Looking for a Favorable Central Place for the Establishment of Educational and Health Care Centre to Equally Facilitate Both Genders in Taluka Kunri of District Umerkot, Sindh, Pakistan

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Abstract—Population in rural areas are scattered in the form of different villages or settlements. The proper selection of land to launch any educational or health activities to equally facilitate both the genders is the sticky situation, both for Govt. and Private organizations. Govt. spends substantial funds for the establishment of education institution/health centre at the place which is feasible and accessible to general public. However for specific gender, the gender population is also considered so that both the gender may be benefited equally. In this research, efforts have been made to illustrate how one can choose or locate the best central place/ area in Taluka Kunri of district Umerkot Sindh Pakistan where the Educational or Health activity is to be initiated. For the purpose the concept of centre of mass theorem is used as a tool to develop mathematical model, subsequently utilize in achieving the objectives.

Keywords—Centre of mass theorem, Establishment of technical/ vocational/ health care centre, Gender population of taluka Kunri of District Umerkot, Graphical interpretation of town committee/villages.

I. Introduction

POPULATION of rural areas are almost scattered in the form of different tribes or settlement. People fetch their earning through different profession like cultivation of lands, from forest, fishing and livestock. Illiteracy is the basic problem of rural areas. A literate person can take better livelihood and increase their earning. Local Govt. as well as Provincial or Federal Govt. takes keen interest to increase the literacy ratio both for boys and girls. As such different program to increase literacy rate with the help of community or through annual development program have been initiated. Moreover, in this regards substantial fund were allocated for the establishment of Primary, Middle and Secondary schools, Colleges and Technical institutions. By getting feasibilies

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reports from field offices under prescribed criteria or format, Govt. in their high forum permitted the site for the construction of educational institution.

The criteria may be ignored when there is some political pressure of the public representative or some bias public demand.

It is pertinent to note that the literacy rate of the area or province or country is not seems to be increased sufficiently, the reasons may be many but one of them will be the selection of right place for the establishment of the facilities. In this paper mathematical model is being developed by using the concept of centre of mass theorem and subsequently propose a suitable place for the establishment of any Govt., Private Educational Institution and Health Care Centre within the close vicinity of dense population to facilitate the inhabitants. In this regard Taluka Kunri [10] of District Umerkot Sindh is taken as a test case for the establishment of Educational institution and Health Care Centre for general public by using specific population data of gender [9].

II. Methodology and Modeling

According to centre of mass of a set of a particle of masses $M_1, M_2, M_3 \ldots M_n$ situated at the points $P_1, P_2, P_3 \ldots P_n$ whose position vector to an origin O are $r_1, r_2, r_3 \ldots r_n$. Then the linear moment of the set of particles with respect to O is the vector $\sum_{i=1}^{n} M_i r_i$

A. Definition

The centre of mass (c.m) of a set of particles is the point with respect to which the linear moment of the set of particles is zero.

B. Theorem [1]-[8]

"Every set of particles has one and only one centre of mass."

Let the particles $M_1, M_2, M_3 \ldots M_n$ be located at the point $P_1(r_1), P_2(r_2), P_3(r_3) \ldots P_n(r_n)$

Suppose C ($\bar{r}$) is a centre of mass

The position vector of $P_i(r_i)$ relative to C is $r_i - \bar{r}$

$$0 = \sum_{i=1}^{n} M_i \, (r_i - \bar{r}) \; ; \text{ where i} = 1,2,3 \ldots \ldots \text{ n}$$

$$= \sum M_i r_i - \sum M_i \bar{r}$$

$$= \sum M_i r_i - \bar{r} \sum M_i \quad OR \quad \bar{r} = \frac{\sum M_i r_i}{\sum M_i}$$

Thus centre of mass C exist and its position vector is $\frac{\sum M_i r_i}{\sum M_i}$

Suppose $C^{'}$ $(\bar{r}^{'})$ is another centre of mass of the set of particles. Then, reasoning as above, the linear moment of the given set of particles with respect to $C^{'}$ is zero if and only if

$$\bar{r}' = \frac{\sum M_i r_i}{\sum M_i}$$

Therefore, $\bar{r}^{'} = \bar{r}$ i.e. $C^{'} = C$

This proves the uniqueness of the centre of mass.

C. Cartesian Coordinates of the Centre of Mass

Let $r_i = (x_i, y_i, z_i)$ and $\bar{r} = (\bar{x}, \bar{y}, \bar{z})$
Then

$$\bar{x} = \frac{\sum M_i x_i}{\sum M_i} \; ; \; \bar{y} = \frac{\sum M_i y_i}{\sum M_i} \; ; \; \bar{z} = \frac{\sum M_i z_i}{\sum M_i}$$

In case of a coplanar set of particles, the last coordinate of the centre of mass may be ignored by choosing x, y-axis in the plane of the set and in case of a collinear set only one coordinate will be sufficient.

