Decision support system for the selection of rice varieties using weighted product method

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Abstract. The selection of rice varieties is a problem because there are a number of criteria that are considered in decision making. The criteria used in this study for the selection of rice varieties are yield potential, average yield, age of harvest, resistance to brown plant hopper pest and resistance to bacterial leaf blight disease. The concept of decision support system is a model for selecting the type of variety desired based on determined criteria (attributes). In this study using the weighted product method because there are a number of criteria in decision making (Multi Attribute Decision Making). The weighted product method calculates the preference value of each alternative where the alternative chosen is the one that has the greatest relative preference value. Based on the test results using an application program created, the relative preference values of each superior rice variety are obtained. From the calculation of the largest preference value is INPARI 1 with a value of V equal to 0.0404.

1. Introduction

The selection of superior rice varieties is a choice because the local varieties have weaknesses that are long harvest time and low productivity. Each rice varieties has different characteristics such as yields, age of harvest, and resistance to pests and diseases. So that the right modelling is needed to select the type of variety desired based on determined criteria. The concept of decision support system is widely used in problem solving because it contains a collection of data processing procedures to help decision making [1].

Decision support system has been applied in various fields, including for planning and regulating warehousing systems [2] and for managing road traffic [3]. A number of methods used in decision making include artificial neural networks [4], fuzzy WP [5], and AHP and TOPSIS methods [6]. A number of studies use the weighted product method, namely in the decision to recruit new employees [7] and in measuring employee performance [8].

This study designed a decision support system model for the selection of rice varieties using the weighted factor method. Model of problem solving in decision making is then designed in a computer application program.

2. Decision support system model

The structure of decision support system model is shown in Figure 1 which the problem of decision making in selecting superior varieties of rice varieties is the goal. The alternative is an object that will be chosen by user namely INPARI 1, INPARI 2, INPARI 3, to INPARI 30 rice varieties [9]. Attributes are criteria that are taken into consideration in decision making, in this case are yield potential, average yield, harvest time, resistance to brown plant hopper pest (BPH), and resistance to bacterial leaf blight disease (BLB).

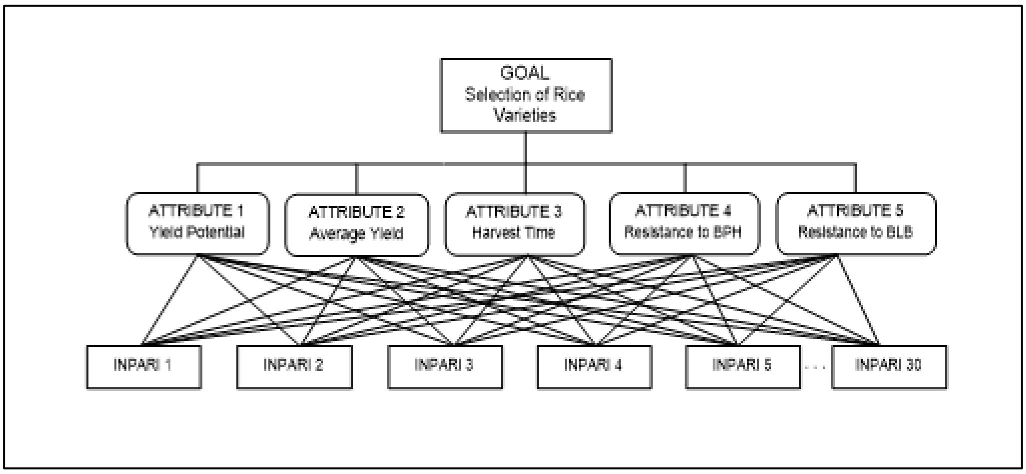

Figure 1. Selection model of rice varieties.

2.1. Weighted product method

Decision making is generally done by choosing the best alternative from a number of alternatives. If the selection of the best alternative by considering a number of criteria, the process is called multi-attribute decision making (MADM). One method that is widely used is weighted products. Weighted product method is as follows:

- Determine criteria for alternative selection.
- Give criteria weight values (w).
- Normalization of criteria weights (wj) using equations (1)

$$w_j = (w_j)\left(\sum w_j\right)^{-1} \quad (1)$$

where j = 1, 2, ..., n and $\sum w_j$ is total weight of each criterion.

