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Decision Support System for Aren Sugar Aid Using SMART Method

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Abstract

Sugar palm, recognized in scientific terms as Arenga pinnata Merr, is a species of palm commonly found all over Indonesia. This plant has the ability to produce a liquid sap that comes from its cut flower bunches. Looking at its chemical makeup, sugar palm sap is made up of 87.2% water, 12.7% carbohydrates, and smaller amounts of 0.24% ash, 0.2% protein, along with 0.02% fat. The Simple Multi Attribute Rating Technique serves as a method for making decisions that takes into account a number of different features, offering assistance to those making decisions when picking from a number of choices. Eachchoice is designedusing a group of features, with ea ch feature having a value that is assessed on a certain scale. On top of that, a weighted value is given to each of the features, which shows how important it is when it is compared to the other features. Using a Decision Support System that uses this technique could result in choices that are more efficient, faster, and more accurate when it comes to choosing who gets help with making palm sugar during the first stage. Evaluations that use White Box Testing and Basis Path Testing methods have shown that this system is reliable, and the V(G) value that was produced was.

Keywords— *Sugar Palm, Plant, Smart, Sugar*

1. Introduction

In today's technologically advanced world, managing academic data is critically important.Aren, scientifically named Arenga pinnata Merr, represents a palm species broadly found across Indonesia. This plant yields a juice called "nira", which is harvested from its severed flower stem.The makeup of nira includes mostly water at 87.2%, alongside 12.7% starch, 0.24% ash, 0.2% protein, and a small 0.02% of fat. Heryani noted in 2016 that freshly extracted nira offers a sugary flavor, a distinctive natural scent, measures an acidity between 5 and 6, boasts a sucrose level exceeding 12%, and possesses an alcohol percentage less than 5%.

The enjoyable taste in nira is attributed to various elements like sucrose, glucose, fructose, as well as carbohydrates.Sap collection occurs twice daily—once in the morning and again in the evening—yielding different sap amounts each time. Typically, the morning extraction results in a higher volume of sap compared to the evening harvest. Aside from collection timing, other aspects such as elevation, rainfall amounts, and soil richness also influence sap production.
For instance, increased rainfall usually causes a greater sap quantity; however, it simultaneously reduces the sugar concentration, thereby diminishing its sweetness (Heryani, 2016).

The aren sugar industry now offers a potentially lucrative chance for individuals looking to start their own businesses. Molded aren sugar, derived from nira, is created utilizing the sap extracted from the male flower stems of the aren tree. Making it is quite straightforward—involving the boiling of sap to create a dense, dark brown substance. However, choosing who will get help to make aren sugar in villages remains hard because more and more people are doing it (Hutami, A., & Budi, S., 2023). Because of this, we need a good way to choose people, ensuring that aid actually goes to those who need it the most. Right now, village leaders are using old information, meaning some people who no longer make sugar are still getting assistance. Because of this, new business owners just getting started often miss out on the chance to get help. The SMART (Simple Multi-Attribute Rating Technique) method is a way to make decisions considering many qualities, where each option has different features with set values. Each feature is assigned a weight to show how much it matters compared to the other features (Morton, M. S., 1970).

Through the application of this method, the local government of Hulawa Village will have the capacity to designate significance weights to the criteria for choosing aid recipients for palm sugar production in an easier manner, resulting in a selection process that is both more equitable and accurate. The origin of the term "system" can be traced back to the Latin word systema and the Greek word sustēma, both of which denote a comprehensive entity comprised of numerous interconnected elements that collaborate to accomplish a particular objective by utilizing information, resources, or power. Alternatively, a system can be characterized as a collection of interconnected components functioning collectively within a designated domain. A Decision Support System (DSS) constitutes an adaptable and sophisticated framework that leverages data to provide, manipulate, and present insights, thereby facilitating decision-making in scenarios characterized by ambiguity or partial definition, wherein the resolution approach remains undetermined. The concept of DSS was initially introduced by Michael Scott Morton in 1970 under the designation Management Decision Systems. This computerized system aids managers in their decision-making processes by employing diverse data types and analytical methodologies to tackle intricate challenges.

2. Theoritical Foundation

a. Decision Support System (DSS)

A Decision Support System (DSS) is a computer-based system designed to assist decision-makers in addressing semi-structured or unstructured problems by providing an integrated environment consisting of databases, analytical models, and interactive user interfaces. The concept of DSS has evolved since Morton’s early idea of Management Decision Systems and has been widely applied in resource planning, aid allocation, and policy decision-making. DSS enables the combination of empirical data and decision models to produce transparent, consistent, and well-documented recommendations.

b. Simple Multi-Attribute Rating Technique (SMART)

The Simple Multi-Attribute Rating Technique (SMART) is one of the Multi-Criteria Decision-Making (MCDM) methods that evaluates the performance of each alternative against a set of criteria and then aggregates the results using weighted scores. This method is popular in applications that require simplicity, transparency, and stakeholder engagement, as its calculations are straightforward (normalized value × weight → weighted sum). Data normalization and weight determination are key steps that significantly influence the final SMART output.

