USING MULTIPLE CRITERIA DECISION MAKINGV (MCDM) TO LOCATION SELECTION FOR GRASS FLOWER WAREHOUSE IN CHIANG RAI PROVINCE, THAILAND

Martusorn Khaengkhan

College of Logistics and Supply Chain ,Suansunandha Rajabhat University
111/3-5 Phuttamonthon District, Nakhon Paththom,Thailand 73170
Email:martusorn.kh@ssru.ac.th, martusorn2533@hotmail.com

ABSTRACT

The purpose of this paper is to select warehouse location of grass flowers in Chiang Rai province Using Multiple Criteria Decision Making (MCDM) the three method for Simple Additive Weighting (SAW) Method, Order Preference by Similarity to Ideal Solution (TOPSIS) and The Analytic Hierarchy Process (AHP). For selected of grass flowers location warehouse in Chiang Rai Province.The entrepreneurs of grass flowers trading need to increase warehouse building to meet customer satisfaction. Thus, this paper is to surveyed 7 criteria of the entrepreneurs consist of size of property, property cost, labor cost, public utility, mode of transportation, ability to access of location and distance from supplier and investigated locating in 4 districts area using conjunctive constrain method to screen the alternative consist of Mae Jan district, Mae Sai district, Chiang Saen district and Chiang Khong district were used to selection. The decisions making of location selection used by SAW, TOPSIS and AHP, the result of this paper found that Tambon Pa Sang, Mae Chan district is appropriate located for building grass flowers warehouse in Chiang Rai province.

Keywords: AHP, TOPSIS, SAW, Location Selection

INTRODUCTION

Regarding the necessity of the inventory, entrepreneurs may not want the much inventory in the stock because of the economic liquidity and the cost of the organization. But, in terms of inefficient logistic management and range and duration of transportation management, there will have the space of time condition. If the distance is longer, there will take longer time for transportation, as well as higher cost of transportation. That are causes to have the inventories to reduce the cost, and the warehouse is also important to store the inventories.

Therefore, the location is very important to pay attention to the distance to the sources of production, the size of the area, land's price, the cost of wage, along with the pattern of transportation. All of these are factors of the new chosen location to set the warehouse to save the logistic cost. That means if the location is not appropriate, there will be following problems such as the logistic cost may be higher because of farther distance from sources of production and market. Moreover, there will be insufficient quality labors, elements or materials, along with other necessary factors. Generally, the location has no dominant advantage than other areas. Only the best properties of the land towards the business will be paid attention for the least effect in the future. Generally, the efficient location for the business should be spent the cost of production and service as least as possible. Thus, many factors will be involved to choose the location of the business because the location is very important to the business of the organization such as transportation planning, investment, and income, etc. (Sudathip Tuntinikulchai and Sakda Hongthong, 2004) [5]. Brooms are important to clean the house and the life of broom may not long, so the demand is also high continually. Form the demand, the production and income of brooms are also high. This is the new business to earn more money for the villages in Northern and Northeastern Thailand. The supporting evidences show that there are more brooms producers. Also, the producing of the broom will use many elements, especially grass which is the main elements of the brooms. The grass will be collected only in one season from November to March. During this period, the grass will be cheaper. The entrepreneur has to store the grass for further demand all year. There is more demand in the market each year and the entrepreneur has to buy the grass at a higher cost because of higher demand. From the

mentioned problem, the entrepreneur needs to find the new appropriate location to store the grass in Chiang Rai Province to increase the capacity of the storage and reduce logistic cost.

LITERATURE & THEORY

SAW method is a simple, hassle-free process. It is calculated from the product of the weight value. And the appropriateness of each rule, then multiply the sum of all the rules together. The highest scoring option will be selected first. The steps of the SAW method are as follows

TOPSIS method are summarized in this section. The criteria to choose the location for the warehouse to gain the information for the study. The involving researches are started form Multi Criteria Decision Making. It is one of the popular criteria to choose to evaluate and analyze in various patterns such as (Kengpol, 2004) [2] who adapted the AHP technique to create the model of transportation problems and analyze the investment to choose the warehouse. He compared 2 locations in Bangkok under the transportation legal regulation. (Thiengburanathum, et al.,2006)'s research who adapted AHP technique to evaluate the transportation route from Khunming, China to Bangkok [6]. This criteria could indicate the significances of the importance of route in term of being the new route linked between Khunming, Yunnan Precinct and Bangkok, Thailand. Rather than AHP technique, there are many criteria from other researches which is the major decision. For example (Milan and Aura, 2002)'s research who adapted the 3 multi criteria decision making about the new center of air traffic of European Union, assigned to administrate the air traffic transportation business [3]. All of 3 criteria decision making are SAW (Simple Additive Weighting Method), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), and AHP (Analytic Hierarchy Process)

