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Analysis of Suitable Residential Location using MULTI-CRITERIA DECISION MAKING Method

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Abstract – *When it comes to buying a home, we always hear of this advice "Location". But what this really mean? The phrase "Location, Location & Location" puts emphasis on the importance of choosing the best place for you when choosing and buying your next home. There are few things to consider when scouting for the perfect location for instance budget, work location, environment, infrastructure, etc these are the things that most people instinctively want when they choose a location for their residence.*

Key Words: Multi criteria decision making, Environmental factors, Infrastructure factors, Amenities, Cost of home/ property, Work location factors, Residential location choice.

1. INTRODUCTION

A residential location plays an important role in the life course events of any individual and family. Due to rapid urbanization in a developing country like India, accompanied by regular migration and frequent movement (mainly job specific and education), issues related to accommodation have become severe in large urban areas. As a result there has been overcrowding in certain areas with high density population, vehicular moment and public transport.

Central zone of Surat is one such place where the population level is extreme. With the increasing creativity of infrastructure, most people are fascinated to buy there new homes, being it a reason for environment or work place or infrastructure and many more.

Out of different locations, shift was found in analysis and among all location, which have higher percentage, which means that majority households want to shift in that location.

This project explores how users, occupants and citizens can express their needs, searching for the enhancement of the individual choice.

2. STUDY AREA PROFILE

Central Zone, which is situated in Surat, Gujarat, India.

Figure 1 Study area profile of Central Zone

Table 1

Zone wise area of Surat city.

Sr. no.	Zones	Areas (sq. km.)
1	**Central zone**	**8.18**
2	South-west zone	111.912
3	South zone	61.764

4	South- east zone	19.764
5	East zone	37.525
6	North zone	36.363
7	West zone	51.279
8	**Total**	**326.515**

(Source: suratmunicipal.gov.in)

3. DATA COLLECTION

As observed from the past data of population in central zone of Surat, it has been noticed that population in that particular zone is decreasing with the passage of time than any other zones. For the study of location shift of households in Central zone of Surat, collection of existing situation is required and survey is important. Data collected from survey indicates that which location households want to shift and which criteria citizens consider for future. Hence for the further analysis we needed sample size that is accurate for the survey. And for sample size calculation we need population of future years. That is why we decided to forecast the future population of central zone in upcoming year. The major factor that affects the population of central zone is migration from one zone to other in search of better facilities, amenities, infrastructure and environment. Hence for forecasting the population we choose incremental increase method so that accurate population can be determined and percentage of sample size can be obtained.

Table 2

Zone wise Population

Sr. no.	Zones	Population		Decade growth 2001-2011 (% age)
		2001 census	2011 census	
1	Central zone	413641	408760	-1.18
2	South-west zone	242466	347447	43.30
3	South zone	407980	695028	70.36
4	South- east zone	397257	748304	88.37
5	East zone	711516	1137138	59.82
6	North zone	416370	705163	69.36
7	West zone	287144	424986	48.00
8	Total	2876374	4466826	55.29

(Source: suratmunicipal.gov.in)

By future forecasting we got 403878 populations. According to online site www.hotjar.com calculation 196 response were calculated out of which we surveyed for 245 public survey and 30 expert surveys.

Table 3

Details of main criteria & sub criteria

Main criteria	Sub criteria
Environmental factors	Pollution
	Garden
	Open Space
Infrastructure factors	Water quality
	Water quantity
	Sewage collection
	Solid waste collection
	Storm water discharge
Amenities	Health facilities
	Market facilities
	Educational facilities
	Social security
	Entertainment facilities
Cost of home/ property	Cost preference
Work location factors	Transportation connectivity to work place
	Mode of travel

Above table shows all the main criteria and their sub criteria which taken in consideration during survey work.

Table 4

Survey samples of type of home/property

Category of types of home	No. of surveyed samples	% of surveyed samples
Apartment	136	55.28
Row houses	80	32.52
Bungalow	16	6.50
Others	14	5.7
Total	245	100

4. ANALYSIS AND RESULTS

For the analysis of residential location choice of household's lives in Central zone is calculated using Rank and Weightage approach of multi criteria decision making. The study is carried out in Central zone and home interviews were carried out in some wards. The Rating is given by descriptive variables to each factor. Each from the Home Interview, average rating was given to different factors for different income groups. From various wards information were collected of household's and location of shift is also collected during household interview. After interviewing households in various wards of Central zone, from that it was found that there 6 different locations at which citizens want to shift for

residential purposes. For that grouping of nearer location is required for decision making. Below table show the 6-different location of nearer locations for residential location choice of households.

Table 5
Grouping of shifting locations of household

Group of location shift for residential	Areas grouped in respective location
Location-1	Adajan
	Rander
	Jahangirpura
Location-2	Althan
	Bhatar
Location-3	Pal
Location-4	Udhana
	Pandesara
Location-5	Vesu
	VIP road
Location-6	Piplod
	Citylight
	Ghod-dod road

A. Analysis for residential location shift using Multi criteria decision making of range and ranking approach

Calculation of each value of row is the sum of each parameters assign value defined in table 6 and multiply with parameters assigns value and response according of people's opinion of that parameter.

