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OPTIMIZING ELECTRICITY SUBSIDIES: A TOPSIS-BASED DECISION-MAKING APPROACH

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Abstract

A individual or household is said to be in poverty if their income is insufficient to cover even the most basic requirements. According to BPS, 40% of Indonesians live in the country with the weakest economy. The use of power subsidies is one of the government's strategies for combating poverty. To combat poverty, the government works with PT. PLN to implement an electrical subsidy scheme that distributes payments to disadvantaged neighborhoods. The goal of the subsidy is to ensure the availability of power while assisting underprivileged customers and those who haven't heard from PT. PLN so they may take part in enjoying electrical energy. However, there are still challenges when there are several procedures, which makes it difficult to make judgments since they must take into account numerous factors. Using TOPSIS to solve 10 possibilities, including the following, is one way to get around the FMADM's various requirements: job, income, dependents, vehicle assets, home ownership, building area, source of drinking water, electrical power range, kind of floor, and type of house wall. According to the study's precise findings, only 11 residents out of 20 submissions received immediate recommendations for receiving power subsidies without having to wait a lengthy period. Additionally, although 9 people received recommendations for aid, only 1 received a recommendation against receiving support.

Keyword: *TOPSIS, Subsidies, Electricity*

1. INTRODUCTION

Poverty is a national and global issue that continues to be discussed by all Countries. Indonesia as a developing country also pays great attention to the handling of poverty in order to create a just and prosperous society as stated in the fourth paragraph of the 1945 Constitution. Poverty is a condition where a person or household has an income that is not enough to meet the minimum needs of life. BPS said that 40% of Indonesians are in the lowest economy. One of the steps to overcome poverty carried out by the government is the implementation of electricity subsidies. The electricity subsidy program is expected to be one of the solutions to help poor households to continue to get electricity at a lower cost [1][2][3]. The 1945 Constitution Article 33 paragraph 2 provides for basic human needs and is provided by the government in the form of electricity, for more detail on the statement as follows "The branches of production which are important to the state and which control the lives of the people are controlled by the state". Electricity has been inspected in accordance with the enactment of Law No. 30 of 2007 on Energy, Part 7: paragraph (1), which states that it has been stipulated that the government intends to subsidize the use of energy. For details, the article reads as follows "Energy prices are determined based on equitable economic values" and subsection (2) that "Governments and Local Governments provide subsidy funds to underprivileged communities"[4]. As the name suggests, PT Perusahaan Listrik Negara (often abbreviated as "PT. PLN") is a government agency that provides electricity tariff subsidies for low-income households in the country[5].

The government cooperates with PT. PLN to control poverty has an electricity subsidy program by providing electricity subsidy assistance funds to underprivileged communities. The main purpose in providing electricity subsidies is to reach electricity capacity and help PT. PLN that is underprivileged and that does not yet have electricity [3]. In addition to the electricity subsidy program from PT. PLN, Energy and Mineral Resources (PERMEN ESDM) No. 17 of 2019 is a targeted program that in accordance with ministerial regulations can also be enjoyed by underprivileged residents by means of residents registering in advance to villages/kelurahan by filling out forms, for the flow to get subsidies as shown in figure 1.

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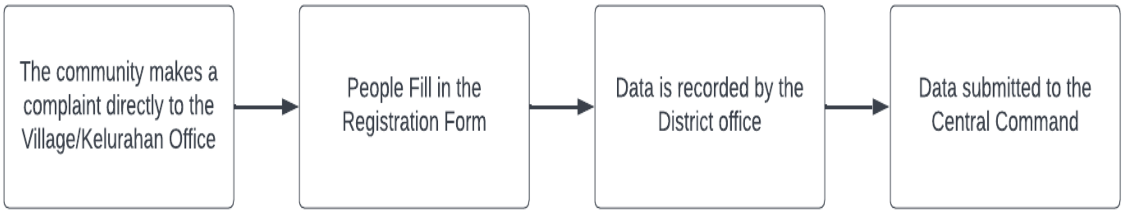

Fig 1. Complaints Mechanism for the application of electricity subsidies on target

In the mechanism for implementing electricity subsidies as seen in Figure 1 above, it still takes a long time, because the process is so long, because after the data from the sub-district is sent to the Post Center, several verifications are still carried out by the post center.