There may be more than one appropriate location so the multi criteria decision making will be the assistance to choose the best location of the warehouse as indicated below. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) TOPSIS, developed by Hwang and Yoon in 1981, is a simple ranking method in conception and application. The standard TOPSIS method attempts to choose alternatives that simultaneously have the shortest distance from the positive ideal solution and the farthest distance from the negative-ideal solution. The positive ideal solution maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. TOPSIS makes full use of attribute information, provides a cardinal ranking of alternatives, and does not require attribute preferences to be independent (Chen and Hwang, 1992; Yoon & Hwang, 1995) [1]. To apply this technique, attribute values must be numeric, monotonically increasing or decreasing, and have commensurable units.

TOPSIS method to the location selection warehouse of grass in Chiang Rai province. TOPSIS is a multiple criteria decision making methodology (MCDM) which determines solution alternatives from a finite set in the basis of maximizing the distance from the negative ideal point and minimizing the distance from the positive ideal point. (Olson, 2004) TOPSIS is interesting with its need for decision maker's limited number of subjective input. Only subjective input is in the criteria weighting phase [7]. The model algorithms steps of TOPSIS (Olson, 2004) and its practice in the case

Analytic Hierarchy Process (AHP)

The elements of AHP are as follows.

- Criteria
- Comparison of criteria
- Table of priority or preference level

Elements in decision process can be divided into 4 parts.

1. The problem or goal is the beginning of the decision that affects the determination and evaluation of the alternatives.
2. Major Criteria.
3. Sub Criteria is secondary criteria used to enhance effective decision making process.
4. Alternative. The consideration of alternatives is the most important step in the decision process. It also affects the ability to diagnose alternatives.

The priority setting of criteria

Priorities among the elements of the hierarchy are established by making a series of judgments based on pairwise comparisons of the element.

METHODOLOGY

This research is the adaptation of the multiple criteria decision making to choose the warehouse of grass in Chiang Rai Province. Chiang Rai province is the appropriate strategic province to set the warehouse. There are many resources in each year, and there is on the important economic route to export the products to nearby countries. If the warehouse is set in Chiang Rai Province, it will be convenient to transport the grass to other provinces in Northern Thailand all years and there will be the storage of the materials from nearby countries. There will be the logistics efficiency of the location. There may be more than one appropriate location so the multi criteria decision making will be the assistance to choose the best location of the warehouse as indicated below. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) TOPSIS, developed by Hwang and Yoon in 1981, is a simple ranking method in conception and application. The standard TOPSIS method attempts to choose alternatives that simultaneously have the shortest distance from the positive ideal solution and the farthest distance from the negative-ideal solution. The positive ideal solution maximizes the benefit criteria and minimizes the cost criteria, whereas the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. TOPSIS makes full use of attribute information, provides a cardinal ranking of alternatives, and does not require attribute preferences to be independent (Chen and Hwang, 1992; Yoon & Hwang, 1995). To apply this technique, attribute values must be numeric, monotonically increasing or decreasing, and have commensurable units.

RESULTS

TOPSIS Method

The results stated that the criteria are depended on the appropriate to the research's objectives. So, TOPSIS method the appropriate criteria were synthesized from the involving researches' reviews. Moreover, the proper criteria were set by considering from the possible choices to choose the warehouse of grass in Chiang Rai Province. From the reviews of involving literatures and the evaluation of the location's surroundings, there are 7 criteria were set to choose the location covered all concerns as below. Size of property (X1), Property cost (X2), Labor cost (X3), Public utility (X4), Mode of transportation (X5), Ability to access of Location (X6) and, Distance from supplier (X7)

The basic of criteria for the location of warehouse of grass in Chiang Rai Province is Conjunctive constrain method. The filtering factors are as below.

1. It must less than 50 kilometers far from material source.

2. It must be located on main transport routes.

3. It has main road linking the area.

From the initial screening by the above constrained conditions, the choices were cut into 5 districts, including.

