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A K-Medoids Clustering Approach to Controlling Assistance Fund Allocation in Madura

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Abstract. Stunting is a condition in which the body does not develop optimally in children as a result of chronic starvation. Stunting is a serious health issue in Madura, with a relatively high frequency. As a result, the local government gives support finances to families experiencing these difficulties. The goal of delivering humanitarian finances is to enhance children's health and avoid future stunting in youngsters. Aside from that, the stunting assistance financing program in Madura is projected to help overcome the problem of stunting in children while also improving the community's health and welfare. However, aid finances must be properly classified and administered in order to deliver the greatest benefit to families in need. As a result, the K-Medoids Clustering approach was used to categorize recipients of stunting aid finances in Madura. To address stunting in Bangkalan Regency, data on 14 qualifying criteria for obtaining relief funding was utilized. K-Medoids clustering is used to classify patients based on their stunting status. This simple and convergent method divides data points into clusters, allowing for efficient allocation of funds. This approach helps identify priority groups for interventions to reduce malnutrition rates and helps identify clusters and locations for providing assistance funds. The K-Medoids Clustering approach tries to divide the population into two groups: the cluster not receiving assistance (C1) and the cluster receiving assistance (C2). As a result, 3 sub-districts were declared unfit to receive assistance and 9 sub-districts were recipients of assistance.

INTRODUCTION

Stunting is a chronic nutritional condition that happens in children who have extended periods of chronic malnutrition [1–3], resulting in the kid becoming physically short and having a severe influence on the child's physical and cognitive growth and development. Stunting is a severe problem in Indonesia, particularly in the Madura area. To combat stunting, the government and health-care groups frequently give financial help to families who have children with stunting. Stunting assistance funds are government or non-government entities that give support or programs to combat stunting [4–6]. The stunting assistance fund in Madura is a program aimed at addressing the issue of stunting in children. The help finances will be supplied to the kid's parents or guardians to be used to purchase healthy food, milk, or vitamins that the youngster requires for maximum growth. Stunting is a disorder in which a child's physical and mental development is delayed owing to persistent malnutrition throughout the early growth phase. This disorder can create health difficulties in children, including physical and mental frailty, as well as make them prone to disease.

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The Indonesian government has identified stunting as a public health issue that must be addressed urgently. As a result, the government has developed programs and aid funding to combat stunting. Stunting help programs and grants in Indonesia include: (a) Toddler Supplementary Food Program: This initiative attempts to offer supplementary nourishment to stunted children under the age of five. Toddler Supplementary Food Program is given in the form of biscuits, milk, and other extra foods, (b) Maternal and Child Health Program: The purpose of this program is to promote maternal and child health, including stunting prevention. The Maternal and Child Health Program includes nutrition and health education, routine health checkups, and vaccines, (c) International organizations such as the World Bank and UNICEF provide assistance funds to support government programs in overcoming the stunting problem in Indonesia, and (d) Private Assistance Funds: Several private companies also provide assistance funds to support government programs in overcoming the stunting problem. The stunting assistance fund is intended to help lower stunting rates in Indonesia and promote the health and welfare of children in society.

However, assistance finances must be managed and distributed appropriately in order for them to be successful and on target. The issue with giving financial support for stunting patients in Madura is that it is difficult to verify that the finances are targeted correctly and can deliver the best possible advantages to the recipients. Aside from that, there are variances in stunting status throughout Madura's areas, necessitating the grouping of receivers of aid finances so that they may be tailored to the needs of each region. As a result, one strategy that can be employed is grouping or clustering. The k-medoids clustering approach was employed in this case to classify aid users based on important criteria such as age, gender, nutritional status, and other factors that impact the prevalence of stunting. The k-medoids clustering algorithm was used in this study to maximize the grouping of recipients of stunting status assistance money in the Madura region. It is intended that by using this strategy, aid monies would be distributed more effectively and efficiently.

METHODS

We will present the research outline, research design, data collection techniques, and research stages in allocating stunting status support funds in Madura using the K-Medoids approach in this session. This study focuses on distributing relief finances in Bangkalan Regency. Figure 1 depicts an overview of the study steps.

