SITE SUITABILITY ASSESSMENT FOR RESIDENTIAL AREAS IN SOUTH CHENNAI REGION USING REMOTE SENSING AND GIS TECHNIQUES

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ABSTRACT

The estimation of land suitability of Chennai southern area is presented. The total area of the study area is 108.69 sq. km, out of which settlement area was found to be 5.51 sq. km and the forest cover is about 16.34 sq. km. Water bodies 12.21 sq. km and the Barren or unclassified land covered 74.63 sq. km. The total percentage of water bodies, forest, settlements and barren lands covers about 11.23, 15.03, 5.07and 68.67 respectively. These studies revels that the southern part of Chennai is best for land-use suitability as compare to northern part. From the study it is clearly identified that 45.6% percent of the study areas come under restricted area (water bodies and forest areas are considered as restricted area in the study), 31.8% of moderate suitability areas and moderate high suitability of about 22 %. The overall suitability map indicated that most of the area is coming under restricted area and only moderate suitability areas can be properly used for residential areas development.

Key words: GIS, Slope, LULC, Drainage

1. INTRODUCTION

Urban planning is the process of influencing, scheming or straight changes in the use of land overtime and space in an urban area. Site suitability analysis (SSA) is used in recognize the most appropriate spatial pattern for future land uses according to specify requirements, preferences, or predictors of some action. Typically suitability analysis is studied for various aspects like planning and landscape assessment (Miller et al., 1998), selecting the best site for the public and private sector amenities (Church, 2002), environmental impact estimation

(Moreno and Seigel, 1988) and tourist infrastructures (Abomeh et al. 2013 and Gomaa M. Dawod, 2013). SSA also provides important reference for planning, management, implementation and evaluation.[10-14] Therefore there is needed to get better land use planning strategies. Now-a-day geographic information system is widely used by various authors such as in planning and management (Brail and Klosterman, 2001; Collins et al., 2001), urban regional environmental planning and management (Janssen and Rietveld, 1990), habitant analysis for animal and plant species (Ereira Duckstein, 1993). Chrisman, (1998), studied Land-use suitability analysis is more than a GIS-based procedure even if it involves participatory approaches. According to Longley et al., (1999) GIS is considering as the science behind the systems. Sieber, (2003), have studied that the progression of the high powered micro computing hard baton the lowering of the costs of desktop GIS software have popularized GIS. Consequently suitability involves in identifying the most excellent location for a new housing development, a new road or pipeline, or a retail store, which reduce the time and enhance the accuracy. Therefore the study is undertaken to use help of ArcGIS 9.2 spatial analyst techniques in evaluating the suitable areas around the southern Chennai regions for the growth of residential areas. The aim of the study is to estimate the site suitability assessment for residential area in southern Chennai region using remote sensing and GIS techniques, by considering the following objectives

- To prepare base maps for the study area.
- To classify and prepare various land use classes such as existing built-up areas, open space area, geology, vegetation cover, water bodies, road networking, drainage etc.
- To prepare the ground water level map in the study area.
- To prepare the soil type map in the study area.
- To prepare of various maps such as slope maps and aspect from DEM data.
- To prepare overall weighting map and to assess the suitability areas.

