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Suitability Analysis of Residential Land Parcel Using AHP tool

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ABSTRACT

Urban growth inevitably decreases the sustainability of land use and the ecosystem. Thus, the application of innovative techniques is urgently necessary to advance the concept of sustainable growth. In recent years, the analytic hierarchy process (AHP) has become one of the most significant modern techniques for land suitability analysis by using a geographic information system (GIS) and multi-criteria approach. The integration between GIS environment and AHP is a potent tool for formulating future policies that are pertinent to urban growth. This paper aims to review the GIS-based AHP as a multi-criteria analysis/evaluation technique for land suitability analysis for south-west zone of Surat city. At first the influential factors were identified. Then the relationships between various factors were obtained by the expertise. Then with modulation and overlay the layers in ArcGIS 10.2.2, due to influencing factors and the evaluated weight in AHP, the suitable map for structural developing was prepared.

KEY WORDS: *Land use, suitability analysis, Multi-criterion decision analysis, AHP, urban growth, GIS, South-West Zone, Surat.*

INTRODUCTION

Increasing population growth, lack of enough service centres and disorder of service distribution and suitable locations are some of major problems of today cities. Land-use suitability is the ability of a given type of land to support a defined use. The process of land Analysis involved evaluation and grouping of aSpecific areas of land in terms of their suitability for a defined use.

The objectives of this paper are: 1) to develop multi-criteria approaches in evaluating land use suitability; and 2) to use different measures of land use suitability as guides to optimally allocate lands to their most suitable uses.

Moreover, the paper also aims to develop an integrated model that accommodates these objectives in a spatially explicit planning and decision making environment through the use of a Geographic Information System (GIS).

An integrated GIS-based multi-criteria approach to land suitability analysis and allocation offers significant advantages. The GIS environment enables the spatially explicit evaluation of site suitability and the assignment of various measures of suitabilities to specific sites or geographic areas. The integration also allows area allocations at specific spatial or geographic locations.

Hence, the integrated GIS-based model combines the spatial capabilities of GIS, with the analytical power of multi-criteria analyses. That is, the GIS-based integrated model permits both analytical planning and optimization of land use decisions at different levels, namely;

1).Site suitability assessments based on different factors and specific land uses;

2).Generation of suitability indices based on combinations of different factors (i.e. composite index/measure of site suitability); and

3). Generation of an optimal land use plan that simultaneously considers the individual site suitabilities, and the optimal allocation to the most suitable land use (i.e., mix of land uses that yields the “highest” overall cumulative suitability.

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CRITICAL LITERATURE REVIEW

Aliterature review is documentation of state of the art. Here the scholarly literature is of articles, books, research papers, reports and other sources like a website which relevant to suitable locations of Residential land parcel and GIS application in suitability analysis which is critically evaluated.

Suitable Locations

Following are the critical literature review under the suitable locations of Land Parcel by using AHP-GIS Approach.

Siqing Chen;(2016) examine the GIS-based land-use suitability analysis and its application in urban planning decision making, using Bendigo, a regional city in Victoria as a case study. Greater Bendigo boasts of large areas of national parks, reserves and bush land, as well as agriculture land, which is the major land use of the area. Based on all reclassified input layers, a weighted overlay analysis was conducted in ESRI ArcGIS package (version 10.2). In weighted overlay, the preferred criteria are processed and input with different weighting (%) applied to each criterion.

Malay Kumar Pramanik; (2016) primarily focused on the identification of the suitable land for agriculture in the Darjeeling district which is mostly covered by tea cultivation and dense vegetation cover. Analytic hierarchy process with a combination of Geographic information system (GIS) is utilized for the evaluation in which nine different criteria were selected. At the end of the evaluation, it was computed that only 5.31 % (16,722.94 ha) of the study area is mostly suitable for farming, and 40.60 % (127,862.76 ha) area is permanently and currently not suitable for agriculture production.

Mario A. Mighty; (2015) presents a site suitability model for coffee production in Jamaica. Based on an MCDA approach, he used the analytic hierarchical process (AHP) devised by Saaty (1990) to create a suitability model considering several biophysical (and one infrastructural) factors. The major objective of this paper was to identify the most suitable locations for growing coffee in Jamaica. After the datasets were reclassified, the next step in the AHP was to create a pair wise comparison matrix which allowed each criterion to be compared against the others.

