

# Determining housing location using weighted product

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## Abstract

Housing is a set of houses that are established with different functions for the owner with equipped infrastructure that is equipped according to the owner wishes. In determining the location of housing in Pringsewu district, the criteria were needed in accordance with the consumer's wish. This study will be explained on how to determine the location of housing in Pringsewu district using weighted product method. Because the weighted product method can help decision making in determining the location of housing, the calculation only resulted the greatest value that will be chosen as the best alternative.

**Keywords:** Weighted Product; Decision Support System; Housing Location.

## 1. Introduction

### 1.1. Background

Housing is a basic (primary) human need besides clothing and food. Housing need from year to year is increasing as the population increase in an area [1-4]. The selection of strategic housing locations in terms of both geography and economics is very important to be done so that the housing that is built will have high use value and selling value and give satisfaction to consumer [5-8]. With the construction of housing or strategic residences in terms of both geography and economics in Pringsewu District can help the government program in providing housing or shelter for people in Pringsewu Regency and its surroundings. In addition, strategic housing development can have a positive impact both socially and economically for the community around the housing location [9-12].

Based on Law No. 4 of 1992 concerning Housing and Settlement, there are several basic meanings, namely, a House is a building that functions as a residence or residential and family development facilities. Housing is a group of houses that function as residential environment that is equipped with environmental infrastructure and facilities.

Some previous studies that had been done previously were: (1) "Decision Support System for Determining Warehouse Locations for Companies Using Weighted Product Methods", this study discusses the determination of warehouse locations for companies. This system works in providing alternative decisions to determine the location of the storage warehouse, and helps the manager in making decisions for determining the location of the warehouse [13-16]. Furthermore, the study discussed development a motorcycle purchasing decision support system with a weighted product

method that can be used to solve problems for users in the process of making a decision to buy a motorcycle [17-20].

Determination of housing location is based on several criteria, namely: Distance to the main road, Distance to shopping center / market, Distance to education / school center, Population density around the location, height of land level for the location.

### 1.2. Problem limitation

Therefore the problem limitations in this research are:

- How to make decision effectively and efficiently in determining housing location in Pringsewu District.
- How to implement Weighted Product Method in determining housing location in Pringsewu District.

### 1.3. Research purpose

The purpose of this research was how to use Weighted Product method to determine housing location

### 1.4. Research benefit

As for the benefits given by this research are:

- To ease in determining strategic housing location in Pringsewu District.
- As useful information for the party, both investor and housing developer in implementation.

## 2. Literature review

### 2.1. Decision support system

Basically decision making is a systematic approach to a problem with fact collection, a mature determination of the alternatives faced. And action taking according to calculation is the right thing to do. On the other hand decision makers are often faced with the complexity and scope of decision making with many data.

For this purpose, most decision makers consider the benefit or cost ratio. Faced with a necessity to rely on a set of system that is able to solve problems efficiently and effectively, which is then called a decision support system (DSS) [21-24].

In general, the Decision Support System is a system that is able to provide the ability, both problem solving abilities and communication skills for semi-structured problems [25-28]. Specifically, a Decision Support System is a system that supports the work of a manager and a group of managers in solving semi-structured problems by providing information or proposals towards certain decisions. The basic framework of managerial decision making in the decision type is divided into:

- 1) Structured decision is a repetitive and routine decision, so it can be programmed. Structured decision occurs and is carried out primarily at lower level management. Examples of this type of decision, for example, are the decision to order goods, the decision to collect receivables and so forth.
- 2) Unstructured decision is a decision that does not occur repeatedly and does not always occur. This decision occurs at the top level of management. Information for unstructured decision-making is not easy to be obtained, is not easily available, and usually comes from the outside environment. Manager's experience is very important in unstructured decision-making. The decision to join another company is a rare example of unstructured decisions.
- 3) Semi – structured decision is a decision that can be partially programmed, some of them are repetitive and routine and some of them are not structured. This type of decision is often complex and requires detailed calculations and analysis. An example of this type of decision, for example, is the decision to buy a more sophisticated computer system. Another example is the promotion of fund allocation decision.

## 2.2. Housing

The definition of housing is a group of houses that functions as living environment or occupancy environment that is completed by environment infrastructure and facilities [29-32].

