

Selection of Optimal Location for Super Shops in Bangladesh Using AHP Method

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Abstract

Super shop, a departmentalized retail store is one of the growing industries in Bangladesh. In a general sense, super shops are self-serviced shops that offer a wide variety of products, consumers can buy groceries, other foods, beverages and household goods. Though the size of the retail industry in Bangladesh is nearly US \$16 billion, super shops hold only a 1.6% share of the retail business. Companies are trying to establish new super shops or spread their outlets all over Bangladesh. In this situation, which location is suitable for establishing them considering various criteria to achieve the highest profit and customer response has come into a great concern to the companies. To prioritize criteria and select the best alternatives based on them, AHP is one of the most used structured techniques. Our paper is about selecting the best location for establishing a super shop in different areas of Bangladesh.

Keywords: AHP, Optimal location, MCDM, OCW, Super shop

1. Introduction

“A super-shop is a self-service shop offering a wide variety of food, beverages, and household products organized into sections. Nowadays super shop has become a growing industry in Bangladesh”. (Islam, 2021). According to the BSOA (Bangladesh Supermarkets Owners’ Association), more than 130 super shops outlets have been set up in Bangladesh by around 40 companies over the last 16 years (Mahmud, 2018). The industry is largely dominated by three major players- Shwapno with 59 outlets, Agora with 13 outlets and Meena Bazar with 18 outlets. As young mid and high-income urban consumers are becoming more aspirational and open to buy a wide range of goods, (Vargas, 1990) the number of super shops is increasing day by day in Bangladesh. As the expansion of super shop is growing rapidly, super shops become the center of interest for many investors. In this situation, the selection of the optimal location of super shops has become the burning question in Bangladesh. Selecting the optimal location considering variables such as environment, customer requirements, transportation costs, time, etc is called facility location. The best alternative has to be selected among some alternatives using some specific method. These methods are called multi-criteria decision-making methods (MCDM). Multiple Criteria Decision Making (MCDM) is complicated and large-scale decision-making method which refers to making decisions in the presence of multiple, conflicting criteria. (Xu & Yang, 2001). Among most inclusive methods in MCDM to make decisions, Analytic Hierarchy Process (AHP) is one of them. (Taherdoost, Decision Making Using the Analytic Hierarchy Process (AHP); A Step by Step Approach, 2017) AHP is divided into two phases- hierarchic design and evaluation. It is a tool that is widely used in the range of problem areas from simple personal to complex decisions. (Vargas, An Overview of analytic hierarchy process and its applications, 1990) In AHP, complex decision problems are organized into hierarchical structures composed of different levels. In super shop facility location problem in Bangladesh, using the AHP method can be a great solution.

2. Literature Review

Since the super shop industry is one of the growing sectors in Bangladesh, the sector has followed up with tremendous opportunities due to the socio-economic development, urbanization, and purchasing power of the middle and upper-middle class of the country (Islam K. w., 2021). The journey of supermarkets started in Dhaka, in early 2000. (Khan, 2021) Agora is the first retail store in Bangladesh established by Rahimafrooz Group. Agora is one of the biggest super shops in Bangladesh. Now it has 13 outlets. Other major players are Shwapno and Meena Bazar have 59 and 18 outlets respectively. Over the last 16 years, about 40 companies have opened more than 120 superstore outlets in Bangladesh. (Akter & Mia, 2020). According to Bangladesh Supermarket Owners Association (BSOA), The present yearly sales growth rate of superstores is 15% to 20%, and annual turnover is already more than BDT 15.0 billion (1500 crore) by 30 operating across the country in this growing business sector. Nowadays, not only high-income people but also middle-income people are becoming customers of the supermarkets. Supermarkets are spreading at a high rate in urban areas. Most of the supermarkets in Bangladesh are located in city areas. (Khan, Factors affecting Customer inclination to shop from supermarkets in Dhaka, Bangladesh, 2021). So, for a company, it is quite brainstorming to select a location to establish a super shop as there are many competitors. Selecting a location to get maximum profit is an important part of the supply chain. Management of the supply chain depends on various decisions like selection of areas of where to deliver or supply, mediums of transportation and production unit capacities etc. Trade environment, the nature of the commodity, corporate strategy, the availability and accessibility of infrastructure, etc. all affect how supply chains are formed. Facility Location selection is related to all forms of supply chain. AHP is one of the most popular methods to make the correct decision. It is a hierarchical process of measurement which measures through pairwise comparisons and relies on the judgements of experts to derive priority scales. (Saaty, 2008) In the facility Location of Super shop, AHP is a good option. Some study has been published to allocate the super shops in only Dhaka city (Rahman & Chakraborty, Optimum Allocation of Super Stores in Dhaka City: An application of geographic information system (GIS) and heuristic model, 2010) but it is not enough as super shops are rapidly growing all around Bangladesh. So, in this paper, we worked on facility location to find the best profitable area outside Dhaka for establishing a super shop among five alternatives - Rajshahi, Rangpur, Narayanganj, Khulna and Chattogram considering

