The Comparison of SAW BORDA and TOPSIS BORDA Methods In the Zakat Recipient Determination System Education programs (Case Study: BAZNAS, West Kalimantan Province)

Renny Puspita Sari[1], Istikoma[2], Fenni Supriadi[3]
{rennysari@sisfo.untan.ac.id[1], istikoma@sisfo.untan.ac.id[2], fennisupriadi@unmuhpnk.ac.id[3]}

Information System Faculty of Mathematics and Natural Sciences, Tanjungpura
University Pontianak, Indonesia [1,2]
Management Study Program, Faculty of Economics and Business, Muhammadiyah
University of Pontianak, Indonesia[3]

Abstract. The National Amil Zakat Agency (BAZNAS) is a zakat distribution institution that has many zakat distribution programs, one of which is in the field of Education. The process for zakat distribution program in the area of Education requires a support system for the Leadership Decision because of the determination of prospective recipients, namely the Head of the BAZNAS of West Kalimantan Province, the chairman of the registrant field, the chairman of the distribution division , the chairman of financial planning, and the head of administration. In this study, each calculation of each SAW and TOPSIS will be obtained from each decision making which gives the value of the weighting of each candidate named after the recipient of the zakat, then proceed with the calculation using the BORDA method which is the result of research from five people who received the decision. The final results of the study can show the results of the ranking and value order of prospective zakat recipients between the SAW BORDA and TOPSIS BORDA methods in decision support systems which can be support decision making in determining the best potential zakat recipients.

Keywords: GDSS, Zakat, TOPSIS, SAW, BORDA

1. Introduction

The fourth pillar of Islam of the five pillars of Islam which is mandatory for every Muslim and becomes one of the important elements in upholding Islamic law, namely Zakat [1]. Zakat is a compulsory worship which is carried out by giving a certain amount of one's own property to those who are entitled to receive it according to the prescribed Islamic Sharia [9]. BAZNAS West Kalimantan Province is a Zakat distribution institution at the provincial level of West Kalimantan, which has several programs for distributing zakat to the poor, one of which is the distribution of zakat for educatin assistance. In the zakat distribution program in the field of Education requires a group decision support system because the determination of zakat recipients involves five decision makers, namely the Chairman of the West Kalimantan Province BAZNAS, the head of collection, head of distribution, head of financial

planning, and head of administration, so that determining the prospective recipients of zakat is not easy and time consuming because to produce a decision must be based on the agreement of 5 decision makers. The method used is a comparison of the BORDA SAW (Simple Additive Weighting) method and the BORDA TOPSIS (Technique for Order Preference by Similarity to Ideal Solution). The criteria used in the case of determining the prospective recipient of zakat are the amount of parents' income, the number of children who are still being covered by their school fees, completeness of the file, the status of the recipient of zakat (never received zakat in the previous year), not currently receiving another scholarship. The final result can show the comparison of the ranking order of prospective recipients of zakat between SAW BORDA and TOPSIS BORDA in a group decision support system which is a collaborative decision of five decision makers so that it can facilitate decision makers in determining the best priority of prospective zakat recipients.

