

Multi Attribute Decision Making Method for Determination of Regional Development Plan Priority in Papua Province based on the Indicator of Gross Regional Domestic Product (GRDP)

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ABSTRACT

Development as ongoing activity needs certain planning in order to be zero in on and has clear direction. Therefore, it is needed a model for the analysis medium in determining regional priority to development implementation in the future. This research applied multi attribute decision making (MADM) concept for analyzing data of GRDP of Papua Province. Two methods of MADM have been used in this research, those are wighted product (WP) and Technique of Order Preference by Similarity to Ideal Solution (TOPSIS). Twenty nine regencies were analyzed based on the data of GRDP to observe which region will be the development priority later. Result of the research by comparing the two methods are obtained six regencies which need special attention, those are Central Mamberamo Regency, Yalimo, Nduga, Intan Jaya, Mamberamo Raya and Deiyai. The research is expected can be the supporting material of decision in development planning field for the policy implementer, so that able to determine regional priority for development activities in the future.

Keywords

Development Plan, MADM, GRDP, Weighted Product, TOPSIS.

1. INTRODUCTION

Process of development is the activity conducted in order to improve the standard of public life to reach prosperity and welfare of life by utilizing the resources owned by each region (Mursidah et al, 2013). The development certainly needs planning from clear direction so that the objectives of the development itself will be reached. The development plannings, one of them can be conducted by reobserving the regional development attainment to observe how far the development successfully conducted. Many methods are used to analyze development result such as Klassen Typology, shift share analysis, Williamson Index, location quotient, Theil Index, Lorenz Curve, Gini Ratio and L Index which are used to measure the attainment of a regional development based on certain indicators (Yunisti, 2012; Dyatmika, 2013). The result of measurement is then used as a reference to implement the development in the future.

Information technology development especially the theory about supporting decision making gives special space to regional development planning activity. Regional planning in this case is related to development priority determination which will be implemented later. Some regions will be made as the development priority alternative appropriate to various criteria used. Therefore, this research is important to study because selection of the regions as the priority to regional

development plan can be conducted using MADM concept. This concept offers selection methods which appropriate to the problem related to determination of regional priority which is going to build based on the ranking. There are many methods of MDAM which can be used, two of them are Weighted Product (WP) and Technique of Order Preference by Similarity to Ideal Solution (TOPSIS).

Some researches show that both of the methods can be used for ranking tecknique in selecting an option of some available alternatives. WP method is more used such as for the need of employee candidat selection at a business (Lestari, 2013), the Equilibrium bargaining strategy at auction business (Wang et al, 2010), for the field of health, the WP is used as the breast cancer detector medium (Azar, 2000) also used for the need of priority determination of superior product of a territory (Alfita, 2011). While TOPSIS, more used for the analysis medium in solving problem of alternative selection with many criteria, some of them are for solving problem related to group's belief in decision making done by many decision makers (Jiang et al, 2010), the decision supporting system for laptop selection according to the need and budgeting (Kurniasih, 2013), the supporting anaylis of goup decision in knowledge management concept (Chu et al, 2007), the development of information system with decision supporting features (Imbar and Hartanto, 2011) and the credible nircable network selection (Savitha and Chandrasekar, 2011).

Remembering the capability of both methods which able to conduct an alternative selection analysis by multi criteria, so this research discusses about regional determination analysis which will be prioritized for the development plan in the future. Data of GRDP indicator which consist of nine components, are become the determiner attribute to determine some of amount regencies which will be prioritized for the development later. The data of GRDP of Papua Province with twenty nine regencies were used in this research. Both methods were used as the analysis medium to observe which regencies need priority on development activities later. The result of research is expected to give suggestion for the policy implementer to implement the development based on analysis result which conducted by the assistance of WP method and TOPSIS, although it is possible to conduct by other methods.

This research is devided into five parts. The first part is an introduction which consists of the background of problem, the second part consists of the theoretical base which is used related to the research topic. The third part explains the research steps, the fourth part discusses the analysis result using method of WP and TOPSIS. The research is then finished by the fifth part that is the conclusion.

