Spatial Distribution Disparity Analysis of Urban Amenities in Municipal Wards Periphery of Jodhpur City

Dr.S. L. Borana[1] Dr.S.K.Yadav[2]
[1,2]RSG, DL, Jodhpur-342011, Rajasthan, India

***Abstract*—The resluts of this study explore the spatial distribution of urban facilities in Jodhpur city. The focus of the study was on the identification of spatial disparity and concentration in the distribution of public amenities and the identification of deficiencies in different municipal wards of the city. Three facilities were mapped consisting of Police Station, School and Hospital using Remote Sensing data and GIS Technology. Additional information collected from field survey and local municipal authorities that used as attribute data for both the database and visualisation mapping. ArcGIS software was used for linking of spatial and attribute data for querying of information. The visualisation map created shows locations of police station, school and health amenities, road network linkages and capacity of each facility. The results shows that certain wards are more developed in terms of a particular urban facility while others lag far behind the mean level of development of the city.**

***Keywords* —Spatial, Disparity, GIS, Mapping, Urban Amenities**

I. INTRODUCTION

Migration of the rural population towards cities has greatly contributed towards increasing levels of urbanization apart from usual growth of the urban residents. Over the past half century, rural-to-urban population move has occurred and the process of urbanization is increases. In this study utility services are shown with the help of the geodatabase using GIS. Urban amenities comprise the infrastructure, goods and services that are jointly needed for the urban public. Jodhpur city shows significant unevenness in the requirement of urban amenities. The analysis of the data reveals that there is complete disparity in the distribution of health care institutions and ration depots in different Municipal wards of the city. Therefore, it becomes very important to find a sustainable solution for the provision of adequate and balanced urban amenities and their optimum utilization.

II. STUDY AREA

Jodhpur city is situated at latitude of 26º 18' N and longitude of 73º 1' E and in the middle of the Thar Desert tract of western Rajasthan about 250 km from the Pakistan border (Fig.1). It is second largest urban city of the Rajasthan state after the Capital Jaipur. Its general topography is characterized by the hills located in the North and North-west. Jodhpur has a tendency of population increase due to employment opportunities in sand stone mining, dyeing industries and handicraft industries, high birth rate, low mortality, increased drinking water facility etc. The present Jodhpur service area covers an approximate area of 80 sq. km under JMC. The city is densely populated within the walled city limits. As these areas have reached saturation levels, development has started on the outskirts of the walled city.

Fig.1. Study Area Base map.

III. DATA USED AND METHODOLOGY

Data used for this study were Remote sensing satellite data (Landsat 2015), Survey of Indiamap, metadata data i.e spatial and non spatial attribute information of urban amenities. The GPS locations were collected from field survey and number of the facilities were received from Municipal ward authorities. Different reports prepared by urban planner were also collected. Lorenz curve is used for measurement of the degree of spatial disparity with respect to various urban facilities. Geodatabase prepared and linked with ArcGIS software for visualization of various amenities distribution. Following research methodology adopted to carry out this study(Fig.2).

