Implementation Weighted Product Method for the Best Carrot Seed Recommendations

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Abstract: So far, in determining and looking for criteria for good/excellent seeds, farmers do not have the right tools or methods. The selection of good/superior seeds is done based on personal experience and views, even some of the Sinabung refugees who cultivate carrots do not know the source of the seeds they use. Varieties of carrots are also very many kinds, almost 40 kinds of varieties. Each variety has different growing criteria and requirements. Thus, this becomes an additional difficulty factor in determining the quality of the type of carrot seed to be planted. This of course affects the production of carrots at harvest. Harvest production is not proportional to the area of land used. Based on the problems above, the search for superior seeds using a decision support algorithm can provide recommendations. This algorithm will provide recommendations for the quality of carrot seeds based on the criteria or characteristics that must be prepared in the selection of plants. The algorithm developed uses the Weighted Product (WP) algorithm. The WP method is a recommendation method with weighting against predetermined criteria. The weights given are based on research results and expert experience. From the results of this trial, several recommendations for prospective carrot plants are sorted based on the results of the algorithm calculations and can be used as superior seeds that produce greater production. The results of the study are expected to because of this research, the system has succeeded in providing recommendations for the best carrot seeds that can help increase carrot production and help economic resilience for farmers displaced by Mount Sinabung.

1 INTRODUCTION

Tanah Karo, which is well-known as a vegetable producer, is the main source of vegetable suppliers in North Sumatra, even vegetables are exported to the national region and abroad. Nowadays, many farmers switch to carrot plants for various reasons, such as the planting age of only three months, practical ways of working and the wide export market in various cities in Indonesia, such as Jakarta, Bandung, Surabaya, Bali and even Papua. Based on previous research, farmers can produce Rp. 7,450,50/ha (Sundari, 2011). The age of carrots until the harvest period is 2.5 - 3 months, judging from the results that can be obtained by farmers in growing carrots, of course this is very supportive of their economic resilience.

Most of the farmers in the land are still farming semi- modern, using tractor tillage, spraying machine showers and mostly with human labor. No one has yet fully utilized modern farming methods such as utilizing an IT system. This the author found in the relocation of karo in the relocation of refugees from Mount Sinabung in the village of Nangbelawan. Things that need to be considered in carrot cultivation to get maximum production, is the optimum temperature for carrot plant growth is 15-21oC. This temperature is suitable for the growth of roots and the top of the plant so that the color and shape of the roots can be optimal (Simon, 2019). Soil that is suitable for growing carrots is soil that is well drained, rich in organic matter and fertile with an altitude of 1200-1500 m above sea level. Sandy loam soil is suitable for carrot cultivation because it is easy for root.

Can reach optimal length and size. This plant can grow well in soil with a pH of 5-8 (Putra, 2018). Soil moisture is very important for the growth of carrot

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plants, including during seeding to obtain seeds with uniform growth and fast growth after planting in the field. Apart from the above requirements, good seeds cannot be separated from the success of obtaining maximum production (Singh, 2018). The fact that the authors found at the location of this research, generally the farmers follow the correct procedures in farming, especially in the selection of good seeds. Determining and searching for criteria for good/excellent seeds, the farmers do not have the tools or methods to get them. The selection of good/superior seeds is done based on personal experience and views, even some of the Sinabung refugees who cultivate carrots do not know the source of the seeds they use (Putra, 2018); (Singh, 2018). This of course affects the production of carrots at harvest. Harvest production is not proportional to the area of land used. Based on the above problems, the search for superior seeds uses decision support algorithms and recommendations. This algorithm will provide recommendations for the quality of superior carrot seeds based on the criteria or characteristics that must be prepared in the selection of plants. The algorithm developed uses the Weighted Product (WP) algorithm.

The WP method is a recommendation method with weighting against predetermined criteria (Linden, 2017). Previous research conducted by for the selection of instant cameras, in this study concluded that the final result of the application evaluation was the overall value of system user satisfaction which obtained a percentage score of 87.98% with a very good predicate (Feng, 2019). The second research is a study for the selection of ornamental plants, in this study it was concluded that with a system success percentage of 84,409% the system was considered successful in implementing the WP method and the criteria used in the recommendation system were appropriate. The WP method is used in the design of this recommendation system because it is considered to have fast computing and is suitable for making ornamental plant recommendations. The advantages of this WP method provide clarity on the weights of costs and benefits on each criterion (Linden, 2017). This study determines the variables or criteria to determine the characteristics of superior carrot seeds, then the process of determining superior seeds is carried out using the WP method. From the results of trials conducted after the harvest period, the production of superior carrot seeds will be compared with seeds without the WP process. From the results of this trial, it can be seen whether superior seeds can produce greater production or not (Singh, 2018).