TABLE I
POPULATION OF TALUKA KUNRI, SEX WISE WITH CARTESIAN COORDINATE OF TOWN COMMITTEES

Sr. No.	Town Committee (TC) of Taluka Kunri District Umerkot	Population Census 1998			Cartesian Coordinates	Male		Female	
		Total (T_p)	Male (M_p)	Female (F_p)	(x,y)	M_px	M_py	F_px	F_py
1	Char	8552	4481	4071	(3,9.6)	13443	43017.6	12213	39081.6
2	Darelo	8188	4350	3838	(2.8,7.8)	12180	33930	10746.4	29936.4
3	Kandiari	7855	4120	3735	(3.8,6.2)	15656	25544	14193	23157
4	Manjhakar	6983	3693	3290	(4.4,10)	16249.2	36930	14476	32900
5	Rindki	5403	2849	2554	(5,8.4)	14245	23931.6	12770	21453.6
6	Saidki	5034	2662	2372	(4.6,7.4)	12245.2	19698.8	10911.2	17552.8
7	Barani	8963	4634	4329	(7,8)	32438	37072	30303	34632
8	Bustan	9610	5027	4583	(5.4,10.4)	27145.8	52280.8	24748.2	47663.2
9	Chajro	15686	8208	7478	(6,12)	49248	98496	44868	89736
10	Kunri	10495	5472	5023	(6.6,10)	36115.2	54720	33151.8	50230
11	Morjhango	10586	5569	5017	(8.4,10.6)	46779.6	59031.4	42142.8	53180.2
12	Dhambharlo	4599	2339	2260	(7,6)	16373	14034	15820	13560
13	Haido	4917	2557	2360	(5,3)	12785	7671	11800	7080
14	Mundhawa	4157	2144	2013	(5.4,5.4)	11577.6	11577.6	10870.2	10870.2
15	Nabisar	6184	3214	2970	(8,7.4)	24712	23783.6	23760	21978
16	Rahmore	4426	2229	2197	(6,7)	13374	15603	13182	15379
17	Talhi	8711	4524	4187	(4.6,4.2)	20810.4	19000.8	19260.2	17585.4
	TOTAL	130349	68072	62277		376377	576322.2	345215.8	525975.4
			$\sum M_p$	$\sum F_p$		$\sum M_px$	$\sum M_py$	$\sum F_px$	$\sum F_py$
	Centre of Mass (point)					$\bar{X}_{m,p} =$ 5.53	$\bar{Y}_{m,p} =$ 8.47	$\bar{X}_{f,p} =$ 5.54	$\bar{Y}_{f,p}=$ 8.45
	$\bar{x}_{m,p} = \frac{\sum M_px}{\sum M_p}$; $\bar{y}_{m,p} = \frac{\sum M_py}{\sum M_p}$; $\bar{x}_{f,p} = \frac{\sum F_px}{\sum F_p}$; $\bar{y}_{f,p} = \frac{\sum F_py}{\sum F_p}$								

D. Application of Methodology on Real Data

As a test case, here we have taken seventeen Town committees in Taluka Kunri [10] of district Umerkot in Sindh province of Pakistan, separated each other by different distances having different population and we need to establish an Educational Institution keeping in view the area age group and gender population. The objectives are set as under:

- To facilitate maximum number of children or people.
- Solution should not be gender bias.
- Gender specific centre place of the area would be determined.

Keeping in view the above objectives, best centre or location would be decided. According to the methodology we can use the concept of centre of mass theorem, as the mass of the particles may represent as the population of the area or village/town committees and the position vectors of the town committees' may be taken from the given fixed points 'O' as origin, so each Town committee of Taluka Kunri may be represented by the points of Cartesian Coordinates in xy-plan, so that each town committee can be shown in the form of directed vectors of the town committees' from the origin 'O'. By using concept of centre of mass theorem [1]-[8] the centre point of all town committees of Taluka Kunri of District Umerkot can be calculated. The graph with Tables I and II shows the Town Committees exist in taluka Kunri along with mass population density of the town Committees [9] and the Cartesian coordinate of corresponding town committees'.