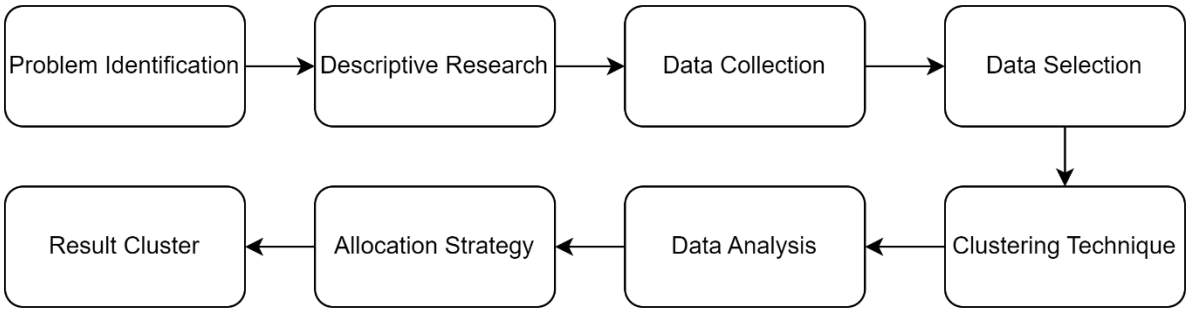

FIGURE 1. Research methodology

Begin by identifying stunting in the Bangkalan Regency. The goal is to identify the problem so that researchers can explain it and measure it from a clear context. Aid beneficiaries might be decided based on the difficulties that have been recognized. This is carried out at the descriptive research stage. To gather information regarding stunting status and eligibility requirements, data collecting methods such as surveys, interviews, or the distribution of questionnaires, as well as literature research and observations, can be used. A data selection procedure is necessary after the estimated capture of original data encompassing all information relevant to stunting. This occurs during the data selection step, which seeks to identify the data to be processed. K-Medoids are used in a clustering approach.

K-Medoids is a clustering technique that divides data points into clusters by picking k medoids, which are defined as cluster points having the fewest dissimilarities to all other cluster points [7,8]. The approach, known as Partitioning Around Medoids (PAM), was proposed by Kaufman and Rousseeuw in 1987. The algorithm operates can be seen in Figure 2 [9]. In the K-Medoids algorithm, the cost is represented as the sum of the differences between each data point and its assigned medoid. K-Medoids is similar to K-Means in that it uses real data points as cluster centers rather than the mean point, which provides for higher interpretability of cluster centers than K-Means [10]. The method is simple to grasp and implement, and it converges in a given number of steps. The fundamental drawback of K-Medoids is that

they are not ideal for clustering non-spherical (arbitrarily shaped) groups of items since they rely on decreasing the distances between non-medoid objects and medoid objects [11]. This method will be used to classify patients based on their stunting status. K-Medoids perform well with categorical data and are suitable for circumstances in which the number of clusters is not defined.

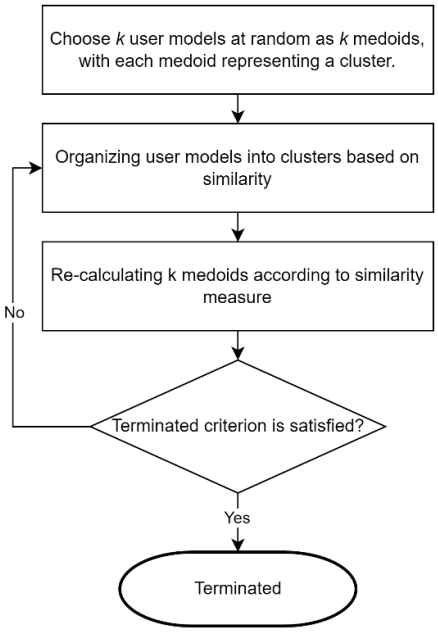

FIGURE 2. Stages of K-Medoid algorithm

Data analysis based on K-Medoids clustering algorithm to group families into clusters based on stunting status. Overall, using clustering algorithms to estimate stunting and nutritional status is a promising strategy that might aid in the identification of priority groups for interventions to reduce malnutrition rates. Optimization Techniques is to create an allocation plan that maximizes the distribution of cash for stunting help among the selected clusters. As a result, appropriate clusters and locations for providing stunting assistance funds were obtained.

