

Analysis of algoritma VIšekriterijumsko KOMPROMISNO Rangiranje (VIKOR) on the selection of the best Watermelon Fruit Types as Farmer Strategy Management

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Abstract

The aim of the research is to utilize the decision support system techniques in making decisions on the selection of the best types of watermelons as a management strategy for farmers. We know that watermelon is the type of fruit that is most sought after by the people, especially in Indonesia. With several different types of variants, an attractive choice for public consumption. But in reality, it is difficult to determine what type of watermelon to be superior, certainly judged by the quality of the fruit produced. The many criteria that affect the quality of good fruit, certainly becomes a problem to be solved. This is also an advantage in the form of a management strategy for farmers to cultivate the best type of watermelon with varieties. The data in this study were obtained by observing and giving questionnaires directly to consumers, the trader and fruit farmers which were carried out randomly. The location of the study was conducted in Simalungun Regency. The technique used in problem solving is VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje). The criteria used as an assessment are: Color (C1), Size (C2), Taste (C3), Water Content (C4). Variants that are alternative are: Sweet Beauty Watermelon (A1), Yellow Baby Watermelon (A2), Farmer Giant Watermelon (A3) and New Dragon Watermelon (A4). The results of the VIKOR calculation recommend that the type of Watermelon New Dragon (A4) be the first alternative with a value of -0.88 and the Yellow Baby Watermelon (A2) be the second alternative with a value of 0.242.

Keywords: VIKOR, DSS, Management Strategy, Farmers.

1. Introduction

Watermelon is a fruit that is rich in vitamins and has many benefits for the body. Watermelon fruit plants come from the half of the desert region of South Africa and then spread to the corners of the world. Watermelons can be found in every fruit shop and fruit seller. This plant is quite resistant to drought, especially if it has entered the formation of fruit. Watermelon has various types of variants such as: watermelon sweet beauty, new dragon, giant farmer, yellow baby. Often people make purchases only because they are interested in the shape or appearance without adjusting to their needs. This makes a mismatch between the price of goods and their quality. However, in choosing the best quality watermelon from the various types of variants is a difficult choice for consumers and traders to determine. Is this type of watermelon variant can be marketed because of the many types of watermelon variants, only a few are the choice of buyers for buyers and traders. Application of techniques using computer science [1] can be a solution to the problems that are being faced. This can be a management strategy for farmers and traders in meeting the needs of consumers in the supply [2] of the best types of watermelon variants in the district of Simalungun. Many computer science techniques can be used to solve ranking cases in selecting the best types of watermelon variants. One of them is a decision support system [3]–[5]. One of the algorithms of the decision support system is VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje). Algoritma VIKOR has several advantages in the multiple ranking process by utilizing the value of preference [6] and can overcome conflicting criteria in the sense of criteria that use different assessments [7]. Many previous researchers used the VIKOR algorithm to solve problems, including [7] with the title Analysis of the Selection Factor of Online Transportation in the VIKOR Method in Pematangsiantar City. The results of the study mentioned that the VIKOR algorithm can be applied in the selection in determining the

main factors that cause people to prefer using online transportation and make alternative (A1) Easy and Safe (VIKOR index value 0) as the main reason why people use online and alternative transportation (A2) Price (VIKOR index value 0.1809520) as the second reason. Based on previous studies, VIKOR is expected to be a solution in recommending the best types of watermelon variants so that they can be information for farmers and traders in managing management strategies to meet the needs of the best types of watermelon variants for consumers.

2. Methodology

2.1. Data

Sources of data used in the study are by means of observation and random questionnaires to consumers, fruit traders and farmers in the district of Simalungun. Samples given as many as 350 respondents conducted for 1 month. Then the data obtained, processed by pre-processing data. In order to obtain several assessment criteria in the selection of watermelon fruit variants namely: Color (C1), Size (C2), Taste (C3), Water Content (C4). As for the alternative types of variants used are Sweet Beauty Watermelon (A1), Yellow Baby Watermelon (A2), Farmer Giant Watermelon (A3) and New Dragon Watermelon (A4).