1. Tambon Krung Mae Chan Chiang Khong District (A1)
2. Tambon Sri Don Chai Chiang Khong District (A2)
3. Tambon Ban Saew Chiang Saen District (A3)
4. Tambon Mae Chan Mae Chan District (A4)
5. Tambon Pa Sang Mae Chan District (A5)

When the TOPSIS adjust the weight to a standard, it will calculate the weight factor by multiplying the available information to make a smooth adjustment to the weighting normalize and identifying positive ways. And negative by calculating v_j^* and v_j^- of the numerical consideration the weight for this study using the Ratio Weighting, which is the weight of the value Geometric Mean of each factor. In order to apply for the S^* S^- *and*

C^*

Table 3.1 Result of weighting normalize and identifying positive ways. And negative

Criteria	A1	A2	A3	A4	A5	v_j^*	v_j^-
X1	0.0787	0.0525	0.0899	0.0630	0.1049	0.1049	0.0525
X2	0.0804	0.0764	0.0402	0.0402	0.0563	0.0804	0.0402
X3	0.0316	0.0316	0.0190	0.0253	0.0316	0.0316	0.0190
X4	0.0365	0.0365	0.0122	0.0243	0.0243	0.0365	0.0122
X5	0.0145	0.0435	0.0145	0.0290	0.0290	0.0435	0.0145
X6	0.0199	0.0199	0.0133	0.0199	0.0199	0.0199	0.0133
X7	0.0169	0.0169	0.0169	0.0084	0.0084	0.0169	0.0084

Table 3.2 Results of TOPSIS show that S^* S^- and C^* and rank of results

Alternative	S^*	Rank	S^-	Rank	C^*	Rank
A1	0.0580	2	0.0657	3	0.5312	2
A2	0.0649	3	0.0695	2	0.5174	3
A3	0.0939	5	0.0390	5	0.2936	5
A4	0.0715	4	0.0590	4	0.4519	4
A5	**0.0356**	**1**	**0.0886**	**1**	**0.7134**	**1**

From the result of TOPSIS method to choose the location of the warehouse of grass in Chiang Rai Province through the 7 criteria, the results stated that A5 Tambon Pa Sang Mae Chan District is the interesting place to be the location of the warehouse. The runner-up district is A1 Tambon Krung Mae Chan Chiang Khong District, A2 Tambon Sri Don Chai Chiang Khong District, A4 Tambon Mae Chan Mae Chan District and A3 Tambon Ban Saew Chiang Saen District respectively.

3.2 AHP Method

After study the related researches to select the multi-criteria to choose the best place for the warehouse, the results stated that the criteria are depended on the appropriate to the research's objectives. So, Analytic Hierarchy Process (AHP) method the appropriate criteria were synthesized from the involving researches' reviews. Moreover, the proper criteria were set by considering from the possible choices to choose the warehouse of grass in Chiang Rai Province. From the reviews of involving literatures and the evaluation of the location's surroundings, there are 7 criteria were set to choose the location The AHP hierarchy can be shown in the figure 3.1

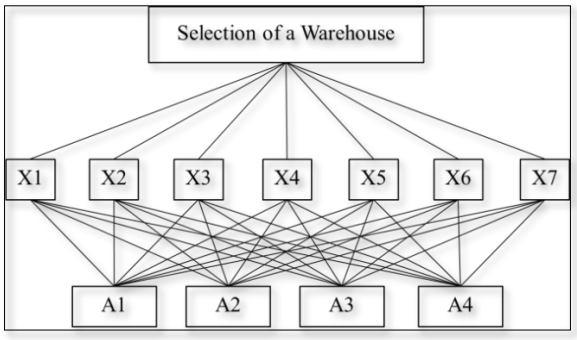

Figure 3.1 A simple AHP hierarchy, with goal to select the Location Selection of Warehouse of Grass in Chiang Rai Province

From the mention above, AHP criteria is to estimate the importance of each attribute. And the criteria to create matrixes pairwise comparisons to set the weight, as shown in table 3.3 with consistency at 0.08, 0.1lower than the criterion is the highest possible index, showing the stability of the committee. And, each of matrixes pairwise comparisons of the attribute X1 to X7 was shown in table 3.4.

