

Advent Geospatial Technologies In Land Evaluation: A Critical Review

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Abstract - This literature review was conducted with an aim to create a clear empirical methodology for the real estate evaluation and to determine & predict the land values using recent geospatial technologies. A number of peer review papers have been published by reputed journals nationally and internationally, government and non-government organizations also published reports regarding the real estate valuations through formal analyses. These published articles and reports were obtained from library and internet sources for review. It is found from the review that there is a strong mutual connection between real estate development and the GDP growth of a country. However, it is continuously affected by various environmental and anthropogenic factors. It can be predicted and analyzed through the recent geospatial models integrated with advanced computational techniques such as AHP, Fuzzy, and ANN. These techniques can be adopted by any region of the world for the optimal real estate evaluation and to precisely calculate the land values based on the evaluation results.

Keywords - Geospatial, Multi-criteria, AHP, Fuzzy, ANN

I. INTRODUCTION

Real estate is always required to make accommodation and to make investments. Due to the determinative character of land values in real estate activities as well as urban planning, it plays a vital role in a country's as well as global economy today. Land values are affected by several factors which have to be identified in progressing urban development and future changes [1]. According to Naik [2], accommodation is an integral aspect of existence for all humans. The new philosophy of accommodation does not restrict the notion of housing solely to the availability of shelter. Porter [3] clarified that understanding the essence of real estate is complex given that it is not a product or service, but an entire industry made up of separate enterprises. Das and Thappa [4] outlined the mechanism of urbanization implies the rising amount of the country's population begins to live in urban regions. Urbanization is linked to urban Geography's central concern. It stands for researching the phenomenon of urban concentration and urbanity. Mustafi [5] stated that owing to rising per capita incomes, growing housing

business penetration, and rising residents concentration in metropolitan areas, demand for housing has risen in the past years. During 2025, the middle-class population is projected to increase as 583 million from 224 million, which will add pressure on the existing housing demand.

II. REAL ESTATE AND GDP

Jin and Zeng [6] established a general equilibrium model in their study, which examines the relationship between the business cycle and housing investment like house prices. The research concludes that monetary policy and interest rates nominal influences property prices; taxation is also known to have an impact on property company retailers. Furthermore, there is a strong connection between house prices, and GDP was revealed. Mavrodiy [7] focused on the principal determinant of real estate pricing variables. Kiev real estate division inquiry confirms the influence on the real estate market by various macro and micro factors. In the Analysis, the effects of GDP shifts, income levels, interest rate, and populations are studied. The study deduced the direct relationship between GDP, level of income, population, and house prices, whilst interest rate increases adversely affect the price levels. The estimations also provide evidence of the connection between micro factors and residential rates. Location and qualitative attributes seem substantial on property values.

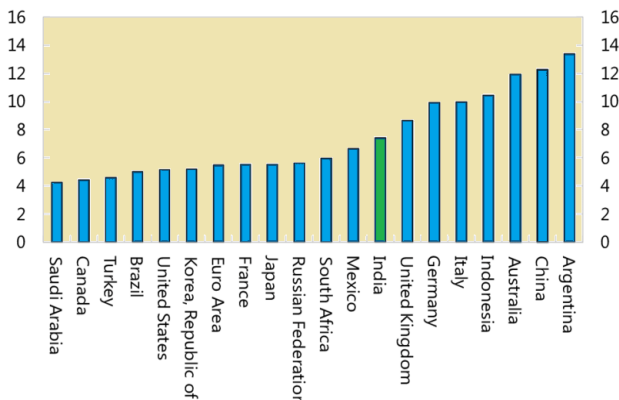
The greater part of evaluative writing is overwhelmed by the interests of scholastics. Conversely, Souza [8] inspected the unique transaction among scholastic and expert land research and suggested the conversation starter with regards to whether the two universes are crashing to shape new and inventive half breed draws near, or are they separating and moving further separated. Scholastic land research has been condemned for not creating speculations and applications that can be moved to industry for venture and portfolio dynamics or to the government for strategy making and organization. Then again, proficient land research has been condemned by scholastics for not delivering speculations and applications that can be moved to the scholarly community for more extensive information building.