According to SNI 03-1733-2004 about Urban Planning, housing environment must fulfill the requirements, one of them is housing location must be in accordance with Local Urban Land Use Planning or other planning documents that are set according to local regulation [33-36].

Housing is a group of houses built with the different function for the owner and be equipped with facility in accordance with owner's desire.

## 2.3. Fuzzy multiple attribute decision-making (FMADM)

Fuzzy Multiple Attribute Decision Making (FMADM) refers to the method used to find optimal alternatives from a number of alternatives with certain criteria [37-40]. The core of FMADM is to determine the weight value for each attribute, then proceed with the ranking process that will select the alternatives that have been given. Basically, there are 3 approaches to find weight value attribute, namely the subjective approach, the objective approach and the integration approach between subjective and objective [41-44].

Each approach has advantages and disadvantages. In the subjective approach, the weight value is determined based on the subjectivity of the decision makers, so that several factors in the alternative ranking process can be determined freely [45-48]. Whereas in the objective approach, the weight value is calculated mathematically so that it ignores the subjectivity of the decision maker.

## 2.4. Weighted product method

Weighted Product Method (WP) is a popular multi criteria analysis decision and is a multi-criteria decision making method, like all FMADM methods, WP (Weighted Product) is a finite set of alternative decisions explained in terms of several decision criteria [49-50].

Weighted Product (WP) Method uses multiplication to relate attribute rating where each attributes rating must be squared using multiplication to relate attribute rating, where testing in each attribute must be squared first with related weight [51-53]. This process is as same as normalization. Preference of  $S_i$  alternative is given as follows :

$$S_i = \prod_{j=1}^n x_{ij}^{w_j}$$

With  $i=1, 2, \dots, m$ .

Description:

S: Alternative preference that is analogized as S vector

X: Criteria score

W: Criteria/sub criteria weight

I: Alternative

J: Criteria

N: The number of criteria where  $\sum W_j = 1$

$W_j$  is positive square for profit attribute and is negative square for cost attribute. Relative preference from each alternative is as follows:

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

Description:

V: Alternative preference that is analogized as V vector

X: Criteria score

W: Criteria/sub criteria weight

I: Alternative

J: Criteria

N: The number of criteria

\*: The number of criteria scored at vector

In general, weighted product method follows the stages namely:

- 1) Determining the criteria that will be used as scoring parameter
- 2) Performing the calculation of initial weight relative score. Initial weight score ( $w_0$ ) is used to show relative importance level from each criteria

$$w_j = \frac{w_0}{\sum w_0}$$

- 3) Performing calculation of preference score for each  $A_i$  alternative (S vector).

Calculation with preference score for  $A_i$  alternative that is started by giving performance rating score for  $i^{\text{th}}$  housing to criteria to j ( $x_{ij}$ ). After each housing candidate location is given performance rating score the score will be squared with calculated relative weight score ( $w_j$ ).  $W_j$  will be positive for benefit attribute and will be negative for cost attribute. The formula for preference of every  $A_i$  (S vector) is as follows:

$$S_i = \prod_{j=1}^n x_{ij}^{w_j}$$

With  $i=1, 2, \dots, m$ .

- 4) Perform calculation of relative preference score from each alternative using formula below

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

With  $i = 1, 2, 3, \dots, m$

Calculation of preference score for  $A_i$  alternative done by dividing  $S$  vector score at  $i^{th}$  housing and  $j^{th}$  criterion.

### 3. Research methods

#### 3.1. Data collection method

##### 3.1.1. Observation method

The point of observation could be viewed into the basic from all knowledge [54-56]. Observation is data collection done by observing research object directly.

In this case, the author conducted observation/ direct observation to future housing location in Pringsewu District.

Observation was done in some locations in Pringsewu district among others: Pringsewu, Gadingrejo, Sukoharjo, Adiluwih, Banyumas, Pagelaran, North Pagelaran, Ambarawa, Pardasuka.

##### 3.1.2. Interview method

The pattern of interview may be determined into the assembly of two persons to exchange information and idea through discussion, so it can be constructed the definition in a topic [54-55]. In this case, authors do the interview with housing development and society in Pringsewu district

##### 3.1.3. Literature research method

Literature research method is data collection by reading book or magazine and other references related to the problem observed. In this case, author read book and look for the information in Internet about strategic housing location.

