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DECISION SUPPORT SYSTEM USING WEIGHTED PRODUCT METHOD IN CHIPS MATERIAL SELECTION (CASE STUDY: HASTI FAMILY CHIPS BUSINESS)

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Abstract

This study designs a decision support system to help the owner of the Hasti Family chips business choose the optimal raw materials in making cassava, banana, and breadfruit chips. The Weighted Product (WP) method is used as a multi-criteria decision-making method by considering criteria such as chip color, chip texture, chip taste, chip durability and fruit price. Criteria data and alternative raw materials are processed using WP calculations to produce the best alternative ranking. The result is a web-based decision support system that implements the WP method, presents an interface for entering data and displays the best alternative ranking. This system improves the efficiency of decision-making, minimizes the risk of selecting inappropriate raw materials, improves product quality, and supports business growth. The results of the research on the decision support system for selecting chips ingredients show that this system determines the best ingredients by finding the final value of the V vector search from 3 cassava data, 3 banana data and 3 breadfruit data that will be entered into the system and get results from butter cassava, which has the highest V value of 0.38311467, followed by wak banana with an impressive V value of 0.398763354, and Bali breadfruit, which has a prominent V value of 0.350015233. The conclusion of this study is that the designed application is able to optimize the process of selecting raw materials for chip production more efficiently, quickly, and this system not only accelerates decision making but also ensures more structured and reliable data recording.

Keywords: ***Selection of Raw Materials, SPK, Weighted Product (WP).***

1. INTRODUCTION

Hasti Family Chips is a business that produces various kinds of chips, including cassava chips, banana chips, and breadfruit chips.(Fajrah & Sumantika, 2022). In the food industry, especially in producing chips, selecting quality raw materials is one of the key factors in producing delicious, crispy, and durable products. These chips have succeeded in attracting the attention of consumers and have developed into a promising business venture that then has great potential in terms of providing abundant profits for its actors.(Toto et al., 2022).

However, the process of selecting the right raw materials is often a challenge for Hasti Family Chips Business. In a competitive production environment, the quality of raw materials is the main differentiator between ordinary products and special products.(SUTRISNO et al., 2024). There are many criteria that must be considered in determining the raw materials to be used, such as the color of the chips, the texture of the chips, the taste of the chips, the durability of the chips and the price of the fruit. So far, the process of selecting raw materials at the Hasti Family Chips Business is still done manually and subjectively, depending on the experience and intuition of the business owner. This can cause inconsistency in the selection of raw materials and has the potential to affect the quality of the resulting product.

Thus, it is important to have a decision support system that is considered to be able to help the Hasti Family Chips Business in choosing the right raw materials and adjusting to existing criteria.(Tjut Adek et al., 2022). This decision support system aims to provide more objective and consistent raw material selection recommendations. This system serves as a valuable tool to guide decision making in semi-structured scenarios where uncertainty prevails and clarity is elusive.(Burhanudin & Maulani, 2021). So that it can improve the quality of chips products and efficiency in the production process. The method that can be applied in designing this decision support system is the Weighted Product method.(Eva Darnila et al., 2020). The advantage of the Weighted Product method lies in its extraordinary ability to make relative comparisons between alternatives, taking into account a complex and

diverse set of criteria.(Anastasya et al., 2023). This method is one approach in a multi-criteria decision support system that can facilitate the selection of alternatives based on a number of predetermined criteria.(Sembiring & Sulindawaty, 2020). Through the application of the Weighted Product method, Hasti Family Chips Business is able to evaluate the weight of preferences for each criterion in selecting ingredients. This allows them to produce recommendations that are more appropriate and in line with business needs.

2. LITERATURE REVIEW

2.1 Previous Research

Research by Iqbal Kamil Siregar, Edi Kurniawan, Muhammad Amin, Hidayatullah and Donni Nasution (2023) entitled Decision Support System for Selecting Favorite Teachers Using the WP Method at UPTD SD Negeri 014697 Banjar. The results of this study: Based on the information provided in the journal, the results of the study using the Weighted Product (WP) method for selecting the most favorite teacher at UPTD SD Negeri 014697 Banjar are Dian Fitriani Siregar (A5) as the most favorite teacher who occupies the top ranking. The WP method is used to determine teacher rankings based on predetermined criteria, such as ability, creativity, appearance, social, professionalism, attitude, and teaching methods. This method helps in more systematic decision making in determining the most favorite teacher in the school.

Research by Ade Napila, Andrian Hidayat, Manullang, Kusumadewi, S., Hartati, S., Harjoko, A., Wardoyo, R., Ilham, F., Prof, Rizky, R., Susilawati, Yunita, AM, Hakim, Z., Sembiring, B., Sulindawaty (2023) entitled Decision Support System for Selecting the Best Employees Using the Weight Product Method: Case Study at the Serpong Healthy Clinic. Research results: Based on the research results, Employee 3 (0.1103) was selected as the best employee out of 10 employee candidates based on the provisions applicable to each criterion that is an aspect of the assessment and the level of importance of the company.

