

Multi Attribute Decision Making Using Simple Additive Weighting and Weighted Product in Investment

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Abstract

Investment always have two sides, namely return and risks, the higher return offered the higher risk to be borne by investors. Return on investment that is stock dividends and capital gains less predictable, in which investors had to do an analysis or judgment shares in order to gain an advantage. Decision objective need a system that could help in the decision. The selection of share is expected to help investors in determining based on sector investment that will rank. It started by cleaning the analysis on key aspects of stock, the assessment criteria that you later then used as the criteria in the rank process and weighting on the respective the assessment criteria. Multi attribute decision making (MADM) is a method of the decision to establish an alternative best of a number of alternatives based on a number of certain criteria. One method the MADM used in research is SAW (simple additive weighting model) and WPM (weighted product) model. The result from the this study by using the Simple Additive Weight (SAW) and Weighted Product (WP) showed that high value is 0,79965 and 0,18434.

Keywords: Alternative, Attribute, Simple Additive Weighting, Weighted Product, Investment

Introduction:

Investment have the role of important in economic development Indonesia. Investment, in particular on the share (of securities) , investors should rational in the face of trade in capital market. Capital market is a place for the company to raised funds that serves to finance directly activities company by conducting a supply of stocks to the community on a stock exchange who is frequently in call go public (Najmiah, Sujana, & Sinardi, 2014).

Investment in the form a share of stock will offer a big profit namely dividends and capital gains but also high risk. Risk in investment shares can be category into two risk that is: systematic risk and unsystematic risk. Systematic risk is part of the risk in securities not can be removed by diversifying or form portfolio,

another term from risk this is common market risk. While unsystematic risk is the risks associated with the state of the company is as a scope investment have characteristic own, different with a company other (Najmiah, Sujana, & Sinardi, 2014). Investors in doing an investment decision in the capital market need information about assessment stock, because can help investors to know stock which growing and cheap (Marlina, 2013).

In making a decision it is not easy are the factor that needs to considered in decision making. One to whose decision a quite difficult taken is a matter of stock investments in the Jakarta Stock Exchange, because the management of stock investments of a corporation very influence many aspects the best the success of shares of the company (Dewanto & Adhikara, 2015). The based data published by the Indonesian stock exchange, Up to the end of April 2016, the company recorded as issuers at the Indonesia Stock Exchange (IDX) were 525 company, which are divided into 9 sector. In making investment, the reasonable value the equity to be bought and sold very is important to see by investors, for this will facilitate investors in estimating the possibility of profit and loss will happen in the future. The purpose of assessment stock is to see if the market price a stock are considered to be too high (overvalued) or too low (undervalued). When price stock undervalued, so stock proper for at buy. Conversely, if stock indicate the value too high (overvalued) mean that stock proper for sale. For valuated stock, there are some methods which facilitate investors for knowvaluate stock and determine selection investment. Investors tend to applies the methods of an easy, simple, and give accurate results in judgment. There are several the methods that can used to assess the relative stock, that is a method of approach price earning ratio (PER), price book value (PBV), book value (BV), current ratio, annual earnings, dividend growth, debt to equity ratio.

PER is the approach the most used by the financier and analysis securities (Aji & Pangestuti, 2012). This approach based results in estimates profit per share to come, so that it can be known how long investment shares will be back. PER will ease and help investors in the sight of stock. Compared to a method of cash flow, this method having an excess among other is ease and practicality and the standard that is easy to financier to do comparison assessment of the company which other. The lower price earning ratio a stock then the better or cheap the price to invested.

Book value (BV) is the value of the price of cents a share of a shares published (Tryfino, 2009). Book value cents a share published representing the amount of assets enterprises to as benchmark in determining reasonable or failure stock prices dipasar capital. So stock good book valuated have to positive.

Price to book value (PBV) used to measure the performance of the market price stock toward the value of his book. This completes the ratio analysis book value, if in the analysis book value, investors are only aware of capacity per share of the value of shares, on ratios PBV investors can immediately discover how many times already market value a stock valued than book value. Price to book value also shows how far company able create value of enterprise relative to the amount of capital invest. The higher value of enterprise the bigger of prosperity that will accept by the owners of the company. Increasingly price high to book value (PBV), the better the market looked at companies and prospects. This means getting managed to create the company value to shareholders (Marlina, 2013). PBV used to compare whether a more stock expensive or is cheaper than other shares.