2. MULTI ATTRIBUTE DECISION MAKING (MADM)

MADM is an analysis method which reduces the use of mathematic and used for the selection of an alternative with some criteria. MADM is also used to solve problem in discrete space with alternative selection number is limited (Ermatita et al, 2010). In this research it was used two methods of MADM, those are Weighted Product (WP) and Technique of Order Preference by Similarity to Ideal Solution (TOPSIS). The explanation of both methods is as follows.

2.1 Weighted Product (WP) method

Method of WP is a solving method which is offered to solve the problem of Multi Attribute Decision Making (MADM) and is similar to method of Meighted Sum (WS), but WP method contains multiplication in the mathematical calculation. This method is also called as an analysis and does not conduct the data normalization process. Below is the steps to analyze WP method (Alfita, 2011):

- Determining the priority level of the weight of each criteria (W_{Init_j}) then it is done the improvement of the weight (W_j) using equation as follows :

$$W_j = \frac{W_{Init_j}}{\sum_{j=1}^n W_{Init_j}}$$

- Making table of weight of criteria that will be selected.
- Calculating the vector of S_i , where each data (X_{ij}) will be multiplied but before that it is done the degreeing with the weight of its criteria, with the equation as follows:

$$S_i = \sum_{j=1}^n X_{ij}^{kW_j}$$

Where $j = 1, 2, 3 \dots m$, $k=1$ for profit attribute and $k = -1$ for cost attribute.

- Calculating vector of V_i and then choosing the highest value as the best alternative in decision making, with equation as follows: $V_i = \frac{S_i}{\sum_{j=1}^n S_j}$

Where $j = 1, 2, 3 \dots m$.

2.2 Technique of Order Preference by Similarity to Ideal Solution (TOPSIS) method

This method selects an alternative based on the gap of the nearest or farthest ideal solutions from the value of the negative ideal solution alternative. Many reasons of the use of TOPSIS as the decision supporting analysis medium are because the concept is simple and easily understood, the computation is efficient and has capability to measure relatively form the decision alternatives in simple mathematical form. Below is the steps for TOPSIS analysis (Behzadian et al, 2012) :

- Making decision matrix which is normalized (r_{ij}). This step is started by forming the first decision matrix, then the normalization is conducted with the equation as follows :

$$r_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^n X_{ij}^2}}$$

For $i = 1, 2, 3 \dots m$ and $j = 1, 2, 3 \dots n$

- Making decision matrix which is in weight normalized of (V_{ij}), with the equation :

$$V_{ij} = W_j * r_{ij}$$

- Determining positive ideal solution value (A^*) and negative ideal solution (A^-) with stipulation as follows :

- Positive ideal solution value (A^*)

$$A^* = \{V_1^*, V_2^*, \dots, V_n^*\} \text{ where}$$

$$V_i^* \begin{cases} \text{Max } V_{ij} \text{ if } j \text{ is attribute profits} \\ \text{Max } V_{ij} \text{ if } j \text{ is cost attribute} \end{cases}$$

- Negative ideal solution value (A^-)

$$A^- = \{V_1^*, V_2^*, \dots, V_n^*\} \text{ where}$$

$$V_i' \begin{cases} \text{Max } V_{ij} \text{ if } j \text{ is attribute profits} \\ \text{Max } V_{ij} \text{ if } j \text{ is cost attribute} \end{cases}$$

- Determining the gap between each alternative value with the positive ideal solution matrix and negative ideal solution matrix, with equation :

- The gap between the alternative and positif ideal solution

$$S_i^* = \left[\sum_j (V_j^* - V_{ij})^2 \right]^{1/2}$$

- The gap between alternative and negative ideal solution

$$S_i' = \left[\sum_j (V_j' - V_{ij})^2 \right]^{1/2}$$

- Calculating the relative closeness value to ideal solution value C_i^* , with equation :

$$C_i^* = \frac{S_i'}{(S_i^* + S_i')}$$

2.3 Gross Regional Domestic Product (GRDP)

GRDP is the result of total value plus all units of business which are owned by certain region and calculated on the applied price also constant price (Indonesian Bank Real Sector Statistic Division, 2014). GRDP with the applied price is used to find out the economic resource ability, the economic displacement and structure of a region. While the

GRDP with the constant price is used to find out the economic growth in real over the years by no influence of the price factor. GRDI is classified based on nine supporting indicators, those are 1) agriculture, animal husbandry, forestry and fishery, 2) mining and excavation, 3) manufacturing industry, 4) electricity, gas and clean water, 5) building, 6) commerce, hotel and restaurant, 7) transportation and communication, 8) finance, real estate and business service, and 9) services (included government service). In this research, the resource of GRDP of Papua Province of the year 2012 which used is based on the constant price, as assumption that the analysis result is used to find out the rank of development based on real growth owned by a certain region.

