

SITE SITABILITY ANALYSIS FOR URBAN DEVELOPMENT USING GIS

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Abstract: - The study illustrates the use of Geographic Information System (GIS) tools and numerical Multi-Criteria Evaluation (MCE) techniques for selection of suitable sites for urban development of a hill town. This study was conducted to identify suitable sites for urban development of a hill town, of Theur, Pune District, Maharashtra using four main parameters slope, road proximity, land use land cover, land values, Geological data. Merged spatial data and four thematic information layers were analyzed using Q- GIS software. A weightage for each norm was provided for each parameters by comparing them with each other according to their importance. With the help of criteria and data suitable site will be prepared. This study allows the local planning authority for the appropriate plans of land use planning in the future.

Keyword: *Geographic Information System (GIS); toposheet, LU/LC, Site suitability analysis*

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I INTRODUCTION

Identification of suitable sites for urban development in hilly areas is one of the critical issues for planning. To satisfy the needs of appropriate site in undulating areas, site suitability analysis has become inevitable. Site suitability is the method of understanding existing site qualities and factors that will determine the location for a particular activity. It involves the detailed investigation of the natural resources and processes that characterize a site and include mapping techniques including GIS tools that help in processing the geographical database that display the areas of the site, suitable for various planning objectives and alternatives. The main aim of the project is to provide proper plan of action that can be used to construct a fully functional database.

An open source of GIS Zanzibar 1.8.0 & 3.4.0 software is used for developing the plan for 263 hectares of Theur, Pune District, Maharashtra State, Four parameters were considered like Road proximity, Land use/Land cover, Aspect Ratio, Geological conditions. By using these parameters the collection of required data can be determined.

Toposheets, aerial photos (Bird eye image), Satellite images, Geological data, revenue records, soil data, and SRTM maps. For development of any area road is most important in site suitability because of transportation of men, machine, Raw material and finished material. The

construction of new road my cost more, hence more efforts are made to locate the site closed to the nearest existing road. LU/LC map of Theur area has been categorized as build up area, barren land, and agriculture, dense and open forest. In these study build up area is not suitable for future development because once the building is constructed it remains for minimum 50-75 years. Thus barren land highly suitable for development.

II LITERATURE STUDY

1. Site Suitability Analysis for Urban Development Using GIS (By Kamal Jain, Y. Venkata Subbaiah, 2007 University- Indian Institute of technology IIT Delhi India): This study tells us about land use suitability analysis for urban development is necessary to overcome the problem with limited land availability against drastic growth of urbanization. The south west of the town match's with the development taken place over the years with the exception of area developed in Solamipuram or near Ramnagar. This could be because of the proximity to IIT Roorkee campus or Avas Vikas. If the local parameters like the area near to the IIT Roorkee, Avas Vikas etc. are considered, the result maybe better. This study will be helpful for urban planners and urban development Authorities to plan development of the city. The selection of suitable site is based upon a specific set of local criteria. The characteristics of a site (eg. Present land use, slopes, water availability, distance to

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employment, geomorphology, geology, etc.) Site suitability is the process of understanding existing site qualities and factors, which will determine the location of a particular activity.

2. A GIS based methodology for safe site selection of a building in a hilly region (By Satish Kumar, V.K. Bansal, 2016, University National Institute of Technology Hamirpur, India): They have studied the GIS based analysis results such as field value, scale value, and cell counts, provides a clear picture of which area is sufficient and safe for locating a particular type of building. Depending upon the relative importance of spatial aspects, the percentage influence on spatial aspects considered in the present study is determined. The current study encourages professionals to consider various aspects identified through literature and reported survey in order to enhance the construction safety in and sustainability of hilly region. The study considers the spatial safety aspects of hilly region to safely locate a building. GIS is utilized to model existing facilities/utilities along with the topography of the given region. Codal provisions of spatial aspects considered in the present study are modeled in Arc GIS to understand their effect in selecting a site for the proposed building. The use of codal provisions of various spatial safety aspects in GIS provides a unique and precise solution to the site selection. The GIS based analysis results such as field value, scale value, and cell counts, provides a clear picture of which area is sufficient and safe for locating a particular type of building. Depending upon the relative importance of spatial aspects, the percentage influence on spatial aspects considered in the present study is determined.