In general, carrot farmers displaced by Mount Sinabung do not have standards in procuring superior seeds in their agricultural business. Most of them get carrot seeds from unknown sources. Usually buy seeds from traders. Some of them also produce their own seeds but do not meet proper standards in producing superior seeds. As a result, crop yields are not optimal, the area of land planted is not proportional to harvest production. The crop yields are not optimal, the impact of Covid-19 has made the price of carrots low, due toa lack of demand both locally and from Jakarta and Java. As a result, it greatly affects the economic resilience of the Mount Sinabung refugees. One of the appropriate solutions to overcome the above problems is to produce superior seeds from carrots themselves using the WP method, for that it can be stated that the problem formulation of this research is How to Design a System Implementation to Get Superior Carrot Seeds with a Weighted Product Algorithm?

2 LITERATURE REVIEW

2.1 Carrot Seeds

Basically, the carrot varieties commonly consumed by the world's population are of many types, both in shape and color, not just one type as we usually find in Indonesia (Simon, 2019). To get maximum production in planting carrots, it is necessary to know the stages that must be done in planting carrots. First, efforts should be made to use superior seeds. From a land that has been planted with carrots and before the post-harvest, a search for carrots can be carried out which will be used as superior seeds. The steps that can be taken in finding sources of superior seeds are as follows (Marpaung, 2017):

1. Age after planting day at least 100 days
2. The tuber texture is straight, dense
3. The thickness of the tuber diameter>=3 cm
4. Glowing bright reddish
5. The shape of the carrot leaves is straight and bright

While the method of seeding carrots, as follows:

1. Carrot leaves cut to about 10 cm
2. Roots that have been selected, cut in thirds
3. The land is loosened, sown with compost
4. Made a bed for planting seeds
5. Plant tubers with about 50 cm

Roots that will be used as seeds must be selected properly; the planting period is at least 100 days. Roots that are not old enough will easily rot and get

disease. To know the planting period of carrots can be known from the date of planting. In addition, from the physical texture, whether it has hardened and looks ripe, it can be a reference that the carrot is old enough. Physical texture that is straight, dense, and shiny can be seen after the carrots that are old enough are removed.

2.2 Weighted Product Method

The research model uses the Weighted Product (WP) method in determining a decision based on several attributes. This method requires the decision maker to determine the weight for each attribute. WP evaluates m alternatives Ai (i=1,2,..,m) against a set of attributes Cj (j=1,2…,n) where each attribute is independent of one another (Linden, 2017). In the WP method normalization is still carried out, where the rating of each attribute must be raised to the first power with the weight of the attribute in question.

3 SYSTEM DESIGN AND METHODOLOGY

3.1 Research Stages

The following is the order from the beginning to the conclusion of the research to be carried out.

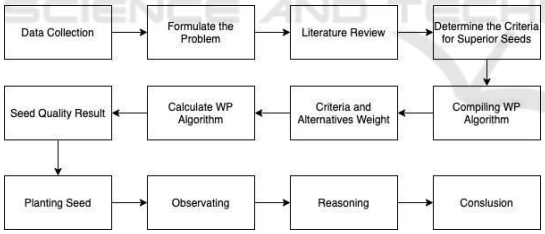

Figure 1: Research Stages.

In Figure 1. Research Stages, the first step is to collect initial data. This research is a case study, so we look at the phenomena that occur in the object or place of research. Next, formulate existing problems to observe reality with a literature review or actual science and theory. The result of the literature review is to determine the criteria for superior seeds from carrot plants and computer computational algorithms that can be used to solve problems.

The next process is to find the value of the criteria for prospective seeds for computational calculations using the WP algorithm to produce recommendations for the quality of prospective seeds. These prospective seeds will be planted and observed to measure the results of the recommendations. The final stage is to reason about the results of plants that have grown to draw conclusions.

3.2 System Design

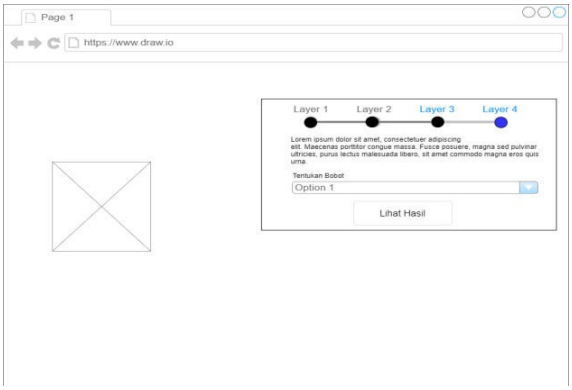

Figure 2: User Dashboard Mockup.

Figure 2. User Dashboard Mockup is the initial user interface design when opening the website. On this page there is a button that functions to start the recommendation process, after the button is pressed, a stepper will appear to guide the user in filling in the desired criteria weights. After all processes are complete, the recommendation results will appear to replace the stepper component.