3. Method

The SMART method is a decision-making approach used for evaluating several alternatives based on multiple criteria. It belongs to the family of Multi-Criteria Decision Making (MCDM) techniques. SMART was developed to provide a clear, straightforward, and easy-to-apply framework, especially when decisions involve many factors that need to be considered simultaneously. In practice, SMART assigns a rating to every criterion for each alternative, determines the importance weight, and then calculates a final composite score that leads to a ranking. In short, SMART transforms complex choices into a structured process that supports rational and accountable decision making.

This research employs a descriptive methodology to create a decision support system, leveraging the SMART method, for choosing beneficiaries of assistance in aren sugar production. The goal is to deliver a structured and unbiased examination of the current challenges, while also putting into action a decision-making framework that enables village officials to allocate resources equitably and efficiently.

3.1 Review Process

The assessment procedure starts by examining the existing method the village uses to determine who gets aren sugar assistance. Information was gathered by directly watching and talking with the Village Leader and other people in charge in Hulawa Village using a set of questions. The main problems discovered are using old information about who should get help and not having clear, fair rules for picking people.

After that, a new system was created using the SMART way, which lets different options (possible help receivers) be judged based on many rules that are given different importance. Rules like how much they can make, how much money they have, if they own land, and how long they've been working were decided after talking with people involved. Each rule was given a score based on how important it is for picking people.

3.1.1 Equations

The SMART approach leverages a formula based on weighted scores to assess every possible option. The comprehensive score for each option is determined through this equation:

$$S_i = \sum_{j=1}^{n} w_j \cdot r_{ij} \qquad (1)$$

4. Where:

Si = comprehensive mark attained for option i
wj = significance given to factor j
rij = standardized assessment of option i with respect to factor j
n = aggregate tally of factors

Each assessment rij undergoes standardization to ascertain uniformity, and significance values wj are designated so that the summation of all significance values tallies to 1.

5. Results And Discussion

Tabel 1. Evaluation Standards (Initial Weights Included – Adjustable

No	Criterion	Description	Type	Weight (%)
1	Land Area for Aren Plantation	A larger plantation area generally indicates a higher potential production capacity.	Benefit	25%
2	Number of Productive	A greater number of healthy trees reflects the	Benefit	20%

	Aren Trees	potential to produce more sap.		
3	Monthly Farmer Income	Farmers with lower income are given higher priority for assistance.	Cost	15%
4	Number of Family Dependents	Assistance needs increase as more family members rely on the farmer's income.	Benefit	10%
5	Availability of Traditional Processing Tools	Indicates whether the farmer already owns necessary tools without external support.	Cost	10%
6	Participation in Farmer Groups	Active engagement shows commitment and increases the likelihood of long-term success.	Benefit	10%
7	Accessibility of Location	Priority rises for farmers who live farther from distribution centers or markets.	Cost	10%

Tabel 2. Alternatives (Potential Recipients):

No	Name
A1	Mr. Ahmad
A2	Mrs. Siti
A3	Mr. Ridwan
A4	Mrs. Lestari
A5	Mr. Yusuf

Tabel 3. Define Criteria and Weights

No	Criterion	Type	Weight (%)	Decimal Weight
C1	Land Area (ha)	Benefit	25	0.25
C2	Productive Aren Trees	Benefit	20	0.20
C3	Monthly Income (IDR)	Cost	15	0.15
C4	Number of Dependents	Benefit	10	0.10
C5	Ownership of Traditional Tools	Cost	10	0.10
C6	Participation in Farmer Groups (1–5)	Benefit	10	0.10
C7	Accessibility (km)	Cost	10	0.10

Tabel 4. Data for Alternatives

Alternative	C1 (Ha)	C2 (Trees)	C3 (IDR)	C4	C5 (1–5)	C6 (1–5)	C7 (km)
A1	1.5	40	1,500,000	4	2	4	12
A2	1.0	30	1,000,000	5	3	5	20
A3	0.8	25	2,000,000	2	4	3	10
A4	1.2	35	1,200,000	3	2	4	15
A5	1.7	50	900,000	6	1	5	25

Normalization (SMART Method)

Normalization for A1:
Implement this process for each of the other options as well.
Determine the ultimate SMART score.