Current ratio is the ratio liquidity commonly used for to interpret the financial position short-term. The ratio this measure how far assets smoothly company can be used to meet obligations the smooth. An

enterprise has been able to meet all their obligations be financial immediate must be fulfilled, so the company it can be said liquid (Aji & Pangestuti, 2012).

Earning per share (EPS) is the result of net income at get company divided by the number of shares outstanding. The higher earning per share show the higher profit get the company. As investors evaluate performances from company, investors it is not enough to know whether income an enterprise experience increase or decrease in, investors also needs to looking at how the income came to investment. A company that established generally has the ratio earning per share high, while the company young have a tendency earning per share (EPS) low (Marlina, 2013).

Dividend per share (DPS) is the total amount of dividends and it will be distributed on investors for each shares. DPS high reflect the company has a fine prospect because it could pay DPS in the number of high. This will attract investor to buy shares the company (Hutami, 2012).

Debt to equity ratio is the ratio that measures the use of debt (laverage) to the total shareholders equity owned the company (Aji & Pangestuti, 2012). The ratio this measured by means of comparing between total debts of the company to the total shareholders equity. The debt means risk faced by company will increase, so that market confidence on the prospect of growth of the company grew steadily smaller and create the share price lower and resulting in per share getting smaller.

Price earning ratio (PER), price book value (PBV), book value (BV), current ratio, annual eps, dividend growth, debt to equity ratio is much of a choice invest. Many options with different attribute (multi-attribute) in order to become difficult in invest to companies that meet the criteria just like everyone the agricultural sector, mining, various industry, basic industry chemical, goods industry consumption, infrastructure and financial. Multi attribute decision making, for model that is SAW (Simple Additive Weighting) and WPM (Weighted Product Mtehod). SAW method (Wulandari & Nugroho, 2015) chosen because compared with a model decision making another located on his ability to make an assessment in a more right because it is based on value criteria and weights prefensi that had been determined, and continued with the process range who will select alternative best of a number of the alternatives. In addition, in the methods of saw there are calculation normalization matrix appropriate with value attribute benefit and cost. In decision making, Investors selection investment for buy or sale.

MADM methods have been proposed is Weighted Product (WP). This method (Kristiawan, Siswanti, & YS) commonly use because in method input riil data can direct be included in the calculation decision making system without presence coversion, because investment quantitative processable data.

Theoretical basis of research:

Multi attribute decision making

The step MADM approach (Sismoro & Hartatik, 2013) is: first, aggregate to decisions in each alternative. The second, ranking alternative decision based result of aggregation.

$$A = \{a_i \mid i = 1, 2, 3, \dots, n\} \quad (1)$$

$$C = \{c_j \mid j = 1, 2, 3, \dots, m\} \quad (2)$$

$$W = (w_1, w_2, w_3, \dots, w_n) \quad (3)$$

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (4)$$

where $A_1, A_2, \dots, A_m$ are feasible alternatives, $C_1, C_2, \dots, C_n$ are attributes (criteria), x_{ij} is the performance rating of i -th alternative with respect to j -th attribute, and w_j is a weight (significance) of j -th attribute. In a typical MADM evaluation, attributes can be classification into two main categories: cost attributes and benefit attributes. In the case of benefit attributes, the higher score is assigned to the alternative which performance rating is higher, i.e., preferable is a maximum of j -th attribute. In contrast to the previous, in the case of cost attributes, higher score is assigned to the alternative which performance rating is lower, i.e., the minimum of j -th attribute is preferable.

Simple additive weighting (SAW)

SAW method (Jaberidost, Olfat, & dkk, 2015) often also known term a method a weighted sum. The fundamental concept of a method of saw is looking for a weighted sum of performance rating of each alternative on all attribute. Methods of saw need the normalization process matrix decree (x) to a scale are comparable with all rating the alternatives. A formula to normalized follows:

$$r_{ij} = \begin{cases} \frac{x_{ij}}{\max_i x_{ij}} & \text{j is beneficial attribute(criteria of benefit)} \\ \frac{\min_i x_{ij}}{x_{ij}} & \text{j is non beneficial attribute(criteria of cost)} \end{cases} \quad (5)$$

r_{ij} is rating performance normalization of alternatives A_i in attribute C_j ; $i = 1, 2, \dots, m$ and $j = 1, 2, \dots, n$. Preference value for each alternative (V_i) given as :

$$V_i = \sum_{j=1}^n w_j r_{ij} \quad (6)$$

Value V_i greater indicates that alternative A_i more elected.