Table 3.3 Pairwise comparisons matrix of analysis criteria

	X1	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**Weight**
X1	1	1/3	4	6	4	4	1/5	0.16
X2	3	1	6	5	6	5	1/3	0.27
X3	1/4	1/6	1	1/2	2	3	1/5	0.06
X4	1/6	1/5	2	1	2	3	1/7	0.07
X5	1/4	1/6	1/2	1/2	1	½	1/4	0.04
X6	1/4	1/5	1/3	1/3	2	1	1/4	0.04
X7	5	3	5	7	4	4	1	0.37
Inconsistency = 0.08								

Table 3.4 Example: Pairwise comparisons Matrix of attribute X1 to X7

For X1	**A1**	**A2**	**A3**	**A4**	**A5**	
A1	1	4	½	3	1/3	0.1723
A2	1/4	1	1/6	1/2	1/7	0.0469
A3	2	6	1	4	1/2	0.2833
A4	1/3	2	1/4	1	1/4	0.0795
A5	3	7	2	4	1	0.4180
consistency = 0.02						

For X2	**A1**	**A2**	**A3**	**A4**	**A5**	
A1	1	2	5	5	3	0.4236
A2	1/2	1	4	4	2	0.2708
A3	1/5	1/4	1	1	1/3	0.0686
A4	1/5	1/4	1	1	1/3	0.0686
A5	1/3	1/2	3	3	1	0.1686
consistency = 0.01						

After making pairwise comparisons, the weight of the alternatives will be obtained and then make adjustments to the sum 1 as, finally summing the scores by multiplying the weight of each criterion by the weight of each criterion as shown in Table 3.5

Table 3.5 The result total sum of alternatives scores by AHP method

Alternative	Score	Rank
A1	0.2331	2
A2	0.2073	3
A3	0.1260	5
A4	0.1712	4
A5	**0.2624**	**1**

From AHP criteria to choose the location of the warehouse of grass in Chiang Rai Province through the 7 criteria, the results stated that Chiang Khong district is the interesting place to be the location of the warehouse. The runner-up district is Mae Chan, Chiang Saen, and Mae Sai, respectively.

When analyzing data for selection in various ways. With different ideas To find the most appropriate alternative from the various methods. There are 3 methods of decision making: SAW, TOPSIS and how to AHP The results of the order of choice in various ways. It can be concluded that Option A5 (Tambon Pa Sang, Mae Chan District) is the most appropriate choice. To build a warehouse of grass since it is the first place selected from the two methods ranked second to the A1 (Tambon Pa Sang, Mae Chan District) A2 (Tambon Sri Srichon, Chiang Khong District) A4 (Tambon Mae Chan, Mae Chan District) and A3 (Tambon Ban Saew, Chiang Saen District),
respectively.

3.3 SAW Method

The results of the selection of grassland storehouse by SAW method

In the data analysis, the first step is to smooth the data shown above. This will make the data considerably more convenient. From Table 3.6, data is smoothed with Vector Normalization. Weight configuration for this study, we used the Ratio Weighting method, which is considered heavy weight by considering the geometric mean of each factor. The weighted values are then calculated by multiplying the score by the smoothness multiplied by the weight of each factor as shown in Table 3.7

Table 3.6 Conclude smooth adjustment information and the weight value of the factors

Weight value of Factors		A1 T.Klung, A.Chiang Khong	A2 T.Sridonchai, A.Chiang Khong	A3 T.Ban Seaw, A.Chiang Saen	A4 T.Mae Chan, A.Mae Chan	A5 T.Pa Sang, A.Mae Chan
X1	0.1789	0.4399	0.2932	0.5027	0.3519	0.5865
X2	0.1368	0.5880	0.5586	0.2940	0.2940	0.4116
X3	0.1263	0.3885	0.4856	0.1943	0.5828	0.4856
X4	0.0947	0.3714	0.3714	0.1857	0.3714	0.7428
X5	0.0632	0.5000	0.5000	0.3000	0.4000	0.5000
X6	0.0632	0.5774	0.5774	0.1925	0.3849	0.3849
X7	0.0632	0.2294	0.6882	0.2294	0.4588	0.4588

Table 3.7 The results are considered by SAW Method and Sequence

Selection	Score	Rank
A1	0.4610	3
A2	0.4622	2
A3	0.3232	5
A4	0.4117	4
A5	**0.4904**	**1**

Table 3.7 shows the SAW results. The result is A5, Pa Sang Sub-District, Mae Chan District, Chiang Rai Province. As the most valuable alternative area, it is considered to be the most suitable area for selection of grass collection areas. Chiang Rai Province by SAW method.