Maher Milad Aburas; (2015)examinedLand suitability analysis for different types of applications. The main challenge in applying this model is that AHP needs the right experts with the widest knowledge and experience in the fields of suitability analysis and application to judge the factors in terms of their importance and weights. The importance of using the pair wise comparison matrix between the factors used in AHP is to identify the relative weight of the criteria according to the importance of each factor to decision makers.

Hou Quanhua; (2015)Studied the Land Use Intensity on Regulatory Plan Management Unit Level of the Small and Medium-Sized City in Guanzhong Area. Two steps are first classifying the basic factors through weighing the most underlying factors and second calculating the weight of each unit in terms of each factor level to get the weight of each unit under the dominant influence factors and minor influence factors, and establish basic intensity and modifying zones so as to finally determine the ultimate reasonable zoning of land use.

L. Kazemi Rad and M. Haghyghy; (2014) handled effectively a land use suitability analysis for towns around the Anzali lagoon. At first the influential factors were identified. Then the relationships between various factors were obtained by the expertise. TheAHP Procedure involves 6 important steps. (1). Define the unstructured problem. (2). Developing the AHP hierarchy. (3).Pair wise comparison. (4).Estimate the relative weights. (5).Check the consistency. (6).Obtain the overall rating. Evaluating weight in AHP, the suitable map for structural developing was prepared.

Douglas R. Moodie; (2014)optimizes the use of land in a new city district with the aim of maximizing the quality of life (QOL) of its workers and the productiveness of its living facilities, such as schools, shops, leisure places, and medical centers. First, the study analyzes the demands of workers for living facilities. Second, the study analyzes how workers select their housing. Third, the study establishes a land use model to simultaneously maximize the QOL and the number of people using the living facilities.

Hao Wang, Bo-sin Tang; (2014)studied threeframework. First, key factors affecting land-use decision making in urban renewal planning are identified. Second, two sub models, namely, the criterion-value generation model and suitability assessment model are designed. Third, five types of land use, i.e., residential, commercial, industrial, government/institutional/community (G/IC), and open space in Hong Kong are defined and considered for land-use suitability grading.

Weifeng Li; (2014)investigated the spatial variations of green space among different land-use categories within the city of Shanghai at the city, inner-outer ring road, and district scales. Land-use patches were delineated from aerial photos, and green coverage was derived from advanced land observation satellite (ALOS) imagery.

Afolabi Aribigbola; (2014)explores constraints to urban land use planning and management in Nigeria using, Ondo State in South Western part of the country as a case study with a view to determining its effects on city development. It discusses land use planning and control mechanisms and suggests how to eliminate the constraints associated with land use planning and management to achieve sustainable urban development in the area.

R. Laxmana Reddy; (2013) Efficient urban information system is a vital pre-requisite for planned development as the ever increasing demands in urban planning and management call for co-ordinate application of Geographic Information System (GIS), for sustainable development of urban areas.

Lee Kuan Yew; (2013)discussedLong-term, forward-looking planning is firmly entrenched as an integral part of Singapore's land use development process. Singapore's Concept Plan, a strategic, long-term land use and transportation plan drawn up to guide the city-state's development over the course of 40 to 50 years, is reviewed every decade.

Khaemba W. Alexander; (2012) aimed at assessing the suitability of urban land use allocation in the municipality through generation of GIS-based land use suitability maps that will enhance land use allocation in the municipality.

Razieh Mosadeghi; (2012), showed how spatial decision-making can be used not only to rank the priority of options and performing scenario analysis, but also to provide insight into the spatial extent of the alternatives.

Marjan Javadian; (2011)spotlights on natural measurement of maintainable urban advancement and will do ecological appropriateness examination of instructive land use in Tehran by utilizing AHP and GIS. A number of areas for instructive land utilize are established in Tehran and a few components, for example, get

to range, slant, and similarity are assessed, then AHP is connected to offer weight to every marker and by utilization of explanatory elements of GIS for overlaying the pointers, it will be chosen what area is naturally reasonable for instructive land utilize.

Babak Nahimi; (2011) land utilize arranging is land utilize appropriateness examination, which decides the reasonableness and accessibility of land for option utilizes, their supportability, and additionally their effect on other ecological assets. Arrive utilize appropriateness examination can be utilized as an instrument to recognize the most reasonable spots for finding future land employments.

