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Decision Support System for Selection of Quality Palm Seeds with the Analytical Hierarchy Process Method

Almi Wihaya Putra [1]
[1] Putra Indonesia University YPTK Padang
almiwijayap@gmail.com

Abstract

At PT. Gersindo, which is located in West Pasaman Regency, is a factory company that processes palm fruit into semi-finished oil or often called CPO (Crude Palm Oil). The main part that is managed in oil palm is the fruit, the fruit of the oil palm produces crude oil. PT. Gersindo is currently still using the manual method in determining the quality of the oil palm kernels, so that problems arise in the selection of the oil palm kernels at PT. Gersindo. At the factory PT. Gersindo in selecting quality palm kernels can be solved by developing an application in a decision support system. A decision support system is a system that is able to solve problems efficiently and effectively, which aims to help make decisions by choosing various alternative decisions. One technique that can be applied in developing a decision support system is to use the AHP (*Analytical Hierarchy Process*) method. The AHP method is a method in a decision support system for solving a very complex and unstructured problem into several component parts in a hierarchical arrangement by giving subjective values. The essence of the AHP method is to determine the weight value for each criterion. The results of this study can be determined *Consistency Ratio* (CR) is 0.0705 . And CR is less than 0.1 , then the matrix is declared consistent, so it is very effective and efficient in making decisions on selecting quality palm kernels.

Keywords: Decision Support System, Palm Oil, *Analytical Hierarchy Process* , *Consistency Ratio* , Matrix .

1. Introduction

The role of computers today is very large in all fields, be it business, entertainment, to the military. With a computer, it can simplify and speed up a job, and carry out complex processes. Changes and developments in technology and advanced information systems are increasingly needed to help complete human work in various fields. A company or agency should have an information system design that suits their needs, so that it can produce high-value technology and can be used in making decisions.

At PT. Gersindo, which is located in West Pasaman Regency, is a factory company that processes palm fruit into semi-finished oil or often called CPO (Crude Palm Oil). The main part that is managed in oil palm is the fruit, the fruit from oil palm produces crude oil and the rest of the processing is used as a mixture of animal feed [1]. PT. Gersindo is currently still using the manual method in determining the quality of the oil palm kernels, so that problems arise in the selection of the oil palm kernels at PT. Gersindo.

Factory PT. Gersindo in selecting quality palm kernels can be solved by developing an application in a decision support system. A decision support system is a system that is able to solve problems efficiently and effectively, which aims to make decisions by choosing various alternative decisions [2].

Decision Support System (DSS) is a system that can provide problem solving, communicate for solving certain problems with structured or unstructured. SPK is designed to be used and operated easily by people who only have basic computer operating skills. SPK is made by implementing high competency adaptation so that it can be used as an alternative in making a decision [3].

SPK as a system that supports a person or a small group of managers who work as a problem solving team (decision making team), to make decisions on semi-structured problems by providing specific information. Decision support systems will also facilitate the decision-making process and provide solutions to existing problems [4]. DSS is designed to support all stages of decision-making starting from problem identification, selecting data, determining the approach used in the decision-making process and evaluating alternative selection activities [5].

One technique that can be applied in developing a decision support system is to use the AHP (*Analytical Hierarchy Process*) method. The AHP method is a method in a decision support system for solving a very complex and unstructured problem into several component parts in a hierarchical arrangement by giving subjective values. The essence of the AHP method is to determine the weight value for each criterion [6].

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-making method was first developed in 1980, by Thomas L. Saatya in his book Analytical Hierarchy Process. The Analytical Hierarchy Process (AHP) is a decision-making process using pairwise comporisons to explain evaluation factors and weight factors in multi-factor conditions [7].