Research by Deliana Sianipar and Hendri entitled: Decision Support System for Selecting the Best Employee Using the Weighted Product Method at PT Steadfast Marine, Pontianak. Research results: The research was conducted to see and prove the truth and develop existing knowledge by using criteria and applying them to web applications. Employees who are selected as the best employees among the alternatives in the company can be seen from the calculation results. Leading the administration of selecting the best employees. The highest value of 0.0490 as an employee who is entitled to an award from the company was obtained on behalf of Sau Kong.

2.2 Chips

Chips or crisps are snacks made from soft slices of vegetables, tubers, or fruits that are fried in vegetable oil to produce the ideal crispiness. To get a delicious and crispy taste, chips are often combined with seasoned flour dough mixed with various spices. This flour dough wraps the fried fruit, vegetables, or tubers, creating a delicious crunchy texture while providing a unique taste and aroma. Chips have a relatively low air content, so they can last longer when stored, especially when compared to storing fresh chips. Chips emerged from the art of frying, either achieved through the application of atmospheric conditions or innovative vacuum method techniques. Frying in atmospheric conditions often causes a decrease in product quality, which is characterized by increased oil content, a darker brown color, and unevenly cooked results.(Sabahannur et al., 2022). Cassava chips are a delicious snack made from thinly sliced tubers, rich in starch content, the manufacturing process begins with slicing cassava very thinly which is then fried in hot oil until dry and crispy. Through this cooking process, these chips have a savory taste and a crispy texture. Cassava chips can be made with an original flavor or seasoned with spices such as balado, sweet and spicy, sweet corn, seaweed or other flavors. Bananas commonly used for chips are kepok bananas and wak bananas. This delicious snack is made from thin slices of banana which are then fried, producing a dry and crispy snack. These banana chips are available in two flavors, namely sweet and original(Jayengsari et al., 2023). Breadfruit chips have become popular as a delicious snack, made by slicing fresh breadfruit into small pieces according to consumer taste. These pieces can be seasoned or unseasoned and fried until cooked.(Hikmana, 2022). Breadfruit chips have a distinctive and slightly sweet taste.

2.3 Weighted Product Method

Weighted Product (WP) is a multicriteria decision analysis technique and serves as a decision-making method across multiple criteria. Similar to many other approaches, WP is a set of decision alternatives arranged across multiple criteria. This approach involves evaluating multiple alternatives across different attributes or criteria, with each attribute standing alone and not affecting the others. The Weighted Product (WP) method is an elegant approach that uses multiplication in an attempt to relate the attribute rankings. In this method, each

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attribute ranking is raised to its corresponding weighted rank, a process known as normalization. This method allows for the aggregation of attributes by multiplying all the criteria by the alternative outcomes, leading to a better relationship between the weights and the alternative products. The following are the steps involved in calculating the Weighted Product (WP) method as explained(Permata et al., 2021).

1) 1Adjustment or normalization of weights

$$w_j = \frac{w_j}{\sum w_j}$$

Run the normalization process to produce values for j= 1, 2,... n, where n is the total number of alternatives, and sum is the overall weight of the criteria.$W_j \sum W_j$

2) Assessing the significance of vector S

$$S_i = \prod_j^n - 1^{x_{ij} w_j}$$

The value vector S arises from multiplying all the criteria by the normalized weights applied to them. Where are the preference criteria located, how many values are assigned to them, and how is the number of criteria measured.

Information :

∏ : represents the Product

S : indicates alternative preferences, similar to the vector

Xij : shows alternative values regarding the jth attribute

wj : weight of each attribute

n : Number of Criteria

3) Assessing the significance of vector V

$$V_i = \frac{\prod_j^n = 1 X_{ij} w_j}{\prod_j^n = 1 (X_{j*}) w_j}$$

V : Choices that resemble vector V in their alternatives

X : Criteria Value

W : Weight of Criteria and subcriteria

i : Alternative

n : Number of criteria

j : Criteria

* : Count of criteria evaluated in the vector S.

3. METHOD

Research methods are a set of systematic techniques, procedures, and processes used in conducting scientific research. Research methods help researchers collect, analyze, and interpret data in an objective and structured manner. Research is a careful and deliberate effort aimed at uncovering facts or principles through a series of organized and systematic steps. Research methods include various procedures or steps taken to gain scientific knowledge or understanding in the field of science. Research methods serve as a structured approach to collecting and organizing knowledge. Research techniques serve as practical tools for applying various research methods.