Research on the evaluation of the determination of the feasibility of providing electricity subsidies has been carried out by Bobi Heri Yanto and Yuhandri Yunus in 2021 [3][6][7] the study used 7 criteria to determine the feasibility of providing electricity subsidies based on criteria from PT. Haleyora Power includes: Work, Dependents, Income, Home Ownership, Vehicle Assets, Drinking Water Sources, Building Area, using the *Multifactor Evaluation Process* (MFEP) Method. But the criteria used still need to be added with compliance with the EXISTING DTKS data in the village with additional criteria such as: Electrical power range, floor type, and type of house wall.

The procedure for providing electricity subsidies for underprivileged residents currently has several obstacles, especially for data verification which takes a long time because there are several procedures, not on target because the field survey section is not from village people / DTKS (Data Terpadu Kesejahteraan Sosial) and lacks suitability of criteria in determining electricity subsidies for underprivileged residents. Amore practical and efficient decision support system is needed to address problems with many of these criteria.

Basedon certain criteria *Fuzzy Multi Attribute Decision Making* (FMADM) chooses the best option. FMADM initialization determines the weight value of each attribute, followed by a scaling process that chooses between alternatives [8]–[11]. In this study, the *Technique for Order Preference by Similarity to Ideal Solution(TOPSIS)* method was used to determine the provision of electricity subsidies for underprivileged residents, it is hoped that the decision support system can facilitate verification of existing registration at village offices in collaboration with DTKS (Data Terpadu Kesejahteraan Sosial), so that the recapitulation of data obtained from the recommendations of madm fuzzy results can be sent to the sub-district and to the Posko Center.

2. METHOD

*Technique for Order Preference by Similarity to Ideal Solution (*TOPSIS)

TOPSIS is a method for determining the outcome of multicritean decisions or alternative options that provide a smaller solution of the ideal positive solution and a larger solution of the ideal negative solution of geometry using Euclidean distances.[12][13][14].

Therefore, TOPSIS considers both, the distance to the positive ideal solution and the distance to the negative ideal solution simultaneously. The optimal solution in the TOPSIS method is obtained by determining the relative proximity of an alternative to the positive ideal solution. TOPSIS will rank alternatives based on the priority of the relative proximity value of an alternative to the positive ideal solution. The alternatives that have been arranged are then used as a reference for decision makers to choose the best solution they want [12].

Several studies in determining scholarships for smart children and determining subsidies for underprivileged residents have been carried out using the TOPSIS method and have very good results. [6], [12], [22]–[24], [14]–[21]

The TOPSIS process is generally carried out with the following seven steps:

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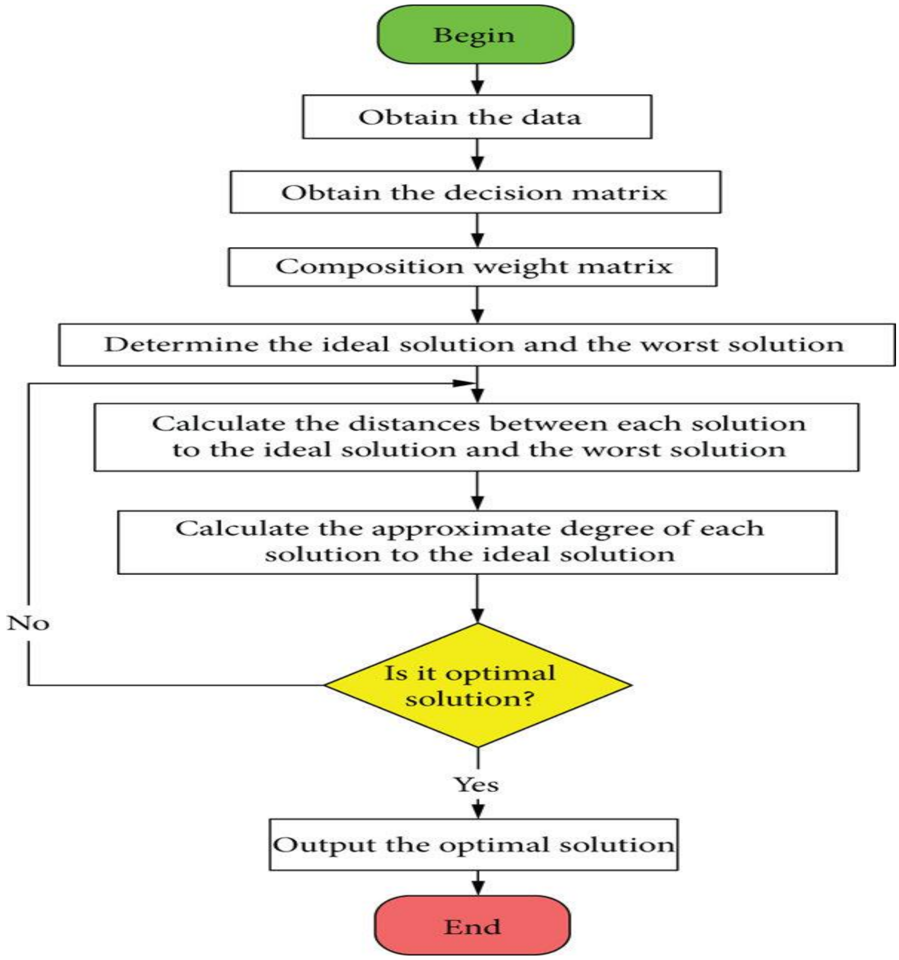

Fig 2. TOPSIS Algorithm Stage Flowchart [14]

Figure 2 Explains the processing process using the TOPSIS algorithm starting from the data formed into the decision matrix. The process of normalizing the decision matrix is then continued for the process of giving weight to the decision matrix by multiplying the decision matrix that has been normalized by the weighting that exists in the company. The next stage is todetermine the positive ideal solution and the negative ideal solution, measuringthe size of the separation. itis relatively close to the ideal solution and the last stage of administration of peringkat according to the order of choice.

3. RESULT AND DISCUSSION

The criteria data used in this study are data from previous studies [3]. coupled with additional criteria adjusted to DTKS data located at the Kramatjati Village office in East Jakarta. The data used, including for electricity subsidy determination data, is data from previous submissions in the Kramatjati village of East Jakarta using eight criteria and, for the weight of each criterion obtained with the results of discussions with dtks in kramatjati. The name of the criteria is found in table 2, and for the weight of each criterion contained in table 1, the higher the weight number indicates that the more important the criterion.

Table 1. Weight Table of Each Criterion For Determining Electricity Subsidies

Criterion Name	Sub Criteria	Weight
Job	Not Working	1
	Casual	2
	Laborer	3
	Self-employed	4
	CIVIL SERVANT	5
Income	< 1.000.000	1

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	1.000.000 - 2.000.000	2
	2.000.001 - 3.000.000	3
	3.000.001 - 4.000.000	4
	> 4.000.000	5
Number of Dependents	0	1
	1	2
	2	3
	3	4
	>3	5
Vehicle Assets	Do not have	1
	Rickshaw	2
	Bicycle	3
	Motorcycle	4
	Car	5
House Ownership Status	Do not own	1
	Rent	2
	Owned	3
Building Size	Not Owned	1
	< 20 M	2
	20 -30 M	3
	31 - 40	4
	> 40	5
Drinking Water Source	Well	1
	PDAM	2
Power Range	900 Watt	1
	1300 Watt	2
	2200 Watt	3
Floor Type	Earth	1
	Bamboo	2
	Tile / Tegel /Teraso	3
	Ceramic	4
	Marble	5
Type of Wall	Woven Bamboo	1
	Wood	2
	Wall	3

Table 2. Table of Criteria for Determining Electricity Subsidies and Weights of Interest