Previously, research on decision support systems had been carried out under the title Application of Decision Support Systems for Acceptance of School Operational Assistance Funds for SMA N 1 Students. The applications designed and implemented are supported by the TOPSIS method, using the waterfall development method and implemented with flowcharts, context diagrams, data. Flow Diagrams, Entity Relationship Diagrams, Table Relations, Table Specifications [8]. Decision Support System for Selection of Computer Service Places in Bandar Lampung City Using the AHP Method, Extreme programming is used as a system development method including planning, design, coding and testing which will be tested by functionality testing (Black Box) and system feasibility testing. The results showed that the best alternative was Asacom with a total score of 7.5204 [9]. Application of the Exponential Comparison Method (Mpe) in the Decision Support System for Outstanding Student Scholarship Recipients at Xyz Vocational High School. This research produced a decision support system to determine outstanding student scholarship recipients with criteria of achievement, discipline, attendance by applying the MPE method [10]. Web-Based Information System for Management of Recipients of Zakat, Infaq and Alms Funds. In this system there is a system for inputting data, searching for data, editing data, updating data and preparing reports that make it easier for users to search for data, change data and update the desired data [11]. As well as Designing an Online-Based Smart Indonesia Scholarship Program (PIP) Information System (Case Study: SMA N 1 Kota Bumi), this information system can be used to register for scholarships online, manage information content, and view scholarship selection results[12]. a decision support system using the AHP method in product selection obtains results to assist in decision making based on the output results provided through the use of predetermined criteria and sub-criteria [13]

2. Research methodology

To assist in the preparation of this research, it is necessary to have a framework with clear stages. This framework is the steps that will be taken in solving the problems to be discussed, can be seen in Figure 1 below:

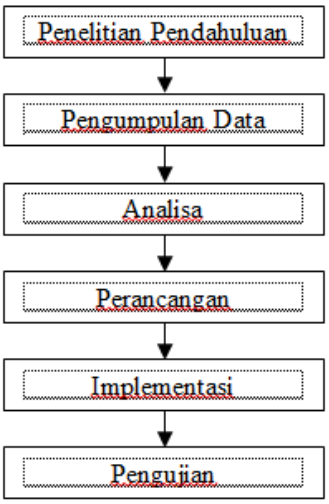


Figure 1. Research Framework

Based on the research stages in Figure 1, each stage can be explained in detail as follows:

1. Preliminary Research

Preliminary research is the process of approaching the research object. The purpose of studying the literature in this research is to strengthen the theory and methods used to solve existing problems as a theoretical basis for conducting studies.

2. Data collection

For data collection, the authors obtained data from various sources, such as this research, obtained from articles, obtained from other references , and the authors conducted interviews directly with the managers at the PT factory. Gersindo. The author records some important information related to the research being carried out.

3. Analysis

a. Data analysis

This analysis is carried out to limit the object to be studied so that it becomes information that is more systematic and easy to understand. The data analysis stage is the most important stage in developing a system. The data obtained is in the form of interviews with the Manager at the PT. Gersindo.

b. Process Analysis

This analysis is carried out to find out how to solve the problem so that it can produce a solution using the right method. The method used in this study is the AHP method which is a method to help agencies/companies to optimize information technology processing.

c. System analysis

A very important stage if there is an error at this stage it will cause an error at the next stage. This analysis is carried out to find out what is needed in system

development. So that it can produce an effective and efficient system in its implementation later. Where the program will be created using the PHP programming language and MySQL database.

4. Design

At this stage the authors design the system to be developed. The author will analyze the program that is currently running and design the application that is being developed.

5. Implementation

System implementation is the stage of laying the system so that it is ready to operate. Implementation aims to confirm design modules, so users can provide input to system development. At this stage the system design is carried out using *the PHP* and *MySQL programming languages.*

6. Testing

Testing is one of the important things in the production process to find out whether the product that has been produced is well controlled or not. After the coding process is complete, a testing process will be carried out on the resulting application to find out whether the designed application is running correctly and in accordance with the design being carried out.

3. Results and Discussion

3.1 *Analytical Hierarchy Process* Method

The analysis of the weighting of the criterion values in the AHP (Analitycal Hierarchy Process) method is by means of create a pairwise comparison matrix that describes the relative contribution. Based on the data that has been obtained, the criteria for selecting high-quality oil palm kernels are as follows:

1. Maturity Fraction(FK)
2. Price (HG)
3. Pickup Distance(JP)
4. Quarantine Statement (PK)
5. Growth (PR)

Doing the weighting, we get a pairwise comparison matrix which can be seen in Table 1 below:

Table 1. Pairing Comparison Matrix

Criteria	FK	HG	JP	PK	homework
FK	1	2	3	5	6
HG	½	1	4	6	7
JP	1/3	¼	1	3	4
PK	1/5	1/6	1/3	1	2
homework	1/6	1/7	¼	1/2	1