3.1 Research Steps

The first steps are literature study, Needs Analysis, System Implementation, System Testing, System Design, and Conclusion. Here is a flowchart of the steps of this research:

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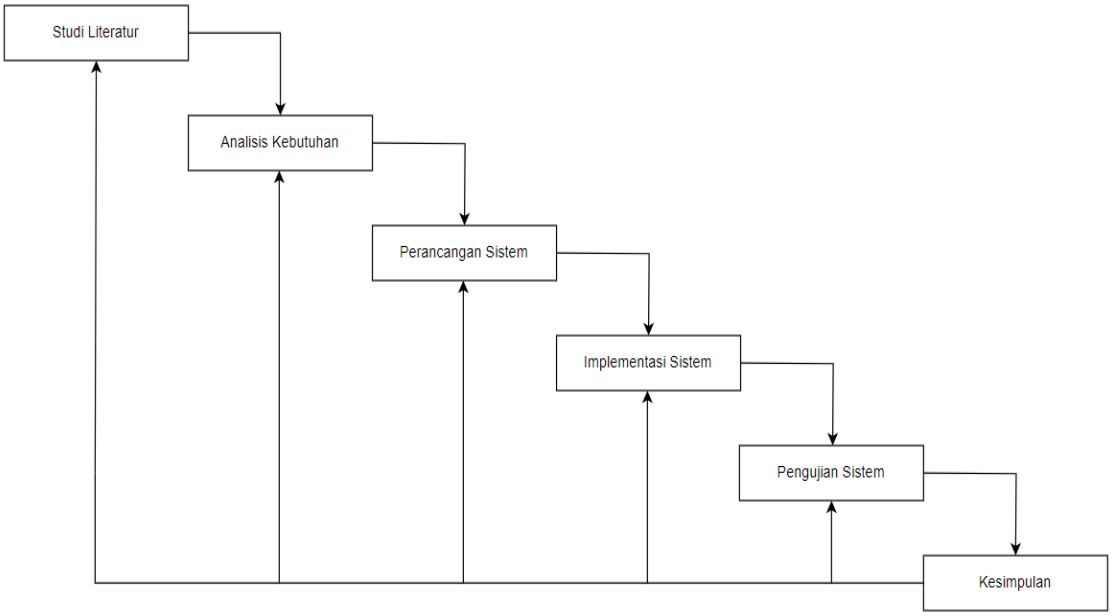

Figure 1 Research Flow

3.2.1 Literature Study

Literature exploration involves a careful examination of various library sources and references that are relevant to the topic or issue being discussed. Researchers engage in literature studies to uncover ideas or reference sources that are relevant to their research. They utilize various reference materials, including papers, the internet, journals, and books that are relevant to their research. After this, evaluation, study, and analysis are carried out, which serve as valuable references for the research process.

3.2.2 Needs Analysis

The requirements analysis process serves as a valuable tool for gathering comprehensive requirements that will shape the system to be developed in the future. This study involves a comprehensive requirements analysis, which is achieved through data collection and direct interviews with the owner of the Hasti family chips business. Once the general requirements data is collected, it will play a significant role in shaping the subsequent system design.

3.2.3 System Design

The design of a system describes its operational flow, which serves as a valuable guide during the development process. This design incorporates the Unified Modeling Language (UML) as an internationally recognized modeling standard for visualizing software architecture. In this design stage, each component of the system is identified and mapped in detail to ensure seamless integration between its parts. The use of UML allows the development team to create a clear visual representation of the structure and behavior of the system through various types of diagrams such as use case diagrams, class diagrams, sequence diagrams, and activity diagrams.

3.2.4 System Implementation

During this system implementation phase, the carefully crafted plans from the previous phase become reality as they are translated into the chosen programming language. System implementation also includes various technical aspects such as database setup, server configuration, user interface creation, and integration with required external systems or services.

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3.2.5 System Testing

At this stage, system testing is performed which is an integral part of the system implementation journey. This process serves as a valuable tool to assess whether the system implementation is in accordance with the established requirements.

3.2.6 Conclusion

This stage is the culmination of all the processes carried out, where conclusions are drawn to address the problems outlined in the formulation phase.

3.2 Algorithm Scheme

The Weighted Product (WP) method algorithm is an interesting approach to handle the complexity of decision making that combines multiple criteria. Here is the algorithm strategy:

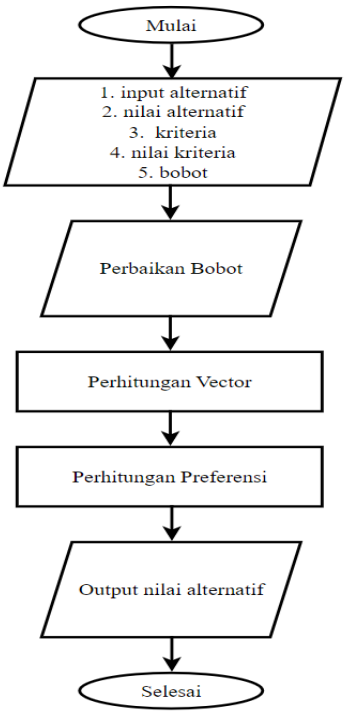

Figure 2 Algorithm Scheme

One of the most prominent decision support system (DSS) approaches, the Weighted Product (WP) method attempts to simplify decision making by including multiple criteria. The graph above illustrates the process flow. The procedure is outlined here:

1. Starting: Using the Weighted Product Method as a starting point for decision making.

2. *Input*alternatives, potential values, benchmarks, criteria values, and weights: Important elements such as the alternatives to be assessed, the criteria used, the scores or values for each criterion, and the weights or degree of importance associated with each criterion are entered by the user in this step.