3. Site Suitability Analysis for Urban Development using GIS based Multicriteria Evaluation Technique- (Santosh C. Krishnaiah C., Praveen G Deshbhandari) Publishing year - (2018 University- Mangalore University, India) - In this study we have learned integrating analytical hierarchy process and GIS has adopted for site suitability. Integrating environmental dimensions into land management practices in urban area from the earlier stage of the planning process can greatly contribute to the future sustainability of urban region. Based on the result the final map is classified into five very low (1.81sq.km.), low (12.71sq.km.), moderately (37.94sq.km.), high

(66.88sq.km.) and very high (22.44sq.km.). The conceptual methodology adopted in the present study will help to locate suitable site for land development in other parts of the world. The outcome of the study will help the local people as well as planners to formulate and implement suitable master plan for development of urban region. Further field investigation needed before the final decision is made. In the study six criteria were selected namely land use/land cover, slope, land cost, aspect, road proximity and lineament. The methodology followed in this study is shown in Figure 2. For the site suitability of urban development it is necessary to give some ranking to each criterion, Saaty's nine points scale was used for comparison matrix (Table 1). To create ratio matrix different criteria are required and for the input pairwise matrix is considered and for the output weights has been used (Table 4). Once pairwise comparison has finished sum the values of elements in each column and divide

every element with their column total and result of the matrix is considered as normalized matrix. To estimate the consistency, first calculate the weighted sum vector for that multiply pairwise matrix with the weight. For vector consistency divide the weighted sum by the weights.

4. GIS based land suitability analysis using AHP model for urban services planning in Srinagar and Jammu Urban centers of J&K, India- (Jahangeer A. Parry, Showkat A. Ganaie, M. Sultan Bhat - (2018 University- University of Kashmir Srinagar, India) - The study on the provision of public facilities in Srinagar and Jammu cities indicate that urban amenities are not evenly distributed among different wards of the city. The suitability analysis of urban amenities in Srinagar city depicted that since the core wards of the city have adequate urban amenities as compared to peripheral wards, therefore peripheral wards in general show medium level of suitability for establishing urban amenities. These peripheral wards though have inadequate urban amenities but due to several factors like high altitude, steep slope, inaccessibility etc. these wards fall in medium level of suitability. The municipal wards lying between core and peripheral wards depict high suitability for the provision of urban amenities because of favorable slope, altitude, accessibility etc. plus lack of existing urban amenities. In Jammu urban center it revealed that since Jammu city has terraced shape as altitude increases.

5. GIS based Multi-Criteria analysis for industrial site selection by- (Aleksandar Rikalovic, Ilija Cosic, and Djordje Lazarevic- 2013 University- University of Novi sad Faculty of technical Science, Serbia)-Industrial site selection is a spatial problem. Spatial decision problem typically involve a large set of feasible alternatives. The large no. Of possible sites was resolve in screening phase, such as the choice came only sites that meet the basic criteria for industrial site selection. In this way, we reduced time required for decision making, increase efficiency and quality in decision making process by optimizing number of potential sites. The developed model allows us to make decision in 10 steps, with generating alternative using assessments with GIS & MCDM method for industrial site selection. A clear need for such model as a decision support system allows efficient resolution of complex problem such in industrial site selection. Optimizing the number of criteria and alternatives, standardization of criterion scores and making suitability map for each criterion gives us to opportunity to perceive each criterion separately and tighter through final suitability map. Depending upon the relative importance of spatial aspects, the percentage influence on spatial aspects considered in the present study is determined. A GIS-based methodology is developed and demonstrated through a case study to locate a safe site that satisfies various spatial safety aspects. The location of building with respect to the topography will cause minimum disturbance to the natural profile of an area reduce cut/fill, developmental and constructional cost, and environmental damage and ensure construction safety.

III METHODOLOGY

It needs to be pointed out that prior to now, the city administration of Pune has spent many years pursuing GIS related initiatives. However, these initiatives have not always been undertaken in a coordinated manner, while information on urban resources were known to be superficial and unreliable levels, as such, previous decisions were based on limited or sketchy information.

