage of poor people, the average length of schooling, and adjusted per capita spending between clusters 1 & 2 with the expected length of schooling

Cluster	Number of Members	Cluster Members	Identification
		Kalimantan Tengah, Kalimantan Selatan, Kalimantan Utara, Sulawesi Utara, Sulawesi Tengah, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat, Maluku, dan Maluku Utara	being above the average. (characteristic of moderate poverty level)
2	5	Lampung, Gorontalo, Nusa Tenggara Timur, Papua Barat, dan Papua	This cluster has the highest percentage of poor people. Expected years of schooling, average years of schooling, and adjusted per capita spending are below average. (Characteristic of the highest poverty rate)
3	5	Kep. Riau, DKI Jakarta, DI Yogyakarta, Bali, Kalimantan Timur, dan Kalimantan Selatan	This cluster has the lowest percentage of poor people and the average length of schooling and adjusted per capita expenditure is above the average. (characteristic of low poverty rate)

Based on Table 6, the poverty classification of 34 provinces in Indonesia is obtained which is the region with the lowest poverty rate in Indonesia as follows: the order of clusters from the lowest, namely cluster 3, cluster 1, and cluster 2.

Cluster 1 contains districts/cities where the percentage of poor people is below the population average (the percentage of poor people above cluster 2) with the expected length of schooling is above the average, but the average length of schooling and adjusted per capita expenditure are still below the average population. This means that in this cluster, educational development has improved from the high school year expectancy rate. However, educational development in the past has lagged, as seen from the low average length of schooling. Economically below because adjusted per capita spending is below average.

Cluster 2 is a region with high poverty characteristics. This can be seen from the percentage of poor people who are above the population average and the expected length of schooling, average length of schooling, and adjusted per capita expenditure which is below average. The lowest condition of all variables, meaning that economically the level is below and past and present education development is still below average. Thus, there is still much to be improved during the construction process.

Cluster 3 is a region with low poverty characteristics. This can be seen from the percentage of poor people who are below the population average with the expected length of schooling being above cluster 2 and the average length of schooling and adjusted per capita expenditure being above the population average. The condition of education for the population aged 25 years and over is a form of educational development in the past and the economic situation is good so that poverty is low. However, it is unfortunate that the school's old expectations have not been maximized. With good human capital, the condition of the current generation should be better.

After knowing that the poverty rate of West Kalimantan is in Cluster 1, it is followed by a k-means cluster analysis of the poverty rate of urban districts in West Kalimantan which will be grouped with urban districts from other provinces in Cluster 1. A descriptive analysis is carried out for each variable in 2022 for all regencies and cities of the province in cluster 1, which is shown in Table 8. This table explains the state of the data to be used, namely there is a lot of data, minimum and maximum values, average values, and standard deviations. This research covers 392 district cities from 24 provinces in Indonesia.

Table 8. Description of poverty indicator variables in 392 districts cities from 24 provinces in Indonesia in 2022

	N	Minimum	Maximum	Mean	Std. Deviation
Percentage of Poor Population	392	.79	27.64	9.8513	4.64414
Expected Years of Schooling	392	11.18	17.81	13.2338	.98833
Average Years of School	392	5.06	13.03	8.7111	1.36138
Adjusted Per Capita Spending	392	6152.00	18345.00	10816.7908	2157.31810
Valid N (listwise)	392				

Table 8 explains that the average percentage of poor people from 392 districts/cities is 9.85% with the smallest percentage of 0.79% in Madiun and the largest percentage of 27.64% in Southwest Maluku. The average expected length of schooling from urban districts in Cluster 1 province is 13.23%. Sampang is a district that has the lowest average length of schooling at 5.06% and the highest average length of schooling at 13.03% belongs to the city of Bandung. Surabaya City is a city with the highest per capita expenditure. Meanwhile, West Nias is a district with the smallest per capita expenditure.

After describing the data, it is followed by grouping the poverty rate data into 3 groups with indicators of the percentage of poor people, expected length of schooling, average length of schooling, and per capita expenditure adjusted using k-means cluster analysis. Table 9 shows the final results of the 3 clusters.