3. Weight Correction: To make the total weight equal to one, it may be necessary to correct or normalize the given weights.

4. Vector Calculation: This is part of the Weighted Product Method when vector calculations are performed. To get a vector, we simply multiply the alternative values by the criteria weights.

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5. Preference Calculation: Preference calculation follows the acquisition of alternative vectors. One way to determine preferences is to sum all possible vectors and compare them with each other.

6. *Output*alternative value: The choice or option with the largest preference value will be selected or recommended based on the preference calculation.

7. Done: We have obtained the results of the decision-making process using the Weighted Product Method, namely the selected option.

4. RESULTS AND DISCUSSION

To find the best raw materials for Hasti Family Chips Business, this study will use the Weighted Product (WP) approach. This study aims to provide a systematic strategy in selecting high-quality raw materials that will improve the quality of the final product by implementing this multicriteria decision-making process.

4.1 System Analysis

Hasti Family Chips Business will develop a decision support system that focuses on the selection of raw materials for chips using the Weighted Product (WP) approach. When selecting raw materials for chips, users can enter criteria and alternative data provided by the system to obtain results. An online application built on the PHP framework and MYSQL database will serve as the backbone of this decision support system. Color, texture, taste, durability, and price of fruit are some of the factors used as evaluation objects in this method.

4.2 Process Analysis

Building a decision support system on the selection of chips ingredients using a login/logout system. Inputting value data from alternative chip ingredient data consisting of several criteria. And performing calculations using the weighted product method. The login/logout system is implemented to ensure data security and then ensure that only users have the right to access the system. This process is an authentication process that can enable administrators to manage user access rights and track activity in the system effectively.

4.3 Basic Model Management

The system is built using an object-oriented design based on the Unified Modeling Language (UML) architecture. This design allows for a smooth description of the internal workings of the system. The system requirements and specifications will also inform the selection of a programming language for the implementation phase, which will realize this new design. The Unified Modeling Language (UML) is a standard for systems development and includes a variety of diagrams that can depict the system from various angles. A variety of visual representations can be used to depict the components and interactions of the system, including class diagrams, use case diagrams, activity diagrams, and sequence diagrams.

4.4 System Testing

This research is based on an analysis approach that is carried out manually and informally, by considering various functional aspects of the system being developed. In order to ensure the quality of the system, the system development process is carried out by implementing the black box testing method, which focuses on testing functionality without looking at the internal program code. The following will show in detail the results of testing using the black box method on various website features and functions that have been thoroughly tested to ensure system reliability.

Table 1. Blackbox System Testing

No	Testing	Test Case	Expected results	Test Results	Conclusion
1	*Login Form*	Select Login Options	The administrator dashboard view appears.	in line with expectations	according to the provisions
2	Add Criteria Data	Select Criteria Data Options	Add Criteria Data Page View	in line with expectations	according to the provisions

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3	Edit Criteria Data	Select the Edit Data Button Option	Edit Criteria Data Page View	in line with expectations	according to the provisions
4	Delete Criteria Data	Select the Delete Criteria Data Button Option	Data Deletion Selected criteria	in line with expectations	according to the provisions
5	Add Sub Criteria Data	Select Sub Criteria Data Options	Add Sub Criteria Data Page View	in line with expectations	according to the provisions
6	Edit Sub Criteria Data	Select the Edit Data Button Option	Sub Criteria Data Edit Page View	in line with expectations	according to the provisions
7	Delete Sub Criteria Data	Select the Delete Sub Criteria Data Button Option	Deleting Selected Sub Criteria Data	in line with expectations	according to the provisions
8	Add Alternative Data	Select Alternative Data Option and Click Add Data	Add Alternative Data Page View	in line with expectations	according to the provisions
9	Edit Alternative Data	Select the Edit Data Button Option	Alternative Edit Page View	in line with expectations	according to the provisions
10	Delete Alternative Data	Select the Alternative Delete Data Button Option	Alternative Data Deletion	in line with expectations	according to the provisions
11	Edit Assessment Data	Select the Assessment Data Option and Select the Edit Data Button Option	Edit Assessment Data Page View	in line with expectations	according to the provisions
12	Calculation Data	Select Calculation Data Option	Calculation Page View	in line with expectations	according to the provisions
13	Final Result Data	Select Final Result Data Option	Final Result Data Page View	in line with expectations	according to the provisions
14	Print Data or Export	Select the Final Result Data Option and Select the Print Data and Export Button Option	Providing Output Results in the Form of Data	in line with expectations	according to the provisions
15	Add User Data	Select User Data Option and Add User Data	Add User Data Page View	in line with expectations	according to the provisions