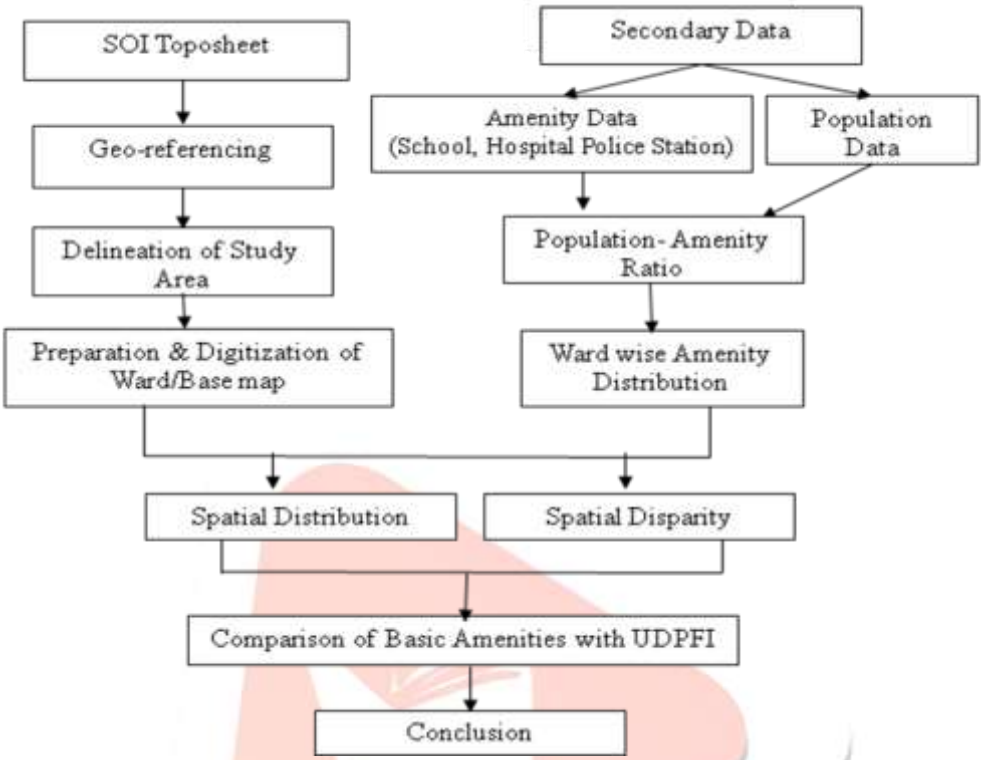

Fig.2. Methodology of Spatial Analysis of Urban Amenities.

IV. RESULT AND DISCUSSION:

A. Spatial Distribution Analysis of Urban Amenities

Jodhpur city is experiencing a steady growth in its urban population. Urban population of the city increased substantially during the last three decades. Jodhpur city experienced the largest increase in population and accounted for about 2.76 percent of the total urban population of the state in 2011 (Census of India, 2011). The rate of growth of population of the city during the last few decades has been quite spectacular. The increasing growth of population of the city leads to increase in the demand of public services and facilities. Although some efforts have been made to increase the provision of different types of public facilities but the increase in population has far exceeded the expansion of such facilities. Thereby leading to deterioration in the quality of such services and facilities. The proceeding analysis clarify the spatial distributional pattern of urban amenities in different wards of the Jodhpur city. It is necessity to analyze the nature and pattern of existing amenities distribution before preparing any spatial locational planning policy and further development of such amenities. An attempt has been made to analyze the spatial distribution and status of urban facilities in different city wards. The analysis of these facilities has been carried out as per the following classification. Ward wise distribution of public amenities in Jodhpur city is presented in the Table-1. A wide variation is observed in the availability of amenities across the wards. Ward no 63, accounts for the largest number of schools while ward no 22 and 25 accounts for the largest number of health care institutions. Such variations indicate that the urban amenities distribution across wards is not proportional to the population distribution.

Spatial DistributionAnalysis of School Facility

Jodhpur is well known as a educational hub in Rajasthan as well as in India. Study has noticed the best educational facilities right from nursery to higher education. It consists of schools, colleges and other institutes. Table-2 indicates the number of schools, whereas Table-3 indicates number of Education and Training Institute in the study area. GIS based spatial distribution snalysis of education facilities has been carried out in ArcGIS environment. The geodatabase of education facility is linked and overlay for visualization purpose. The distribution of different educational institutions in the city has been presented in the Fig.3.

Table-2: Total Numbers of Schools in the Study Area.

S.No.	School category	No. of School	No of Students	% of School
1	**Primary School**			
	Govt.	124	7198	11.57
	Private	146	15408	13.63
2	**Higher Primary School**			
	Govt.	98	12320	9.15
	Private	369	67762	34.45
3	**Secondary School**			
	Govt.	27	3142	2.52
	Private	134	30813	12.51
4	**Higher Secondary School**			
	Govt.	31	8529	2.89
	Private	152	92556	14.19
	Total	1071	237728	100