Our activities and involvement in the project is in respect of “The development of selection land for town plan and implementation of the same Plans.” This task will be highlighted from two different perspectives:

1. Establishment of an urban information system.

2. Development of an operational cadastral system for study area.

The project began its development of the new capability for geographic data collection in January 2020 by conducting a formal information needs assessment after identifying the generic business functions that will be supported by the technology.

This information needs assessment served as the basis in building the data base model to meet the requirements of Thuer urban program. An inventory of geographic information was also conducted. The good news is that we found ourselves moving from using the technology mainly for cartographic purposes to using it as a tool to support planning operations.

The application of these project was primarily engineered to focus upon the urban development. In these regards 3 important elements were focused upon:-

1. The People - whom the system is to support and serve.
2. The Process – which the system is required to perform.
3. The Product – which the system is expected to generate.

All the above three elements are closely related in Their Urban Program. A precise data requirement investigation was performed with the aim of following needs:-

1. Identifying all data requirements and data of selected location.
2. What are available?
3. Identify the data formats available or required.
4. Evaluate and assess the comparability and compatibility of data from other sources and their accessibility; this includes identifying those who controls the data and the methodology by which the data will be released to the project.

5. Identifies roles, responsibilities and relationships of all agencies and individuals to be involved.

6. Identifies tasks and expected products to be achieved in accordance with the time schedule. Approximately, 4 basic data types were identified; these data types described the manuscript data layers that was later to be developed. In order to ensure the system compatibility with the existing data information, specific requirements were adhered to. These includes among others, a specification for positional accurate data (reference to a

projection system). A solid geographic reference is an imperative for a GIS; if not adequately referenced, data will sooner or later be lost or become inaccessible for other potential users. Also each of the different features was assigned a unique combination of layer and symbology and for the purpose of data exchange, features were categorised according to Rwanda survey & mapping feature code. In this project, there were two types of application front ends; urban information and land related information (cadastral). The database is maintained by GIS software (Quantum View). This software accepts non-intelligent drawings as well as converting points and lines into spatial database format while providing tools to correlate each piece of graphics with the appropriate textual record in the textual database. These spatial entities are categorised as different themes. Basically, the task contains two sub-tasks; the system infrastructure development and the application development.

In these project the GIS being generated at this stage of the project were yet in a simple form. While it focuses on the present and immediate needs of planning and development of urban areas. It is made flexible and expandable to enable future and further development into a complete multi-purpose system. The entire suitability of land structure thus depends upon four major elements:-

- Geological information of study area.
- Road proximity.
- Land use/ Land cover (LC/LU).
- Slope, Aspect ratio.

1. Geological information of study area: - The geological information of the area is the most important factor considered while the planning of urban site suitability. In these study the geological information of the study area was analyzed, the barren land, agricultural land, the soil type, earth conditions under the ground, hard strata, etc. was taken into consideration and accordingly weightage was given to the suitable land for development.

2. Road proximity:- Transportation of men and materials is very important in the development

of any project whether it is a small scale or a township, the construction of new road can affect the whole project by time and money. Therefore roads are very important in the weightage given to the suitable site. In these project the better accessibility of existing road, buffer zones have

been created by taking 100m distance from present road conditions.

3. Land use/Land cover (LC/LU):- In current project the LC/LU map of Theur was analyzed and following categories were made barren land, agricultural land, built-up land, forest land, and dense forest. In these study the most suitable land was considered for development which will not affect the cost of the project. Because of these barren land was very suitable for the development.

4. Slope :- These is one of the most important criteria, construction on a sloping land costs more than the flat surface, extra cost of excavation is required, cutting and filling should be done, retaining wall is must if build on sloping area. So in these study sloping ground was given less weightage. And flat ground was given more weightage.

Images Generated During the Study:-

1. Study Area: - The study area of Theur, Haveli Taluka, Pune District, Maharashtra, which extends between 18o31'25.67" N 74o2'46.62" E a total area of 262 hectors was considered for these study. Altitude of 560m above sea level, Theur is located at the bank of Mula Mutha River.