2. Research Methodology

A research framework to describe the research environment using the Hevner framework. The phases carried out in this research are determining the Environment, which explains the research environment, the IS Research Phase, which explains the phases traversed in the study, and finally the Knowledge base phase explains the knowledge base used in research [2]. The research framework can be seen in Figure 1 below:
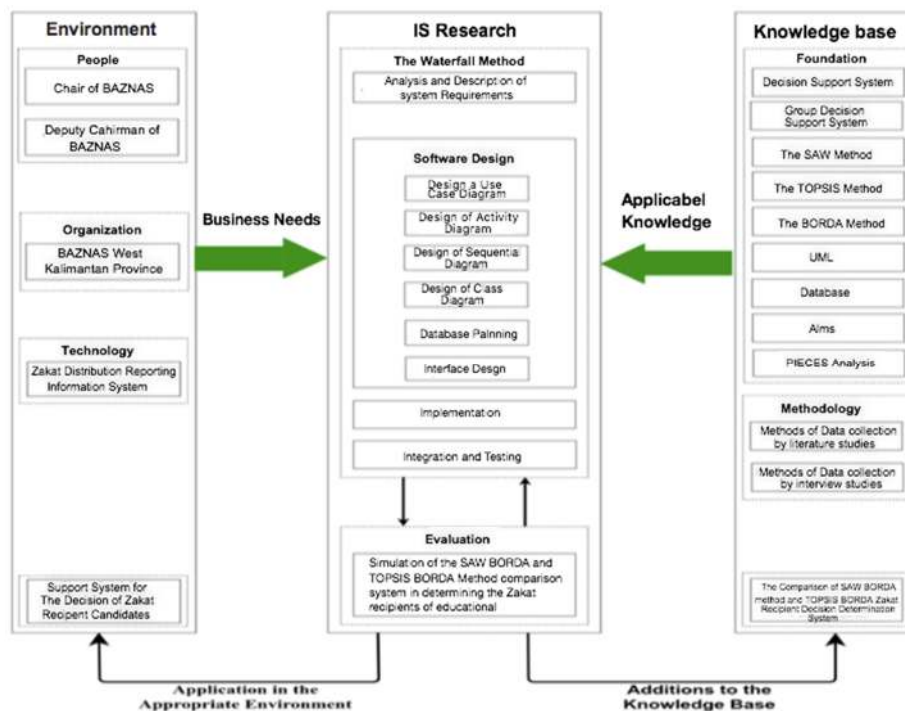

Fig.1. Hevner framework.

The method used in this research is the comparison of SAW BORDA and TOPSIS BORDA methods.

2.1. Simple Additive Weighting (SAW)

According to [6] the SAW method is called the weighted sum method because the basic concept is to find the weighted sum of performance ratings for each alternative on all attributes. The work process of the SAW method: (a) Determine the criteria that will be used as a reference in making decisions, namely Cj. (b) Give the value of each alternative to each predefined criterion, where the value is obtained based on the value of crips. (c) Determine the suitability rating value of each alternative on each criterion and then model it into fuzzy numbers after that convert to crips. (d) Define the weight of preference or level of importance (W) on each criterion. (e) Make a decision matrix (X) formed from the match rating table of each alternative for each criterion. (f) Normalize the decision matrix by steps in calculating the value of the nominal performance rating (rij) from Ai alternatives on the Cj criteria [5].

r_ij = X_ij / (Max X_ij) if j is a profit attribute(benefit)   (2.1.1)
r_ij = (Min X_ij) / X_ij if j is the profit attribute (cost)

Criteria with the benefit attribute if the value provides benefits for decision makers, on the contrary the criteria with the cost attribute if it raises the cost for decision makers and if it is in the form of profit criteria then the value is divided by the value of each column, whereas for the cost criteria, the value of each column is divided by value.

(g) The results of the normalized performance rating value (rij) form a normalized matrix (R) and the final result of the preference value (Vi) is obtained from the sum of the multiplications of the work elements of a normalized matrix with preference weights (W) corresponding to the matrix column elements (W).

$$V_i = \sum_{j=1}^{n} W_j \, r_{ij}$$ (2.1.2)

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

TOPSIS (Technique for Orders Reference by Similarity to Ideal Solution) is based on the concept that the best alternative is chosen not only to have the shortest distance from a positive ideal solution, but also to have the longest distance from a negative ideal solution [3]. In general, the Topsis procedure follows the following steps:

1. Calculate the normalized matrix $r_{ij} = \dfrac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_y^2}}$ (2.2.1)

2. Calculating a weighted normalized matrix $y_{ij} = w_i r_{ij}$ (2.2.2)

3. Identifying positive ideal solutions and negative ideal solutions

$$A^+ = (y1^+, y2^+, \ldots yn^+)$$ (2.2.3)
$$A^- = (y1^-, y2^-, \ldots yn^-);$$ (2.2.4)

4. Calculate the distance between the values of each alternative with the positive ideal solution matrix and the Negative ideal solution matrix.

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(y_i^+ - y_{ij})^2} \quad \text{and} \quad D_i^- = \sqrt{\sum_{j=1}^{n}(y_{ij} - y_i^-)^2}$$ (2.2.5)

5. Determine the value of the closeness of each alternative to the ideal solution (preference).

$$v_{i\,=\,\dfrac{D_i^-}{D_i^- + D_i^+}}$$ (2.2.6)

2.3. BORDA

The principle of the BORDA method is to rank alternatives. According to Bouyssu (Sari, et al, 2014), the alternative that has the highest rank is given the highest value and so onward is given a lower value for the rank below it until the lowest rank is given a value of 0 or 1. In this study involving 5 decision makers by producing alternative prospective recipients of zakat that require a combination of BORDA methods both in the SAW method and TOPSIS. Using the BORDA method will later help in finding the best alternative recipient of zakat from the five priorities resulting from the SAW calculation or the TOPSIS calculation for each decision maker.