	Weight
Job	5
Income	5
Number of Dependents	4
Vehicle Assets	5
House Ownership Status	4
Building Size	3
Drinking Water Source	3
Power Range	4
Floor Type	3
Type of Wall	3

The data used is data on prospective recipients of electricity subsidies in Kramatjati Village in 2021 which is obtained through data on citizen submissions. The data used consists of 20 prospective recipients of electricity subsidies that will be processed using the TOPSIS method. The following is an algorithm in the calculation process using the TOPSIS method:

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1. Forming a matrix of decisions.
   D =

=

1	3	1	5	3	2	1	2	2	2
2	2	4	1	3	3	1	2	2	1
2	3	5	5	3	3	2	2	2	1
2	2	4	1	3	2	1	2	2	1
2	3	4	1	3	2	2	2	2	1
3	3	4	1	3	2	2	1	2	2
3	2	5	4	3	2	1	2	2	1
1	3	4	4	1	2	1	2	2	1
1	2	3	4	3	3	1	2	2	1
1	2	4	4	3	2	2	1	2	1
1	3	3	1	3	3	1	2	2	1
1	2	3	5	3	3	1	2	2	1
1	3	4	5	3	3	1	2	2	2
1	2	5	1	3	2	2	2	2	1
1	2	4	1	1	3	2	2	2	1
2	2	4	1	1	3	1	1	2	1
1	3	4	1	3	2	1	2	2	1
3	2	3	1	3	3	1	2	2	1
2	3	4	1	3	3	2	2	2	1
1	2	4	5	3	2	2	2	2	1

2. Conducting normalization of the decision matrix D.

0,127000	0,268328	0,057354	0,353553	0,240192	0,175412	0,150756	0,237356	0,223607	0,371391
0,254000	0,178885	0,229416	0,070711	0,240192	0,263117	0,150756	0,237356	0,223607	0,185695
0,254000	0,268328	0,286770	0,353553	0,240192	0,263117	0,301511	0,237356	0,223607	0,185695
0,254000	0,178885	0,229416	0,070711	0,240192	0,175412	0,150756	0,237356	0,223607	0,185695
0,254000	0,268328	0,229416	0,070711	0,240192	0,175412	0,301511	0,237356	0,223607	0,185695
0,381000	0,268328	0,229416	0,070711	0,240192	0,175412	0,301511	0,118678	0,223607	0,371391
0,381000	0,178885	0,286770	0,282843	0,240192	0,175412	0,150756	0,237356	0,223607	0,185695
0,127000	0,268328	0,229416	0,282843	0,080064	0,175412	0,150756	0,237356	0,223607	0,185695
0,127000	0,178885	0,172062	0,282843	0,240192	0,263117	0,150756	0,237356	0,223607	0,185695
0,127000	0,178885	0,229416	0,282843	0,240192	0,175412	0,301511	0,118678	0,223607	0,185695
0,127000	0,268328	0,172062	0,070711	0,240192	0,263117	0,150756	0,237356	0,223607	0,185695
0,127000	0,178885	0,172062	0,353553	0,240192	0,263117	0,150756	0,237356	0,223607	0,185695
0,127000	0,268328	0,229416	0,353553	0,240192	0,263117	0,150756	0,237356	0,223607	0,371391
0,127000	0,178885	0,286770	0,070711	0,240192	0,175412	0,301511	0,237356	0,223607	0,185695
0,127000	0,178885	0,229416	0,070711	0,080064	0,263117	0,301511	0,237356	0,223607	0,185695
0,254000	0,178885	0,229416	0,070711	0,080064	0,263117	0,150756	0,118678	0,223607	0,185695
0,127000	0,268328	0,229416	0,070711	0,240192	0,175412	0,150756	0,237356	0,223607	0,185695
0,381000	0,178885	0,172062	0,070711	0,240192	0,263117	0,150756	0,237356	0,223607	0,185695
0,254000	0,268328	0,229416	0,070711	0,240192	0,263117	0,301511	0,237356	0,223607	0,185695
0,127000	0,178885	0,229416	0,353553	0,240192	0,175412	0,301511	0,237356	0,223607	0,185695