some criteria. This research will help the organizations to find the best places for establishing super shops.

3. Data Collection and Analysis

To select the best alternative and also prioritize all the alternatives, we needed some data and their analysis. We conducted a survey of more than 20 super shop companies in various locations in Bangladesh to collect data. Experts also helped us by giving their opinion. Their opinion and our survey helped us to find the important criteria and sub criteria for facility location of super shops, to rate them and to select the alternatives too. The most important criteria are Inventory management, Marketing, Transportation, Communication Facilities, Labor, Infrastructure Facilities, and Customer demand. Transportation facilities and Transportation cost were the two sub-criteria of 'Transportation' and 'Labor' had also two sub-criteria - Labor availability and Labor Cost. We selected 5 alternatives or places. Those were Narayanganj, Chattogram, Rangpur, Rajshahi and Khulna.

Criteria responsible for the super-shop location selection:

- **Inventory Management:** Inventory is the goods or materials a business tends to sell to customers for profit. Inventory management is the tracking of inventory from manufacturers to warehouses and from warehouses to a point of sale. Inventory Management is one of the most important parts of the supply chain. In any super-shop inventory management system, a shopkeeper can manage their product by adding, selling, stock checking, stock changing, searching, and so on. Every shop owner wants to know how many products are available in their shop. In any shop, if some product quantity is

low, then they can purchase the product again and put them in stock. Suitable location selection facilitates super-shop owners to purchase products in the shortest possible time.

- **Marketing:** Marketing is the process of getting potential clients or customers interested in any services. Marketing involves researching, promoting, distributing, and selling products. Marketing is one of the major aspects of business these days. For newly launched companies or organizations, marketing is implemented to achieve goals in their growth strategy. Side by side, marketing is an important factor to gain huge customers response towards newly arrived business. Marketing can be done offline, through billboards, posters, advertising in a certain local area, or online through media coverage. Marketing is dependent on:

-Marketing medium

-Marketing cost

- **Transportation Facilities:** Transportation is the movement of goods or services from one place to another by various means. Whereas transportation cost includes all the entire costs of moving inventory from one point to another. Super shops have to cope with different challenges of selling vegetables and fish due to Bangladesh's limitations of transportation and cold storage. Many customers believe that the super shop's vegetables, fish, and meats are not fresh. Moreover, for keeping emphasis on cleanliness and hygiene, a specific temperature is constantly maintained in the super shops. That's why transportation facilities play a vital role in ensuring the cleanliness and hygiene of veggie products, fish, and meats. Side by side costs of the entire transportation plays a major role in running a super shop. Costs of products delivery from the warehouse to the shop vary from location to location.