$$
\begin{aligned}
\text{Skor A1} =& (0.882 \times 0.25) + (0.800 \times 0.20) + (0.600 \times 0.15) + \\
& (0.667 \times 0.10) + (0.500 \times 0.10) + (0.800 \times 0.10) + (0.833 \times 0.10) \\
=& 0.2205 + 0.160 + 0.090 + 0.0667 + 0.050 + 0.080 + 0.0833 \\
=& **0.7505**
\end{aligned}
$$

Here are the ultimate outcomes from the SMART approach calculation, utilized to pinpoint individuals who could benefit from help with palm sugar production:

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Table 5. Alternative Rankings Based on Final Scores

Ranking	Alternative	Final Score
1	A5	0.9400
2	A1	0.7506
3	A4	0.6756
4	A2	0.6687
5	A3	0.5035

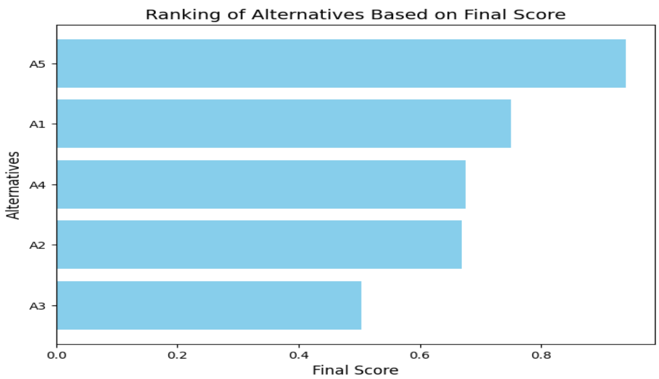

Figure 1. The Arrangement of Choices by Achieved Totals

• Due to its superior score, A5 emerges as the leading contender to receive immediate support.
• The remaining options can be organized by score and subsequently addressed in that sequence.

After creating all the parts, the system is tested to make sure it works how it should. During the testing of both separate parts and how they work together, strategies like looking inside and outside the box are used. To check important routes and figure out how complicated things are, testing that looks inside the box is done. On the other hand, testing that looks outside the box focuses on how well the multimedia learning setup meets its required purposes.

Testing that looks inside the box is a way of checking software by looking at the code to make sure that what goes in and what comes out matches what is expected. There are multiple steps to testing that looks inside the box using the basic route method, like making a diagram of how the function being tested flows, figuring out how complicated it is, and doing tests on individual pieces.

From the flowgraph shown in Figure 5.2, the following values were obtained:

- Region (R) = 9
- Node (N) = 20
- Edge (E) = 27
- Predicate Node (P) = 8

V(G) = E – N + 2

The subsequent formulas can be employed to figure out the Cyclomatic Complexity of the program:

- **V(G)**: Cyclomatic complexity
- **E**: Total number of edges
- **N**: Total number of nodes

Based on the flowgraph, the Cyclomatic Complexity is:

V(G) = 27 – 20 + 2 = 9
or

V(G) =8+1=9

The derived value of 9 signifies the count of distinct routes essential for fundamental path assessment. To put it differently, this signifies the quantity of testing scenarios mandated to guarantee each line of code within the application undergoes execution a minimum of one time.
List of Independent PathsThe independent paths derived from the flowgraph are as follows:

- R1 : 1-2-3-4-5-6-2
- R2 : 1-2-3-4-5-6-7-8-9-10-2
- R3 : 1-2-3-7-8-9-10-2
- R4 : 1-2-3-7-12-13-14-2
- R5 : 1-2-3-7-12-16-17-18-2
- R6 : 1-2-3-7-12-16-17-19-20
- R7 : 1-2-3-7-8-9-11-20
- R8 : 1-2-3-7-12-13-14-15-2
- R9 : 1-2-3-7-12-16-20

Notes:

- A distinct route represents any course of action within the software that incorporates, at a minimum, a single, unprecedented compilation of commands or an unfamiliar scenario.
- Every unique route needs to pass over, as a bare minimum, one pathway that hasn't been utilized by any preceding route.
- Distinct routes are required to commence from the initial node and conclude at the final node at all times.
- The initial route recognized often represents the briefest distinct route..

6. Conclusions

According to the outcomes of the study, the Decision Support System (DSS) created to help choose the first group of people to get help making palm sugar showed these things:

1. A technique has been made to create a decision support system for choosing the first group of people to get help making palm sugar, and it uses the SMART method. This system is made to help the Hulawa Village government choose people who should get aid, making sure the aid is given to the right people and meets their needs better.

2. The decision support system that was created using the SMART method is now being used successfully in Hulawa Village. The White Box method was used to test how well the system works, and the results show that the designed system works as it should and is well computerized, as shown by the V(G) 9 value that was calculated..

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