2. METHODOLOGY

For the present study, the available data sets like SOI toposheet, LANDSAT satellite data were collected for years namely 1970, and 2009 respectively. LANDSAT image have been taken from Global Land Cover Facility (GLCF), a NASA funded member of the Earth Science Information Partnership at the University of Maryland. The GLF develops and distribute remotely sensed satellite data and products are available free of cost by the GLCF. Visual interpolation techniques were adopted to classify the pixels in the images into different classes such, water bodies, settlements, road network, rail lines, and barren land. The base map was geo-referenced and was projected to standard projection called the Universal Transverse Mercator (UTM) projection with the zone 44N by using Quantum GIS (QGIS) software. The satellite data which was downloaded composed of seven bands and the standard band combination was carried out for the generation of false composite colour (FCC) image. The satellite images were subset by using clip analysis for the limitation of the study area. Therefore all the pixels within the study area are classified into various classes or themes. The generalized flowchart adopted for the present study is shown in figure 1.
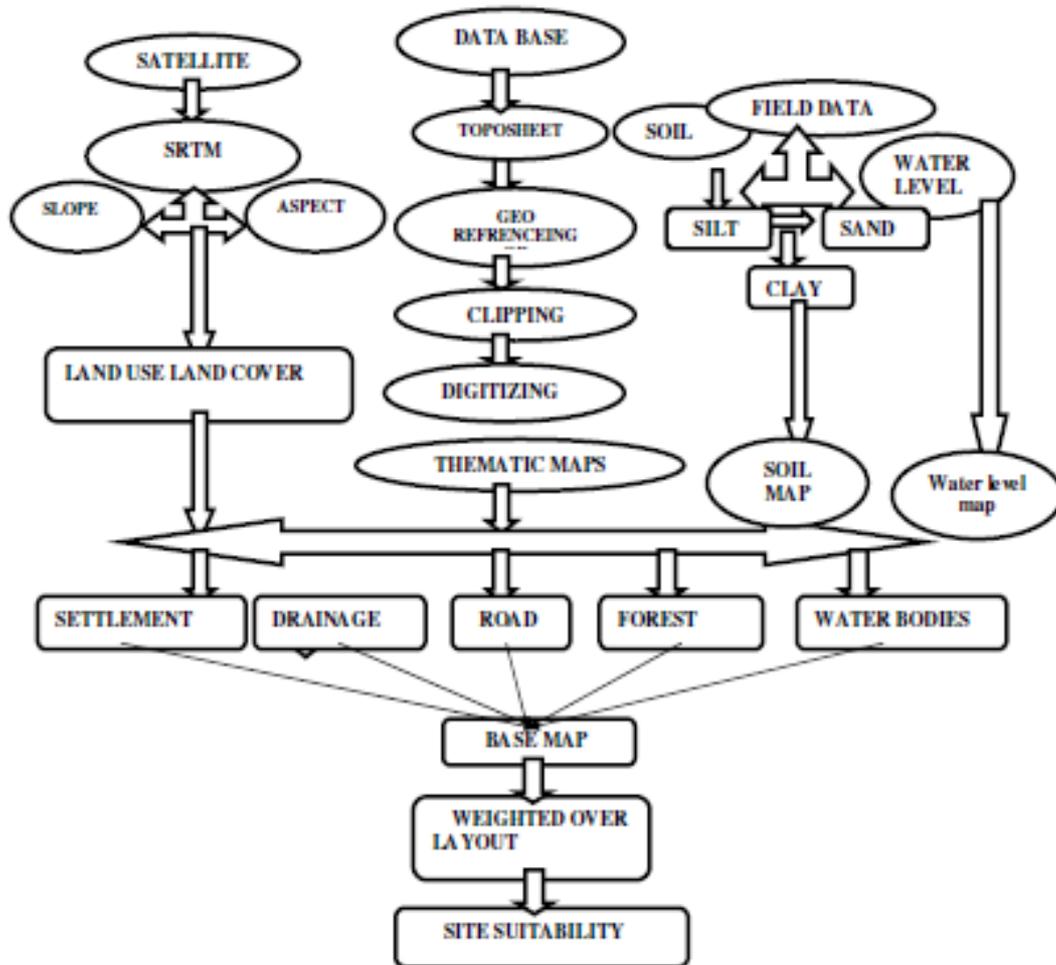
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Figure 1 Methodology of work flow

3. STUDY AREA

The study area considered for the present work is a part of South Chennai in Kanchipuram district of Tamil Nadu state. The study area covers 10869 hectors area and located between N 12^0 831' to N 12^0 900' Latitude and E 80^0 129' to E 80^0 184' Longitude. It has an average elevation of 83.2 meters. The soil samples were collected from the study area by using shovel and tillers. The soil samples were collected from the depth of about 30cm and then locations were collected by using GPS. The latitude and longitude were given in the table1. A total of 9 samples were collected from different places in the study area. The samples are transported to our college department laboratory, Bharath University and air dried and was used in determination of the soil texture. The detailed of the soil percentage were calculated and given in the table1.