- **Communication Facilities:** Communication facility depicts the relationship between customers and the organization upon which a customer depends for service or product. Communication facilitates customers to get services in the shortest possible time and at a lesser cost. Selection of location for super-shop can help to gain expected customer responses in a short time.
- **Labor Availability:** Labor is the amount of physical, mental and social effort used to produce goods and products in an economy. Responsibilities of super shop laborers are performing housekeeping duties, operating basic hand or powered hand tools, products handling, operating product handling equipment, performing product procurement, inventory handling, product delivery engagement, etc. Varieties of labors engagement are necessary to run a super shop following their ability to work in a cold environment, physical fitness, knowledge of shop and equipment safety as well as basic reading skill. Finding the best place for the availability of huge, skilled labor is one of the major factors for starting a super shop. Bangladesh has a huge workforce who are roaming around for work and their betterment.
- **Labor Cost:** Bangladesh has a government-mandated minimum labor cost. No worker in Bangladesh can be paid less than this mandatory minimum rate of pay. The Bangladesh minimum wage is 1500 taka per month for all economic sectors. The rate can be varied among different types of labor. As well as cost can vary from place to place in the country.
- **Infrastructure Facilities:** Super shop chains in Bangladesh are mainly concentrated in densely populated urban areas. Infrastructure facilities depend on the entire supply chain management, logistics, procurement of the super shop management. Supply chain management deals with the supply system of the products which is really tough in the perspective of Bangladesh. Goods pass through the supplier to the manufacturer with proper implementation of transaction, finance, packaging, warehousing, and transportation. Then all goods are delivered from the distributor to customers through retailers.

- **Customer Demand:** Fixed price facility, one-stop service, brand image, quality commodities, convenient locations, hassle-free shopping environment are the key facilities provoking the customer to visit the super-shops. Most of the super shops have been established in highly dense urban areas in Bangladesh because of numerous customer gains.

Graphical representation of survey data for the preferable location for super shops based on different criteria:

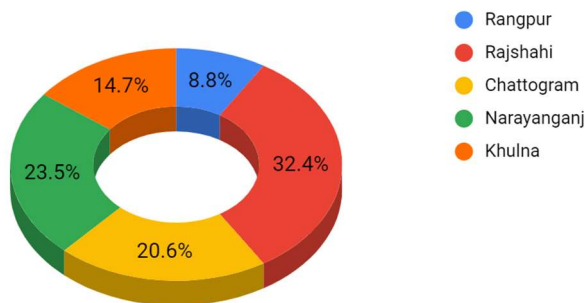


Fig 1. Count for which location is preferable for "Marketing Cost"

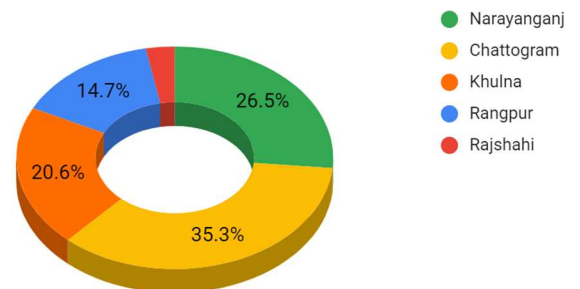


Fig 2. Count for which location is preferable for "Inventory Management"

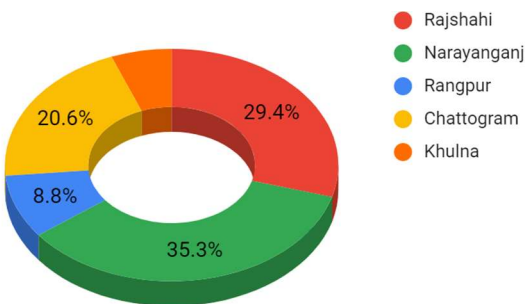


Fig 3. Count for which location is preferable for "Transportation Cost"