Imtiaz Chandio; (2011)selectedLarkana city of Pakistan as the study area where the land suitability model was applied to determine suitable land for public parks. Computed composite weights were inserted into the spatial analysis function of GIS and produced three scenarios of suitability maps, i.e.: (a) land availability, (b) land value and (c) population density.

S.V. Bobade, B.P. Bhaskar; (2010)studied land evaluation for agricultural planning in Seoni district based on soil survey data within a geographical information system. The soil-based GIS data was compiled and interpreted for land use suitability and fertility assessment. The land use suitability analysis indicated that 44% of land was non-arable and was found to be suitable for silvi pasture and wildlife conservation and 56% of land was arable.

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Wakuru Magigi; (2005)studiedIbungilo and Ubungo Darajani. These are unplanned settlements found in Mwanza and Dar Es Salaam city respectively. The settlements (i.e. Ibungilo and Ubungo Darajani) are located 15 and 9 kilometer from city centers. The major actors involved in land use planning decision in determining planning standards and implementation include Central government,Local government, Tribal groups, individual landholders, tenants, donor community, religious groups and UCLAS.

Ministry Of Land, Infrastructure & Transport; (2003) the urban land utilize arranging framework is set up to bolster effective urban exercises, accomplish a charming urban environment, and make townscape with critical elements. The framework gives an arrangement of tenets concerning distinctive sorts of land utilize, including private, business, business and mechanical utilize. This handout will give an essential depiction of the urban land utilize arranging framework in Japan.

World Bank; (2003)Land-use regulation leads to reduced emissions from transportation systems, less average commuting time, cultural flowering in new public spaces, less crime, and most importantly, a much greater capacity to be informed about one's city and a greater capacity to broadly communicate the advantages of such regulation. This, in turn, leads to a less corrupt government, a very strong citizen-participation system, a much greater flow of information, and a much more intelligent use of it by citizens and organizations.

K.G.P.K. Weerakoon; (2002) examined that the problem in Sri Lanka like more developing countries, is not a shortage of developable land, but the in effective and unplanned mechanisms the use to ensure supply of suitable land for urban expansion. A GIS is a powerful tool for land use planners in their effort to make land development processes more efficient and attractive. This evaluation is useful for planners for their future urban expansions. Least suitable areas for development and conservation is important to decision making, when making a planning decision it should be considered.

Jeffrey D. Kline and Ralph J. Alig; (2001)describes a exact model depicting the likelihood that backwoods and farmland in western Oregon and western Washington were produced for private, business, on the other hand modern uses amid a 30-year time frame, as an element of spatial financial variables, ownership, and geographic and physical land attributes. Changes in land utilize, and especially woods utilize, have imperative outcomes for the future accessibility of timber, natural life environment, and different advantages gave by woodlands.

EdwardJ.Kaiser; (1995) proposes a model for understanding and Reconciling the dissimilar needs among contending partners; it discloses how to manufacture arranging Support frameworks to survey future conditions, assess arrangement decisions, make dreams, and think about situations; and It puts forward a strategy for making arranges that will Influence future land utilize change.

Vedia F. Giilen and Selma Tokcan; (1993) exhibits a summed up land-utilize model to decide the most effective use of land in light of two intuitive targets: (1) Maximization of return; and (2) minimization of the total of weighted separations among the diverse land-utilize units. Every arrangement is taken as an option. The adequacy of every option is figured (i.e., the aggregate of weighted efficiencies of every option as far as every goal). The option that has the greatest adequacy is picked as the most productive land-utilize design.

Arthur C. Nelson; (1993)examined 11 most imperative issues or contemplations of viable statewide land-utilize arranging. It is conceivable that arranging can be successful without all components display, however viable arranging would be made hazardous. Many states have discovered that neighborhood governments don't consider arranging important if there are no immediate expenses connected with uncooperativeness.

Wright Hiatt; (1989) describes the current political, economic, legal and social influences on urban planning in one of the world's most intensely developed tourist destination areas—Waikiki.It briefly describes existing land uses in the area, and the legal framework, guidelines and controls on urban planning at the federal, state and local levels.