Weighting analysis converts the values in the pairwise comparison matrices into decimal numbers to get the Total matrix (*Priority Vector*). Then normalize the values on the matrix, which can be seen in Table 2 below:

Table 2. Value Normalization

Criteria	FK	HG	JP	PK	homework
FK	1.0000	2,0000	3,0000	5,0000	6,0000
HG	0.5000	1.0000	4,0000	6,0000	7,0000
JP	0.3333	0.2500	1.0000	3,0000	4,0000
PK	0.2000	0.1667	0.3333	1.0000	2,0000
homework	0.1667	0.1429	0.2500	0.5000	1.0000
Total	2,2	3.5596	8.5833	15.5	20

The results of carrying out the normalization calculation phase can be seen in Table 3 below:

Table 3. Calculation of Normalization

Criteria	FK	HG	JP	PK	homework
FK	1.0000 / 2,2	2,0000 / 3.5596	3,0000 / 8.5833	5,0000 / 15.5	6,0000 / 20
HG	0.5000 / 2,2	1.0000 / 3.5596	4,0000 / 8.5833	6,0000 / 15.5	7,0000 / 20
JP	0.3333 / 2,2	0.2500 / 3.5596	1.0000 / 8.5833	3,0000 / 15.5	4,0000 / 20
PK	0.2000 / 2,2	0.1667 / 3.5596	0.3333 / 8.5833	1.0000 / 15.5	2,0000 / 20
homework	0.1667 / 2,2	0.1429 / 3.5596	0.2500 / 8.5833	0.5000 / 15.5	1.0000 / 20

Results normalization And *Eigen Vector* (EVs) or value the average matrix can be seen in Table 4 below:

Table 4. The Average Value of the Matrix

Kritehappy	FK	HG	JP	PK	homework	EV
FK	0.4545	0.5619	0.3495	0.3226	0.3000	0.3977
HG	0.2273	0.2809	0.4661	0.3871	0.3500	0.3423
JP	0.1515	0.0703	0.1165	0.1935	0.2000	0.1463
PK	0.0909	0.0468	0.0388	0.0645	0.1000	0.0682
homework	0.0758	0.0401	0.0291	0.0323	0.0500	0.0455
Total	1	1	1	1	1	1

It is necessary to carry out *the Consistency Ratio* (CR) matrix or check the consistency of the matrix. And the theoretical study of this matter has been discussed in the previous chapter, where CR can be calculated by referring to the *Random Index* (RI) which can be taken with conditions according to the number of criteria used. RI is a divisor of *the Consistency Index* (CI) to get CR results. The following is the equation for calculating *the Consistency Index* and *Consistency Ratio values* , followed by the *Random Index values* :

$$\mathrm{CI} = (\lambda\mathrm{maks} - \mathrm{n})/(\mathrm{n} - 1$$

And/or

$$CR = CI/RI$$

Get *Eigen*maximum (*Principal Eigen*) or calledAlso *Lambda* maximum (λmax), that is with method

multiply *priority Vector* with *Eigen Vector* Which has got previously. And result can seen Table 5 following:

Table 5 Total Maximum Lambda

Criteria	EV	Total Matrix	Results
FK	0.3977	2,2000	0.8749
HG	0.3423	3.5595	1.2183
JP	0.1463	8.5833	1.2563
PK	0.0682	15,5000	1.0574
homework	0.0455	20,0000	0.9091
Total or λmax			5.3160

Inspect matrix consistency (*Consistency Ratio*) can seenon the following stages:

Determine Consistency Index

$$\mathrm{CI} = (\lambda\mathrm{maks} - \mathrm{n})/(\mathrm{n} - 1$$
$$CI = (5{,}316 - 5)/(5 - 1)$$
$$CI = 0.0790$$

Determine the Consistency Ratio

$$CR = CI/RI$$
$$CR = 0.0790/1.12$$
$$CR = 0.0705$$

So, from matrix on can determined *Consistency Ratio* (CR) is 0.0705 . _ And CR is smaller than 0 .1 , then matrix stated consistently.

3.2 System Testing

Testing this system is an important part of the software development stage. Testing is done to see the quality and find out the weaknesses that exist in the software. The purpose of testing is to confirm and guarantee that the system that has been built can run properly .