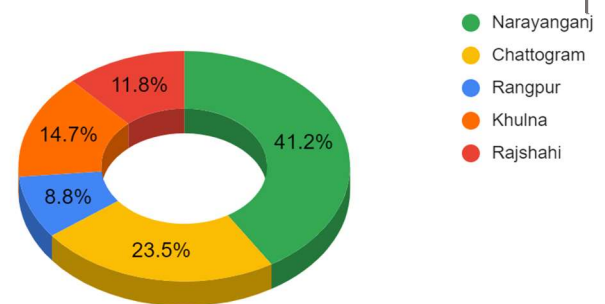
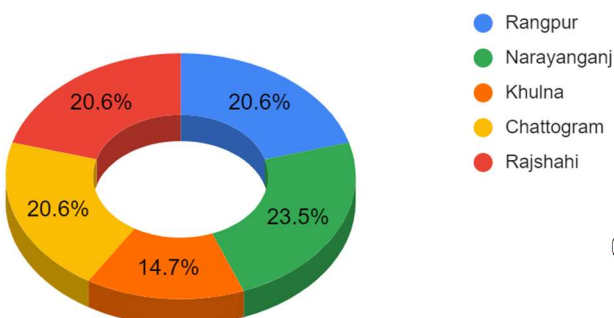


Fig 4. Count for which location is preferable for "Communication Facility"



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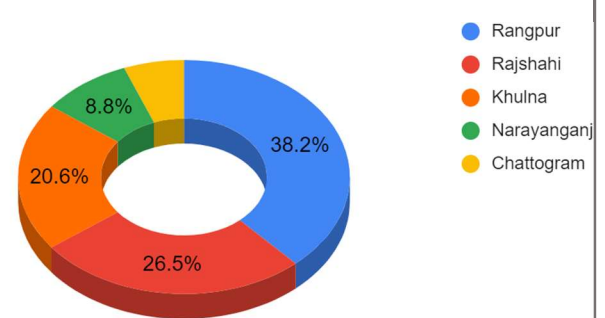


Fig 5. Count for which location is preferable for “Labor Availability”

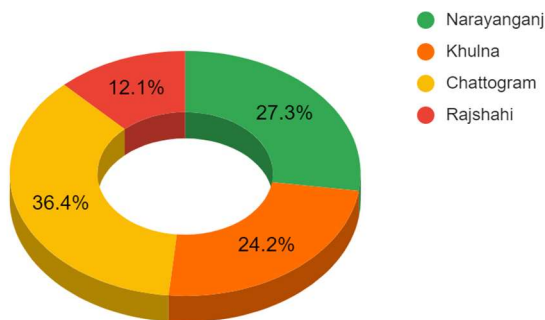


Fig 6. Count for which location is preferable for “Labor Cost”

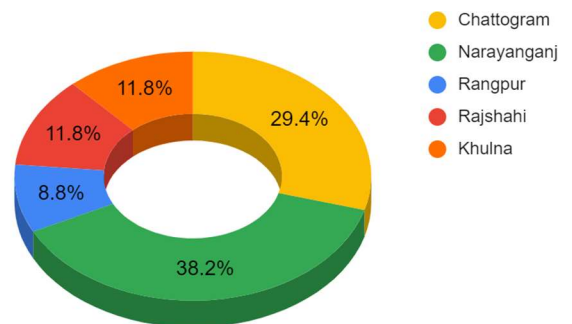


Fig 7. Count for which location is preferable for “Infrastructure Facilities”

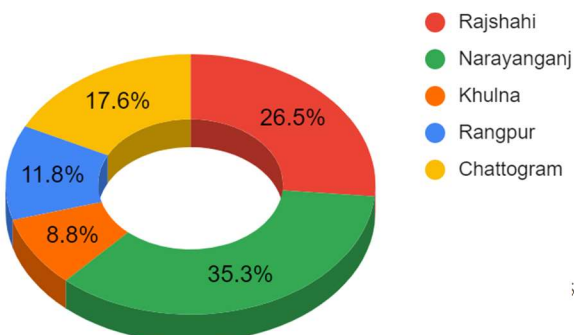


Fig 8. Count for which location is preferable for “Customer Demand”

Fig 9. Count for which location is preferable for “Transportation Facility”

4. Methodological Approach

4.1 Analytical Hierarchy Process (AHP) Analysis

T. L. Saaty (1977) introduced the Analytic Hierarchy Process (AHP) as one of the Multi-Criteria Decision-Making Approaches. AHP is one of the most popular MCDM approaches because of its easy structure and easy calculation process. It has been used in many sectors such as in public administration, airways, in Govt sector, the department of Defense, companies for customer satisfaction, battles, Military, politics, sports etc. ((Saaty, 2008)