Table 9. Final cluster center

	Cluster		
	1	2	3
Zscore: Percentage of Poor Population	-.77995	1.28278	-.36352
Zscore: Expected Years of Schooling	1.48699	-.02531	-.41986
Zscore: Average Years of School	1.66074	-.37828	-.30797
Zscore: Adjusted Per Capita Spending	1.46196	-.82808	-.04346

After getting 3 clusters, the next step is to test whether there are differences in the variables between clusters. This can be seen from the F value and the probability value (sig). Following are the results from the ANOVA output:

Table 10. Anova

	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
Zscore: Percentage of Poor Population	119.315	2	.392	389	304.611	.000
Zscore: Expected Years of Schooling	91.639	2	.534	389	171.611	.000
Zscore: Average School Years	107.629	2	.452	389	238.235	.000
Zscore: Adjusted Per Capita Expenditures	104.989	2	.465	389	225.611	.000

Based on table 10, the cluster column is the average value between clusters, and the error column is the average value in each cluster. In column F, the following formula is obtained:

$$F = \frac{between\ cluster\ means}{within\ cluster\ means}$$

Hypothesis:
H0: the three clusters did not have a significant difference
H1: the three clusters have a significant difference
If the significant value is > 0.05 then H_0 is accepted and H_1 is rejected
If the significant value <0.05 then H_0 is rejected and H_1 is accepted
Thus, it can be concluded that all variables have significant differences because the significance value is <0.05 and the result is that the indicator of the percentage of poor people is the variable that most differentiates members of the three clusters, this is because it has the largest F value among the variables.

Table 11. The results of grouping poverty indicators in 392 urban districts from 24 provinces in cluster 1 using the k-means method

Cluster	Number of Members	Identification
1	65	This cluster has the percentage of poor people and adjusted per capita spending between clusters 1 & 2. The expected length of schooling is the highest and the average length of schooling is the lowest (a characteristic of a moderate poverty rate).
2	103	This cluster has the highest percentage of poor people with the expected length of schooling, average length of schooling, and the lowest per capita expenditure (characteristic of a high poverty rate).
3	224	This cluster has the lowest percentage of poor people with the expected length of schooling being between clusters 1 & 2 and the highest average length of schooling and adjusted per capita expenditure (characteristic of a low poverty rate).

Based on Table 11, the poverty classification is obtained from 392 urban districts in 24 provinces which are the regions with the lowest poverty rates in Indonesia as follows: the order of clusters from the lowest is cluster 3, cluster 1, and cluster 2.

Cluster 1 consists of urban regencies where the percentage of poor people and adjusted per capita expenditure is below the population average (municipal regencies with a higher percentage of

poor people than Cluster 2). City districts in cluster 1 have a high expected length of schooling, but the average length of schooling is low. Therefore, cluster 1 is an urban district with moderate poverty characteristics. To overcome this, further research can be carried out to find out the factors that influence the average length of schooling for people in the Cluster 1 area.

Cluster 2 contains urban districts with high poverty characteristics. This can be seen from the high percentage of poor people with the expected length of schooling, the average length of schooling, and adjusted per capita spending below the average. Policies that can be taken by the government are to support and encourage the quality of education where education is an important component in human development. If the quality of education in an area is good, then this will have a positive impact on the people's economy.

Cluster 3 contains urban districts with low poverty characteristics. This is indicated by the percentage of poor people who are below the average district/city population with the expected length of schooling above cluster 2 and the average length of schooling and adjusted per capita expenditure being above the average district/city population. Because the longevity expectations of the urban district community in cluster 3 are still below average, the government can adopt policies to develop the potential of human resources. Thus, adjusted per capita spending can become more stable.

CONCLUSION AND RECOMMENDATION

Based on the results of the research and discussion that have been described, the researchers obtained the following conclusions:

1. based on available data from 34 provinces in Indonesia, 5 provinces are at a high poverty level due to the high percentage of poor people and the low expected length of schooling, average length of schooling, and adjusted per capita spending in the region. Furthermore, there are 24 provinces at the moderate poverty level which is caused by the low average length of schooling and adjusted per capita spending and there are 5 provinces at the low poverty level. This can be seen from the low percentage of the population and is supported by the average length of schooling and expenditure. adjusted per capita is above the population average,
2. based on the grouping results in stage 1, it is known that West Kalimantan is included in cluster 1 then it is continued with stage 2 clusters. The results obtained are that there are 103 urban districts with high poverty levels which can be seen from the high percentage of poor people and supported by low expectations of school years, average -the average length of schooling, and adjusted per capita spending in the area. There are 65 urban districts at moderate poverty levels due to the percentage of poor people, adjusted per capita spending, and the average length of schooling is below the population average and the expected length of schooling is above the population average. Furthermore, there are 224 urban districts with low poverty levels because the percentage of poor people and the expected length of schooling are below the average, but the average length of schooling and per capita expenditure in these areas are above the average.
3. West Kalimantan is a province with a moderate poverty rate among other provinces. So that after conducting research, it is known that 13 urban districts are areas with low poverty characteristics, and 1 city, namely Pontianak City, is an area with moderate poverty characteristics. Factors affecting the city of Pontianak are the characteristics of moderate poverty, this is caused by the average length of schooling which is still below the average population. Thus, the government must provide support and encouragement to develop the potential of society to create a better quality of education.
4. It is hoped that the results of this research can help the provincial government or regional government in making policies that can overcome poverty.

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