#### 3.2. Research framework

##### 3.2.1. Problem formulation

The Research Framework in this research method was made so that the steps taken by the author in this design do not deviate from the subject matter and will be easier to understand, so the sequence of steps will be systematically made so that it can be used as a clear and easy guide to solve existing problems. Research framework in Decision Support System in Determining Housing Location in Pringsewu District using Weighted Product method.

##### 3.2.2. Data collection

###### 3.2.2.1. Importance level

The level of importance for each criteria is as shown in table 1:

Table 1: Level of Importance

Importance Level	Weight
Very Important	5
Important	4
Quite Important	3
Unimportant	2
Very Unimportant	1

###### 3.2.2.2. Criteria

Considered factor or criteria in determining housing location in Pringsewu District among others:

C1 = Distance to main cost (Cost)

C2 = Distance to shopping center/market (Cost)

C3 = Distance to education center/school (Cost)

C4 = Population density around housing (Benefit)

C5 = Land level of location (Benefit)

All above factors are divided into two namely benefit and cost. An attribute is called as benefit if the liked score is greater while an attribute is called as cost if the score is greater than increasingly disliked.

Preference weight at each criteria is determined as follows:

Table 2: Preference Weight at Each Criteria

Symbol	Weight
C1	3
C2	3
C3	5
C4	4

Alternative given to future housing in Pringsewu District was:

A1 = Gading Rejo

A2 = Sukoharjo

A3 = Pringsewu

### 4. Designing and implementation

#### 4.1. System analysis

In order to achieve the best result, there needs to be enhanced in collaborating the way to entirely engage with weighted product has to be involved with using simple additive weighting (SAW). Searching using weighted product of decision support system for determining location of housing in Pringsewu district, the location those will be alternative were:

A1 = Gading Rejo

A2 = Sukoharjo

A3 = Pringsewu

Criteria used as reference:

C1 = distance to main road

C2 = distance to shopping center/market

C3 = distance to education center/school

C4 = population density around location

Weight for each criterion can be scored with score 1-5 namely:

- 1) Very important
- 2) Important
- 3) Quite important
- 4) Unimportant
- 5) Very unimportant
- 6) Weight decision making among other:  $W=(3, 3, 5, 4)$

#### 4.2. Calculation

Table 3 shows calculation.

Table 3: Calculation

Alternative	Criteria			
	C1	C2	C3	C4
A1	5	3	500	1000
A2	3	3	550	800
A3	6	4	400	900

Category in each criteria:

- C1 criteria (distance to main road) and C3 (distance to education center/school).
- C2 criteria, distance from shopping center/market) and C4 (population density around location)

Description:

A: alternative

C: criteria

W: weight

S: preference for alternative

V: vector score used for ranking

X: alternative score for each criteria

Before weight improvement done then that must be done first:

$$W1 = 3/(3+3+5+4) = 3/15 = 0.2$$

$$W2 = 3/(3+3+5+4) = 3/15 = 0.2$$

$$W3 = 5/(3+3+5+4) = 5/15 = 0.33$$

$$W4 = 4/(3+3+5+4) = 4/15 = 0.27$$

Then s vector can be calculated as:

$$S1 = (5^{0.2}) (3^{0.2}) (500^{0.33}) (1000^{0.27}) = 0.7498$$

$$S2 = (3^{0.2}) (3^{0.2}) (550^{0.33}) (800^{0.27}) = 0.7577$$

$$S3 = (6^{0.2}) (4^{0.2}) (400^{0.33}) (900^{0.27}) = 0.8012$$

V vector score that will be used for ranking, it can be calculated:

$$V1 = 0.7498/(0.7498+0.7577+0.8012) = 0.3247$$

$$V2 = 0.7577/(0.7498+0.7577+0.8012) = 0.3282$$

$$V3 = 0.8012/(0.7498+0.7577+0.8012) = 0.3470$$

V3 score showed greatest score so A3 alternative was selected as best alternative. Therefore Pringsewu will be selected as housing location in Pringsewu District. Therefore it can be concluded alternative result with weighted product.

## 5. Conclusion

There are some conclusions from Decision Support System for Determining Housing Location in Pringsewu District using Weighted Product Method.

- By conducted decision support system for determining the endeavors in building the program of housing location in Pringsewu district, it can help investor in decision making when they will open housing business in Pringsewu District.
- After conducting this research hoped it can help developer know housing location in Pringsewu District.

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