Source: District Education Department

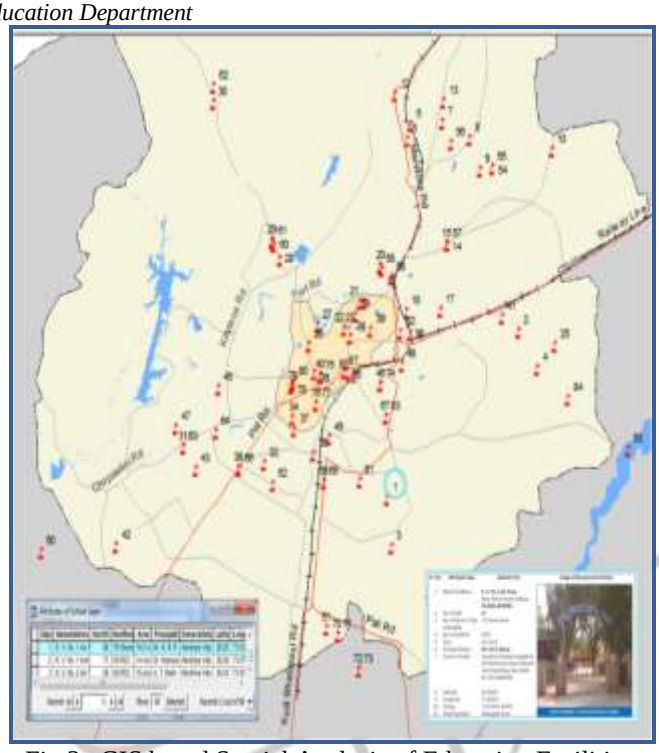

Fig.3. GIS based Spatial Analysis of Education Facilities.

Table-3 Education and Training Institute (2012-13)

S.No.	Educational Institute	No of Students
1	J.N.V.University, Jodhpur , (Aff. colleges- 52)	18926, 13967
2	IIT Jodhpur	635
3	Rajasthan Ayurved University	335
4	National Law University	584
5	AIIMS Jodhpur	100
6	Sardar Patel University of Police, Jodhpur	60
7	National Institute of Fashion Technology, Jodhpur	110
8	Indian Institute of Hathkarga Technology, Jodhpur	50
9	Govt Mahila Polytechnic College, Jodhpur	166
10	Govt Polytechnic College, Jodhpur	357
11	Institute of Industrial Training, Jodhpur	594
12	Govt Physical Education College , Jodhpur	120
13	Govt College Chainpura, Jodhpur	380
14	District Education and Training Institute, Jodhpur	94
15	Govt S.N. Medical College, Jodhpur	250
16	Pashudhan Sahayak Training Center, Jodhpur	200
17	Footwear Design & Development Institute, Jodhpur	180
18	AIIMS Nursing College, Jodhpur	60
19	Agriculture University, Jodhpur	200

Spatial Distribution Analysis of Hospital Facilities

Proper establishment and distribution of health care institutions are vital for the development of any region as it is intimately related to the nature and welfare of better human resource. The health care institutions of the city have been categorized into sub-centers, Allopathic dispensaries, Primary health centers, hospitals and nursing homes and the spatial distribution of these institutions in the city has been presented in the Fig .4. GIS based spatial distribution snalysis of healt facilities has been carried out in ArcGIS domain. The geodatabase of hospital facility is linked and overlay for visualization purpose. It is clear from the figure that there exists remarkable disparity in the health care establishments in different wards. Most of the wards lying close to the main city center do posses the appropriate health care facilities and the peripheral wards from the city center are devoid of the same.

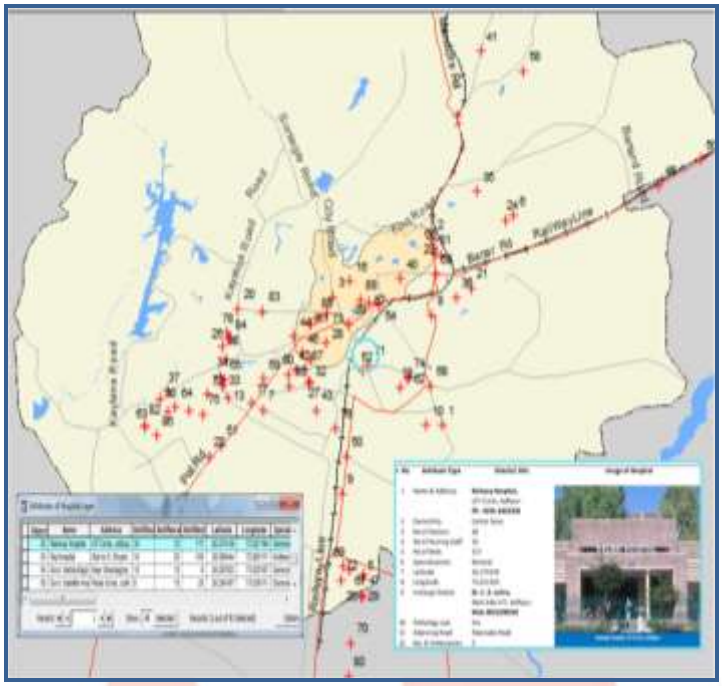

Fig. 4. GIS based spatial Analysis of Hospital Facilities.

