### Geotechnical Properties of Silty Sand Reinforced with Polypropylene Woven Bags

Moiz Ali
ijmrem 2019; 2 (12) : 1-6; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 0 | References: 0 | Resolved references: 0

### Artificial Neural Network Modeling for Aircraft Engine Health Monitoring

Esra Kurtoglu
ijmrem 2019; 2 (12) : 1-7; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 4 | References: 0 | Resolved references: 0

### Evaluation of Pre and Post Lined Conveyance Efficiency and Cropping Intensity of selected Watercourses under SIAPEP

Makhdoom Azfar Latif,
Dr. Kanya Lal Khatri,
Dr. Syed Naveed Raza Shah
ijmrem 2019; 2 (12) : 1-11; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 5 | References: 0 | Resolved references: 0

### Model Updating of Connections Used in a Virtual Ship Unloader Structure

No data
ijmrem 2019; 2 (12) : 1-12; Language: EN
Full text: Yes | Abstract: Yes | Keywords: 5 | References: 0 | Resolved references: 0

## Effects on Pervious Concrete's Properties Using Different Shapes of Aggregate

Haider Ali,
Prof. Dr Fareed Ahmed Memon,
Muhammad Ali Rehman, Umer Shahzad

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# Application of MADM SAW Method in The Selection of The Best Making Process of Kahwa Daun (Herbal Tea)

[1]Rilma Novita, [2]Anwar Kasim, [2]Tuty Anggraini, [3]Deddi Prima Putra
[1]*Postgraduate Agricultural Science, Faculty of Agricultural, Andalas University, Indonesia*
*Department of Agricultural Technology, Agricultural Polytechnic of Payakumbuh*
[2]*Faculty of Agricultural Technology, Andalas University, Indonesia*
[3]*Faculty of Pharmacy, Andalas University, Indonesia*

**ABSTRACT**

The study was conducted to decide the best process in making kahwa daun. Kahwa daun is a herbal tea made of coffee leaves. The best process of kahwa daun making was chosen by the Multiple Attribute Decision Making with the Simple Additive Weighting Method (MADM-SAW). With the MADM-SAW method, the total value of each alternative is obtained and ranked. There is 3 alterntives process, using a traditional furnace, oven blower, and coffee leaf smoker. The alternative which is ranked 1 is stated as the best process. The making process of kahwa daun using a coffee leaves smoker is chosen as the best based on 7 assessment criteria.

**KEYWORDS:** Decision Matrix, Simple Additive Weighting, Preference, Optimation, Qahwa Making.

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## I. INTRODUCTION

Optimization is not just looking for the maximum and minimum values of a function or a set of functions but is also used to explain that optimization is the process of selecting the best alternative (where each alternative is characterized by some criteria) of many alternative answers available. Expansion of this meaning causes optimization to get a wider place, especially in the realm of computer science [1]. Optimization is also a problem of decision-making systems, where optimization problems are modeled into a Multiple Attribute Decision Making (MADM) or other decision models. MADM is a method used to find optimal alternatives from many alternatives with certain criteria. In MADM we determine the weight value for each attribute, then rank and choose the best alternative. There are several MADM methods including Simple Additive Weighting Method (SAW), Multiplicative Exponential Weighting (MEW), Weight Product (WP), ELECTRE, Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Analytic Hierarchy Process (AHP) [2][3]. The study was conducted to decide the best process in making kahwa daun. Kahwa daun is a herbal tea made of coffee leaves. Kahwa daun is a popular herbal tea in West Sumatera, Indonesia. Kahwa itself comes from the word *qahwa* in Arabic which means coffee. Kahwa daun was made by traditional drying coffee leaves above the cooking fire, smoking, and toasting [4]. The smoker of coffee leaf has been developed to improve the quality of kahwa daun [5]. Furthermore, the best process of kahwa daun making was chosen by the Multiple Attribute Decision Making with the Simple Additive Weighting Method (MADM-SAW).

## II. MATERIAL AND METHOD

Simple Additive Weighting is also known as Weighted Sum Model (WSM) or Scoring Method (SM). It is the most often used in multi-attribute decision making. The method consists of quantifying the values of attributes (criteria) for each alternative, constructing the decision matrix X containing these values, deriving the normalized decision matrix R, assigning the importance (weights) to criteria, and calculating the overall score for each alternative. Then, the alternative with the highest score is selected as the preferred (best) one. The steps of the MADM-SAW can be detailed as follows:

a. For N alternatives and M attributes (criteria), determine the criteria that will be used as a reference in making decisions, namely $C_i$.

b. Make a decision matrix (X) based on criteria ($C_i$)

Table 1. Table Decision

| | $C_1$ | . | . | $C_i$ |
|---|---|---|---|---|
| $A_1$ | $X_{11}$ | . | . | $X_{i1}$ |
| . | . | . | . | |
| . | . | . | . | |
| $A_j$ | $X_{1j}$ | . | . | $X_{ij}$ |

c. Normalize the decision matrix based on equation 1 that is adjusted to the type of attribute (profit or cost attribute) to obtain a normalized matrix R.