4. RESULT AND DISCUSSION

4.1. Preparation of various thematic maps

The total area of the study area is 108.69 sq. km (Fig. 2) out of which settlement area was found to be 5.51 sq. km and the forest cover is about 16.34 sq. km. Water bodies 12.21 sq. km and the Barren or unclassified land covered 74.63 sq. km. Thematic maps for cost, water level, drainage,

slope, aspect, drainage density and road density were prepared (Fig 3 a-g). The Ground Water Levels were collected in the field by measuring the water table from the open wells. The cost of the land values are collected from the local person and by using the IDW method the ground water levels and the cost map of the study area are prepared. From figure the ground water level is more in the southern part and the cost of land is high in the northern part of the study area. Land cover is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground, water, etc. Soil is the mixture of minerals, organic matter, gases, liquids, and myriad organisms that together support plant life.
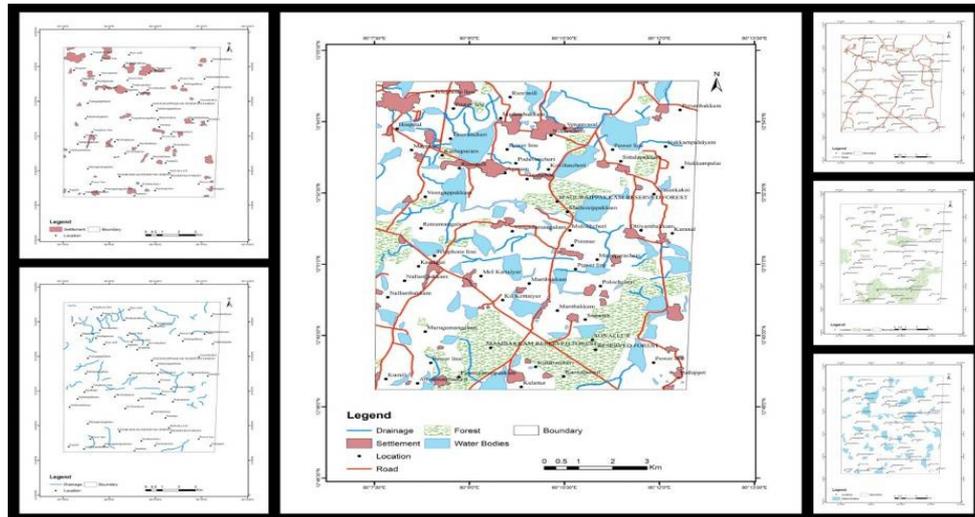

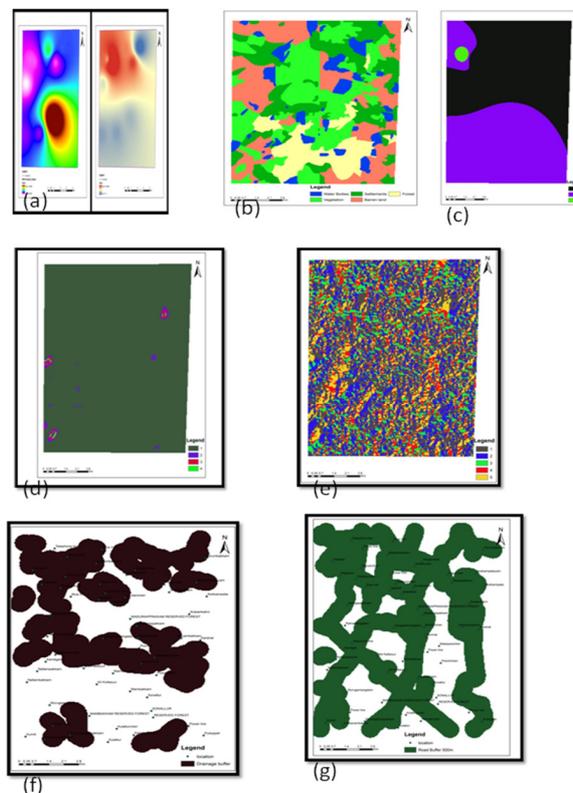**Figure 2** Base map of the study area

Figure 3 (a) Cost and groundwater level map, (b) LULC map, (c) Soil map, (d) Slope map, (e) aspect map, (f) drainage density map, (g) road density map