Image 01. Arial Image, Theur

Contour Image:-



Image 02. Contour line map, Theur

Site Selection Weightage:-

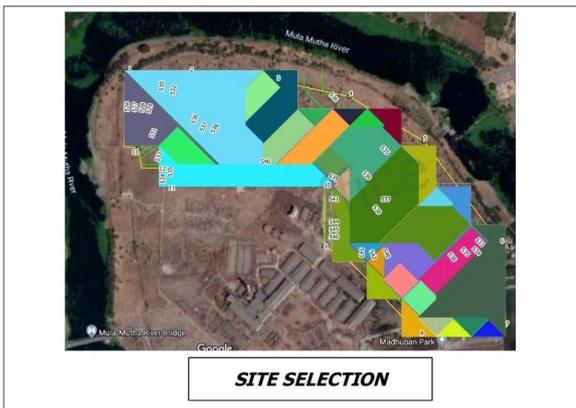


Image 03. Site selection, Their

Digital Elevation Model (DEM):-

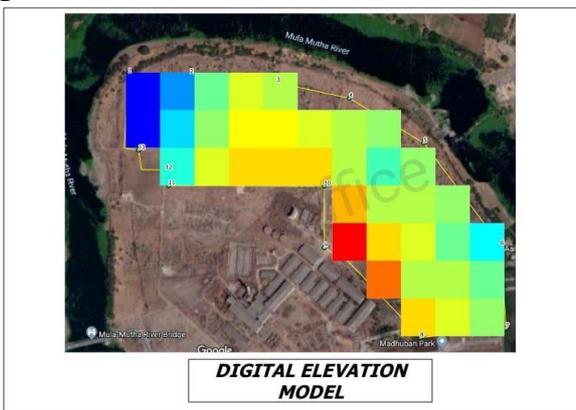


Image 04. DEM map, Their

IV RESULTS:-

1. During the project work, a GIS model was developed that integrated land-use suitability and stakeholders' wishes. In addition, land-use was not focused on a single land-use category, but consisted of all land-use categories that give shape to a country.
2. Project's scope almost always increases and never decreases. Sometimes you have to be honest and simply recognise one's limitations and not take on more than what can reasonably be accomplished within the resources available
3. Knowledge about urban planning and management decision-making process is very diffuse. It is spread widely among various field practitioners and policy makers, and is not easily captured in a decision-making support system. In many respects, it is tied up in "natural expert system"
4. Hand in hand with setting the scope for the project is the need to manage user's expectations. They often expect that once they have provided you with input, an

application solution is literally weeks away, and expect you to fulfil all of the user's specifications at the same time.

5. Utilising GIS in urban planning and management is an iterative process, between the systems professionals, domain professionals, and end users. Likewise, applications of GIS technology will have an impact on corporate policy and procedures. Issues around standards, business rules, and processes to be employed in the planning will have to be addressed to ensure the smooth integration of the application into the business environment of the project.

6. Land size versus use:-

A. As shown below, land uses can be determined by the size of the land available. Land size in this case is used to refer to the level of subdivision and ownership not the size of undeveloped land available.

B. Residential- This is the land use type that can be accommodated by the smallest units. This can be as small as 2000m² to 2,500 m². This range can also accommodate other land uses like: light industries and small recreational grounds, small-scale commercial entities.

C. Green land- As much as it is possible to practice agriculture in any size of land, the most

d. Following pie chart shows the required output for land use in town ship.

V CONCLUSION:-

The new technology of geographic information system has brought and integrated diverse disciplines and professionals into a single framework for data acquisition, storage, and analysis and tracking a host of problems confronting Their urban management. This framework has made planning and control of Their urban development easier and more practicable.

The advantage of GIS to urban planning and urban management is therefore obvious. By using GIS, all necessary data and information needed for Their urban planning were stored, organized, and made available on request to users. It also provides the capability to respond adequately, to rapid urban growth and societal changes in norms and values with increasing ease, foresight, and responsiveness. Finally, possible scenarios for resolving diverse urban problems has become easy to generate and

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has become handy in the decision making process with respect to planning in the Region Theur

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