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16	Edit User Data	Select User Data Option And Click Edit Data Button	Edit User Data Page View	in line with expectations	according to the provisions
17	Delete User Data	Select User Data Option And Click Clear Data Button	Delete User Data Page View	in line with expectations	according to the provisions
18	Add Profile Data	Select the Data Profile Option and Click the Update Button	Profile Data Page View	in line with expectations	according to the provisions
19	Reset Profile Data	Select Data Profile Option And Click Reset Button	Profile Data Page View	in line with expectations	according to the provisions

4.5 System Implementation

1. Login Page

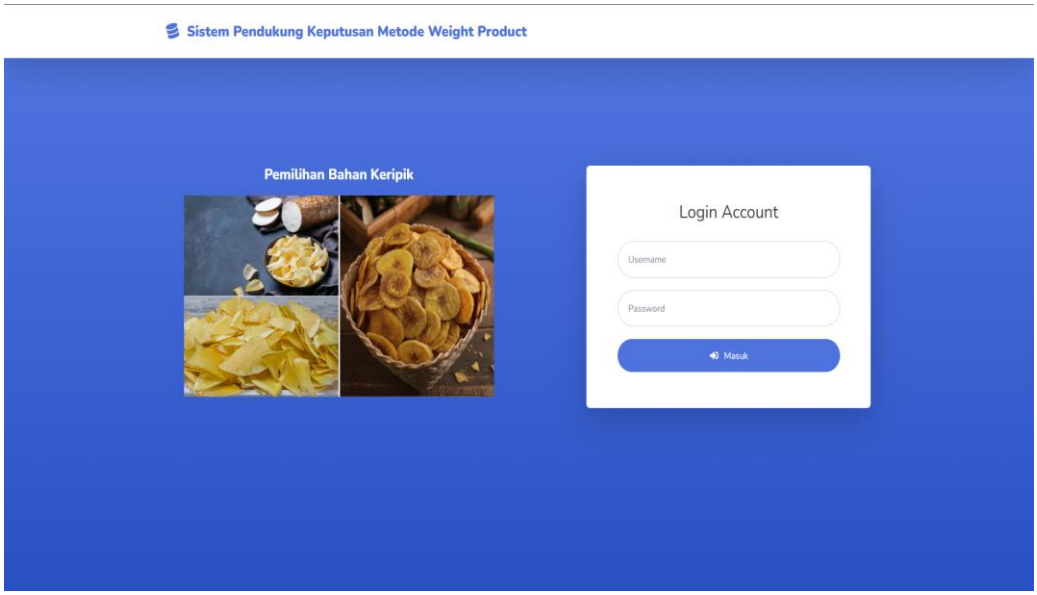

Figure 3. Login Page

The above image shows the admin login interface, where the administrator enters their password and username. Once successful, the system will guide the administrator to the system dashboard page.

2. Dashboard Page

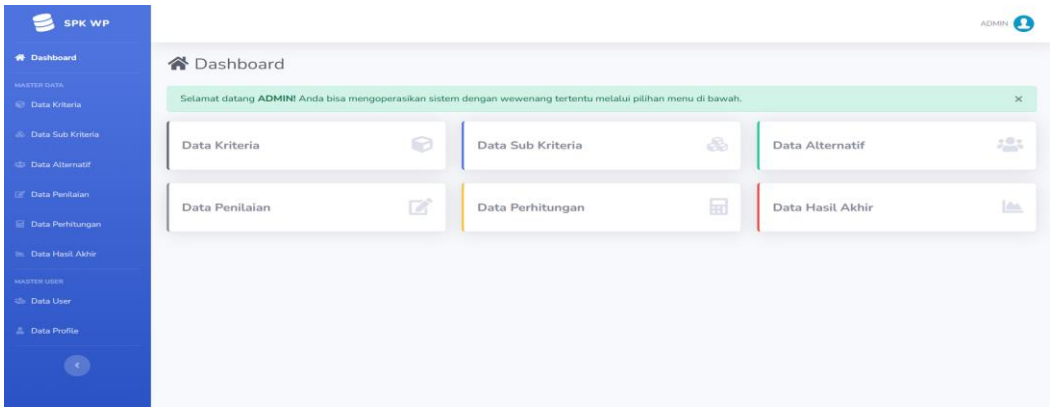

Figure 4. Dashboard Page

The page above is the system dashboard page, on the following page you can see a display of all the elements contained in the system.