Table 6 Range approach in decision-making

Parameters	**Location 1**	**Location 2**	**Location 3**	**Location 4**	**Location 5**	**Location 6**
Pollution	2.76	3.27	3.18	3.14	3.43	2.45
Garden	3.6	3.44	3.27	3.04	3.57	3.8
Open Space	3.73	3.88	3.72	3.47	3.81	3.7
Water Quality	1.67	1.88	2.22	1.80	1.5	1
Water Quantity	1.6	1.55	1.81	1.76	1.64	1.09
Sewage Collection	1.82	1.83	1.95	1.80	2.08	1.81
Solid Waste Collection	1.6	2.16	2.22	2.19	1.9	1.27
Storm Water Discharge	1.63	1.83	1.95	2.14	1.79	1.18
Cost of home	2.32	2.5	2.52	3.42	2.7	1.72
Transportation Connectivity	1.06	1.05	1.09	1.14	1.08	1
Mode of travel	1.13	1.11	1.18	1.38	1.12	1
Health Facility	1.33	1.44	2.04	1.61	1.5	1
Market Facility	1.36	1.66	1.95	1.7	1.53	1.09
Educational facility	2.67	227	2.5	1.85	2.36	2.91
Social Security	1.7	1.83	2.45	1.90	2.64	1.55
Entertainment Facility	3.53	2.55	3.13	2.33	3.41	4
Score Sum	33.52	34.25	37.18	34.67	36.09	30.57
Total Sum	206.28					
Percentage of location choice	16.24	16.60	**18.02**	16.80	17.49	14.81

Estimation of each estimated line is the total of every parameter are allocated with respect to the characters in table and with increased parameters. Then after sum of each column was found out. Location 3 is standardized into 37.18/206.28 (Sum of each column) x 100%=18.02% which shows that **location 3 is higher choice** among all location.

B. **Rank based evolution**

In this step, instead of using arbitrary values for each parameter, just rank the choice for each parameter. Smaller rank value is preferable than higher rank. Transforming the score value of each parameter according to the range value such that each parameter will have the same range.

The values of each row show the rank. Since smaller rank value is more preferable than higher rank, need to normalize the sum using formula below:

Normalized Score= 0.5 x (1 - sum / Total sum)

The total sum is 336 (=63+58+37+52+47+79). The normalized score of location 3 is 0.5 x (1-37/336) = 44.49 % which shows that **location 3 is higher choice** of household.

Table 7 Rank based evolution for locations

Parameters	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6
Pollution	5	2	3	4	1	6
Garden	2	4	5	6	3	1
Open Space	3	1	4	6	2	5
Water Quality	4	2	1	3	5	6
Water Quantity	4	5	1	2	3	6
Sewage Collection	4	3	2	6	1	5
Solid Waste Collection	5	3	1	2	4	6
Storm Water Discharge	5	3	2	1	4	6
Cost of home	5	4	3	1	2	6
Transportation Connectivity	4	5	2	1	3	6
Mode of travel	3	5	2	1	4	6
Health Facility	5	4	1	2	3	6
Market Facility	5	3	1	2	4	6
Educational facility	2	5	3	6	4	1
Social Security	5	4	2	3	1	6
Entertainment Facility	2	5	4	6	3	1
Score Sum	63	58	37	52	47	79
Total Sum	336					
Normalized Score	40.62	41.36	**44.49**	42.26	43.01	38.24

C. Converted new score based on evolution

Now transforming the score value of each parameter into the same range value 0 to 1 by following formula based on simple geometric of a line segment;

olb) + nlb

nub = New upper bound
oub = Original upper bound
nlb = New lower bound
olb = Original lower bound

Table 8 Converted new score based on range for each location

Parameters	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6
Pollution	0.44	0.56	0.54	0.53	0.60	0.36
Garden	0.65	0.61	0.56	0.51	0.64	0.7
Open Space	0.68	0.72	0.68	0.61	0.70	0.67
Water Quality	0.16	0.22	0.30	0.2	0.12	0
Water Quantity	0.15	0.13	0.20	0.19	0.16	0.02
Sewage Collection	0.20	0.22	0.23	0.2	0.27	0.20
Solid Waste Collection	0.15	0.29	0.30	0.29	0.22	0.06
Storm Water Discharge	0.16	0.20	0.23	0.28	0.19	0.04

Parameters	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6
Cost of home	0.33	0.37	0.38	0.60	0.42	0.018
Transportation	0.01	0.01	0.02	0.03	0.02	0
Mode of travel	0.03	0.02	0.04	0.09	0.03	0
Health Facility	0.08	0.11	0.26	0.15	0.12	0
Market Facility	0.09	0.16	0.23	0.17	0.13	0.02
Educational facility	0.41	0.31	0.37	0.21	0.34	0.47
Social Security	0.17	0.20	0.36	0.22	0.41	0.13
Entertainment Facility	0.63	0.38	0.53	0.33	0.60	0.75
Score Sum	4.34	4.51	5.23	4.61	4.97	3.6
Total Sum	27.26					
Percentage of location choice	15.9	16.54	**19.18**	16.91	18.23	13.24

D. Weightage based approach

In the wake of acquiring master review frames in different field masters, the ratings of different parameters were given by our specialists in 1-5 scales.