Spatial Distribution Analysis of Police Station

Security is the important part of a society and civilians. It provides all sense of confidence to peoples in all situations. City has adequate police station covering major populations. GIS based spatial analysis of Police Station is carried out in ArcGIS and visualization of distribution is presented in Fig.5.

Fig.5. GIS based spatial Analysis of Police Station.

Visualizationof Spatial Distribution of Public Amenities

The spatial distribution map (Fig.6.) clearly shows that there is maximum concentration of civic amenity establishments within five kilometer radius from the center of the city zone-I (Buffer Zone-5km) and the concentration decreases slowly towards the peripheries. The spatial disparity can be gauged from the fact that out of the total number of amenity establishments (680) in the city, zone-I has 462(68%) while as in the zone-II (Buffer Zone-7.5km) it equals to 184 (27%) and rest 34(5%) are beyond zone-II.

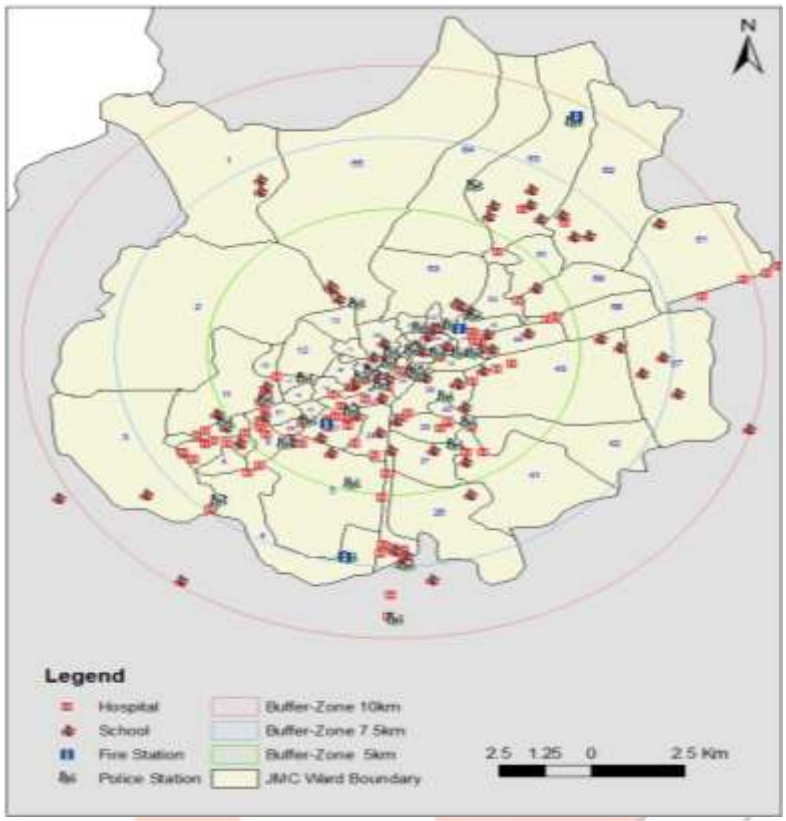

Fig.6. Buffer map of the Amenities within the 5, 7.5 and 10 km radius.

B. Spatial Disparity Analysis of Urban Amenities

The spatial locational pattern analysis carried out in the above section has revealed that the level of concentration with respect to various amenities vary significantly across different wards of the Jodhpur city. This imbalance in spatial concentration has led to various degree of spatial disparity of these amenities. In order to have an idea about the degree of spatial disparity with respect to various public amenities, Lorenz Curve commonly used for measuring inequality in income has been used to represent the magnitude of disparity graphically. In the present study, percentage of a facility instead of income and percentage of population of wards instead of income recipients has been used. The line of equality shows the equal distribution of the facilities. The deviation of Lorenz curve depicts the degree of spatial disparity. The magnitude of Lorenz curves of various urban amenities in Jodhpur city is presented below.

