Site Suitability Analysis for Urban Development using GIS: A Review

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Abstract:
For Urban area development, suitable site selection is one of the critical problem or issue in planning nowadays. The analysis of suitable site has become the inevitable for delineating appropriate site for various development activity initiatives. The study elaborates the use of Geographic Information System (GIS) technique for selection of suitable site for Urban Development in Theur, Pune District, Maharashtra. For this purpose Toposheet, satellite images, SRTM maps other data were used to generate various thematic layers using QGIS software. By using four parameters criteria i.e. Road proximity, Land use/Land cover, Land values and Aspect Ratio for analysis of land valuation. The generated thematic layers maps of above criteria were standardized using pairwise comparison matrix method known as analytical hierarchy process. A weight for each norm will generate by comparing them with each other according to their importance. With help of criteria and data, final map of suitable site will get prepared. This study allows the local people as well as planner for the appropriate plans of land use planning in sustainable urban development.

Keywords: Site suitability analysis, Toposheet, DEM, Land use/Land cover, QGIS.

I. INTRODUCTION

Site suitability analysis helps in identifying the acceptable site that meets the precise criteria or restrictions. This analysis greatly reduces the time as well as efforts that have to be put to make proper plan. Otherwise it is done manually by searching the records, processing the data and undertaking surveys. Acquisition of land for development of the area is becoming more challenging due to the environmental standards and due to growing real estate market. Depending upon the local norms, the criteria for selection of suitable site for specific uses is decided. The main aim of the project is to provide a proper plan of action that can be used to construct a fully functional database.

An Open source Quantum GIS, Zanzibar 1.8.0 & 3.4.0 software is used for developing the plan for 262 hector area of Theur, Haveli Taluka, Pune District, Maharashtra. Six parameters were considered like Road proximity, land use/land cover, slope, aspect ratio, soil type, rocks type. By using these parameters the collection for required data can be determined. The data sheets required are Toposheets, satellite images, Arial photo (Bird eye Image), geological data, revenue records, soil data, and SRTM maps. For development of any area, Road is most important in site suitability because of transport of men, machine, raw material and finished materials.

The construction of new road is more expensive, hence more efforts are made to locate the site close to the nearest existing road. Land use/ Land Cover map of Theur area has been categorized as built-up area, barren land, agriculture, open forest and dense forest. In this study, built-up area is not suitable for future development because once the building is constructed; it remains for minimum 50 to 75 years. Thus barren land is considered for highest suitable for development.

II. LITERATURE STUDY

1. Geographic Information System (GIS) in Urban Planning (By Dr. Sonila Xhafa, Dr. Albana Kosovrasti. 2015, University- State University of Tirana, Albania):-
From this study we’ve got learned about the employment of GIS software. Use of wide selection of multi thematic data within the service of higher cognitive process within the Urban Planning. Improve the standard of spatial analysis process and a public service in urban planning institution increasing consciousness on the territory and spatial thinking in community. Use of quality analytical product, and consequently effective higher cognitive process. Higher efficiency within the extraction of spatial information, and thus quality analysis. Improve the standard of spatial analysis process & of public service in urban planning institution. GIS Product mainly with spatial containing is that the results of spatial information and other data with multi-thematic character. In GIS planet model generally comes in mapping and imaging format. GIS is an element of spatial system. They process and generate spatial information. Use of GIS continues to grow beyond business, industries, universities and government sectors. GIS plays a necessary role in providing optimum models of land use and its resources. It’s important to understand where this resources, there relation with object, event and other phenomenon, condition during which they developed, ways how you’ll be able to continuously monitor them.

2. Identification of potential site for housing development using GIS based Multi-Criteria Evaluation in Dire Dawa City, Ethiopia (By Weldemariam Gezahegn Weldu, Iguala Anteneh Deribew. 2016, University- Haramaya University, Ethiopia):-
The main objective of the study was to search out best suited development sites in Dire Dawa City, Ethiopia. Hence eleven
environmental and economic factors which affect site selection of development were identified. Accordingly, about 5.42sq.km (8.04%) is extremely highly suitable, 25.58sq.km (37.90%) is very suitable, 10.68sq. km (15.83%) moderately suitable. The finding of the study apart from demonstrative the effectiveness of GIS based multicriteria evaluation technique, it's visiting function a spatial decision supporting system with a vast potential to handle the uncertainty about where additional houses should be develop within town. Moreover it's going to significantly function decision support tool serving as a tenet to mitigate further environmental hazard beside encourage authority to use GIS platform to support to safe guard sustainable urban land use management. they need used analytical hierarchy process, weight liner combination and its consistency ratio.

3. GIS and Site suitability for sustainable residential communities: Three case study from the USA. (By Azza Kamal. 2013, University- University of Texas and San Antonio):-
The Three case studies presented during this paper address the invaluable use of GIS and quantitative and qualitative methods for evaluating sustainable housing on the neighborhood. In these case study using GIS tool these process wouldn't be possible. this system provided valuable support to form maximum beneficial use of land sure as shooting area; a planner should take into consideration the particular geo-environment. this can allow the accuracy and implementation of basic information to be improved so applied within the planning process. The evaluation can assets planners within the making the choice ashore use alternatives for specific land parcels. This are intended only to be a guide in determining the final trends and spatial distribution of suitability for various possible varieties of development. GIS was utilizing in assessing different aspects of sustainable residential development, and identifying the common approaches and methods used therein. The paper presents and analyzes the methodologies utilized in three case studies, all of which were conducted by the author from 2011 to 2013 as a method of illustrating the various approaches in utilizing GIS capabilities.