Centre of mass point is $(\bar{x}, \bar{y})$

$$\bar{x} = \frac{\sum M_i x_i}{\sum M_i} \; ; \; \bar{y} = \frac{\sum M_i y_i}{\sum M_i}$$

By applying above formula of centre of mass on the data embodied in Tables I and II we get the following results

The population of all town committees in Taluka Kunri mentioned in Table I. As the centre point/ location to establish the facilities for the population are at points (5.53, 8.47) and

(5.54, 8.45) for male and female respectively, which is almost same, and from graph the Cartesian point for desired location is somewhere in southern of Bustan listed at Sr. No 8 in Table I. However, Table II which indicates the population of Taluka Kunri having educational qualification at least Primary but below Metric [9], so to make them useful and skilled citizen, the arrangement of technical / vocational institute is

considered mandatory. As such the suitable place for the establishment of institution for both the genders of all 17 town committee are at point (5.63,8.32) and (5.73,8.12) for Boys and Girls respectively, and from graph the Cartesian coordinate for desired location is somewhere in Rindki and Barani listed at sr. No. 5 and 7 respectively in Table II.

TABLE II

POPULATION OF ELEMENTARY EDUCATION OF TALUKA KUNRI SEX WISE WITH CARTESIAN COORDINATE OF TOWN COMMITTEES

Sr. No.	Town Committee (TC) of Taluka Kunri District Umerkot	Population having Elementary Education (Census 1998)			Cartesian Coordinates	Male		Female	
		Total (T_e)	Male (M_e)	Female (F_e)	(x,y)	$M_e x$	$M_e y$	$F_e x$	$F_e y$
1	Char	499	435	64	(3,9.6)	1305	4176	192	614.4
2	Darelo	401	351	50	(2.8,7.8)	982.8	2737.8	140	390
3	Kandiari	400	335	65	(3.8,6.2)	1273	2077	247	403
4	Manjhakar	292	221	71	(4.4,10)	972.4	2210	312.4	710
5	Rindki	142	116	26	(5,8.4)	580	974.4	130	218.4
6	Saidki	179	169	10	(4.6,7.4)	777.4	1250.6	46	74
7	Barani	545	402	143	(7,8)	2814	3216	1001	1144
8	Bustan	773	569	204	(5.4,10.4)	3072.6	5917.6	1101.6	2121.6
9	Chajro	1120	833	287	(6,12)	4998	9996	1722	3444
10	Kunri	998	741	257	(6.6,10)	4890.6	7410	1696.2	2570
11	Morjhango	758	578	180	(8.4,10.6)	4855.2	6126.8	1512	1908
12	Dhambharlo	286	214	72	(7,6)	1498	1284	504	432
13	Haido	409	295	114	(5,3)	1475	885	570	342
14	Mundhawa	442	322	120	(5.4,5.4)	1738.8	1738.8	648	648
15	Nabisar	325	290	35	(8,7.4)	2320	2146	280	259
16	Rahmore	533	429	104	(6,7)	2574	3003	624	728
17	Talhi	1018	667	351	(4.6,4.2)	3068.2	2801.4	1614.6	1474.2
	TOTAL	9120	6967	2153		39195	57950.4	12340.8	17480.6
			$\sum M_e$	$\sum F_e$		$\sum M_e x$	$\sum M_e y$	$\sum F_e x$	$\sum F_e y$
	Centre of Mass (point)					$\overline{X}_{m,e} =$ 5.63	$\overline{Y}_{m,e} =$ 8.32	$\overline{X}_{f,e} =$ 5.73	$\overline{Y}_{f,e} =$ 8.12
	$\bar{x}_{m,e} = \dfrac{\sum M_e x}{\sum M_e}$; $\bar{y}_{m,e} = \dfrac{\sum M_e y}{\sum M_e}$; $\bar{x}_{f,e} = \dfrac{\sum F_e x}{\sum F_e}$; $\bar{y}_{f,e} = \dfrac{\sum F_e y}{\sum F_e}$								

III. RESULTS AND DISCUSSION

The concept of Centre of mass theorem [1]-[8] is used as a tool to select an appropriate central place for the population density of both the gender of any age group. The site so selected is considered to be best location for the construction of educational institution to facilitate the population gender equally. The feasible place or centre place found is southern of Bustan listed at sr. No. 8 with coordinate (5.5, 8.5) for both gender mentioned in Table I. so, this place is suitable for the establishment of any general purpose Educational Institution or Hospital. However, for the arrangement when considering the construction of specific purpose Educational Institution of Technical/Vocational Institution for both genders' population mentioned in Table II. The central places will be Rindki with coordinate (5.6, 8.3) for Boys and Barani with coordinate (5.7, 8.1) for Girls listed at sr. No. 5 and 7 respectively in Table II.