RESULTS

Madura is divided into four districts, with Bangkalan Regency serving as the study's focal point. Bangkalan Regency, with an area of 1,260.14 km2, is located on Madura Island's westernmost tip [12-15]. In terms of stunting, it was discovered that at the end of 2022, there were 1,931 stunted children under the age of five in this district, compared to 2,300 stunted children under the age of five in 2021. This share will fall to 26.2% in 2022, from 38.9% in 2021. In the descriptive study stage, it is required to determine the distribution of financial aid. This stage divides users of stunting support funding into two groups depending on their stunting status in Bangkalan: the cluster not receiving assistance (C1) and the cluster receiving assistance (C2).

The Central Statistics Agency and the Bangkalan District Health Service collected data using survey and interview methods. The Bangkalan Regency is reported to be divided into 18 sub-districts and 281 villages/sub-districts. Data was acquired for 12 sub-districts from 18 sub-districts, including Tunjung, Burneh, Langkap, Banangkah, Alaskembang, Arok, Kapor, Sobih, Pangolangan, Binoh, Perreng, and Jambuh. Aside from sub-district numbers, information such as the number of families, the number of target families (NTF), At risk of stunting 1, At risk of stunting 2, At risk of stunting 3, At risk of stunting 4, At risk of stunting > 4, Total, No danger, BADUTA children are the goal, BALITA children are the goal, CCA target, CCA target is pregnant, family lacks a proper main supply of drinking water (FLDW), family lacks a good toilet (FLGT), CCA 4 is too young (20 years), CCA 4 is too elderly (35-40 years), CCA 4 is too close (2 years), CCA 4 is too many (3 children), CCA 4 as well, and not a Modern Family Planning. At this point, the outcome is a total of 22 data (original data). The degree of welfare is indicated by the numbers 1 to 4 in the stunting risk statistics. If the numbers are between 1 and 2, it is called a low welfare level,

whereas anything above 2 is regarded a normal welfare level. Finally, the larger the value, the higher the amount of welfare. Table 1 shows certain concepts that need to be defined.

TABLE 1. Terms

Term	Datasets
BADUTA	Two year old baby
BALITA	Five year old baby
CCA	Couples of childbearing age

The data selection procedure is carried out during the data selection step to collect the data utilized in the K-Medoids calculation based on all of the original data obtained. It is possible to determine that 14 of the 22 data are used or are claimed to represent features (as indicated in Tables 2 and 3).

TABLE 2. Selection data

Decision	Datasets
Selected	Sub-district, NTF, At risk of stunting 1, At risk of stunting 2, At risk of stunting 3, At risk of stunting 4, At risk of stunting >4, No danger, BADUTA children are the goal, BALITA children are the goal, CCA target, CCA target is pregnant, FLDW, FLGT.
Eliminated	The number of families, Total, CCA 4 is too young (20 years), CCA 4 is too elderly (35-40 years), CCA 4 is too close (2 years), CCA 4 is too many (3 children), CCA 4 as well, and not a Modern Family Planning.

TABLE 3. Feature

Sub-district	NTF	At risk of stunting 1	At risk of stunting 2	At risk of stunting 3	At risk of stunting 4	At risk of stunting >4	No danger	BADUTA children are the goal	BALITA children are the goal	CCA Target	CCA target is pregnant	FLDW	FLGT
Tunjung	1124	18	29	40	48	210	779	48	228	1119	13	1	58
Burneh	869	3	11	26	21	165	643	48	151	863	13	0	42
Langkap	1012	17	23	38	43	208	683	91	230	1006	34	3	83
Banangkah	919	65	70	84	57	220	423	58	236	909	21	148	384
Alaskembang	397	147	36	31	7	4	172	47	119	392	14	59	82
Arok	112	4	3	11	5	16	73	11	30	112	6	0	2
Kapor	298	44	19	17	10	34	174	21	42	298	10	7	80
Sobih	264	43	36	26	17	93	49	17	69	260	7	2	195
Pangolangan	293	115	46	22	13	24	73	26	87	292	9	2	194
Binoh	219	60	22	9	4	1	123	10	49	215	1	2	19
Perreng	142	17	16	5	7	12	85	1	1	142	0	0	31
Jambuh	363	60	44	31	17	77	134	11	65	360	3	3	159