1. Page Display an Main

The main page is the appearance of the admin's initial page after the login process. This page will later display menus of options that will be used to process data on a decision support system in determining the selection of oil palm seeds, as shown in Figure 2.

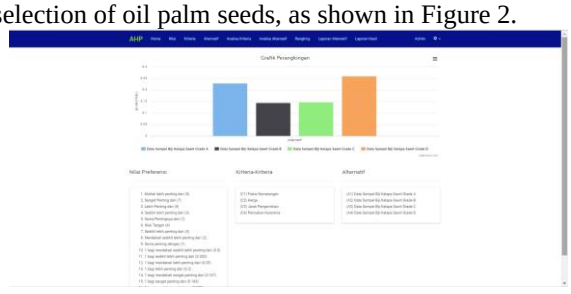


Figure 2. Main Page Display

2. Value Input Display

This view is useful for viewing, editing and deleting value data that has been entered and stored in the database. as in Figure 3 .

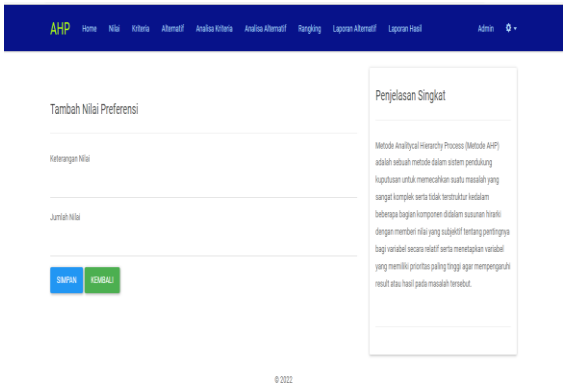


Figure 3. Value Input Display

3. Criteria Input Display

view is used to view, edit and delete criteria data that has been entered and stored in the database. as in Figure 4 .

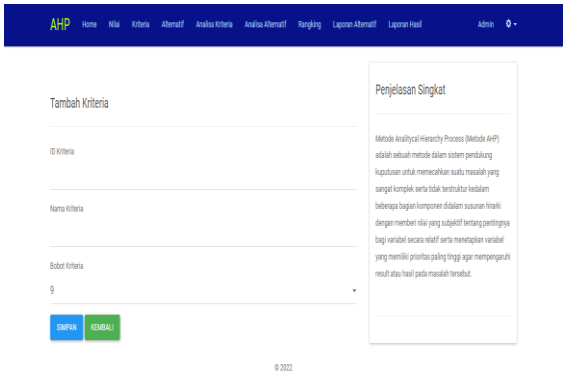


Figure 4. Display of Criteria Page

4. Display Criteria Analysis Page

This page is useful for viewing data and selecting data to be viewed and then stored in the database. It looks like Figure 5.

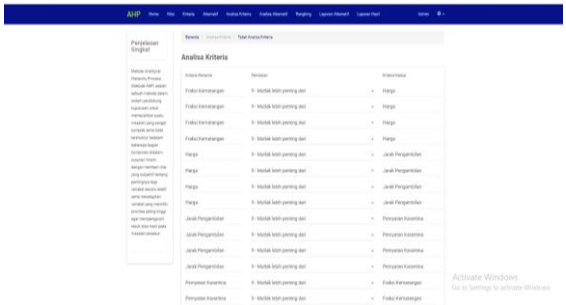


Figure 5. Display of Criteria Analysis Page

5. Rank Data Display

This page is useful for viewing ranking data that has been carried out and stored in the database. It looks like Figure 6.

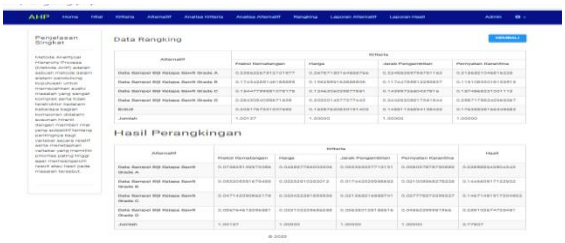
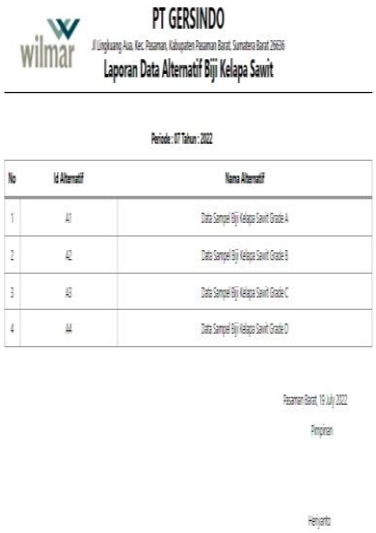