Spatial Disparity Analysis of Schools Facility

Spatial disparity exists in the provision of adequate higher secondary schools in Jodhpur city. It can be inferred from Fig.7(a), that seventy five percent population of the city share only 30 percent of the facility, while as the rest twenty five percent have the easy access to the remaining 70 percent of the facility which indicates the inequality in the provision of this facility.

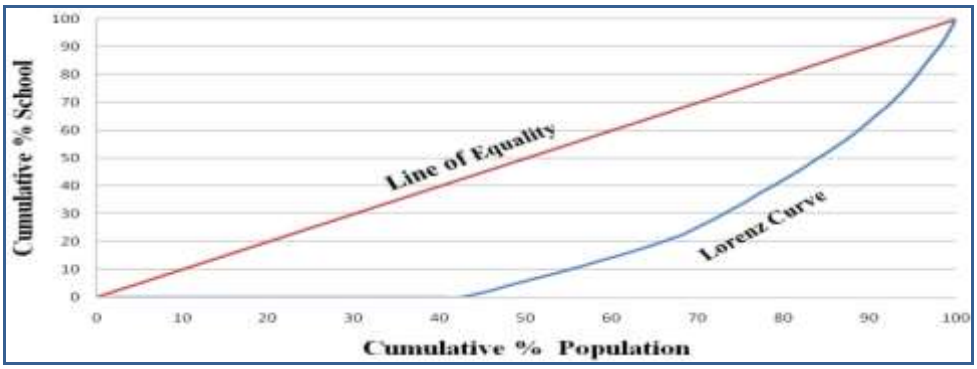

Fig.7(a) Lorenz Curves for School Facility

Spatial Disparity Analysis of Hospital Facility

Spatial disparity exists in the provision of health care institutions in the Jodhpur city which is highlighted by the Fig.7(b). From the figure, it is evident that seventy percent population of the city have only 20 percent share of the facility, while as the rest 30 percent share the remaining 70 percent of the facility which is an indication of the inequality in the provision of this facility.

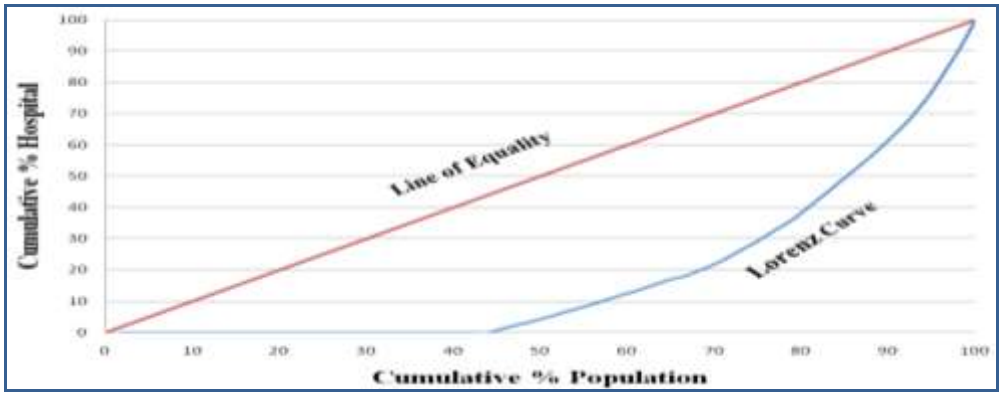

Fig.7(b). Lorenz Curves for Hospital Facility

Spatial Disparity Analysis of Police StationFacility

The analysis of the Fig.7 (c) reveals that seventy percent population of the city have access to 10 percent of the facility, while as the remaining 30 percent population share 90 percent of the facility, which reflects the spatial disparity among the distribution of the police station between the wards of the city.