The process of AHP is well structured and described in previous papers. ((Islam & Hasan, 2018)

The first step for criteria is to construct a matrix which is pairwise. Then, the next step is to

normalize every column of this matrix and to calculate the priority of the weights. After that, the Consistency Ratio (CR) has to be computed and checked.

$$CR = CI/RI$$

Here, CI = Consistency index = Eigen value -n /n-1

Table 1: Value of RI (Random Consistency Index):

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

If the value of CR is less than 0.10, it is considered acceptable to continue the analysis. In case the value of CR is more than 0.10, this is not acceptable and the reason should be re. In the comparison matrix, the relative importance values are determined with Saaty's 1-9 scale.

Table 2: The fundamental scale of absolute numbers (Saaty, 2008)

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
3	Weak importance	Experience and judgment slightly favor one activity over another.
5	Strong importance	Experience and judgment slightly strongly one activity over another.
7	Very strong importance	An activity strongly favored and its dominance demonstrated in tactics.
9	Extreme importance	Importance of one over another affirmed on the highest possible order.
2,4,6,8	Intermediate values	When compromise is needed between the priorities.
Reciprocals of nonzero	If activity i has one of the above nonzero numbers assigned to it when compared to activity then j	

	has the reciprocal value compared with i	
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After that, the next step is to derive the importance for each decision alternative in the respect of each criterion. To do this, a comparison matrix among the alternatives has to be constructed. For the alternatives, the same process is done like the previous calculation and priority is calculated by concerning each criterion and sub-criterion. Now, overall priorities have to be derived. To derive this, local priorities (priorities of alternative calculated for each criterion) have to be multiplied with derived priorities. Then the whole weight score of the alternatives has to be calculated and prioritized by their scores.

4.2 Solution Methodology for Analytic Hierarchical Process with Problem Formation

In this paper, our target is to find out the best place (optimal location) for establishing a super shop in Bangladesh. For this, some criteria and sub-criteria have been considered. Criteria are Inventory management, Marketing, Transportation, Communication Facilities, Labor, Infrastructure Facilities, and Customer demand. Transportation facility and Transportation cost are

the two sub-criteria of Transportation and 'Labor' has also two sub-criteria - Labor availability and Labor Cost.