Figure 6. Rank Data Display

6. Alternative Report Display

Alternative data page is a form used by the admin section useful for printing alternative data that has been processed and stored in the database. It looks like Figure 7.



PT GERSINDO

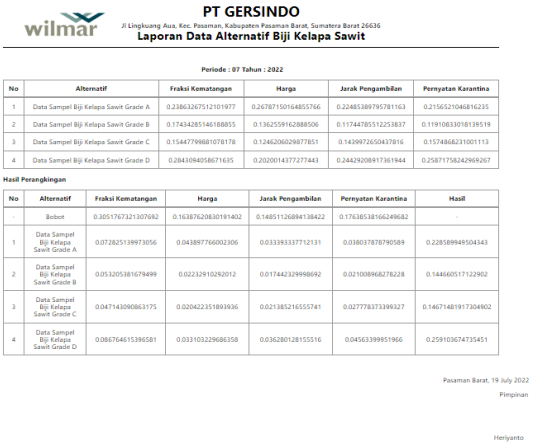
Laporan Data Alternatif Biji Kelapa Sawit

No	Id Alternatif	Nama Alternatif
1	A1	Data Sampel Biji Kelapa Sawit Grade A
2	A2	Data Sampel Biji Kelapa Sawit Grade B
3	A3	Data Sampel Biji Kelapa Sawit Grade C
4	A4	Data Sampel Biji Kelapa Sawit Grade D

Figure 7. Display of Alternative Reports

7. Display of Decision Result Report

The decision result report page is a report regarding the decision letter regarding the selection of oil palm seeds. This page is useful for printing decision data that has been processed and stored in the database. It looks like Figure 8.



PT GERSINDO

Laporan Data Alternatif Biji Kelapa Sawit

No	Alternatif	Fraksi Kematangan	Harga	Jarak Pengambilan	Pernyatan Karantina
1	Data Sampel Biji Kelapa Sawit Gracie A	0.2386326751210197	0.26787150164855766	0.22485389795781163	0.2156521046816235
2	Data Sampel Biji Kelapa Sawit Grade B	0.17434285146168855	0.13625591628888506	0.11744785512253837	0.11910833018139519
3	Data Sampel Biji Kelapa Sawit Gracie C	0.15447799881078178	0.12462060298778851	0.1439972650437816	0.15748682310011113
4	Data Sampel Biji Kelapa Sawit Grade D	0.2843094058671635	0.2020014377277443	0.24429208917361944	0.25871758242969267

Hasil Perangkingan

No	Alternatif	Fraksi Kematangan	Harga	Jarak Pengambilan	Pernyatan Karantina	Hasil
-	Bobot	0.30517673213076921	0.16387620830191402	0.14851126894138422	0.17638538166249682	-
1	Data Sampel Biji Kelapa Sawit Grade A	0.07282513997305 6	0.043897766002306	0.033393337712131	0.038037878790589	0.22858994504343
2	Data Sampel Biji Kelapa Sawit Grade B	0.05320538167949 9	0.022329102920 12	0.017442329998692	0.021008968278228	0.14466051712290 2
3	Data Sampel Biji Kelapa Sawit Grade C	0.04714309086317 5	0.020422351893936	0.021385216555741	0.027778373399327	0.14671481917304902
4	Data Sampel Biji Kelapa Sawit Grade D	0.08676461539658 1	0.033103229686358	0.036280128155516	0.045633999519 66	0.25910367473545 1

Pasaman Barat, 19 July 2022

Pimpinan

Heriyanto

Figure 8. Display of the Decision Result Report

4. Conclusion

Based on research on decision support systems in selecting quality palm kernels using the *Analytical Hierarchy Process* (AHP) method it has proven to be very helpful in the process of determining the selection of palm kernels to be more effective and efficient.

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