3. RESEARCH METHODOLOGY

This part discusses about the steps of the research conducted. This had been begun by data collecting of GRDP indicator of

every regency/city in Papua Province from the official site of National Central Bureau of Statistics, either province or regency. The nine indicators which become the data in this research are, agriculture (V1), mining and excavation (V2), manufacturing industry (V3), electricity and clean water (V4), building (V5), commerce, hotel and restaurant (V6), transportation and communication (V7), finance, real estate and business service (V8), and services (V9). Twenty nine regencies/cities were analyzed in this research using method of Weighted Product (WP) and Technique of Order Preference by Similarity to Ideal Solution (TOPSIS). In this research, it used the data of GRDP of regencies of the year 2012. The analysis result of both methods were compared to know which regency that must be prioritized for development plan in the future.

Table 1. The Beginning Decision Matrix

	V1	V2	V3	V4	V5	V6	V7	V8	V9
K01	730.285,85	30.192,02	54.377,31	7.878,56	150.869,31	187.006,01	199.508,22	72.551,55	292.499,75
K02	202.753,31	5.665,84	2.097,24	1.893,73	71.294,72	86.831,08	85.834,55	25.032,14	124.544,40
K03	324.380,32	29.081,17	74.920,73	1.790,52	129.907,12	130.544,34	186.147,31	47.387,62	167.163,68
K04	307.850,76	138.896,28	7.933,00	4.114,96	150.807,94	156.437,10	72.964,27	40.386,93	123.144,36
K05	74.461,54	4.562,27	5.858,32	2.575,36	58.884,81	61.100,11	34.795,96	35.699,03	123.991,33
K06	184.412,90	15.021,44	69.344,06	13.506,06	116.586,38	182.847,72	198.854,04	72.355,96	136.653,85
K07	97.845,30	4.592,92	497,79	69,83	36.917,65	16.188,48	7.131,27	3.222,56	38.503,05
K08	102.720,22	4.518,51	1.904,31	154,28	43.793,39	22.706,56	6.375,26	1.767,31	49.599,46
K09	163.839,62	5.555.631,81	8.594,88	9.292,32	302.233,14	412.581,98	401.527,34	104.176,53	99.054,14
K10	106.710,21	4.059,88	225.657,35	40,56	120.718,19	29.377,14	13.166,09	10.418,63	42.634,50
K11	124.690,08	1.755,53	1.445,01	10,46	86.664,26	24.858,19	12.843,59	5.147,84	102.469,19
K12	101.877,80	249,59	3.324,08	18,65	39.769,29	18.202,62	9.591,11	4.985,62	118.219,20
K13	111.774,91	730,16	1.229,07	-	19.167,34	8.659,11	10.738,40	2.797,34	54.381,95
K14	138.756,47	2.343,32	176,03	-	64.783,84	21.576,09	16.566,49	5.444,16	52.984,28
K15	123.123,36	1.093,57	862,54	42,27	33.441,60	11.502,11	10.630,30	1.430,17	44.120,85
K16	122.771,65	5.201,19	7.824,00	574,02	45.726,90	22.895,14	34.139,38	9.548,40	38.404,20
K17	113.062,53	6.488,85	37.387,45	489,52	118.837,27	44.769,37	13.876,41	10.981,12	73.201,17
K18	49.677,63	2.216,28	889,12	328,81	36.220,31	12.059,69	6.781,01	6.254,25	62.412,78
K19	60.681,80	1.989,77	3.410,04	38,13	15.572,61	26.897,16	11.015,36	5.196,29	13.651,88
K20	43.863,99	1.794,68	446,58	-	23.825,42	20.957,32	5.992,96	5.092,79	74.262,11
K21	44.499,44	967,19	-	-	17.000,22	1.537,47	3.183,81	1.707,88	36.224,44
K22	45.194,65	363,09	-	-	15.715,42	615,65	791,36	1.151,73	34.602,26
K23	1241.68,26	2.017,46	-	-	58.168,66	1.206,67	1.796,30	1.337,14	58.385,78
K24	40.685,67	357,46	-	-	22.322,41	585,18	1.022,86	621,85	44.855,11
K25	101.570,11	110,56	-	63,96	41.571,16	17.456,65	3.215,31	1.148,16	76.422,19
K26	180.854,63	5.063,36	151,70	-	16.638,85	42.155,47	1.487,21	4.704,99	40.024,17
K27	78.893,58	1.972,21	215,20	-	19.602,91	6.811,13	1.044,61	297,85	31.644,53
K28	50.353,46	601,49	373,34	-	12.874,56	5.498,22	1.292,11	440,88	45.106,25