Weighted product (WP)

WP method (Effendy, 2012), using multiply to connect rating attribute, where rating any attribute must be done quadrate with weight attribute concerned. These process the same as the normalization process.

Preference to alternative A_i given as follows:

$$S_i = \prod_{j=1}^n x_{ij}^{w_j} \quad (7)$$

$i=1,2,\dots,m$; where $w_j = 1/W_j$ is rank are positive to beneficial attribute, and negative for non beneficial.

Research Background

In the paper (Sismoro & Hartatik, 2013), Of this study is comparing measure accuracy level relative to the result of reckoning preference relative of each alternative (V_i) each of the method in the case of small and medium macro entrepreneurs the selection of a proposal UMKM in DISPERINDAG of Cirebon city. Than 30 rank alternative, there are only 3 an alternative that occupying a position the same order. Determine the level of the size of the accuracy of relative of 2 this method used method of standard deviations relatively. Of the result of reckoning, been gained value relative standard deviations to the method SAW is 6,12 % while the value of standard deviations relatively to the method WPM is 13,08 %.

In the paper (Effendy, 2012), Fuzzy MADM (Multiple Attribute Decision Making) this chosen because this model determine the value of weights to any attribute, and continued with the process rank who will select alternative best of a number of alternatives, in this case alternative referred to are entitled to receive scholarship based on set criteria. Based on the calculation on percentage the level of (T_{ki}) for the support system decision scholarship with a model FMADM obtained a method of weighted product as a method of settled with value the greatest number. The result of calculation system is rank the highest score to low and the highest score is the result of required for consideration to obtain scholarship.

In the paper (Adriyendi, 2015), Food alternative is rice, corn, cassava, potato, sago, sorghum, wheat, and analog rice. The method used is Simple Additive Weighting (SAW) and Weighted Product (WP). Alternative on MADM as data training, alternative on SAW method and alternative on WP method as data testing. Experimental result on SAW method and WP method, best alternative (highest value) is wheat with value 0.8833 and 0.1563.

In the paper (Prihasto, Irawan, & Masduqi, 2014), the pollution of the Surabaya River has increased along with the rapid development of the industry in Surabaya. This causes the water quality decreases Surabaya. Surabaya is expected to meet the quality standards of water quality class II. Then the results are followed by Fuzzy Multi-Attribute Decision Making (MADM) to get the most polluted sites in times of Surabaya by using the Simple Additive Weighting Method (SAW) showed that location is the 5th most polluted location to produce value for 32.2917, Weighted Product (WP) 0.139 and TOPSIS showed 0.2753.

In the paper (Wulandari & Nugroho, 2015), Election superior products is expected to help district governments Klaten in determining superior products based on the number of business unit for each type of the industry, the amount of labor, investment value and value of production will a rank. Next, each criterion to be made as a factor to determine best product. Result of its research is known that an alternative that high value is the best alternative.

Research methodology

Research Conceptual Model

In this paper, frame work can be depicted as shown in Figure 1.