3. Criteria Data Page

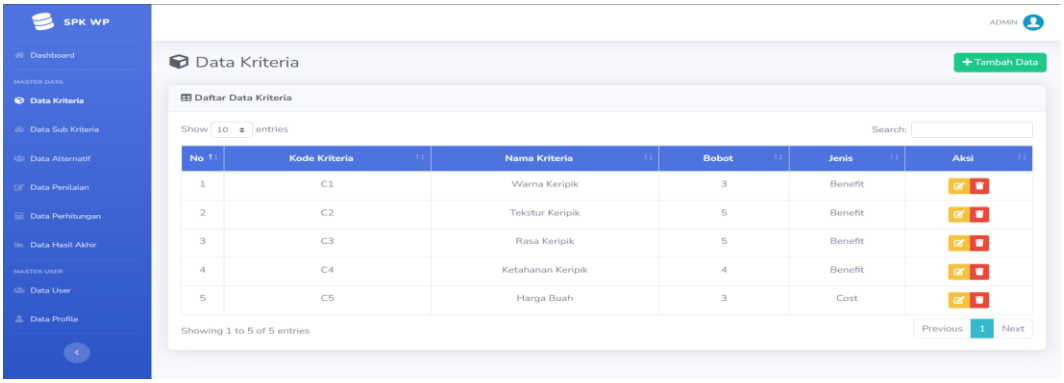

Figure 5. Criteria Data Page

The above mentioned page displays all the database data, which is referred to as criteria data. The content on this page can be added, updated or deleted by the administrator.

4. Sub Criteria Data Page

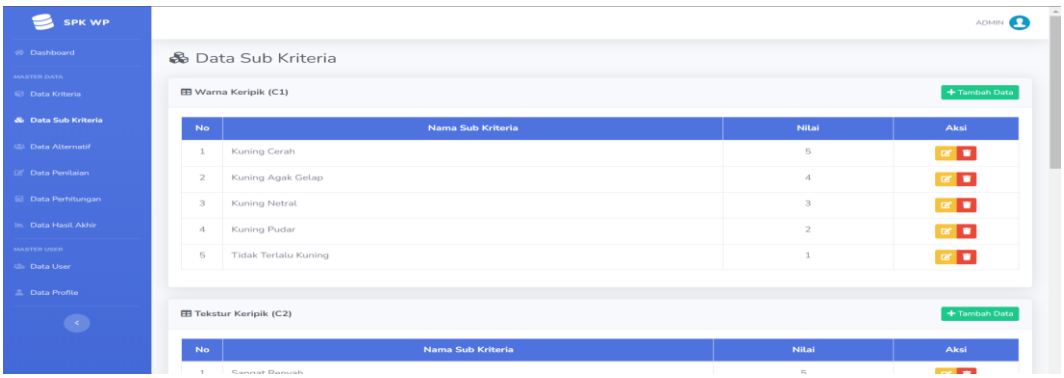

Figure 6. Sub Criteria Data Page

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5. Alternative Pages

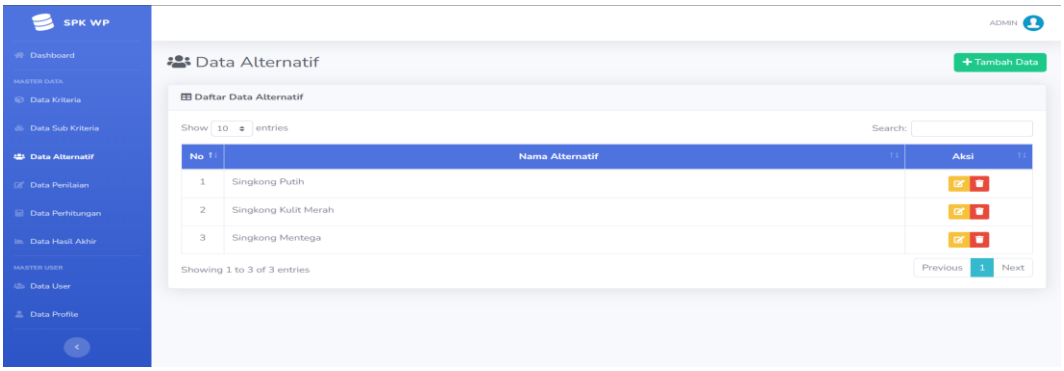

Figure 7. Alternative Pages

Admin can fill out the form to add, change or delete data on the alternative page above, and then the system will save the data into the database.