- Calculates the preference value (S), as in equation (2) [10].

$$S_i = \prod_{j=1}^{n} x_{ij}{}^{w_i} \quad (2)$$

with $\sum w_j$=1 and rank w_j is positive for the profit attribute and negative value for the cost attribute.

- Calculating the relative preferences of each alternative obtained through equation (3).

$$V_i = \left(\prod_{j=1}^{n} x_{ij}{}^{w_i}\right)\left(\prod_{j=1}^{n} (x_j{}^*)^{w_i}\right)^{-1} \quad (3)$$

with i = 1,2,...,m

- The best alternative is the alternative that has the greatest preference value.

2.2. Weighted product for selection of rice varieties

The calculation of preference values using the weighted product method begins by giving weight (w) to each criterion that shown in Table 1.

Table 1. Weight of criteria.

Value of importance	Weighted (w)
Very important	1
Important	0.75
Quite important	0.5
Less important	0.25
Not important	0

The criteria weights for yield potential, average yield, harvest time, resistance to BPH pests, and resistance to BLB disease are shown in Table 2.

Table 2. Criteria weights for selection of rise varieties.

Criteria (C)		Value of importance	Weighted (w)
C1	Yield potential	very important	1
C2	Average yield	very important	1
C3	Harvest time	very important	1
C4	Resistance to brown planthopper	important	0.75
C5	Resistance to bacterial leaf blight	important	0.75

Crisp values for BPH pest and BLB disease resistance criteria are given in Table 3.

Table 3. Criteria weight of resistance to BPH and BLB.

Criteria (C)	Resistant	Quite resistant	Susceptible
Resistance to brown planthopper	0.9	0.5	0.1
Resistance to bacterial leaf blight	0.9	0.5	0.1

The steps to calculate the preference value are as follows:

- Normalize attribute weights. The value of attribute weights is:

  w = [1; 1; 1; 0.75; 0.75]

  Using Equation (1), the result is:

  w*=[0.2222; 0.222; 0.2222; 0.1667; 0.1667]

- Calculate the preferences of each alternative (S) using Equation (2)

  The criteria for potential yield, average yield, resistance to BPH and resistance to BLB are profit attributes, while harvest time is a cost attribute. As example calculation preference values of INPARI 1 that has characteristic given in Table 4.

Table 4. Characteristic of rice variety INPARI 1.

Rice varieties	Yield potential (t/ha)	Average yield (t/ha)	Harvest time (days)	Resistance to BPH	Resistance to BLB
INPARI 1	10	7.3	108	Resistant	Resistant

$$S_1 = (10^{0.2222})(7.3^{0.2222})(108^{-0.2222})(0.9^{0.1667})(0.9^{0.1667})$$
$$= (1.668)\ (1.5554)\ (0.3533)\ (0.9826)\ (0.9826)$$
$$= 0.8850$$

The calculation of preference values is continued until all rice varieties.

- Calculate the relative preferences of each alternative using Equation (3).

3. Results and discussion

The results of relative preference values (V) of rice varieties are given in Table 5.

Table 5. Preference value of each varieties.

Variety	Preference value (S)	Relative preference (V)
INPARI 1	0.8850	0.0404
INPARI 2	0.7019	0.0320
INPARI 3	0.6523	0.0297
INPARI 4	0.7374	0.0336
INPARI 5	0.6973	0.0318
INPARI 6	0.8070	0.0368
INPARI 7	0.6775	0.0309
INPARI 8	0.6800	0.0310
INPARI 9	0.6774	0.0309
INPARI 10	0.5858	0.0267
INPARI 11	0.7649	0.0349
INPARI 12	0.6807	0.0310
INPARI 13	0.7613	0.0347
INPARI 14	0.6739	0.0307
INPARI 15	0.6442	0.0294
INPARI 16	0.7164	0.0327
INPARI 17	0.7299	0.0333
INPARI 18	0.8694	0.0396
INPARI 19	0.8657	0.0395
INPARI 20	0.7638	0.0348
INPARI 21	0.7284	0.0332
INPARI 22	0.7094	0.0323
INPARI 23	0.8494	0.0387
INPARI 24	0.7383	0.0337
INPARI 25	0.7732	0.0353
INPARI 26	0.6989	0.0319
INPARI 27	0.6917	0.0315
INPARI 28	0.7578	0.0346
INPARI 29	0.6981	0.0318
INPARI 30	0.7144	0.0326