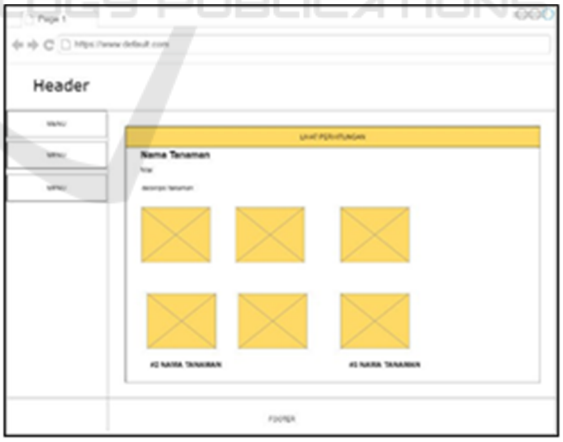

Figure 3: Admin Dashboard Mockup.

Figure 3. Admin Dashboard Mockup is an interface design for the results page on the admin dashboard. This page will display the 5 criteria for the best carrot seed varieties, pictures of carrot plants and the final WP weight value of the existing varites. At the top there is a button to display the modal that contains the recommendation calculation process in detail.

3.3 Criteria and Weighted Scale

The following are the criteria and the value of each criterion weight designed in this study:

Table 1: Criteria and Wighted Scale.

Code	Criteria	Weighted	Description	Weighted Score
C1	Root Texture	1-5	Benefit	1-5
C2	Root thickne	1-5	Cost	3,8,11,15,18
C3	Root Color	1-5	Benefit	1-5
C4	Leaf Color	1-5	Benefit	1-5
C5	Plant Age	1-5	Cost	59,69,79,90,110

Based on the results of interviews with farmers/experts who have done planting and research for more than 20 years, there are 5 criteria in determining the quality of candidate carrot seeds. C2 and C5 are cost criteria because the root thickness and plant age, the higher the cost for planting and land use. so that the resulting value is higher, but the weight of the criteria is getting lower in the WP calculation (Ameliana, 2019).

4 RESULT AND DISCUSSION

4.1 Implementation of WP

In choosing the best carrot seed candidate to be the best carrot seed recommendation based on 5 criteria inputted by the user, 10 alternatives were used. One of these alternatives will be selected and then sorted based on the final weighted score of the WP. Each alternative is given the necessary criteria and weights in performing calculations so that the results obtained are as follows:

Table 2: Description of Criteria.

Criteria	Description
Root Texture	The texture of the tuber plays an important role in the growth resistance and strength of the carrot plant against pests or temperatures.
Root thickness	The thickness of the tubers is proportional to the texture of the tubers to provide strong resistance to the would-be carrot plant.
Root Color	The color of the tubers affects the criteria for carrot plants. A good tuber color is a bright color and reddish or yellow depending on the carrot variety produced.
Leaf Color	Leaf color is an important factor. Leaf color affects the quality ofthe carrot tubers produced.

The selected alternatives from various varieties of carrot plants have the following criteria weights:

Table 3: Weighted Scale of Each Alternatives.

Code	Alternatives	C1	C2	C3	C4	C5
A1	Imperator	5	11	5	5	110
A2	Chantenay	4	8	4	4	79
A3	Danvers	5	5	5	3	89
A4	Mini Carrot	5	5	3	2	59
A5	Nantes	4	11	5	5	110
A6	Hercules	5	15	3	5	69
A7	Oxheart	3	15	1	5	110
A8	Red-cored	2	15	3	2	79
A9	Merida	4	8	1	1	110
A10	Rainbow	3	11	5	4	110

Next, the process of calculating the WP based on the weight of the criteria inputted by the user. From the results of the weights of the inputted criteria, normalization of the weights of each criterion will be sought.

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Table 4: Input Level Criteria By User.

Code	Lv.1	Lv.2	Lv.3	Lv.4	Lv.5
C1	Branch two	Double bend	One Bend	Not straight	Straight unbranc hed
C2	1-3 cm	4-5 cm	6-8 cm	9-11 cm	12-15 cm
C3	Pale Yellow	Less bright	Pale red	bright and less red	bright and red
C4	Dark green brown	Dark Green and not fresh	Not Fresh and Dark Green	Fresh and Dark Green	Fresh and Light Green
C5	50-59 days	60-69 days	70-79 days	80-89 days	90-110 days

In this calculation simulation, the level value inputted by the user is:

1. C1 : Level 5, straight unbranched
2. C2 : Level 4 , 9-11 cm
3. C3 : Level 5, bright and red
4. C4: Level 5, fresh and light green
5. C5: Level 5, 90-110 days

Then the calculation starts from weight normalization, the first step is to normalize the weights of the criteria that have been entered. The normalization process can be seen in table:

Table 5: Normalization Process.