K29	249.829,87	21.104,12	134.988,98	23.101,14	980.092,85	612.385,39	813.903,40	458.220,43	887.309,83
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4. RESULT AND DISCUSSION

Result of data collecting of GRDP of regencies is as the data of beginning decision matrix that contain preference values of result of double comparison between twenty nine alternatives and nine attributes. Table 1 above shows the data of beginning decision matrix which would be used to analyze development priority level using method of WP and TOPSIS.

Where K01–K029 shows the name of regencies serially as follows, Merauke, Jayawijaya, Jayapura, Nabire, Kepulauan Yapen, Biak Numfor, Paniai, Puncak Jaya, Mimika, Boven Digoel, Mappi, Asmat, Yahukimo, Pegunungan Bintang, Tolikara, Sarmi, Keerom, Waropen, Supiori, Mamberamo Raya, Mamberamo Tengah, Yalimo, Lanny Jaya, Nduga, Puncak, Dogiyai, Deiyai, Intan Jaya Regency and Jayapura City.

Table 2. Attribute Weight

Attribute	Weight
V1	0,191
V2	0,266
V3	0,029
V4	0,003
V5	0,130
V6	0,099
V7	0,099
V8	0,043
V9	0,140

Before being analyzed using both methods, firstly it had been held weight determination for each attribute. The determination of weight value was carried out by deviding total values of each attribute with total number of the attributes, so it was obtained the weight value for each attribute as follows (look at table 2).

It is necessary to note that the ranking which conducted on the last step of method analysis, was conducted by putting the data in order from the smallest value to the highest one. The analysis result towards steps of each method shows that the preference value on double comparison matrix did not influence to the final result of ranking for TOPSIS method although there was value of beginning decision matrix that had no value. This was caused by on the calculation step of either positif or negative ideal solution was done by calculating quadrate root to difference adding from either negative or positive ideal solution values with in weight normalized matrix which was being in quadrate, for each alternative towards the attributes. Therefore, each alternative had its own ideal solution value. Different from WP method, the calculation of each step on WP was extremely influenced by the completeness of value on beginning decision matrix. So the last value of vector of each alternative would depend on values calculated on the previous step. Below is the description of analysis result of both methods.

The first analysis had been conducted using WP method and showed that eleven regencies/cities which must obtain special attention in development plan in the future. The eleven regencies are Yahukimo, Pegunungan Bintang, Mamberamo Raya, Mamberamo Tengah, Yalimo, Lanny Jaya, Nduga,

Puncak, Dogiyai, Deiyai and Intan Jaya. Table 3 below shows the ranking result towards value of vector V_i to select the lowest value as the best alternative to determination development priority level. Figure 1 below shows the ranking result of WP method in the pie chart.

Table 3. Ranking result of WP method

No	Regency	V_i	Rank
1	K01	0,098	26
2	K02	0,034	22
3	K03	0,072	25
4	K04	0,110	27
5	K05	0,029	20
6	K06	0,054	24
7	K07	0,020	16
8	K08	0,023	19
9	K09	0,269	29
10	K10	0,030	21
11	K11	0,022	17
12	K12	0,012	12
13	K13	0	1
14	K14	0	1
15	K15	0,013	14
16	K16	0,023	18
17	K17	0,037	23
18	K18	0,016	15
19	K19	0,012	13
20	K20	0	1
21	K21	0	1
22	K22	0	1
23	K23	0	1
24	K24	0	1
25	K25	0	1
26	K26	0	1
27	K27	0	1
28	K28	0	1
29	K29	0,118	28