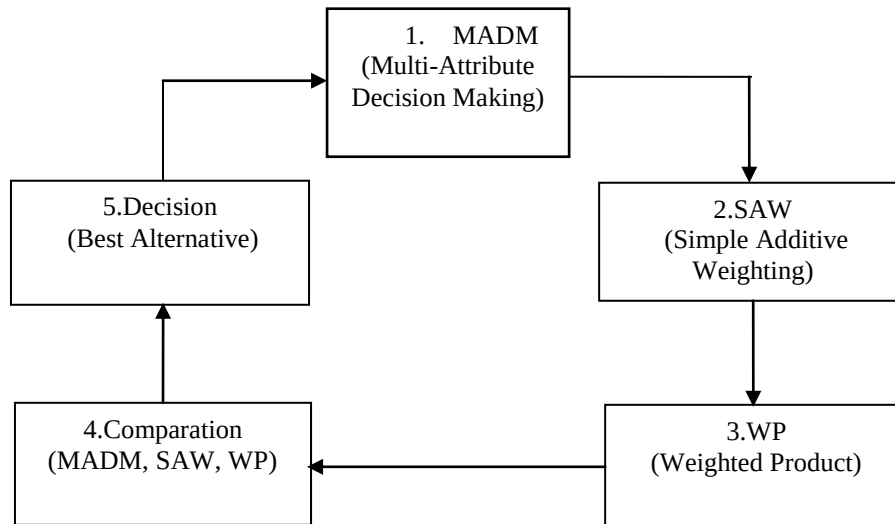


Figure 1: Framework

Figure 1 shows framework in decision model. Framework is 5 step. Step 1, MADM as decision model. Step 2, SAW as method in MADM. Step 3, WP as method in MADM. Step 4, comparison SAW and WP. Step 5, decision in MADM, result of SAW method and WP method is best alternative on decision model.

Research Findings

Step 1: MADM

In MADM, several alternatives had been identified. Election alternative intended for the purpose of diversified share stock. Several criteria used for consideration to make decisions. Criteria and alternative displayed in table 1.

Table 1: Criteria and alternative Decision

Criteria	Symbol	Attribute	Alternative	Symbol
PER < 1.5 x	C1	Cost	Agriculture	A1
PBV < 1.5 x	C2	Cost	Mining	A2
BV positive	C3	Benefit	Miscellaneous Industry	A3
CR > 2	C4	Benefit	Basic Industry and Chemical	A4
Annual EPS growth	C5	Benefit	Consumer Goods Industry	A5
Dividend growth	C6	Benefit	Infrastructure, Utilities and Transportation	A6
DER < 2	C7	Cost	Finance	A7

Table 1 shows 7 criteria and 7 alternatives in MADM. Attribute can be classified into two main categories: benefit (4 attribute) and cost (3 attribute).

The following table containing price to earnings ratio (PER), price to book value (PBV), Book Value (BV), Annual EPS and debt to equity ratio (DER) from each sectors and industries in Indonesia stock exchange (BEI) based on the annual financial report 2015:

Table 2: sector and criteria stock.

Sector	Ann EPS	BV	PER	PBV	DER
Agriculture	36	950	36.62	3.46	1.40
Mining	178	916	-10.09	2.65	0.14
Miscellaneous Industry	154	1.138	19.79	1.08	1.31
Basic Industry and Chemical	40	1.544	11.45	1.55	2.50
Consumer Goods Industry	7.080	16.105	15.01	3.04	-1.41
Infrastructure, Utilities and Transportation	64	1.074	14.68	2.11	0.97
Finance	116	996	14.11	1.42	4.32

Step 2: SAW

Attribute stock, value of attribute, and criteria attribute can be seen on Table 3.

Table 3: Attribute Value Criteria

Attribute	Value	Criteria
C1	1 = large	Cost
	2 = medium	
	3 = small	
C2	1 = large	Cost
	2 = medium	
	3 = small	
C3	1 = negative	Benefit
	2 = normal	
	3 = positive	
C4	1 = small	Benefit
	2 = medium	
	3 = large	
C5	1 = low	Benefit
	2 = sufficient	
	3 = high	
C6	1 = low	Benefit
	2 = sufficient	
	3 = high	
C7	1 = large	Cost
	2 = medium	
	3 = small	

Table 3 shows share attribute with feasible alternatives based investment, best value of attribute, and attribute category (criteria of benefit and criteria of cost). Stock attribute, value of attribute, attribute category to determine score of weight.

Table 4: Weight of Criteria on MADM

Criteria	Weight	Conversion
C1	15,00	0.15
C2	15,00	0.15
C3	12,50	0.125
C4	20,00	0.20
C5	12,50	0.125
C6	15,00	0.15
C7	10,00	0.10
Total	100%	100%

Table 4 shows weight of criteria and conversion in calculating decision matrix, normalized matrix, and score of each alternative.

The score for each alternative given to any criteria, displayed in table 5.