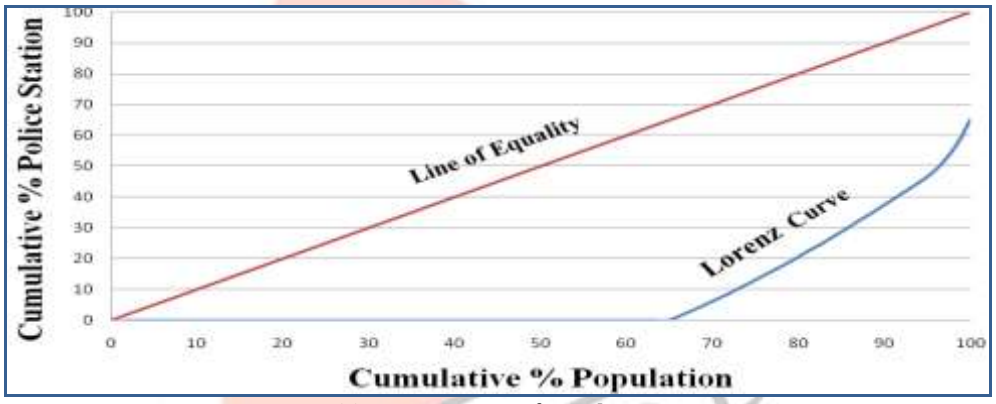

Fig.7(c) Lorenz Curves for Police Station

C. Comparison of Basic Amenities in Jodhpur city

The existing facilities have been compared with the Urban Development Plans Formulation and Implementation (UDPFI) guidelines to check the current status of facilities and further identify service gaps. It is observed that the city has adequate facilities in terms of higher education, graduation schools and Health facility. It is observed that the city has adequate facilities in terms of primary schools, senior secondary schools and colleges (Table-4). There are several private institutions, colleges and universities which offer medical courses, technical education, and other professional courses. The city is a pioneer in terms of overall healthcare facilities. However, in the area of public health care facilities, intermediate hospitals and specialty hospitals could be developed for the BPL population within the district.

Table-4. Existing Basic Amenities in Comparison with URDPFI Norms

Urban Amenities	URDPFI Guidelines	Requirement as per guidelines	Existing situation	Met the Benchmark
Pre-primary, nursery	1 for 2500 population	455	270	no
Primary school	1 for 5000 population	227	467	yes
Senior secondary	1 for 7500 population	151	161	yes
College	1 for 1.25 lakh	9	15	yes
Engg Medical/ college	1 for 10 lakh population	1	1	yes
Police Post/Station	1 for (40,000 - 50,000)/ 90,000	22/12	33	yes
Fire Station	2 lakh (5-7 km radius)	6	4	no
Polyclinic	1 for 1 lakh population	11	14	yes
General Hospital (NBC) (200beds)	1 for 2.5 lakh population	4	4	yes
LPG (Capacity :500)	1 for 40000 population	28	36	yes

V. CONCLUSION

The study on the provision of public facilities in Jodhpur City indicate that urban amenities are not uniformly distributed among different wards of the city which leads to various problems like separation of people towards interpersonal disparities in standards of life and declining of city surroundings. The analysis of the distribution of urban amenities as presented in the preceding chapters indicates that there is a lead-lag relationship among different wards in terms of the provision of public amenities. Some wards are more urbanized in terms of a particular facility while others lag far behind the correspond to level of development of the city in terms of that facility. The reasons for the disparity are unplanned urban structures of the city which also led to an notched distribution of various amenities. The peripheral wards being the newer ones are devoid of many amenities as it is difficult to ensure all amenities in an area within a petite span of time. The variation in concentration and distribution of different types of urban amenities shows that the existing planning efforts could not produce adequate results in terms of balanced development of different parts of the City. The municipal ward authorities and planners should include RS and GIS technology in the decision-making process pertaining to urban land uses.

VI. ACKNOWLEDGMENT

The authors are thankful to the Director DL, Jodhpur and Head, Department of Mining Engineering, Jai Narain Vyas University, Jodhpur for help and encouragement during the study.