To make the utmost beneficial use of land for a specific area, a planner should take into consideration the particular Geo-environment. a vital goal in Geo-environmental evaluation is to produce assistance to important person, planners and developers within the optimal development of a section while preserving the environment. The evaluation result can assist planners in making decision ashore use alternatives for specific land parcels. There are intended only to guide in determining the final train on spatial distribution on suitability for various varieties of development. The GIS methodology for micro or micro zonation is capable of providing a degree of accuracy in assessing the potential suitability of land parcels for urban development. the foremost advantages of this technique over manual map production in geo-environmental evaluation in urban planning and development purpose are assessable methodology at relatively low cost of use of commonly available data with minimum cost, very short time for data manipulation, the chance to explore diverse scenarios potential to develop an optimum form of development and simple of handling the graphic output.

5. GIS based Multi-Criteria analysis for industrial site selection (By Aleksandar Rikalovic, Ilija Cosic, Djordje Lazarevic. - 2013 University- University of Novi sad Faculty of technical Science, Serbia):-

Industrial site selection may be a spatial problem. Spatial decision problem typically involve oversized set of feasible alternatives. The big number of possible sites was resolve in screening phase, rather like the selection come only sites that meet the essential criteria for industrial site selection. During this fashion, we reduced time required for higher operation, increase efficiency and quality in higher operation by optimizing number of potential sites. The obtained model allows us to form decision in 10 steps, with forming the alternative using assessments with GIS & MCDM method for industrial site selection. A transparent need for such model as a call network allows efficient resolution of complex problem such in industrial site selection. To adjust the quantity of norm and standardization is done and making suitability map for every norm gives us to chance to identify each norm separately through final suitability map.

III. METHODOLOGY

In order to develop site suitability map, various thematic layers are generated using E43H13 of 1:10,000 scale for digital elevation model (DEM) which is obtained from NRSC Bhuvan. A geological formation map is obtained through Geological Survey of India, Pune. Land value buffer zones were created along the road using land value information acquired through land revenue department of Pune. All these information layers are integrated and analyzed under QGIS.

1. Study Area: -
The study area of Theur, Haveli Taluka, Pune district, Maharashtra which extends between 18°31’25.67” N 74°2’46.62” E encompasses an area of 262 hect. Its average altitudinal height is 560 m above mean sea level. Theur is part of the Mula-Mutha River.
2. Selection and preparation of criteria maps:
In this study five criteria were selected. The principal criteria that are used for spatial analysis are Toposheets, satellite image, DEM, Geological maps. Road proximity, land use/land cover, land values, soil types, rocks and geological formation. These parameters were used in the preparation of criteria maps. For suitability analysis it is necessary to give some score to each of the criteria as per their suitability for urban development. To develop a pairwise comparison matrix different criteria are required to create a ratio matrix. The pairwise comparisons will take as an input and relative weights will produced as an output.

Image 2. Contour plotting, Theur.

3. Maps, Photo & Software required:
1. Toposheets
2. Satellite Images
3. Aerial Photograph (Bird Eye Image)
4. Geological Data
5. Revenue Records
6. GIS software (QGIS- 1.8.0 & 3.4.0)

4. Method of working:

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1.4.1 Road Proximity:
For development of any area, Road is most important in site suitability because of transport of men, machine, raw material and finished materials. The construction of new road is more expensive, hence more efforts are made to locate the site close to the nearest existing road as possible. In order to maintain the better accessibility of existing road, buffer zones have been created by taking 100m distance from existing road.

1.4.2 Land Use/Land Cover:
Land use/ Land Cover map of Theur area has been categorized as built-up area, barren land, agriculture, open forest and dense forest. In this study, built-up area is not suitable for future development because once the building is constructed; it remains for minimum 50 to 75 years. Thus barren land is considered for highest suitable for development.

1.4.3 Slope:
Slope is an important criteria in finding the suitable sites for the urban development. Steeper the slope more disadvantages for construction. Steeper slope increase construction cost. Slope < 10 degree considered as gentle slope (Rawat 2010) having highest intensity of importance. Slope > 10 degree has been classified as unsuitable because it increase construction cost.

IV. CONCLUSION:
The results of the study will display the detailed most suitable area of land for improvement and implementation of certain facility by filtering out unusable or less desirable site. The above mentioned aspects are more important than other aspects for determining the land valuation and the best location for each facility should be provided or construction.

V. REFERENCE:
[2]. Santosh Kumar, Ritesh Kumar (2014), Site suitability Analysis for Urban Development of a Hilly Town using GIS based Multicriteria Evaluation Technique, Hariyana Space Application Center, India (Volume 3, Issue 1, Page no516-524)
[4]. Dr. Sonila Xhafa, Dr. Albana Kosovrsti. (2015), Geographic Information System (GIS) in Urban Planning, State University of Tirana, Albania (Volume 1, Issue 1, Page no 85-92)
Spatio temporal monitoring of urban sprawl using GIS & remote sensing (Volume 182, Issue 27, Page no 0975-8887)


[8] Santosh C., Krishnaiah C., Praveen G Deshbhandari,(2018), Site Suitability Analysis for Urban Development using GIS based Multicriteria Evaluation Technique, Manglore University, India. (Volume no 169)