Table 5: Alternative and value criteria

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	1	1	3	2	1	3	2
A2	3	2	3	1	2	2	2
A3	3	3	2	2	2	2	2
A4	2	3	2	3	1	2	3
A5	3	1	2	1	3	2	1
A6	3	2	2	1	1	3	2
A7	3	3	3	2	3	3	1

Normalized of the value of alternative and criteria in table 5, displayed in table 6

Table 6: normalized value

r₁₁=1	r ₁₂ =1	r ₁₃ =3	r ₁₄ =2	r ₁₅ =1	r ₁₆ =3	r ₁₇ =2
r₂₁=3	r ₂₂ =2	r ₂₃ =3	r ₂₄ =1	r ₂₅ =2	r ₂₆ =2	r ₂₇ =2
r₃₁=3	r ₃₂ =3	r ₃₃ =2	r ₃₄ =2	r ₃₅ =2	r ₃₆ =2	r ₃₇ =2
r₄₁=2	r ₄₂ =3	r ₄₃ =2	r ₄₄ =3	r ₄₅ =1	r ₄₆ =2	r ₄₇ =3
r₅₁=3	r ₅₂ =1	r ₅₃ =2	r ₅₄ =1	r ₅₅ =3	r ₅₆ =2	r ₅₇ =1
r₆₁=3	r ₆₂ =2	r ₆₃ =2	r ₆₄ =1	r ₆₅ =1	r ₆₆ =3	r ₆₇ =2
r₇₁=3	r ₇₂ =3	r ₇₃ =3	r ₇₄ =2	r ₇₅ =3	r ₇₆ =3	r ₇₇ =1

In normalized, r₁₁ means that the value attribute criteria to the first line and first column .With r (row) 1 = the first line and 1 = first column, r₁₂ means that the value attribute criteria to the first line and second column, and so on.

Table 7: Normalized A1

$r_{11} = \frac{\min \{1;3;3;2;3;3;3\}}{1} = \frac{1}{1} = 1$	$r_{15} = \frac{1}{\max \{1;2;2;1;3;1;2\}} = \frac{1}{3} = 0,33$
$r_{12} = \frac{\min \{1;2;3;3;1;2;3\}}{1} = \frac{1}{1} = 1$	$r_{16} = \frac{3}{\max \{3;2;2;2;2;3;3\}} = \frac{3}{3} = 1$
$r_{13} = \frac{3}{\max \{3;3;2;2;2;2;3\}} = \frac{3}{3} = 1$	$r_{17} = \frac{\min \{2;2;2;3;1;2;1\}}{2} = \frac{1}{2} = 0,5$
$r_{14} = \frac{2}{\max \{2;1;2;3;1;1;3\}} = \frac{2}{3} = 0,667$	

Table 8: Normalized A2

$r_{21} = \frac{\min \{1;3;3;2;3;3;3\}}{3} = \frac{1}{3} = 0,33$	$r_{25} = \frac{2}{\max \{1;2;2;1;3;1;2\}} = \frac{2}{3} = 0,667$
$r_{22} = \frac{\min \{1;2;3;3;1;2;3\}}{2} = \frac{1}{2} = 0,5$	$r_{26} = \frac{2}{\max \{3;2;2;2;2;3;3\}} = \frac{2}{3} = 0,667$
$r_{23} = \frac{3}{\max \{3;3;2;2;2;2;3\}} = \frac{3}{3} = 1$	$r_{27} = \frac{\min \{2;2;2;3;1;2;1\}}{2} = \frac{1}{2} = 0,5$
$r_{24} = \frac{1}{\max \{2;1;2;3;1;1;3\}} = \frac{1}{3} = 0,33$	

Table 9: Normalized A3

$r_{31} = \frac{\min \{1;3;3;2;3;3;3\}}{3} = \frac{1}{3} = 0,33$	$r_{35} = \frac{2}{\max \{1;2;2;1;3;1;3\}} = \frac{2}{3} = 0,667$
$r_{32} = \frac{\min \{1;2;3;3;1;2;3\}}{3} = \frac{1}{3} = 0,33$	$r_{36} = \frac{2}{\max \{3;2;2;2;2;3;3\}} = \frac{2}{3} = 0,667$
$r_{33} = \frac{2}{\max \{3;3;2;2;2;2;3\}} = \frac{2}{3} = 0,667$	$r_{37} = \frac{\min \{2;2;2;3;1;2;1\}}{2} = \frac{1}{2} = 0,5$
$r_{34} = \frac{2}{\max \{2;1;2;3;1;1;2\}} = \frac{2}{3} = 0,667$	