2.2. Decision Support System

Decision Support System is a computer-based information system that approaches to produce various alternative decisions to help certain parties in dealing with problems [5], [8].

a) Normalization matrix

$$R_{ij} = \frac{x_j^+ - x_{ij}}{x_j^+ - x_j^-} \quad (1)$$

Where:

- R_{ij} = sample normalization value i criteria j
- X_{ij} = sample data values i criteria j
- X_j^+ = best value in one criterion
- X_j^- = worst value in one criterion
- i = alternative
- j = criteria

b) Calculating the value of Utility Measure (S) and Regret Measure (R)

$$S_i = \sum_{j=1}^n W_j \left(\frac{x_j^+ - x_{ij}}{x_j^+ - x_j^-} \right) \quad (2)$$

and

$$R_i = \text{Max } j \left[W_j \left(\frac{x_j^+ - x_{ij}}{x_j^+ - x_j^-} \right) \right] \quad (3)$$

Where:

- S_i = value *Utility Measure*
- R_i = value *Regret Measure*
- W_j = Criteria weight

c) Menghitung indeks VIKOR (Q)

$$Q_i = \left[\frac{(S_i - S^-)}{(S^+ - S^-)} \right] v + \left[\frac{(R_i - R^-)}{(R^+ - R^-)} \right] (1 - v) \quad (4)$$

Where:

- Q_i = Index value VIKOR
- S^+ = The largest Utility Measure value
- S^- = The smallest Utility Measure value
- R^+ = The largest Regure Measure Value
- R^- = The smallest Regure Measure Value
- v = 0,5

d) Ranking the VIKOR value (Q)

2.1. VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje)

The VIKOR method (Vise Kriterijumska Optimizacija I Kompromisno Resenje in Serbian, which means Multicriteria Optimization and Compromise Solution) is a ranking method using a multicriteria ranking index based on a certain size of proximity to the ideal solution [9]. The following are the steps to complete the VIKOR method:

3. Results and Discussion

3.1. Application of the VIKOR Method

In this study the criteria, alternatives and weighting criteria used to determine the type of watermelon variant with quality using the VIKOR method can be seen in the following table. In this case the weighting uses the concept of reasoning in which the priority determination of the assessment criteria is obtained from traders and consumers. The results of the assessment in the form of linguistics are changed into a percent scale (%).

Table 1. Alternatives

Alternatives	Information
Watermelon Sweet Beauty	A1
Yellow Baby Watermelon	A2
Watermelon Farmer Giant	A3
New Dragon Watermelon	A4

Table 2. Selection Criteria

Criteria	Information	Alias	Weight
Criteria 1	Color	C1	40%
Criteria 2	Size	C2	35%
Criteria 3	Taste	C3	15%
Criteria 4	Water content	C4	10%

The following are the sub criteria for each of the criteria as shown in the following table:

Table 3. Weighting of color criteria (C1)

Sub criteria	Value	Weight
Red	Very nice (80-90)	40%
Yellow	Very nice (70-79.9)	
Pale	Not Good (<70)	

Table 4. Weighting of size criteria (C2)

Sub criteria	Weight
Big (90-100)	35%
Small (70-80)	
Normal (81-89.9)	

Table 5. Weighting of taste criteria (C3)

Sub criteria	Value	Weight
Sweet	Very nice (70-100)	15%
Tasteless	Not Good (<70)	

Table 6. Weighting of Water content criteria (C4)

Sub criteria	Value	Weight
Lots of water	Very nice (80-100)	10%
Less water	Enough (<80)	

Following are the research data that will be used and processed using the VIKOR algorithm as shown in the following table:

Table 7. Research data

Alternative	C1	C2	C3	C4
Watermelon Sweet Beauty	Red	Small	Tasteless	Less water
Yellow Baby Watermelon	Yellow	Big	Tasteless	Less water
Watermelon Farmer Giant	Pale	Big	Sweet	Lots of water
New Dragon Watermelon	Red	Normal	Sweet	Lots of water

from table 7, the results of the conversion data based on sub criteria evaluation (tables 3, 4, 5, 6) can be seen as follows:

Table 8. Rating table that has been weighted

Alternative	C1	C2	C3	C4
Watermelon Sweet Beauty	80	70	60	75
Yellow Baby Watermelon	75	90	60	75
Watermelon Farmer Giant	65	95	70	80
New Dragon Watermelon	90	85	80	90
Max	90	95	80	90
Min	65	70	60	75

After weighting the data, the calculation processing using the VIKOR algorithm can be done to determine the type of watermelon variant

a. Step I: do normalization

Use equation (1).

$$\begin{aligned}
 R_{11} \left(\frac{90 - 80}{90 - 65} \right) &= 0,4 & R_{31} \left(\frac{90 - 65}{90 - 65} \right) &= 1 \\
 R_{12} \left(\frac{95 - 70}{95 - 70} \right) &= 1 & R_{32} \left(\frac{95 - 95}{95 - 70} \right) &= 0 \\
 R_{13} \left(\frac{80 - 60}{80 - 60} \right) &= 1 & R_{33} \left(\frac{80 - 70}{80 - 60} \right) &= 0,5 \\
 R_{14} \left(\frac{90 - 75}{90 - 75} \right) &= 1 & R_{34} \left(\frac{90 - 80}{90 - 75} \right) &= 0,6 \\
 R_{21} \left(\frac{90 - 75}{90 - 65} \right) &= 0,6 & R_{41} \left(\frac{90 - 90}{90 - 65} \right) &= 0 \\
 R_{22} \left(\frac{95 - 90}{95 - 70} \right) &= 0,2 & R_{42} \left(\frac{95 - 85}{95 - 70} \right) &= 0,4 \\
 R_{23} \left(\frac{80 - 60}{80 - 60} \right) &= 1 & R_{43} \left(\frac{80 - 80}{80 - 60} \right) &= 0 \\
 R_{24} \left(\frac{90 - 75}{90 - 75} \right) &= 1 & R_{44} \left(\frac{90 - 90}{90 - 75} \right) &= 0
 \end{aligned}$$

Following are the results of the normalization steps which can be seen from the following table.

Table 9. Normalization Result

Alternative	C1	C2	C3	C4
Watermelon Sweet Beauty	0,4	1	1	1
Yellow Baby Watermelon	0,6	0,2	1	1
Watermelon Farmer Giant	1	0	0,5	0,6
New Dragon Watermelon	0	0,4	0	0

b. Step II: Calculating S and R.

Values to calculate the value of S and R, use equation (2) and (3).

$$\begin{aligned}
 S_1 &= \sum (0,4 * 0,4) + (0,35 * 1) + (0,15 * 1) + (0,1 * 1) \\
 &= 0,16+0,35+0,15+0,1 = 0,76 \\
 S_2 &= \sum (0,4 * 0,6) + (0,35 * 0,2) + (0,15 * 1) + (0,1 * 1) \\
 &= 0,24+0,07+0,15+0,1 = 0,56 \\
 S_3 &= \sum (0,4 * 1) + (0,35 * 0) + (0,15 * 0,5) + (0,1 * 0,6) \\
 &= 0,4+0+0,075+0,06 = 0,535 \\
 S_4 &= \sum (0,4 * 0) + (0,35 * 0,4) + (0,15 * 0) + (0,1 * 0) \\
 &= 0+0,14+0+0 = 0,14
 \end{aligned}$$

$$\begin{aligned}
 R_1 &= (0,4*0,4) = 0,16 \quad (0,35*1) = 0,35 \\
 &= (0,15*1) = 0,15 \quad (0,1*1) = 0,1
 \end{aligned}$$

Max = 0,35

$$\begin{aligned}
 R_2 &= (0,4*0,6) = 0,24 \quad (0,35*0,2) = 0,07 \\
 &= (0,15*1) = 0,15 \quad (0,1*1) = 0,1
 \end{aligned}$$