3. Result and Discussion

The results of this study will produce a ranking sequence of prospective recipients of zakat by comparing the SAW BORDA method with the TOPSIS BORDA method. Based on the interview results obtained five criteria used to select prospective recipients of zakat namely, income of parents, dependents of parents, status of recipients of zakat in the previous year, completeness of file, status of other scholarships.

3.1 Metode SAW dan BORDA

At this stage the manual calculation of zakat recipients is calculated using the SAW method followed by BORDA. Basically Decision Makers (DM) consist of 5 decision makers, but in the example of this test only involves 1 level of decision makers. At first the criterion data from each alternative is converted to an assessment with an importance weight value that has been adjusted to the value then in addition to the normalization stage with the formula (2.2.1). In the example calculation below it only shows the results of the assessment of one of the Decision Makers, namely Super DM.

Table 1. Results of Super DM Normalization

Name	Income COST	Dependents BENEFIT	File BENEFIT	Zakat Status BENEFIT	Scholarship status BENEFIT
Abi Yasa	0,40	0,60	1,00	1,00	1,00
Adi Setiawan	0,67	0,40	0,50	1,00	0,50
Amira Safitri	0,33	0,20	1,00	1,00	1,00
Aulia Putri	1,00	0,80	0,75	0,50	1,00
Dinda	0,67	1,00	1,00	1,00	1,00

After obtaining the normalization results, a matrix multiplication will be made using the formula (2.1.2) to get the ranking of all alternatives which can be seen in Table 2 After getting the ranking of the prospective recipients of zakat, then the ranking obtained can be continued using BORDA ranking which can be seen in table 3 below:

Table 2. Preference values and ranking of all decision makers

Name	Preference Super DM	Rank	Preference DM 1	Rank	Preference DM 2	Rank	Preference DM 3	Rank	Preference DM 4	Rank
Abi	82,00	2	70,00	3	55,00	2	80,00	3	64,00	2
Adi	58,67	4	57,00	4	40,67	5	61,33	5	44,17	5
Amira	69,33	3	56,00	5	50,33	4	70,67	4	53,33	4
Aulia	28,00	5	84,00	2	53,00	3	81,00	2	63,75	3
Dinda	96,67	1	90,00	1	61,67	1	93,33	1	76,67	1

Table 3. Ranking results are converted to the BORDA method

Name	Rank Super DM	BORDA	Rank DM1	BORDA	Rank DM2	BORDA	Rank DM3	BORDA	Rank DM4	BORDA	Final Rank
Abi	2	**4**	3	**3**	2	**4**	3	**3**	2	**4**	18
Adi	4	2	4	2	5	1	5	1	5	1	7
Amira	3	3	5	1	4	2	4	2	4	2	10
Aulia	5	1	2	4	3	3	2	4	3	3	15
Dinda	1	5	1	5	1	5	1	5	1	5	25

3.2 TOPSIS and BORDA METHODS

Based on the decision value then the normalized matrix is calculated, the calculation uses equation (2.2.1), then the normalized matrix is obtained as follows:

Table 4. Alternative values are squared

Name	Income COST	Dependents BENEFIT	File BENEFIT	Zakat Status BENEFIT	Scholarship status BENEFIT
Abi Yasa	25	9	16	4	4
Adi Setiawan	9	4	4	4	1
Amira Safitri	36	1	16	4	4
Aulia Putri	4	16	9	1	4
Dinda	9	25	16	4	4

Based on the decision value then the normalized matrix is calculated, the calculation uses equation (2.2.1), then the normalized matrix is obtained as follows:

Table 5. Normalized Matrik

Name	Income COST	Dependents BENEFIT	File BENEFIT	Zakat Status BENEFIT	Scholarship status BENEFIT
Abi Yasa	0,55	0,40	0,51	0,49	0,49
Adi Setiawan	0,33	0,27	0,26	0,49	0,24
Amira Safitri	0,66	0,13	0,51	0,49	0,49
Aulia Putri	0,22	0,54	0,38	0,24	0,49
Dinda	0,33	0,67	0,51	0,49	0,49

After getting the normalization matrix, the next step is to calculate the weighted normalized matrix using equation (2.2.2), which can be seen in table 6:

Table 6. Weighted normalization.