Table 10: Normalized A4

$r_{41} = \frac{\min \{1;3;3;2;3;3;3\}}{2} = \frac{1}{2} = 0,5$	$r_{45} = \frac{1}{\max \{1;2;2;1;3;1;3\}} = \frac{1}{3} = 0,33$
$r_{42} = \frac{\min \{1;2;3;3;1;2;3\}}{3} = \frac{1}{3} = 0,33$	$r_{46} = \frac{2}{\max \{3;2;2;2;2;3;3\}} = \frac{2}{3} = 0,667$
$r_{43} = \frac{2}{\max \{3;3;2;2;2;2;3\}} = \frac{2}{3} = 0,667$	$r_{47} = \frac{\min \{2;2;2;3;1;2;1\}}{3} = \frac{1}{3} = 0,33$
$r_{44} = \frac{3}{\max \{2;1;2;3;1;1;2\}} = \frac{3}{3} = 1$	

Table 11: Normalized A5

$r_{51} = \frac{\min\{1;3;3;2;3;3;3\}}{3} = \frac{1}{3} = 0.33$	$r_{55} = \frac{3}{\max\{1;2;2;1;3;1;3\}} = \frac{3}{3} = 1$
$r_{52} = \frac{\min\{1;2;3;3;1;2;3\}}{1} = \frac{1}{1} = 1$	$r_{56} = \frac{2}{\max\{3;2;2;2;2;3;3\}} = \frac{2}{3} = 0,667$
$r_{53} = \frac{2}{\max\{3;3;2;2;2;2;3\}} = \frac{2}{3} = 0,667$	$r_{57} = \frac{\min\{2;2;2;3;1;2;1\}}{1} = \frac{1}{1} = 1$
$r_{54} = \frac{1}{\max\{2;1;2;3;1;1;2\}} = \frac{1}{3} = 0.33$	

Table 12: Normalized A6

$r_{61} = \frac{\min\{1;3;3;2;3;3;3\}}{3} = \frac{1}{3} = 0.33$	$r_{65} = \frac{1}{\max\{1;2;2;1;3;1;3\}} = \frac{1}{3} = 0.33$
$r_{62} = \frac{\min\{1;2;3;3;1;2;3\}}{2} = \frac{1}{2} = 0.5$	$r_{66} = \frac{3}{\max\{3;2;2;2;2;3;3\}} = \frac{3}{3} = 1$
$r_{63} = \frac{2}{\max\{3;3;2;2;2;2;3\}} = \frac{2}{3} = 0,667$	$r_{67} = \frac{\min\{2;2;2;3;1;2;1\}}{2} = \frac{1}{2} = 0.5$
$r_{64} = \frac{1}{\max\{2;1;2;3;1;1;2\}} = \frac{1}{3} = 0.33$	

Table 13: Normalized A7

$r_{71} = \frac{\min\{1;3;3;2;3;3;3\}}{3} = \frac{1}{3} = 0.33$	$r_{75} = \frac{3}{\max\{1;2;2;1;3;1;3\}} = \frac{3}{3} = 1$
$r_{72} = \frac{\min\{1;2;3;3;1;2;3\}}{3} = \frac{1}{3} = 0.33$	$r_{76} = \frac{3}{\max\{3;2;2;2;2;3;3\}} = \frac{3}{3} = 1$
$r_{73} = \frac{3}{\max\{3;3;2;2;2;2;3\}} = \frac{3}{3} = 1$	$r_{77} = \frac{\min\{2;2;2;3;1;2;1\}}{1} = \frac{1}{1} = 1$
$r_{74} = \frac{2}{\max\{2;1;2;3;1;1;2\}} = \frac{2}{3} = 0.667$	

From the results of normalized, then got matrix normalized (r) in table 14.

Table 14: Matrix Normalized R

$r_{11}=1$	$r_{12}=1$	$r_{13}=1$	$r_{14}=0,667$	$r_{15}=0,33$	$r_{16}=1$	$r_{17}=0,5$
$r_{21}=0,33$	$r_{22}=0,5$	$r_{23}=1$	$r_{24}=0,33$	$r_{25}=0,667$	$r_{26}=0,667$	$r_{27}=0,5$
$r_{31}=0,33$	$r_{32}=0,33$	$r_{33}=0,667$	$r_{34}=0,667$	$r_{35}=0,667$	$r_{36}=0,667$	$r_{37}=0,5$
$r_{41}=0,5$	$r_{42}=0,33$	$r_{43}=0,667$	$r_{44}=1$	$r_{45}=0,33$	$r_{46}=0,667$	$r_{47}=0,33$
$r_{51}=0,33$	$r_{52}=1$	$r_{53}=0,667$	$r_{54}=0,33$	$r_{55}=1$	$r_{56}=0,667$	$r_{57}=1$
$r_{61}=0,33$	$r_{62}=0,5$	$r_{63}=0,667$	$r_{64}=0,33$	$r_{65}=0,33$	$r_{66}=1$	$r_{67}=0,5$
$r_{71}=0,33$	$r_{72}=0,33$	$r_{73}=1$	$r_{74}=0,667$	$r_{75}=1$	$r_{76}=1$	$r_{77}=1$