Max = 0,24

$$\begin{aligned}
 R_3 &= (0,4*1) = 0,4 \quad (0,35*0) = 0 \\
 &= (0,15*0,5) = 0,075 \quad (0,1*0,6) = 0,06
 \end{aligned}$$

Max = 0,4

$$\begin{aligned}
 R_4 &= (0,4*0) = 0 \quad (0,35*0,4) = 0,14 \\
 &= (0,15*0) = 0 \quad (0,1*0) = 0
 \end{aligned}$$

Max = 0,14

Following are the complete results of the recapitulation of the calculated S and R values as shown in the following table:

Table 10. Result of S and R

Alternative	C1	C2	C3	C4	S _i	R _i
Watermelon Sweet Beauty	0,4	1	1	1	0,76	0,35
Yellow Baby Watermelon	0,6	0,2	1	1	0,56	0,24
Watermelon Farmer Giant	1	0	0,5	0,6	0,535	0,4
New Dragon Watermelon	0	0,4	0	0	0,14	0,14

c. Step III: Ranking (Q_i)

Q_i value is obtained from equation (4)

$$\begin{aligned}
 Q_1 &= \left[\frac{0,76 - 0,535}{0,76 - 0,535} \right] * 0,5 + \left[\frac{0,35 - 0,14}{0,4 - 0,14} \right] * (1 - 0,5) \\
 &= (1 * 0,5) + (0,807 * 0,5) \\
 &= 0,5 + 0,4035 \\
 &= 0,9035
 \end{aligned}$$

$$\begin{aligned}
 Q_2 &= \left[\frac{0,56 - 0,535}{0,76 - 0,535} \right] * 0,5 + \left[\frac{0,24 - 0,14}{0,4 - 0,14} \right] * (1 - 0,5) \\
 &= (0,1 * 0,5) + (0,384 * 0,5) \\
 &= 0,5 + 0,192 \\
 &= 0,242 \\
 Q_3 &= \left[\frac{0,535 - 0,535}{0,76 - 0,535} \right] * 0,5 + \left[\frac{0,4 - 0,14}{0,4 - 0,14} \right] * (1 - 0,5) \\
 &= (0 * 0,5) + (1 * 0,5) \\
 &= 0 + 0,5 \\
 &= 0,5 \\
 Q_4 &= \left[\frac{0,14 - 0,535}{0,76 - 0,535} \right] * 0,5 + \left[\frac{0,14 - 0,14}{0,4 - 0,14} \right] * (1 - 0,5) \\
 &= ((-1,76) * 0,5) + (0 * 0,5) \\
 &= (-0,88) + 0 \\
 &= -0,88
 \end{aligned}$$

Following are the complete results of the Q calculation as shown in the following table:

Table 11. Results of calculations Q

Initial	Alternative	Q _i	Ranking
A ₁	Watermelon Sweet Beauty	0,9035	3
A ₂	Yellow Baby Watermelon	0,242	2
A ₃	Watermelon Farmer Giant	0,5	4
A ₄	New Dragon Watermelon	-0,88	1

Based on the final calculation from the VIKOR algorithm that the best alternative type of watermelon variant is the Watermelon New Dragon (A4) with a final value of -0.88 and the second alternative is the Yellow Baby Watermelon (A2) with a value of 0.242.

4. Conclusion

Based on the results of the research conducted obtained several conclusions that the application of the VIKOR algorithm can be applied to the selection of watermelon variants. The alternatives used in the research are Sweet Beauty Watermelon (A1), Yellow Baby Watermelon (A2), Farmer Giant Watermelon (A3) and New Dragon Watermelon (A4) and the criteria used as a reference in ranking are Color (C1), Size (C2), Taste (C3), Water Content (C4). The results of the study stated that of the 4 alternatives used, there were 2 alternatives that became the solution for traders in selling and profit farmers in the form of a management strategy for farmers in cultivating the type of watermelon with the best variants namely: New Dragon Watermelon (A4) with the final value -0.88 and the second alternative is the Yellow Baby Watermelon (A2) with a value of 0.242.

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