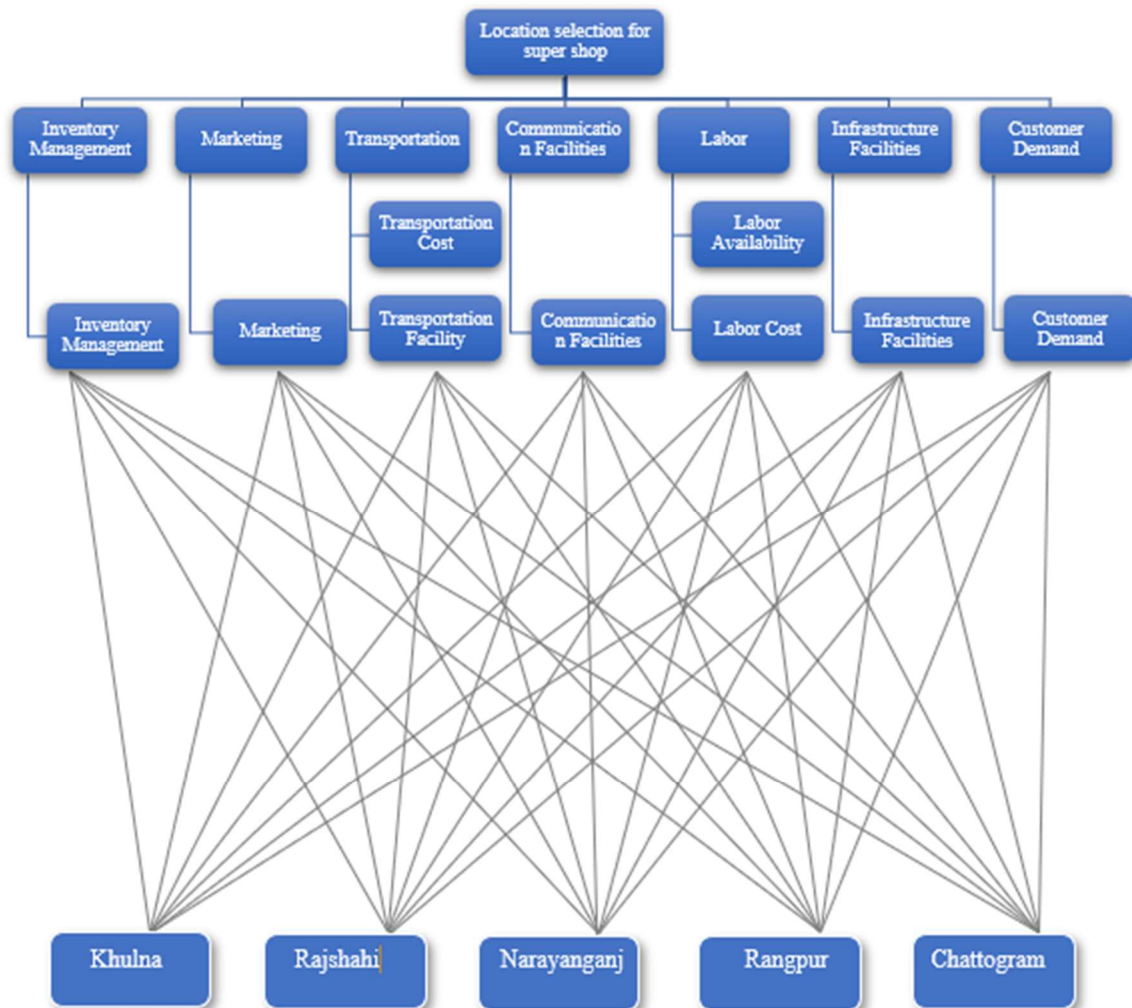


Fig: Hierarchical Structure for Super-shop Location Selection

By considering all the criteria and sub-criteria, we have to select the best alternative among the alternatives - Narayanganj, Rajshahi, Khula, Rangpur, and Chattogram.

Table 3: Pairwise Comparison Matrix based on relative importance among all criteria

	Invent ory Manag ement	Mark eting	Transport ation	Communicati on facilities	Labo r	Infrastructu re facilities	Customer Demand
Invent ory Mana gemen t	1	7	5	4	6	2	3
Mark eting	1/7	1	1/3	1/4	1/2	1/6	1/5
Trans portat ion	1/5	3	1	1/2	2	1/4	1/3
Com munic ation faciliti es	1/4	4	2	1	3	1/3	1/2
Labor	1/6	2	1/2	1/3	1	1/5	1/4
Infras tructu re faciliti es	1/2	6	4	3	5	1	2
Custo mer Dema nd	1/3	5	3	2	4	1/2	1

In table 3 pairwise comparison matrix of the criteria has been formed in terms of their relative importance.

Table 4: Calculating normalized weights of matrix in pairwise comparisons

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	Inve ntor y Ma nag eme nt	Mar keti ng	Trans porta tion	Comm unici on facilitie s	Labo r	Infra struc ture facili ties	Custom er Deman d	Weighted Sum	Priority
Ma rke ting	.055	.036	.021	.023	.023	.037	.027	0.226	.032
Tra nsp ort atio n	.077	.107	.063	.045	.093	.056	.046	0.493	.069
Inv ent ory Ma nag eme nt	.386	.25	.316	.361	.279	.450	.412	2.572	.350
Co mm uni cati on faci litie s	.096	.143	.126	.090	.140	.075	.069	0.756	.105
Lab or	.064	.071	.032	.030	.047	.045	.034	0.326	.046
Infr astr uct ure faci litie s	.193	.214	.253	.271	.233	.224	.275	1.746	.240