The results the rank processes by using of weights have been given by the decision makers and conversion of the weight in table 15.

Table 15: Vector V in SAW

No	Vector V
1	$V_1 = (0,15*1) + (0,15*1) + (0,125*1) + (0,20*0,667) + (0,125*0,33) + (0,15*1) + (0,10*0,5) = 0,79965$
2	$V_2 = (0,15*0,33) + (0,15*0,5) + (0,125*1) + (0,20*0,33) + (0,125*0,667) + (0,15*0,667) + (0,10*0,5) = 0,54893$
3	$V_3 = (0,15*0,33) + (0,15*0,33) + (0,125*0,667) + (0,20*0,667) + (0,125*0,667) + (0,15*0,667) + (0,10*0,5) = 0,54921$
4	$V_4 = (0,15*0,5) + (0,15*0,33) + (0,125*0,667) + (0,20*1) + (0,125*0,33) + (0,15*0,667) + (0,10*0,33) = 0,58218$
5	$V_5 = (0,15*0,33) + (0,15*1) + (0,125*0,667) + (0,20*0,33) + (0,125*1) + (0,15*0,667) + (0,10*1) = 0,67393$
6	$V_6 = (0,15*0,33) + (0,15*0,5) + (0,125*0,667) + (0,20*0,33) + (0,125*0,33) + (0,15*1) + (0,10*0,5) = 0,51513$
7	$V_7 = (0,15*0,33) + (0,15*0,33) + (0,125*1) + (0,20*0,667) + (0,125*1) + (0,15*1) + (0,10*1) = 0,7324$

Based on value r in matrix normalized R (every alternatives) table 15, multiplied by conversion weight on each criteria) in table 16

Table 16: Vector value on SAW

Vector	Value
V1	0,79965
V2	0,54893
V3	0,54921
V4	0,58218
V5	0,67393
V6	0,51513
V7	0,7324

Table 17: Best Alternative on SAW

No	Value	Alternative
1	0,79965	Agriculture
2	0,7324	Finance
3	0,67393	Consumer Goods Industry
4	0,58218	Basic Industry and Chemical
5	0,54921	Miscellaneous Industry
6	0,54893	Mining
7	0,51513	Infrastructure, Utilities and Transportation

Table 18: Comparison alternative MADM and SAW

Alternative MADM		Alternative SAW	
No	Alternative	No	Alternative
1	Agriculture	1	Agriculture
2	Mining	2	Finance
3	Miscellaneous Industry	3	Consumer Goods Industry
4	Basic Industry and Chemical	4	Basic Industry and Chemical
5	Consumer Goods Industry	5	Miscellaneous Industry
6	Infrastructure, Utilities and Transportation	6	Mining
7	Finance	7	Infrastructure, Utilities and Transportation

Table 18 shows highest value is alternative on V_1 , so alternative A_1 (agriculture) is chosen as the best alternative.

Step 3: WP

Table 19: Normalized Decision Matrix on WP

No	Vector S
1	$S_1 = (1^{-0,15})(1^{-0,15})(3^{0,125})(2^{0,20})(1^{0,125})(3^{0,15})(2^{-0,10}) = 1,44981$
2	$S_2 = (3^{-0,15})(2^{-0,15})(3^{0,125})(1^{0,20})(2^{0,125})(2^{0,15})(2^{-0,10}) = 0,98991$
3	$S_3 = (3^{-0,15})(3^{-0,15})(2^{0,125})(2^{0,20})(2^{0,125})(2^{0,15})(2^{-0,10}) = 1,01696$
4	$S_4 = (2^{-0,15})(3^{-0,15})(2^{0,125})(3^{0,20})(1^{0,125})(2^{0,15})(3^{-0,10}) = 1,03205$
5	$S_5 = (3^{-0,15})(1^{-0,15})(2^{0,125})(1^{0,20})(3^{0,125})(2^{0,15})(1^{-0,10}) = 1,17712$
6	$S_6 = (3^{-0,15})(2^{-0,15})(2^{0,125})(1^{0,20})(1^{0,125})(3^{0,15})(2^{-0,10}) = 0,91695$
7	$S_7 = (3^{-0,15})(3^{-0,15})(3^{0,125})(2^{0,20})(3^{0,125})(3^{0,15})(1^{-0,10}) = 1,28192$