$r_{ij} = x_{ij} / max_i\, x_{ij}$ for the benefit (1)
$r_{ij} = min_i\, x_{ij} / x_{ij}$ for the cost
where :
$r_{ij}$ : is the normalized rating of the i*th* alternative for the j*th* criterion
$x_{ij}$ : is an element of the decision matrix, which represents the original value of the j*th* criterion of the i*th* alternative

d. Determine the weight vector priority value (w). It is done according to the manager's policy which gives the weight vector value directly. There are 3 approaches to find the value of attribute weights, namely the subjective approach, the objective approach and the integrated approach between subjective and objective. Each approach has strengths and weaknesses. In the subjective approach, the weight value is determined based on the subjectivity of the decision-makers. The weighting of criteria is done by using rank criteria according to decision-maker. Weighting is done by the equation 2 [6]:

$W_j = (n - r_j + 1) / \sum (n - r_p + 1)$ (2)

Where :
*Wj*: weight for criteria j*th* (j = 1, 2, 3, ... n)
*n*: the number of criteria being studied
$r_j$: rank of a criterion
*p*: criteria (p = 1, 2, 3, ... n)

e. Determine the suitability rating of each alternative on each criterion based on equation 3.

$$S_i = \sum_{j=1}^{m} w_j r_{ij} \qquad (3)$$

where :
$S_i$ : is the overall score of the i*th* alternative
$r_{ij}$ : is the normalized rating of the i*th* alternative for the j*th* criterion
$w_{ij}$: is the importance (weight) of the j*th* criterion

## III. RESULT AND DISCUSSION

In the MADM-SAW method, several alternatives will be chosen. Then set the criteria that will be used in choosing the best alternative. The application of the MADM-SAW method in the selection of the best making process of kahwa daun is done with 3 alternatives. One of the alternatives is shown in figure 1 and research on other alternatives has been done. The alternative is listed as follows :

1. Traditional drying above the cooking fire (A1)
2. Using an oven blower (A2)
3. Using a coffee leaves smoker (A3)

Fig. 1. Traditional Making Process of Kahwa Daun

Some criteria for selecting the best making process is set. These criteria are:
1. Production capacity in kilograms (C1)
2. Kahwa daun that was produced in kilograms (C2)
3. Loss or rejected product in grams (C3)
4. The time is needed to process kahwa daun in hour (C4)
5. Expertise needed in making process of kahwa daun in 3 category (C5)
6. Cost in processing kahwa daun in rupiah (C6)
7. Availability of fuel on the market in 3 category (C7)

The first step was quantifying the values of attributes (criteria) for each alternative and constructing the decision matrix. A decision matrix is normalized using equation 1.

Table 2. Table Decision of Kahwa Daun Making Process

| Alternative | Criteria | | | | | | |
|---|---|---|---|---|---|---|---|
| | C1 | C2 | C3 | C4 | C5 | C6 | C7 |
| A1 | 40 | 7 | 200 | 4.25 | high | 36500 | rare |
| A2 | 1 | 0.2 | 20 | 12 | medium | 42250 | easy |
| A3 | 10 | 3.8 | 50 | 2.5 | low | 30600 | medium |

Normalize the Decision Matrix

| | | | | | | |
|---|---|---|---|---|---|---|
| 1.0000 | 1.0000 | 0.1000 | 0.5882 | 0.3333 | 0.8384 | 0.3333 |
| 0.0250 | 0.0286 | 1.0000 | 0.2083 | 0.6667 | 0.7243 | 1.0000 |
| 0.2500 | 0.5429 | 0.4000 | 1.0000 | 1.0000 | 1.0000 | 0.6667 |

The weighting of criteria is done by using rank criteria according to decision-makers. The weight value is determined based on the subjectivity of the decision-makers.

Table 3. Weighting of Criteria

| Criteria | Rank | (n – rj + 1) | wj |
|---|---|---|---|
| C1 | 1 | 7 | 0.2500 |
| C2 | 6 | 2 | 0.0714 |
| C3 | 3 | 5 | 0.1786 |
| C4 | 2 | 6 | 0.2143 |
| C5 | 4 | 4 | 0.1429 |
| C6 | 5 | 3 | 0.1071 |
| C7 | 7 | 1 | 0.0357 |
| | ∑ (n – rp + 1) | 28 | 1.0000 |

Next step, calculating the overall score for each alternative. Then, the alternative with the highest score is selected as the preferred (best) one.

Table 4. Alternative with Summaries Score

| Alternative | C1 | C2 | C3 | C4 | C5 | C6 | C7 | ∑ |
|---|---|---|---|---|---|---|---|---|
| Weight | 0.2500 | 0.0714 | 0.1786 | 0.2143 | 0.1429 | 0.1071 | 0.0357 | 1.0000 |
| A1 | 0.2500 | 0.0714 | 0.0179 | 0.1261 | 0.0476 | 0.0898 | 0.0119 | 0.6147 |
| A2 | 0.0063 | 0.0020 | 0.1786 | 0.0446 | 0.0952 | 0.0776 | 0.0357 | 0.4401 |
| A3 | 0.0625 | 0.0388 | 0.0714 | 0.2143 | 0.1429 | 0.1071 | 0.0238 | 0.6608 |

With the MADM-SAW method, the total value of each alternative is ranked. The alternative which has the highest score is stated as the best making process of kahwa daun based on 7 assessment criteria. The making

process of kahwa daun using a coffee leaf smoker is chosen as the best. It is not recommended making kahwa daun using oven blower.

## IV. CONCLUSION

Kahwa daun as a herbal tea can be produced using traditional method or using equipment such as oven blower and coffee leaves smoker. Comparing the process and choosing the best one is not easy. The best making process of kahwa daun is chosen with MADM-SAW method. By application of the method, it can be stated that kahwa daun using a coffee leaf smoker is chosen as the best followed by the traditional process and using oven blower as the third.

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