3. Determine the positive ideal solution and the negative ideal solution.

A +	**0,076200**	**0,053666**	**0,071692**	**0,070711**	**0,060048**	**0,087706**	**0,100504**	**0,059339**	**0,074536**	**0,123797**
A-	**0,025400**	**0,035777**	**0,014338**	**0,014142**	**0,020016**	**0,058471**	**0,050252**	**0,029670**	**0,074536**	**0,061898**

4. Calculate the size of the separation. The separation of each positive ideal alternative is given by :

Table 3. Results of Separation of each alternative

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D+	D-
0,115734	0,1209828
0,118882	0,1007007
0,066907	0,1492118
0,125867	0,0918217
0,114005	0,1061908
0,096958	0,1271342
0,093734	0,1297883
0,121091	0,0922005
0,106311	0,1050693
0,100662	0,1141536
0,130315	0,0880883
0,104413	0,1176416
0,074277	0,141587
0,121826	0,114846
0,129416	0,0938914
0,134976	0,0778153
0,132128	0,0900337
0,121332	0,1001009
0,106244	0,1139556
0,094089	0,1292723

5. Calculate relative proximity to the ideal solution. The relative proximity of A_i to A* is defined as :
$C_i^* = S_i^- / (S_i^* + S_i^-),\ 0 \leq C_i^* \leq 1$ (1)
Where i = 1.2,....,m
The greatest C_i* value is the best alternative. And rankings.

Table 4. Table of Ranking Results of each alternative and criterion

Candidate's Name	V	Status
Warga 16	0,634311043	Approved
Warga 11	0,596671765	Approved
Warga 17	0,594738608	Approved
Warga 15	0,579541024	Approved
Warga 4	0,578196501	Approved
Warga 8	0,567725276	Approved
Warga 18	0,547939817	Approved
Warga 2	0,541400419	Approved

Warga 5	0,517744041	Approved
Warga 14	0,514745165	Approved
Warga 9	0,502937488	Approved
Warga 1	0,488912378	Considered
Warga 19	0,482489209	Considered
Warga 12	0,470212904	Considered
Warga 10	0,46859844	Considered
Warga 6	0,432670331	Considered
Warga 20	0,421240077	Considered
Warga 7	0,419349787	Considered
Warga 13	0,34409179	Considered
Warga 3	0,309585073	Not Approved

The results of the information are obtained based on discussions with DTKS members, where for values above 0.5 approved and below 0.5 will be considered, and if the value shows below 0.3 it is automatically not approved. Based on Table 4. It was concluded that from 20 data processed using the TOPSIS algorithm, there were 11 approved residents and 8 residents who were still being considered and 1 resident who was automatically disapproved. This result turned out to be in accordance with the calculation of each criterion where resident 3 was not approved because they had a car, income above 2 million, and an electricity range of 1300 Watts. For 8 Residents who are still being considered will be re-examined the value of the criteria whether to own a car, and a high income or not for acc electricity subsidy recommendations.

4. CONCLUSION

This research produces decisions that are in accordance with the weights given to each criterion. Of the 20 submissions, only 11 residents were automatically approved without having to wait long in the decision to grant electricity subsidies. Meanwhile, 9 residents received recommendations for approval, and 1 resident was given a recommendation not to get approval. The decision was then returned to the central post in the provision of electricity subsidies. For future research, it is expected to be measured again using other FMADM algorithms such as SAW, ELECTRE, AHP. And measured using validity to make recommendation decisions more accurate. The use of various algorithms is expected to provide a deeper understanding of electricity subsidy decisions, as well as open space for further comparison and evaluation of the most effective approaches to making decisions related to electricity subsidies. In addition, other aspects such as efficiency and user satisfaction can also be integrated in future research to improve the accuracy and quality of the decision. By involving inter-algorithm benchmarking and additional validation, this research contributes to the development of decision-making methods in the context of electricity subsidies.

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