Summary of the results of the selection of grass collection from all three methods. Based on the multiple deterministic decision-making (MCDM) approach, three methods can be used to summarize the average of the responses from the MCDM method of consideration, as shown in Table 3.8, and summarize the results of each final score. How loud is shown in the table 3.9

Table 3.8 Results from the MADM method and sequence mean

Selections	SAW METHOD	TOPSIS METHOD	AHP METHOD	Sequence Mean
A1	3	2	2	2.33
A2	2	3	3	2.67
A3	5	5	5	5
A4	4	4	4	4
A5	**1**	**1**	**1**	**1**

Table 3.9 show last of each method

Sequence	**SAW METHOD**		**TOPSIS METHOD**		**AHP METHOD**	
	Selection	**Score**	**Selection**	**Score**	**Selection**	**Score**
1	**A5**	**0.4904**	**A5**	**0.7134**	**A5**	**0.2624**
2	A1	0.4622	A2	0.5312	A1	0.2331
3	A2	0.4610	A1	0.5174	A2	0.2073
4	A4	0.4117	A4	0.4519	A4	0.1712
5	A3	0.3232	A3	0.2936	A3	0.1260

When analyzing data for selection in various ways with different ideas to find the most appropriate alternative from the various methods. There are 3 methods of decision making: SAW, TOPSIS and AHP from the results of the order of choice in various ways. It can be concluded that option A5 (Tambon Pa Sang, Mae Chan Districts) is the most appropriate choice to create a grass store because it is the first place to be selected from the three methods ranked second A1(Tambon Klung, Chiang Khong Distric), A2 (Tambon Sri Don Chai, Chiang Khong Distric), A4 (Tambon Mae Chan, Mae Chan Distric) and A3 (Tambon Ban Saew, Chiang Saen Distric), respectively. After the appropriate area, in the next step, the researcher will use the area to design and arrange the flowering store.

CONCLUSION AND FUTURE WORK

Based on the objectives of the study on the selection, location and design of grassland inventory in Chiang Rai province, the objectives were firstly to select suitable locations for the establishment of grass collection store in Chiang Rai province. This study investigates the factors that are important for site selection. And from an entrepreneur interview. And who is involved in the decision 3 people.

The selection of appropriate locations for grassland inventory will be based on a total of 16 criteria, including land price factors, size of land area Number of raw material suppliers Quantity of raw materials in the area Accessibility to the source of labor resources near raw material sources. The number of competitors in the feng shui area, the environment, transport patterns, community outlook, future opportunities, sources of funding, and transportation routes. All factors have been taken into account. And ratings from entrepreneurs and 3 related persons, Pairwise Comparison and Analytic Hierarchy Process (AHP) based on all 21 factors analyzed.

The importance of each factor was determined and the factor of 95 percent was determined. The total of 16 factors influenced the selection of the grass collection area in Chiang Rai province. As mentioned above, it is a decision-making tool. And then, we have considered the appropriate areas by introducing Geographic Information System (GIS) to help screen the appropriate areas in the preliminary selection of locations. Chiang Rai province based on the preliminary selection criteria:

1) Away from sources of raw materials up to 50 kilometers.

2) The area adjacent to the main road.

3) It is the area that is on the major transportation routes.

4) Non-conservation areas and national parks.

5) Is an empty area and no land and flat land or more.

6) It is a non-community area and an area with buildings.

7) Is basically agricultural. It is not the area where perennials and fruit trees are planted, as well as the nursery.

8) Non-water areas such as natural water sources. And the water source created.

In addition, considering the appropriate areas. Also, take into account the area available for sale. And the price of land. After doing the preliminary area study, collect information about the area from the area. And selected All 5 areas were selected from 14 areas. After that, 5 areas were selected for the site selection. TOPSIS and AHP methods. The results of these three methods, as shown in Table 5.1, are compared. And choose the most suitable area only one area. It can be seen that the area that has been selected as the suitable area for establishing grass collection in Chiang Rai is area A7, Pa Sang, Mae Chan, Chiang Rai. Because it is the first place to calculate the three methods, with a score from the SAW method 0.4904, the TOPSIS method 0.7134, and the AHP method 0.2624.

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