4.2. Suitability Map

The process of weighting involves emphasizing the contribution of some aspects of a phenomenon to a final effect or result, giving them more weight in the analysis. To obtain a suitability map the multi criteria analysis was used by using the standard nine-point weighing and given in the table 2. The details of parameters used to derive the suitability map were shown in the table 3. The suitability map was obtained by given proper weightage (fig 4), from the study it is clearly identified that 45.6% percent of the study areas come under restricted area (water bodies and forest areas are considered as restricted area in the study), 31.8% of moderate suitability areas and moderate high suitability of about 22 % (Table 4). The overall suitability map indicated that most of the area is coming under restricted area and only moderate suitability areas can be properly used for residential areas development.

Figure 4 Suitability map of the study area

Table 2 Nine point weighting scale for pair wise comparison**.**

SL. NO	CATEGORY
1	Lowest suitability
2	Very low suitability
3	Low suitability
4	Moderate low suitability
5	Moderate suitability
6	Moderate high suitability
7	High suitability
8	Very high suitability
9	Highest suitability

Table 3 Identifying of LULC, slope, Aspect, soil texture, water level, drainage and road percentage details.

SL.NO	Classes	Weightage %	Sub classes	Ranking
1	LULC	40	Water bodies	0
			Vegetation	8
			Settlement	3
			Baron Land	3
			Forest	0
2	SLOPE	10		
			0-4	8
			4-10	7
			11-15	3
			15-20	4
3	Aspect	5		
			1	5
			2	5
			3	6
			4	8
			5	9
4	Soil texture	10		
			1	1
			2	5
			3	9
5	Water level	5		
			1	4
			2	5
			3	9
6	Drainage	10	1	1
7	Cost	5	1	8
			2	8
			3	3
			4	3
8	Road	15	2	9

Table 4 Suitability percentage.

ROW ID	VALUE	COUNT	PERCENTAGE
0	0	14771	45.633
1	4	4	0.012
2	5	10321	31.885
3	6	7272	22.466
4	7	1	0.003

5. CONCLUSION

The estimation of land suitability of Chennai southern area is presented. The total area of the study area is 108.69 sq. km, out of which settlement area was found to be 5.51 sq. km and the forest cover is about 16.34 sq. km. Water bodies 12.21 sq. km and the Barren or unclassified land covered 74.63 sq. km. The total percentage of water bodies, forest, settlements and barren lands covers about 11.23, 15.03, 5.07and 68.67 respectively. These studies revels that the southern part of Chennai is best for land-use suitability as compare to northern part. From the study it is clearly identified that 45.6% percent of the study areas come under restricted area (water bodies and forest areas are considered as restricted area in the study), 31.8% of moderate suitability areas and moderate high suitability of about 22 %. The overall suitability map indicated that most of the area is coming under restricted area and only moderate suitability areas can be properly used for residential areas development.

REFERENCES

[1] Church, R.L., 2002. Geographical information systems and location science. Computers and Operations Research 29 (6), 541–562.

[2] Sachithananntham, P., Sa Nkaran, S., Elavenil, S., Experimental study on the effect of rise on shallow funicular concrete shells over square ground plan, International Journal of Applied Engineering Research, v-10, i-20, pp-41340-41345, 2015.

[3] Kumar J., Sathish Kumar K., Dayakar P., Effect of microsilica on high strength concrete, International Journal of Applied Engineering Research, v-9, i-22, pp-5427-5432, 2014.

[4] Iyappan L., Dayakar P., Identification of landslide prone zone for coonoortalukusing spatialtechnology, International Journal of Applied Engineering Research, v-9, i-22, pp-5724-5732, 2014.