Name	Income COST	Dependents BENEFIT	File BENEFIT	Zakat Status BENEFIT	Scholarship status BENEFIT
Abi Yasa	5,49	12,14	15,36	9,70	4,85
Adi Setiawan	3,29	8,09	7,68	9,70	2,43
Amira Safitri	6,59	4,05	15,36	9,70	4,85
Aulia Putri	2,20	16,18	11,52	4,85	4,85
Dinda	3,29	20,23	15,36	9,70	4,85

Based on the weighted normalized matrix in the values of positive (A +) and negative (A-) ideal solutions using the formulas (2.2.5) can be seen in Table 7 and Table 8 as follows:

Table 7. Value of positive ideal solutions

Name	Income COST	Dependents BENEFIT	File BENEFIT	Zakat Status BENEFIT	Scholarship status BENEFIT
Abi Yasa	1,20	65,45	0,00	0,00	0,00
Adi Setiawan	10,84	147,27	59,02	0,00	5,88
Amira Safitri	0,00	261,82	0,00	0,00	0,00
Aulia Putri	19,28	16,36	14,75	23,53	0,00
Dinda	10,84	0,00	0,00	0,00	0,00

Table 8. Value of negative ideal solutions.

Name	Income COST	Dependents BENEFIT	File BENEFIT	Zakat Status BENEFIT	Scholarship status BENEFIT
Abi Yasa	10,84	65,45	59,02	23,53	5,88
Adi Setiawan	1,20	16,36	0,00	23,53	0,00
Amira Safitri	19,28	0,00	59,02	23,53	5,88
Aulia Putri	0,00	147,27	14,75	0,00	5,88
Dinda	1,20	261,82	59,02	23,53	5,88

Then after the value of a positive ideal solution is obtained and a negative ideal solution will then determine the alternative ideal solution (preference) using the formula (2.2.6) which can be seen in table 9 to get a rating of all alternatives. After getting the ranking of each alternative, namely the prospective recipient of zakat, the ranking obtained can be continued by using the BORDA rating which can be seen in table 10 below:

Table 9. Preference values and ranking of all decision makers

Name	Preference Super DM	Rank	Preference DM1	Rank	Preference DM2	Rank	Preference DM3	Rank	Preference DM4	Rank
Abi	0,61	2	0,63	2	0,67	2	0,67	2	0,67	2
Adi	0,30	5	0,30	5	0,32	5	0,32	5	0,32	5
Amira	0,39	4	0,48	3	0,53	3	0,53	3	0,53	3
Aulia	0,60	3	0,46	4	0,48	4	0,48	4	0,48	4
Dinda	0,61	1	0,65	1	0,68	1	0,68	1	0,68	1

Table 10. Ranking results are converted to the BORDA method

Name	Rank Super DM	BORDA	Rank DM1	BORDA	Rank DM2	BORDA	Rank DM3	BORDA	Rank DM4	BORDA	Final Rank
Abi	2	4	2	4	2	4	2	4	2	4	16
Adi	5	1	5	1	5	1	5	1	5	1	4
Amira	4	2	3	3	3	3	3	3	3	3	11
Aulia	3	3	4	2	4	2	4	2	4	2	9
Dinda	1	5	1	5	1	5	1	5	1	5	20

3.3 Comparison of the results of the BORDA SAW Algorithm and the BORDA TOPSIS

The final results of ranking prospective zakat recipients by comparing the SAW BORDA method and the TOPSIS BORDA can be seen in the Table shows the results of the ranking order are not always the same, the difference can be caused by differences in the calculation process algorithm as well as the difference in the weighting scale scale for each criteria.