REFERENCES

[1] Akanbi A. K, Santosh Kumar and Uwaya Fidelis, Application of remote sensing, GIS and GPS for efficient urban management plan – A case study of part of Hyderabad city, Novus International Journal of Engineering & Technology 2013, 2(4).
[2] Cheng, J. and Masser, I. (2003). Urban Growth Pattern Modelling: A Case Study of Wuhan City, PR China, Landscape and Urban Planning, 52, pp. 199-217.
[3] Hite, J. S. (2008). School Mapping and GIS in Educational Micro-Planning. Working Document, International Institute for Education Planning (UNESCO).
[4] Jothimani, P. (1997) Operational Urban Sprawl Monitoring using Satellite Remote Sensing: Excerpts from the studies of Ahmedabad, Vadodara and Surat, India, Paper presented at 18th Asian Conference on Remote Sensing, Malaysia.
[5] Rahman, A., Aggarwal, S. P., Netzband, M., and Fazal, S. (2011). Monitoring Urban Sprawl using Remote Sensing and GIS Techniques of a Fast Growing Urban Centre, India. IEEE International Journal of Applied Earth Observations and Remote Sensing.
[6] R. Manonmani , S. Prabaharan , R. Vidhya & M. Ramalingam, Application of GIS in urban utility mapping using image processing techniques, Geo-spatial Information Science, Vol. 15, No. 4, December 2012, 271–275.
[7] Paulsson, Bengt Urban Application of Satellite Remote Sensing and GIS Analysis; Urban Management Programme, The Word Bank: Washington, DC, 1992.
[8] Tiwary, D. P. (2003), Remote Sensing and GIS for efficient Urban planning in India, Map Asia conferences 2003, Urban Planning.
[9] Kibon Usman Ado and M. Ahmed (2013). Distribution of Primary Health Care Facilities in Kano Metropolis Using GIS. Research Journal of Environmental and Earth Science.
[10] Sule J. O, H. S. Abdullahi and J. Bungwon (2012), Acquisition of Geospatial Database for Primary Schools in Kaduna Metropolis, Research Journal of Environmental and Earth Science.
[11] Khan Rubayet Rahaman, Md. Salauddin, A Spatial Analysis nn The Provision Of Urban Public Services and Their Deficiencies: A Study of Some Selected Blocks in Khulna City, Bangladesh, Theoretical and Empirical Researches in Urban Management Special Number 1S/April 2009: URBAN ISSUES IN ASIA.
[12] Hakeem Bishi, Oluwafemi Olajide, Effects of Information Technology Facilities on the Urban Environment: A Comparative Study of Lagos Island and Victoria Island, Lagos, Proceedings REAL CORP 2011 Tagungsband 18-20 May 2011, Essen. http://www.corp.at, https://www.researchgate.net/publication/228469675, ISBN: 978-3-9503110-1-3.
[13] Nai Yang, Shiyi Chen, Weilu Hu, Zhongheng Wu and Yi Chao, Spatial Distribution Balance Analysis of Hospitals in Wuhan, Int. J. Environ. Res. Public Health 2016, 13, 971; doi:10.3390/ijerph13100971.
[14] Abubakar Sadiq Bukhari, Ibrahim Muhammed , Geospatial Mapping of Health Facilities in Yola, Nigeria, IOSR Journal Of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT) e-ISSN: 2319-2402,p- ISSN: 2319-2399. Volume 7, Issue 3 (Nov. - Dec. 2013), PP 79-85 www.iosrjournals.org.
[15] Chiung-Hsu Liu, Tzu-How Chu, Meng-Lung Lin, Chia-Hao Chang,Exploring Spatial Pattern of Tourist Behavior Using Geographic Information Techniques, Latest Trends in Renewable Energy and Environmental Informatics, ISBN: 978-1-61804-175-3.
[16] Yanhua Yuan, Jiangang Xu, Zhenbo Wang, Spatial Equity Measure on Urban Ecological Space
[17] Layout Based on Accessibility of Socially Vulnerable Groups:A Case Study of Changting, China, Sustainability 2017, 9, 1552; doi:10.3390/su9091552 www.mdpi.com/journal/sustainability.
[18] Bhagat R. B (2010). Access to Basic Amenities in Urban Areas by Size class of Cities and Towns in India. International Institute for Population Sciences, Mumbai.
[19] Stevenson, D., 2004. 'Civic Gold' Rush: Cultural Planning of the Politics of the Third Way. International Journal of Cultural Policy, 10(1): 119-131.
[20] Adekunle, Aderamo and Aina (2011), "Spatial Inequalities in Accessibility to Social Amenities in

[21] Developing Countries: A Case from Nigeria. Australian Journal of Basic andApplied Sciences, 5(6):316-322, 2011 ISSN 1991-8178.
[22] Adekunle, Aderamo and Aina (2011), "Spatial Inequalities in Accessibility to Social Amenities in Developing Countries: A Case from Nigeria. Australian Journal of Basic and Applied Sciences, 5(6): 316-322, 2011 ISSN 1991-8178.
[23] Ifabiyi, I. P. (2011). Spatial distribution and performance of water pumps in the rural areas of Kaduna State,Nigeria; before the Second Republic. European Journal of Social Sciences. 26(1):15-25
[24] Jahangeer A. et al., (2012), Spatial Analysis on the provision of Urban Amenities and their Deficiencies -A Case Study of Srinagar City, Jammu and Kashmir, India, Research on Humanities and Social Sciences www.iiste.org ISSN 2224-5766(Paper) ISSN 2225-0484(Online)Vol.2, No.6.