Cus tom er De ma nd	.129	.179	.189	.180	.186	.112	.137	1.157	.159
							Sum	7.276	1.001

In table no. 4, normalized weights of matrix have been formed. Here priority of all the criteria has been determined.

$$\lambda_{\max} = (7.0653 + 7.145 + 7.349 + 7.2 + 7.087 + 7.275 + 7.277) / 7 = 7.199$$

$$CI = (7.199 - 7) / (7 - 1) = .033$$

$$RI = 1.32 \text{ (For } n = 7\text{),}$$

$$CR = CI / RI = .033 / 1.32 = .025$$

Since the value of CR is less than .1, this result is accepted. Now the system is consistent. Comparison between each sub-criterion and determining weights of sub-criteria were done by using the similar process.

Overall Criteria Weight (OCW) was calculated by multiplying criteria weight with sub-criteria weight in table no. 5

Table 5: Calculation of OCW (Overall criteria weight) for each criteria

Criteria Name	Weight of Criteria	Sub-criteria Name	Weight of Sub-Criteria	OCW
Inventory Management	.350	-	-	.350

Marketing	.032	-	-	.032
Transportation	.069	Transportation Facility	.733	.051
		Transportation Cost	.267	.018
Communication Facilities	.105	-	-	.150
Labor	.046	Labor Availability	.548	.025
		Labor Cost	.452	.021
Infrastructure Facilities	.240	-	-	.240
Customer Demand	.159	-	-	.159

In table no. 6, considering the criteria and sub-criteria, local priorities for all alternatives were derived doing same process. After that by multiplying local priorities with OCW, overall priorities were derived. Thus, alternative's total weighted score was determined. The best alternative was determined by the highest weight score.

Table 6: Prioritizing alternatives

	OC W	Local Priority (Alternatives)					Weighted Score of Alternatives = OCW*Alternatives				
		Rajs hahi	Nar ayan ganj	Ran gpur	Khu lna	Chatt ogram	Rajs hahi	Nar ayan ganj	Ran gpur	Khul na	Chat togr am
Inventory Management	.350	.029	.265	.147	.206	.353	.011	.093	.051	.072	.124 a
Marketing	.032	.324	.235	.088	.147	.206	.010	.008	.003	.005	.007
Transportation Facility	.051	.265	.353	.118	.088	.176	.014	.018	.006	.004	.009
Transportation Cost	.018	.294	.353	.088	.059	.206	.005	.006	.002	.001	.004
Communication Facilities	.150	.118	.412	.088	.147	.235	.012	.062	.013	.022	.035
Labor Availability	.025	.206	.235	.206	.147	.206	.005	.006	.005	.004	.005
Labor Cost	.021	.265	.088	.382	.206	.059	.006	.002	.008	.004	.001
Infrastructure Facilities	.240	.121	.263	.129	.241	.246	.029	.063	.031	.058	.059
Customer Demand	.159	.118	.382	.088	.118	.294	.019	.061	.014	.019	.047
Total							.111	.319	.133	.189	.291
Decision							5th	1st	4th	3rd	2nd

5. Result & Discussion:

We worked on facility location selection for super shops in Bangladesh in this paper. Rajshahi, Narayanganj, Rangpur, Khulna and Chattogram were our main alternatives. The main objective was to find out the best alternative considering the criteria of inventory management, marketing, transportation, communication facilities, labor, infrastructure facilities and customer demand. Also, sub criteria of some criteria were considered. We used the AHP Method which is one of the methods of MCDM. First of all, the pairwise comparison matrix was done among all alternatives. OCW (overall criteria weight) was calculated from this. Then we determined the local priorities of alternatives and weight score of alternatives. After that, the total weight score was calculated by summation of weight scores for respective alternatives.

Table 7: Comparison between decisions

Alternatives	Total Weight Score	Decision
Rajshahi	.111	5th
Narayanganj	.319	1st
Rangpur	.133	4th
Khulna	.189	3rd
Chattogram	.291	2nd

Total weight scores of Rajshahi, Narayanganj, Rangpur, Khulna, Chattogram were calculated .111, .319, .133, .189, .291 respectively.