6. Assessment Data Page

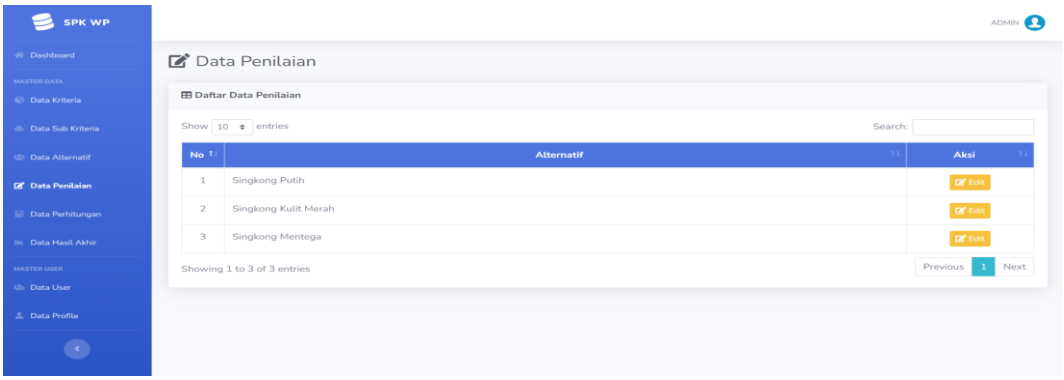

Figure 8. Assessment Data Page

On the assessment data page, which is there, the administrator has the ability to add assessments for each option and change the assessment data.

7. Calculation Data Page

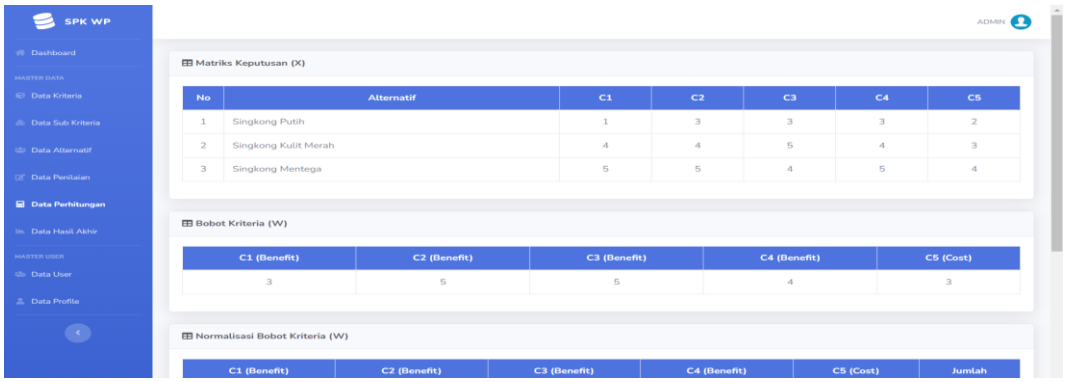

Figure 9. Calculation Data Page

You can find the calculation procedure for the weighted product method, including for alternative and criteria weights, on the calculation page which can be accessed via the link above.

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4.6 Results

1. Final Results Data of Cassava Calculation

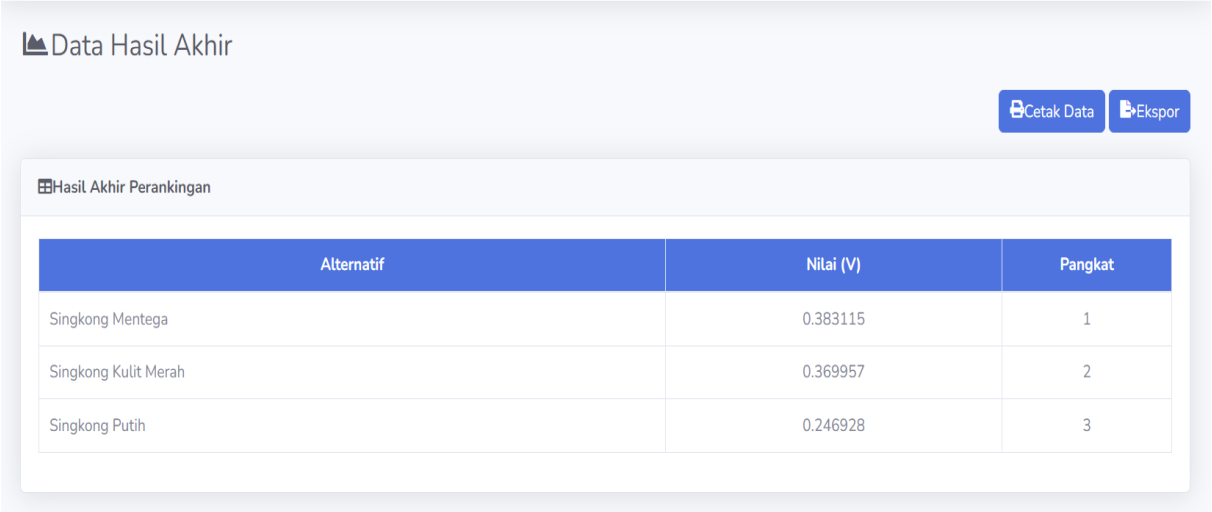

Figure 10. Final Data Page of Cassava Calculation

The image above is the final data page from calculating 3 types of cassava and getting the final results with the highest to lowest values.