Table-1. Distribution of Urban Amenities in Jodhpur City.

Ward no.	Population	% of Population	No. of Hospital	% of Hospital	No. of School	% of School	No of Police Station	% Police Station
1	13699	1.613	0	0	2	2.78	0	0
2	14211	1.673	0	0	0	0	0	0
3	14543	1.712	2	2.41	1	1.38	1	3.57
4	12148	1.430	2	2.41	0	0	1	3.57
5	12402	1.460	2	2.41	2	2.78	1	3.57
6	13316	1.568	0	0	0	0	0	0
7	14434	1.700	7	8.43	1	1.38	0	0
8	13220	1.557	3	3.61	1	1.38	1	3.57
9	12905	1.519	4	4.82	1	1.38	1	3.57
10	14305	1.684	1	1.2	0	0	0	0
11	15054	1.773	4	4.81	2	2.78	1	3.57
12	14086	1.659	0	0	0	0	0	0
13	14547	1.713	0	0	0	0	0	0
14	14010	1.650	0	0	0	0	0	0
15	12373	1.457	0	0	0	0	0	0
16	12897	1.518	0	0	2	2.78	0	0
17	13282	1.564	2	2.41	0	0	1	3.57
18	14433	1.699	1	1.2	0	0	0	0
19	13335	1.570	0	0	0	0	0	0
20	12299	1.448	0	0	0	0	1	3.57
21	12071	1.421	1	1.2	0	0	0	0
22	11826	1.392	2	2.41	0	0	0	0
23	13640	1.606	6	7.23	2	2.78	0	0
24	12842	1.512	2	2.41	1	1.38	1	3.57
25	14363	1.691	6	7.23	2	2.78	1	3.57
26	14568	1.715	0	0	0	0	0	0
27	11360	1.337	0	0	2	2.78	1	3.57
28	11135	1.311	4	4.81	1	1.38	0	0
29	13543	1.595	3	3.61	2	2.78	0	0
30	12760	1.503	3	3.61	2	2.78	1	3.57
31	14341	1.689	3	3.61	1	1.38	0	0
32	12283	1.446	1	1.2	0	0	3	10.71
33	13828	1.628	1	1.2	1	1.38	1	3.57
34	11702	1.378	0	0	2	2.78	0	0
35	12061	1.420	1	1.2	0	0	1	3.57
36	11411	1.343	0	0	2	2.78	1	3.57

37	12495	1.471	0	0	0	0	0	0
38	13117	1.545	0	0	2	2.78	0	0
39	12024	1.416	1	1.2	4	5.56	1	3.57
40	11341	1.335	0	0	0	0	0	0
41	19040	2.242	2	2.41	1	1.38	0	0
42	13125	1.545	1	1.2	0	0	1	3.57
43	13246	1.560	3	3.61	3	4.16	0	0
44	14415	1.697	3	3.61	1	1.38	3	10.71
45	11520	1.356	1	1.2	0	0	0	0
46	10282	1.210	0	0	0	0	0	0
47	12970	1.527	0	0	1	1.38	0	0
48	11629	1.369	0	0	0	0	0	0
49	12066	1.421	0	0	1	1.38	1	3.57
50	10340	1.217	0	0	1	1.38	0	0
51	12311	1.449	0	0	0	0	1	3.57
52	10201	1.201	0	0	1	1.38	0	0
53	15181	1.787	0	0	3	4.16	0	0
54	13986	1.647	1	1.2	1	1.38	1	3.57
55	10424	1.227	1	1.2	0	0	0	0
56	13332	1.570	1	1.2	3	4.16	0	0
57	15706	1.849	0	0	4	5.56	0	0
58	11138	1.311	1	1.2	0	0	0	0
59	11103	1.307	1	1.2	1	1.38	0	0
60	14794	1.742	0	0	0	0	0	0
61	15350	1.807	4	4.61	1	1.38	0	0
62	11621	1.368	1	1.2	4	5.56	0	0
63	14001	1.649	1	1.2	6	8.33	2	7.14
64	14332	1.688	0	0	0	0	0	0
65	12729	1.499	0	0	4	5.56	0	0
Total	849052		83	100	72	100	28	100