Code	Normalization	Result
C1	5/(5+2+5+5+1)	0.278
C2	2//(5+2+5+5+1)	0.111
C3	5/(5+2+5+5+1)	0.278
C4	5//(5+2+5+5+1)	0.278
C5	1/(5+2+5+5+1)	0.056

Next the normalization process is complete, then the S vector value is calculated. The calculation process is carried out by raising the alternative weight value to the normalized weight value, for the weight with the cost rank attribute to be negative while the benefit attribute to the positive rank. The process of calculating the value of the vector S can be seen in Table 6. Vector S Calculation Process.

Table 6: Vector S Calculation Process.

No.	Calculation Vector S	Result
S1	(50.278) (11-0.111) (50.278) (50.278) (110-0.056)	2.256
S2	(40.278) (8-0.111) (50.278) (40.278) (79-0.056)	1.976
S3	(50.278) (5-0.111) (50.278) (30.278) (89-0.056)	2.162
S4	(50.278) (5-0.111) (30.278) (20.278) (59-0.056)	1.715
S5	(40.278) (11-0.111) (50.278) (50.278) (110-0.056)	2.12
S6	(50.278) (15-0.111) (30.278) (50.278) (69-0.056)	1.94
S7	(30.278) (15-0.111) (10.278) (50.278) (110-0.056)	1.209
S8	(20.278) (15-0.111) (30.278) (20.278) (79-0.056)	1.157
S9	(40.278) (8-0.111) (10.278) (10.278) (110-0.056)	0.898
S10	(30.278) (11-0.111) (50.278) (40.278) (110-0.056)	1.839

After getting the results from the calculation of vector S, the next process is calculating the value of vector V by dividing each vector S by the total sum of all vectors S. The calculation of vector V can be seen in Table 7. Vector V Calculation process:

Table 7: Vector V Calculation Process.

No.	Calculation Vector V	Resul
V1	2.256/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.13
V2	1.976/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.114
V3	2.162/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.125
V4	1.715/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.099

V5	2.12/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.122
V6	1.94/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.112
V7	1.209/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.07
V8	1.157/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.067
V9	0.898/(2.256+1.976+2.162+1.715+2.12+1.94 +1.209+1.157+0.898+1.839)	0,073
V10	1.839/(2.256+1.976+2.162+1.715+2.12+1.94+1.209+1.157+0.898+1.839)	0.106

Based on the results of calculations and results of sorting out the WP method above that carrot seeds which are selected to be the best carrot seeds is:

Table 8: Weighted Scale of Each Alternatives.

Code	Alternatives	Result	Rank
A1	Imperator	0.13	1
A2	Chantenay	0.114	4
A3	Danvers	0.125	2
A4	Mini Carrot	0.099	7
A5	Nantes	0.122	3
A6	Hercules	0.112	5
A7	Oxheart	0.07	9
A8	Red-cored	0.067	10
A9	Merida	0,073	8
A10	Rainbow	0.106	6

4.2 Implementation the Website

Figure 4: User Dashboard Website.

The website page for the carrot seed recommendation system is divided into two, namely for users and admins. The user only has a feature to search for the best weight of carrot seeds, while the features that the admin has are adding alternative data and seeing detailed calculations from searching for the best weight of carrot seeds.

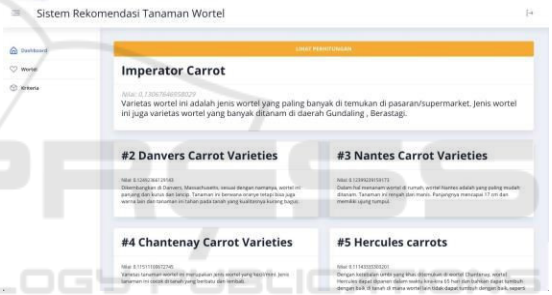

Figure 5: Admin Dashboard Website.

5 CONCLUSION

Based on the results of research that has been successfully carried out, the conclusions of this study are as follows:

1. Implementation weighted product method for the best carrot seed recommendations is determined based on 5 criteria's: root texture, root thickness, root color, leaf color and plant age.
2. The process of selecting carrot plants uses the Weighted Product (WP) method which helps in making decisions from several alternatives that must be taken by considering the criteria.
3. This decision support system was developed in the form of a website so that users can easily see the results of wp calculations and see pictures of carrot seed recommendations.
4. For further system development, giving weights to alternatives and criteria can use fuzzy values.

In addition, the weight of the criteria can also be obtained using the Analytical Hierarchy Process (AHP) questionnaire, not just interviews so that it can consist of several sources people (Surbakti, 2019).

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