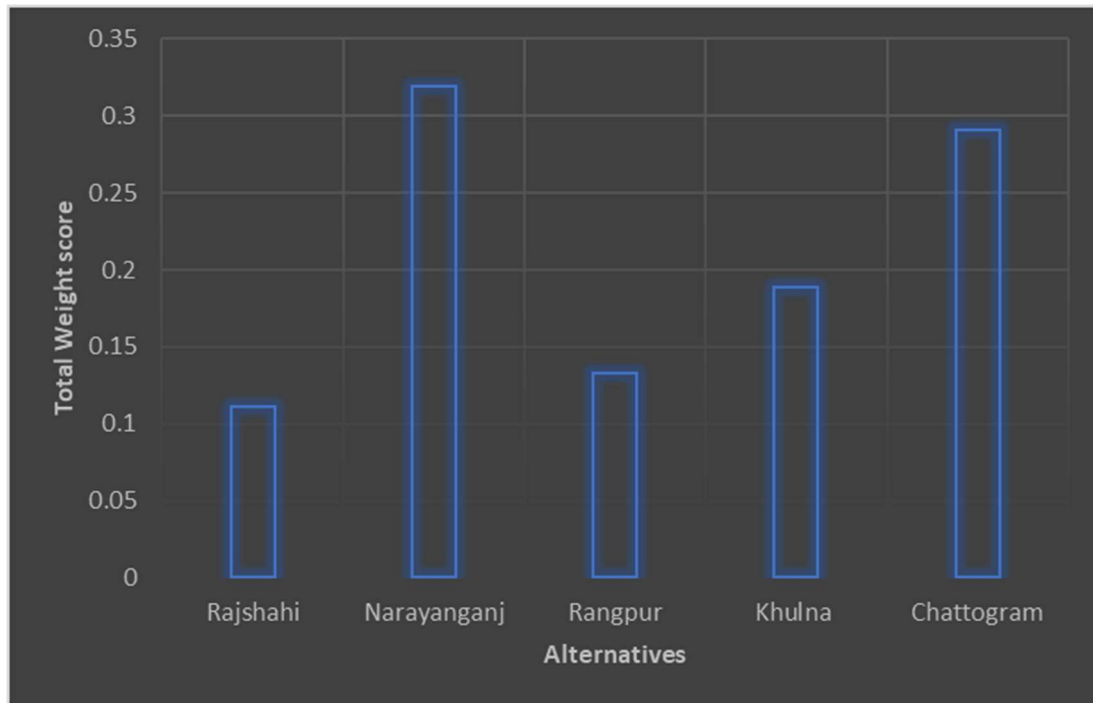


Fig: Total weight score for all alternatives

Narayanganj was selected as the best alternative because its weight score was the highest. Then Chattogram, Khulna, Rangpur & Rajshahi had secured 2nd, 3rd, 4th and 5th place respectively according to their weight score.

6. Conclusions and Recommendations:

In this research, the facility location of a super shop in Bangladesh has been selected using the most popular Analytical Hierarchical Method (AHP) to achieve more profit and customer response. 7 criteria have been considered in this report that is considered for establishing super shop in Bangladesh. A survey was conducted to find out all the criteria and sub-criteria as well as their relative importance. By considering all the criteria and sub-criteria, optimum location for super-shop business. As a result, Narayanganj was the best place to establish a new super shop.

Our final result might be affected if we used more criteria, sub-criteria and alternatives. This might be possible if we conducted more surveys. Some challenges we faced in our research and doing surveys. First of all, data providers didn't want to disclose their confidential data. If this type of data can be collected in the future, then further approaches of AHP can be used. We didn't consider uncertainty in this research. Fuzzy logic concepts can be used if there is uncertainty. The result might be changed if other MCDM methods can be used in the future. Narayanganj was the optimum location for our research considering all the criteria. Finding the limitations behind why other locations except Narayanganj were not optimum can be further approached in future.

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