[5] Sandhiya K., Kaviya B., Safe bus stop location in Trichy city by using gis, International Journal of Applied Engineering Research, v-9, i-22, pp-5686-5691, 2014.

[6] Sachithanandam P., Meikandaan T.P., Srividya T., Steel framed multi storey residential building analysis and design, International Journal of Applied Engineering Research, v-9, i-22, pp-5527-5529, 2014.

[7] Srividya T., Saritha B., Strengthening on RC beam elements with GFRP under flexure, International Journal of Applied Engineering Research, v-9, i-22, pp-5443-5446, 2014.

[8] Saraswathy R., Saritha B., Planning of integrated satellite township at Thirumazhisai, International Journal of Applied Engineering Research, v-9, i-22, pp-5558-5560, 2014.

[9] Saritha B., Ilayaraja K., Eqyaabal Z., Geo textiles and geo synthetics for soil reinforcement, International Journal of Applied Engineering Research, v-9, i-22, pp-5533-5536, 2014.

[10] Ilayaraja K., Krishnamurthy R.R., Jayaprakash M., Velmurugan P.M., Muthuraj S., Characterization of the 26 December 2004 tsunami deposits in Andaman Islands (Bay of Bengal, India), Environmental Earth Sciences, v-66, i-8, pp-2459-2476, 2012.

[11] Ilayaraja K., Ambica A., Spatial distribution of groundwater quality between injambakkam-thiruvanmyiur areas, south east coast of India, Nature Environment and Pollution Technology, v-14, i-4, pp-771-776, 2015.

[12] Collins, M.G., Steiner, F.R., Rushman, M.J., 2001. Land-use suitability analysis in the United States: historical development and promising technological achievements. Environmental Management 28 (5), 611–621.

[13] Janssen, R., Rietveld, P., 1990. Multicriteria analysis and geographical information systems: an application to agricultural land use in the Netherlands. In: Scholten, H.J., Stillwell, J.C.H. (Eds.), Geographical Information Systems for Urban and Regional Planning, Kluwer Academic Publishers, Dordrecht, pp. 129–139.

[14] Miller, W., Collins, W.M.G., Steiner, F.R., Cook, E., 1998. An approach for greenway suitability analysis. Landscape and Urban Planning 42 (2–4), 91–105.

[15] Pereira, J.M.C., Duckstein, L., 1993. A multiple criteria decision-making approach to GIS-based land suitability evaluation. International Journal of Geographical Information Systems 7 (5), 407–424.

[16] Turner, A.K., Miles, R.D., 1971. The GCARS system: a computer-assisted method of regional route location. Highway Research Record 348, 1–15.

[17] Innes, J.E., 1995. Planning theory's emerging paradigm: communicative action and interactive practice. Journal of Planning Education and Research 14 (3), 183–189.

[18] Harvey, F., Chrisman, N., 1998. Boundary objects and the social construction of GIS technology. Environment and Planning A 30 (9), 1683–1694.

[19] Xiao et al., (2002), Using evolutionary algorithms to generate alternatives for multi objective site-search problems. Environment and Planning A 34 (4), 639–656.

[20] Sieber, R.E., (2003). Public participation geographic information systems across borders. The Canadian Geographer 47 (1), 50–61.

[21] SS.Asadi, Biswajita Mohanty, J.K.Sai Varma and G.Goutham Krishna, Evaluation of Land Use and Land Cover using Remote Sensing and Gis:A Model Study from Gundur District, Volume 8, Issue 5, May 2017. pp. 559-566, International Journal of Civil Engineering and Technology (IJCIET).

[22] D Dadoria, H L Tiwari and R K Jaiswal, Assessment of Reservoir Sedimentation In Chhattisgarh State Using Remote Sensing and GIS. International Journal of Civil Engineering and Technology, 8(4), 2017, pp. 526–534.

[23] Li, X., Yeh, A.G., (2000). Modelling sustainable urban development by the integration of constrained cellular automata. International Journal of Geographical Information Science 14 (2), 131–152.