Tabel 11. Comparison of the Results of the SAW BORDA and TOPSIS BORDA Algorithms

Name	Total Value SAW BORDA	Ranking	Name	Total Value TOPSIS BORDA	Ranking
Abi	18	2	Abi	16	2
Adi	7	5	Adi	4	5
Amira	10	4	Amira	11	3
Aulia	15	3	Aulia	9	4
Dinda	25	1	Dinda	20	1

This can be seen in table 13 which produced the same rank 1 decision, namely Dinda as a prospective recipient of zakat, with the SAW BORDA method producing a value of 25 whereas based on the TOPSIS BORDA method a value of 20, but there is a difference in rank 3 namely the SAW BORDA method on behalf of Aulia with value 15 while the BORDA TOPSIS method on behalf of Amira with a value of 11. Then it can be concluded that the final results are obtained from calculations with both methods. different results from ranking.

3.4 Display of System Interface

Fig.2. Login Interface Implementation

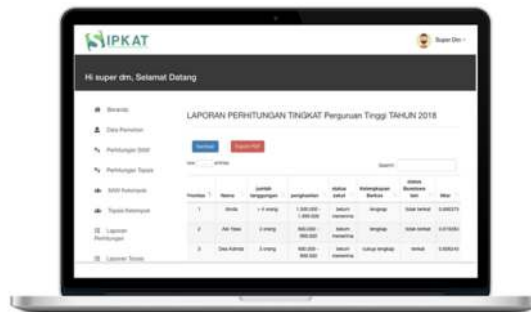**Fig.3.** Implementation of Admin Main Page

Fig.4. Implementation of Calculation Result Interface

Fig. 5. Implementation of the Interface   Report of Recommendations for Prospective Recipients of zakat

4. Conclusion

1) The SAW BORDA and TOPSIS BORDA methods can be applied to the decision support system of the zakat recipient group in the Education program to help computerize selection in the form of ranking results of prospective zakat recipients.

2)   The final results of the ranking order of candidates for Zakat acceptance show are different results between the SAW BORDA method and TOPSIS BORDA. This

difference can be caused by differences in the algorithm of the calculation process and the difference in the scale of the weighting value for each criteria.

3) In the SAW BORDA Method the speed and ease of understanding the calculation process is very good, this can be seen from the simple and few calculation formulas on the TOPSIS BORDA method the calculation formula is quite difficult. However, when viewed from the maturity process, the data processing of the TOPSIS BORDA method is much better because it not only normalizes values, but also considers distance alternatives to positive ideal solutions with distance to negative ideal solutions.

References

[1]   Habibillah. 2015. Kitab Lengkap Panduan Ibadah Muslim Sehari-hari. Yogyakarta: Saufa.

[2]   Hevner, A, 2004, Design Science in Information System Research, MIS Quarterly Vol.28, ed.1, hal 75-105.

[3]   Janko, W. 2005. Multi-Criteria Decision Making: An Application Study of ELECTRE & TOPSIS, dalam Fuzzy Multi-Attribute Decision Making (FUZZY MADM). Graha Ilmu: Yogyakarta.

[4]   Jatmiko, Ari Wibisono, David Bayu Ananda, Abdul Haris, Big Zaman, M. Nanda Kurniawan, M. Anwar Ma'sum, Mira Suryani, Moh Yusuf, Dian Firmansyah. 2014. Sistem Informasi Zakat Pemberdayaan Potensi Masyarakat dengan Teknologi. Depok: Lembaga Penerbit UI Press.

[5]   Kusumadewi. 2006. Fuzzy Multi-Attribut Decision Making (Fuzzy MADM).   Yogyakarta: Graha Ilmu.

[6]   Nofriansyah. 2014. Konsep Data Mining Vs Sistem Pendukung Keputusan. Yogyakarta: Deepublish.

[7]   Sari, dkk. 2014. "Sistem Pendukung Keputusan Kelompok Metode TOPSIS dan BORDA untuk Evaluasi Kegiatan Penanganan Infrastruktur Jalan". Seminar Nasional Teknologi Informasi dan Komunikasi (SENTIKA). ISSN 2089-9813

[8]   Sommerville. 2006. Software Engineering 8th edition. Hongkong: China Machine Press.

[9]   Sari, Elsa Kartika. 2006. Pengantar Hukum Zakat dan Wakaf, Jakarta: PT. Grasindo.

[10]   Turban, Jay E. Aronson, TIng-Peng Liang. 2007. Decission Support Systems and Intelligent Systems Seven Editions. New Delhi: Prentice-Hall, Inc.