IV. CONCLUSION

Seeking of right central place for initiating social activities is the major dilemma for the population of a particular area. It has been observed that the tendency of gradual increase in population seems in the areas where the peoples feel comfortable to fetch their basic needs. As such in this study,

Taluka Kunri [10] of district Umerkot of Sindh province in Pakistan was taken as a test case and by using the concept of centre of mass theorem [1]-[8], a right feasible place for the establishment of Educational Institution / Health Care Centre is obtained, having Cartesian Coordinate (5.5, 8.5) of the mass population of 17 town committees which is located somewhere in the town committee Bustan circled '1' in the graph. However, the right central places for the establishment of Technical and Vocational Institutes for specific gender populations are at Rindki and Barani circled '2' & '3 having Cartesian Coordinates (5.6,8.3) and (5.7,8.1) respectively.
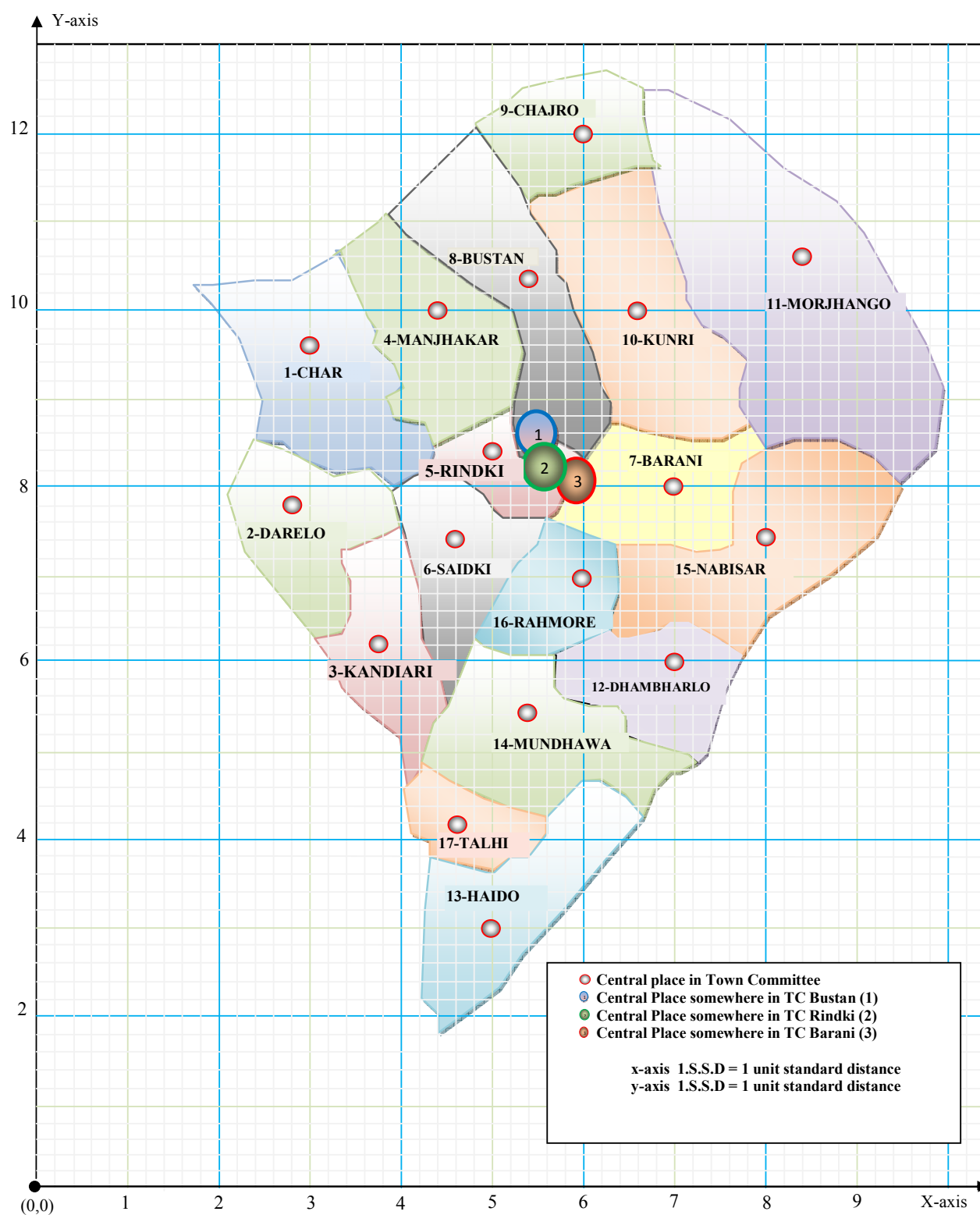
Fig. 1 Graph Indicating the Feasible Central Place to Establish the Educational/ Technical/ Vocational Institute and Health Care Centre to Facilitate the Local Population of Taluka Kunri

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