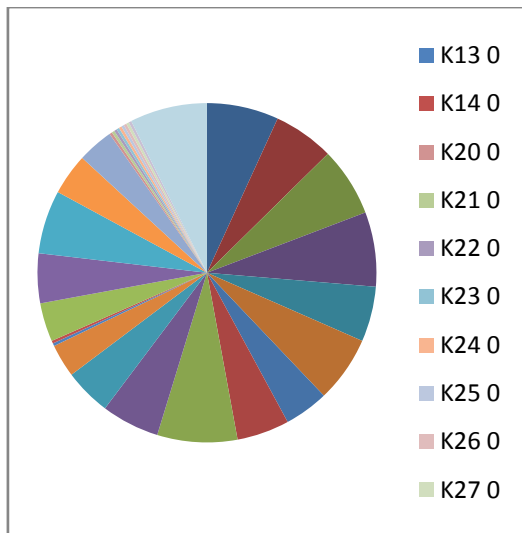


Figure 1. Rangking result of WP method in the pie chart

Table 4. Ranking result of TOPSIS method

No.	Regency	C Ideal Solution	Rank
1	K01	0,328	27
2	K02	0,198	20
3	K03	0,215	25
4	K04	0,230	26
5	K05	0,193	11
6	K06	0,186	1
7	K07	0,193	12
8	K08	0,194	14
9	K09	0,606	29
10	K10	0,203	23
11	K11	0,199	22
12	K12	0,197	18
13	K13	0,194	13
14	K14	0,196	17
15	K15	0,194	15
16	K16	0,190	4
17	K17	0,199	21
18	K18	0,191	8
19	K19	0,189	2
20	K20	0,192	9
21	K21	0,190	3
22	K22	0,191	5
23	K23	0,197	19
24	K24	0,191	6
25	K25	0,196	16

26	K26	0,203	24
27	K27	0,192	10
28	K28	0,191	7
29	K29	0,395	28

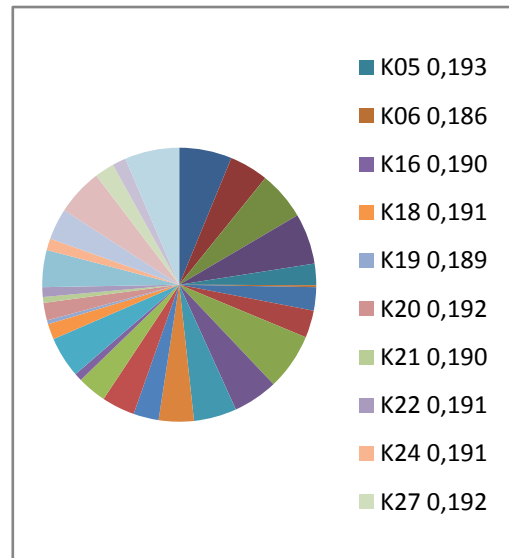


Figure 2. Ranking result of TOPSIS method In the pie chart

The second analysis was conducted by the medium of TOPSIS and showed the eleven regencies which need special priority to future development planning. The eleven regencies are Biak Numfor, Supiori, Mamberamo Tengah, Sarimi, Yalimo, Nduga, Intan Jaya, Waropen, Mamberamo Raya, Deiyai dan Kepulauan Yapen. Table 4 above is the ranking result based on ideal solution value on the last step of TOPSIS calculation. Figure 2 below shows the rangking result of Topsis method in the pie chart.

Based on the analysis comparison result of both methods, it can be seen that from the eleven regencies which need priority to development plan according to both methods, the six regencies that have the same result when both methods were compared. The six regencies are Mamberamo Tengah, Yalimo, Nduga, Intan Jaya, Mamberamo Raya dan Deiyai.

5. CONCLUSION

This research indicates some regencies which still need priority towards the development plan in the future. The analysis result from both methods shows from twenty nine regencies observed, there are six regencies needing special attention those are Mamberamo Tengah, Yalimo, Nduga, Intan Jaya, Mamberami Raya dan Deiyai. This research also shows that the last step of calculation of preferency value for WP method was extremely influenced by completeness of beginning decision matrix value. The result is expected can be decision supporting item in the field of development planning for policy implementer, so it is able to determine the regional priority for development activities in the future.

The coming research will be directed how to develop FMADM method combined with various methods of using other indicators.

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