The K-Medoids method is used to do calculations, with the first step being to calculate the centroid or center of the medoids. The centoid was calculated using data from the Tunjung and Alaskembang sub-districts. The shortest distance between the centroid point and the item is then calculated. Use the Euclidian Distance computation to generate a distance table from the Centroid and determine the minimum value of the two centroids to compute the distance between the Centroid point and each object point. Table 4 contains the distance table from the centroid.

TABLE 4. Centroid value

Sub-district	Value 1	Value 2	Closest distance	Cluster
Tunjung	0	1225.650032	0	1
Burneh	398.4243968	848.5729197	398.4243968	1
Langkap	193.7059627	1046.0239	193.7059627	1
Banangkah	589.0509316	880.6832575	589.0509316	1
Alaskembang	1225.650032	0	0	2
Arok	1619.131249	458.9923747	458.9923747	2
Kapor	1338.626535	199.9324886	199.9324886	2
Sobih	1439.07922	297.6088036	297.6088036	2
Pangolangan	1399.15939	222.5780762	222.5780762	2
Binoh	1466.328408	295.5283404	295.5283404	2
Perreng	1580.318322	418.8699082	418.8699082	2
Jambuh	1276.788941	173.4473984	173.4473984	2
	TOTAL		3248.138681	

The computation is repeated, checking for Clusters in the following iteration until the iteration values match. Table 5 shows the results of the 2nd iteration value table. In the 2nd iteration, it was stopped because the deviation value was > 0. The deviation value was obtained from the total difference between the 1st iteration and the 2nd iteration. So the results of the provision of stunting assistance funds given to 9 sub-districts and 3 sub-districts were not considered acceptable. Overall results are displayed in Table 6.

TABLE 5. 2nd iteration value

Sub-district	Value 1	Value 2	Closest distance	Cluster
Tunjung	1619.131249	1338.626535	1338.626535	2
Burneh	1225.706327	947.8644418	947.8644418	2
Langkap	1440.380505	1159.110435	1159.110435	2
Banangkah	1295.961033	1008.326336	1008.326336	2
Alaskembang	458.9923747	199.9324886	199.9324886	1
Arok	0	296.6934445	0	1
Kapor	296.6934445	0	0	2
Sobih	305.4553977	190.078931	190.078931	2
Pangolangan	346.3105543	176.7427509	176.7427509	2
Binoh	170.1910691	145.5403724	145.5403724	2
Perreng	64.46704585	250.1979217	64.46704585	1
Jambuh	404.7616583	139.9249799	139.9249799	2
	TOTAL		5370.614316	

TABLE 6. Clustering results

Cluster	Sub-district
1	Alas Kembang, Arok, Perreng
2	Tunjung, Burneh, Langkap, Banangkah, Kapor, Sobih, Pangolanga, Binoh, Jambuh

CONCLUSION

The Indonesian government has identified stunting as a public health issue that must be addressed urgently. To combat stunting, the government has developed programs and aid funding, but it is crucial that the assistance finances are managed and distributed appropriately for them to be successful and on target. One strategy that can be employed is grouping or clustering utilizing the k-medoids clustering approach. This research was aimed at Bangkalan Regency using 14 features, including sub-district, NTF, at risk of stunting 1, at risk of stunting 2, at risk of stunting 3, at risk of stunting 4, at risk of stunting > 4, no danger, BADUTA children are the goal, BALITA children are the goal, CCA target, CCA target is pregnant, FLDW, and FLGT. The results of the provision of stunting assistance funds given to 9 sub-districts and 3 sub-districts were not considered acceptable. Cluster 1 consists of Alas Kembang, Arok, and Perreng sub-districts. On the other hand, cluster 2 consists of Tunjung, Burneh, Langkap, Banangkah, Kapor, Sobih, Pangolanga, Binoh, and Jambuh.

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