Vector value S got of the value of alternative, raised to the power of with the conversion weight criteria, the results displayed in table 19 .Value every vector S compared to value of all vector (S) , the results displayed in table 20.

Table 20: Weight Normalized Decision Matrix on WP

No	Vector V
1	$V_1 = \frac{1,44981}{1,44981 + 0,98991 + 1,01696 + 1,03205 + 1,17712 + 0,91695 + 1,28192} = 0,18434$
2	$V_2 = \frac{0,98991}{1,44981 + 0,98991 + 1,01696 + 1,03205 + 1,17712 + 0,91695 + 1,28192} = 0,12587$
3	$V_3 = \frac{1,01696}{1,44981 + 0,98991 + 1,01696 + 1,03205 + 1,17712 + 0,91695 + 1,28192} = 0,12931$
4	$V_4 = \frac{1,03205}{1,44981 + 0,98991 + 1,01696 + 1,03205 + 1,17712 + 0,91695 + 1,28192} = 0,13123$
5	$V_5 = \frac{1,17712}{1,44981 + 0,98991 + 1,01696 + 1,03205 + 1,17712 + 0,91695 + 1,28192} = 0,114967$
6	$V_6 = \frac{0,91695}{1,44981 + 0,98991 + 1,01696 + 1,03205 + 1,17712 + 0,91695 + 1,28192} = 0,11659$
7	$V_7 = \frac{1,28192}{1,44981 + 0,98991 + 1,01696 + 1,03205 + 1,17712 + 0,91695 + 1,28192} = 0,163$

The results of value vector (V in WP) sorted of V1-V8, displayed in table 21

Table 21: Score of Each Alternative on WP

Vector	Value
V1	0,18434
V2	0,12587
V3	0,12931
V4	0,13123
V5	0,11496
V6	0,11659
V7	0,163

Table 21 shows score of each alternative on WP method for investment alternative in MADM.

Table 22: Best Alternative on WP

No	Value	Alternative
1	0,18434	Agriculture
2	0,163	Finance
3	0,13123	Basic Industry and Chemical
4	0,12931	Miscellaneous Industry
5	0,12587	Mining
6	0,11659	Infrastructure, Utilities and Transportation
7	0,11496	Consumer Goods Industry

The greatest value is V1 so alternative A1 is alternative chosen as alternative best. In other words, from agricultural sector as an alternative choice to invest.

Step 4: Comparison

Comparison between investment alternative on MADM, investment alternative on SAW, investment alternative on WP, displayed in Table 23.

Table 23: Comparison of Food Alternative

Alternative MADM	Alternative SAW	Alternative WP
Agriculture	Agriculture	Agriculture
Mining	Finance	Finance
Miscellaneous Industry	Consumer Goods Industry	Basic Industry and Chemical
Basic Industry and Chemical	Basic Industry and Chemical	Miscellaneous Industry
Consumer Goods Industry	Miscellaneous Industry	Mining
Infrastructure, Utilities and Transportation	Mining	Infrastructure, Utilities and Transportation
Finance	Infrastructure, Utilities and Transportation	Consumer Goods Industry

Step 5: Decision

Alternative on MADM as data training, alternative on SAW and alternative on WP as data testing. On SAW method, high value is 0.79965 On WP method, high value is 0.18434. High value is the best alternative in investment. Best alternative based on high value is agriculture. MADM using SAW and WP in investment, experimental result is agriculture as best alternative.

Conclusion:

From the calculation, SAW method and WP method resulting decision or recommendation based on criteria investment alternatives with the high value. High value is the best alternative. Best alternative in investment is agriculture in Indonesia. For the future work, how to decision making in MADM with multi-goal.

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