Guillermo A. Mendoza; (1987) addresses two basic issues in land utilize arranging; arrive utilize reasonableness and land utilize assignments. The targets of this paper are: 1) to create multi-criteria approaches in assessing land utilize appropriateness; and 2) to utilize distinctive measures of land utilize reasonableness as advisers for ideally assign terrains to their most appropriate employments.

CONCOLUSION

Land suitability analysis is the way toward deciding the wellness of a given tract of land for a characterized utilize. As it were, it is the procedure to figure out if the land asset is appropriate for some particular uses and to decide the reasonableness level. Keeping in mind the end goal to decide the most attractive course for future improvement, the appropriateness for different land uses ought to be painstakingly contemplated with the point of guidingdevelopment to the most suitable sites. Suitability investigation procedures incorporate three variables of a territory: area, advancement exercises, and biophysical/ecological procedures.

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REFERENCES

[1]. Malay Kumar Pramanik 2016. Site suitability analysis for agricultural land use of Darjeeling district using AHP and GIS techniques.

[2]. Siqing Chen 2016. Land-use suitability analysis for urban development in Regional Victoria.

[3]. Maher Milad Aburas 2015. A Review of Land Suitability Analysis by using the GIS-Based AHP.

[4]. Mario A. Mighty 2015 "Site suitability and the analytic hierarchy process".

[5]. Hou Quanhua; 2015 AHP Evaluation Study of the Land Use Intensity on Regulatory Plan Management Unit Level of the Small and Medium-Sized City in Guanzhong Area.

[6]. L. Kazemi Rad and M. Haghyghy; 2014 Integrated Analytical Hierarchy Process (AHP) and GIS for Land Use Suitability Analysis.

[7]. Douglas R. Moodie; 2014 Optimization of Land Use in a New Urban District.

[8]. Hao Wang, Bo-sin Tang; 2014 GIS-Based Framework for Supporting Land Use Planning in Urban Renewal: Case Study in Hong Kong.

[9]. Weifeng Li; 2014 Land Use Significantly Affects the Distribution of Urban Green Space: Case Study of Shanghai, China.

[10]. Afolabi Aribigbola; 2014 Constraints to Urban Land Use Planning and Management in Nigeria: Evidence from Ondo State.

[11]. R. Laxmana Reddy; 2013 GIS Applications in Land Use and Land Development of a City.

[12]. Lee Kuan Yew; 2013 Long-Term Land Use Planning In Singapore.

[13]. Khaemba W. Alexander; 2012 Urban Land use Suitability Assessment Using Geo information Techniques for Kisumu Municipality in Kenya.

[14]. Razieh Mosadeghi; 2012Comparison of Fuzzy-AHP and AHP in a spatial multi-criteria decision making model for urban land-use planning.

[15]. Marjan Javadian; 2011 Application of sustainable urban development in environmental suitability analysis of educational land use by using AHP and GIS in Tehran.

[16]. Imtiaz Chandio; 2011 GIS-based Land Suitability Analysis Using AHP for Public Parks Planning in Larkana City.

[17]. S.V. Bobade, B.P. Bhaskar; 2010 A GIS-based land use suitability assessment in Seoni district, Madhya Pradesh, India.

[18]. Wakuru Magigi; 2005 Planning Standards for Urban Land Use Planning for Effective Land Management in Tanzania.

[19]. Ministry Of Land, Infrastructure & Transport; 2003 Urban Land-use Planning System in Japan.

[20]. World Bank ; 2003 Land Use Planning.

[21]. K.G.P.K. Weerakoon; 2002 Integration of GIS Based Suitability Analysis for Urban Land Use Planning; Contribution from AHP.

[22]. Jeffrey D. Kline and Ralph J. Alig; 2001 A Spatial Model of Land Use Change for Western Oregon and Western Washington.

[23]. Edward J. Kaiser; 1995 Urban Land Use Planning.

[24]. Vedia F. Giilen and Selma Tokcan 1993 "Comparison of Fuzzy-AHP and AHP in a spatial multi-criteria decision making model for urban land-use planning".

[25]. Arthur C. Nelson 1993 "Elements of Effective State Land-use Planning Policy".

[26]. Wright Hiatt; 1989 Land Use and Urban Planning In Paradises Waikiki.

[27]. Luo Lingjun, He Zong, Hu yan;1985"Study on Land Use Suitability Assessment Of Urban-Rural Planning Based On Remote Sensing—A Case Study Of Liang ping In Chongqing.