2. Final Result Data of Banana Calculation

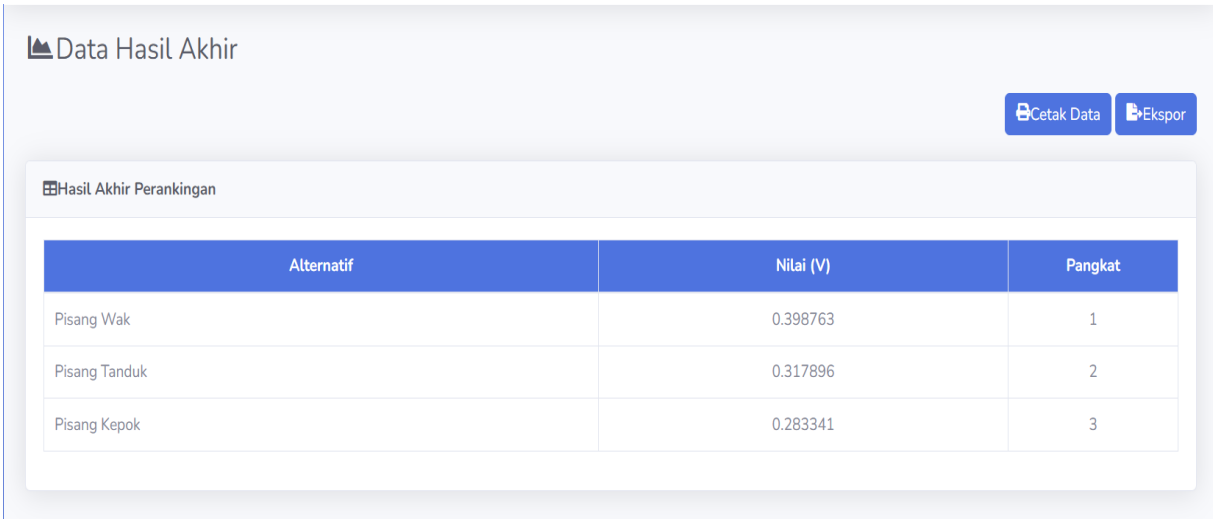

Figure 11. Banana Calculation Final Data Page

The image above is the final data page from calculating 3 types of bananas and getting the final results with the highest to lowest values.

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3. Final Result Data of Sukun Calculation

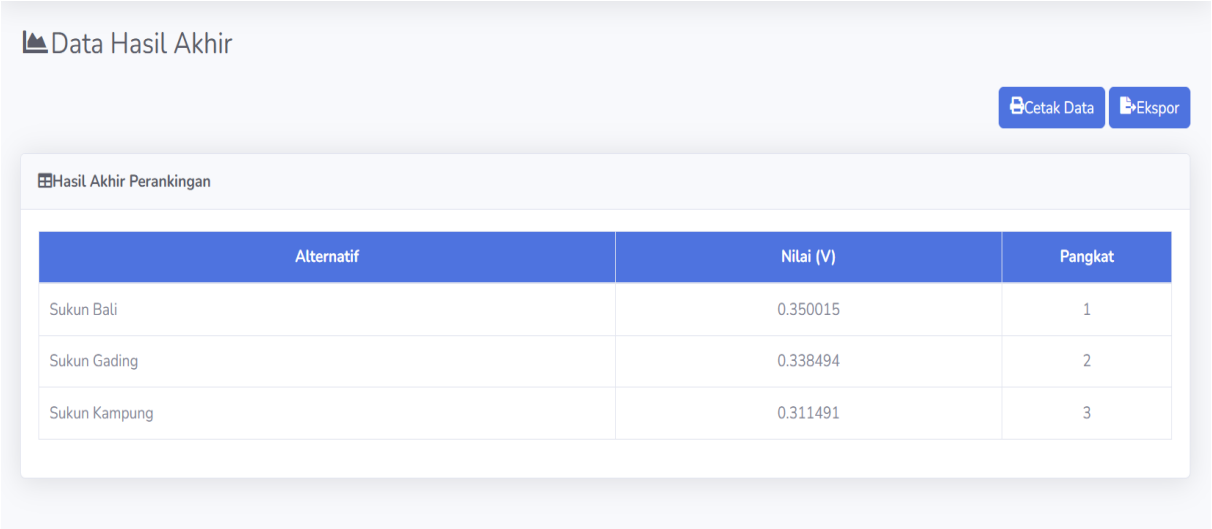

Figure 12. Banana Calculation Final Data Page

The image above is the final data page from calculating 3 types of breadfruit and getting the final results with the highest to lowest values.

5. CONCLUSION

Cassava butter (V = 0.3831), banana wak (V = 0.3987), and Balinese breadfruit (V = 0.3500) are the top three items according to research conducted at the Hasti family chips company by utilizing a decision support system that uses the Weighted Product approach. This approach has succeeded in increasing production efficiency and product quality by optimizing raw material selection through systematic criteria weighting. A more standardized manufacturing process and more consistent product quality are the end results of the effective implementation of this system, which in turn leads to happier customers and more stable revenue development for the company.

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