We acquired reviews of around 30 experts. Figuring of weightage of all parameters are given underneath. Significance level of all parameters figured by increase of rate of every parameter and number of reaction of its rate and whole of it and divided by adding up the numbers of structures. For example importance level of pollution is calculated using an equation as: [(1x8)+(2x2)+(3x6)+(4x6)+(5x8)/30]=3.13 and percentage of each parameter were also calculated. Importance of weightage of each parameter found out by percentage out of

Table 9 Converted new score based on light of range for every location

Parameters	**1**	**2**	**3**	**4**	**5**	**Importance level**	**Importance of weightage**
Pollution	8	2	6	6	8	3.13	5.52
Garden	4	6	10	9	1	2.90	5.12
Open Space	8	6	3	10	3	2.80	4.93
Water Quality	2	1	4	13	10	3.93	6.93
Water Quantity	-	3	2	17	8	4.00	7.05
Sewage Collection	1	2	4	16	7	3.86	6.84
Solid Waste Discharge	-	3	4	14	9	3.96	6.98
Storm Water	1	4	7	11	7	3.63	6.42
Cost of home	1	4	15	8	2	3.20	5.64
Transportation	1	-	8	7	14	4.10	7.23
Mode of travel	4	4	6	8	8	3.40	5.99
Health Facility	1	5	4	12	8	3.70	6.53
Market Facility	1	1	8	10	10	3.96	6.98
Educational facility	1	5	5	14	5	3.56	6.27
Social Security	1	4	8	11	6	3.56	6.27
Entertainment Facility	4	6	8	10	2	3.00	5.29
Total						56.69	100

Table 10 Percentage of each parameter converted into weight

Parameters	Weight
Pollution	0.0552
Garden	0.0512
Open Space	0.0493
Water Quality	0.0693
Water Quantity	0.0705
Sewage Collection	0.0684
Solid Waste Collection	0.0698
Storm Water Discharge	0.0642
Cost of home	0.0564
Transportation Connectivity	0.0724
Mode of travel	0.0599
Health Facility	0.0653
Market Facility	0.0698
Educational facility	0.0627
Social Security	0.0627
Entertainment Facility	0.0529

The value of each row is calculated using value of table 10 of each row and multiplied with weight of each parameter and divided by 100. For example, location 3 of pollution parameter calculates by 0.54 x (0.0552)/100= 0.000298. Then after sum of each column is calculated and total sum of each column is found out. (0.00248+0.00262+0.00309+0.00271+0.00288+0.00198) = 0.01576. Normalized score of location 3 is found out by (0.00309 x 100)/ 0.01576 = 19.60%. In Range approach method percentage of location 3 is 18.02%, in ranking approach method normalized score of location 3 is 44.25 % and in Weightage approach method percentage of location 3 is 19.60% which is highest percentage among all location.

Table 11 Weightage score of each location

Parameters	Location 1	Location 2	Location 3	Location 4	Location 5	Location 6
Pollution	0.000242	0.000309	0.000298	0.000292	0.000331	0.000198
Garden	0.000332	0.000312	0.000286	0.000261	0.000327	0.000358
Open Space	0.000335	0.000354	0.000335	0.000300	0.000345	0.000330
Water Quality	0.000110	0.000152	0.000207	0.000138	0.0000831	0
Water Quantity	0.000105	0.0000916	0.000141	0.000133	0.000112	0.0000141
Sewage Collection	0.000136	0.000150	0.000157	0.000136	0.000184	0.000136
Solid Waste Collection	0.000104	0.000202	0.000209	0.000202	0.000153	0.0000418
Storm Water Discharge	0.000102	0.000128	0.000147	0.000175	0.000121	0.0000256
Cost of home	0.000186	0.000208	0.000214	0.000338	0.000236	0.0000101
Transportation Connectivity	0.00000724	0.00000724	0.0000144	0.0000217	0.0000144	0
Mode of travel	0.0000179	0.0000119	0.0000239	0.0000539	0.0000179	0
Health Facility	0.0000522	0.0000718	0.0000169	0.0000979	0.0000783	0
Market Facility	0.0000628	0.000111	0.000160	0.000118	0.0000907	0.0000139
Educational facility	0.000250	0.000194	0.000231	0.000131	0.000213	0.000294
Social Security	0.000106	0.000125	0.000225	0.000137	0.000257	0.0000815
Entertainment Facility	0.000333	0.000201	0.000280	0.000174	0.000317	0.000396
Score Sum	0.00248	0.00262	0.00309	0.00271	0.00288	0.00198
Total Sum	0.01576					
Percentage of location choice	15.73	16.62	**19.60**	17.19	18.27	12.56

5. CONCLUSION

The study has found the sensitivity of various parameters on residential location, with the preferences of the housing demand in the Surat city. This paper presents a holistic approach of the MCDM methodology to select the optimal location, which fits best for the residents. From all the methods of MCDM, it was concluded that "Location-3" is most suitable residential location among all others.

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