Based on the Table 5, the largest relative preference (V) is INPARI 1 with V = 0.0404. The application program is shown in Figure 2 that user can login using username and password.

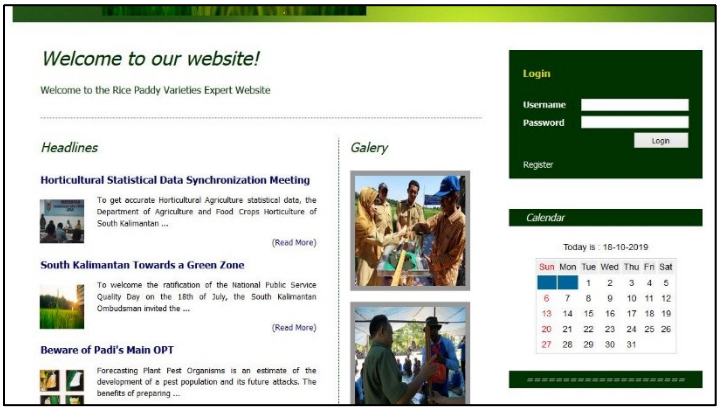

Figure 2. Login page.

To calculate the preference value, user presses Process Ranking button as shown in Figure 3.

Ranking Process

No	Name	Harvest time	Yield Potential	Avarage Yield	Resistance to BPH	Resistance to BLB
1	INPARI 1	108	10	7.3	Resistance	Resistance
2	INPARI 2	115	7.3	5.83	Resistance	Quite Resistance
3	INPARI 3	110	7.52	6.05	Quite Resistance	Quite Resistance
4	INPARI 4	115	8.8	6.04	Quite Resistance	Resistance
5	INPARI 5	115	7.2	5.74	Quite Resistance	Resistance
6	INPARI 6	118	12	6.82	Quite Resistance	Resistance
7	INPARI 7	110	8.7	6.2	Quite Resistance	Quite Resistance

[1] 2 3 5 Next »

Figure 3. Value importance of criteria.

The system will calculate the rank of all existing data on rice varieties based on importance value. The next process is shown in Figure 4 where the calculation results will be displayed for each variety.

No	Variety Name	Final Score	Rangk
1	INPARI 1	0.0403527	1
2	INPARI 18	0.0396426	2
3	INPARI 19	0.0394719	3
4	INPARI 23	0.0387275	4
5	INPARI 6	0.0367971	5
6	INPARI 25	0.035257	6
7	INPARI 11	0.0348744	7
8	INPARI 20	0.0348285	8
9	INPARI 13	0.0347105	9
10	INPARI 28	0.0345526	10

Figure 4. Final process.

In Figure 4, the varieties will be ordered according to the relative preference value from the largest to the smallest. Based on the calculation results obtained that the INPARI 1 variety has the largest relative preference value, so that the variety is recommended by the system based on predetermined criteria.

As with other methods in decision support systems that use multi attribute decision making (MADM), the solutions obtained do not always provide unique results because they are determined by the criteria used.

4. Conclusions

The selection of rice varieties in this study uses the criteria of yield potential, average yield, harvest time, resistance to brown plathopper pest and resistance to bacterial leaf blight disease. The varieties selected are those that have the highest relative preference value compared to other varieties. Based on the results of calculations using predetermined criteria weights, obtained the greatest relative preference value is INPARI 1 with V = 0.0404 so that the variety will be selected based on predetermined criteria.

5. References

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