Souza [8] predicts the rise of another sort of land research directed in a more coordinated style and where



the ranges of abilities of applied genuine and monetary market analysts will be sought after in both industry and the institute. These experts will bring both the scholastic and expert universes together and encourage and cultivate coordinated answers for complex true issues. Future exploration will observe a move from the physical to the monetary and will comprise of cutting edge hypothesis building, framework improvement, numerical programming, and theory testing applied straightforwardly to land and monetary resource and responsibility portfolio to the board.

A formal value theory is required to articulate the researcher's contemporary perception of what real estate is worth. And when it's the actual economy, the value of an asset is calculated to be able to determine if a property is under or overpriced. The importance of real estate is linked to culture, politics, and the economy. Life in various economies hungered for researchers' indulgence in dearth information required for property valuation. Valuation gives momentum to significant property tax changes and other steps of public policy [9].



Sources: Haver, IFS, and staff estimates.

Fig. 1 Construction and real estate share in GDP % as of 2011 (Source: Lu and Sun, [16])

A. Global Perspective

The only fact that real estate differs from all other businesses is its products are not portable [10]. Goetzmann and Wachter [11] documented the early 1990's real estate crash felt by almost all countries in the world. Quan and Titman [12] found a significant correlation of real estate with stock returns and GDP changes using the time series analysis of international property returns data. Renaud [13] considered that the level of distinctive circumstances in the late 1980s might lead to the associated changes in land values and the world market. Studies by Eicholtz [14], Eicholtz and Hartzell, [15]; Lu and Sun, [16]; Eicholtz et al. [17], Liu and Mei, [18] and Liu et al. [19] reported in the late 20th century, mixing of national with international financial components control the world's land and property businesses (Fig. 1).

Tichaona [20], in his analysis, recognized that the real estate and property management business is also important in the growth of a region and its economic development. The researcher felt it appropriate to take a closer look at this overlooked, almost invisible, but still important field in the city of Beira, the second capital of Mozambique.

The subject of his report (Challenges for Real Estate Management and Property Management in Beira, Mozambique) has not been seriously discussed at the regional level in general and at the provincial level in particular. As a matter of truth, this particular field of research, which is both management and policy-making in nature, is a fairly new domain for the rest of the world.

Hui [21] concludes that real estate production, consisting of housing projects in China, is a significant field for local government to raise revenue from consumer charges as a supplement to comparatively small tax collections from this industry. User charge revenue contributes greatly to fund local municipal spendings, such as roads, public services, and public facilities, which are essential for local development. Real estate comprises four elements which are ground floor, sub-surface, air sheet, permanently attached artifacts, and fixtures. The charges or conditional privileges entitled to the usage thereof; and the immovable property of the landowner in the statute.

B. Indian Context

The business in developing countries like India was negatively impacted by the 2008 recession due to their large dependency on foreign direct investment (FDI) to increase the country's real estate and infrastructure developments. Loss of savings and reduction of further investment by business organizations and individuals due to the global financial crisis leads to discontinuing the large-scale projects by developers. It has shown that Indian real estate has great growth demand with many sectors, particularly residential, healthcare, hospitality, retail, commercial, industrial, etc. [22].

Naik [2] reported that rapid urbanization and growing land-use changes lead by the population and economic growth in specific landscapes are being witnessed of late in developing countries like India and others. Expansion of cities in all directions leads to regional-scale urban sprawl and land-use changes. These changes can be noticed spatially on the urban peripheral and rural areas than the urban center, which reflects the pattern changing in urban land exploitation. Therefore accurately determining the land-use changes is very important for sustainable management planning. Naik analyzed to increase the financial sources through the property tax as major revenue to the Greater Hyderabad Municipal Corporation (GHMC), Hyderabad.

Gopinath [23] suggests that housing crises constitute a systemic trend. In developing countries, this is more acute. The housing units must be annually built in the 21st century India is about 4.5 million. Borthakur & Bhriugu [24], in their analysis, found a dramatic change in the urban landscapes of the Guwahati metropolitan area over the last 20 years, which leads to the reduction of natural ground cover. As a consequence, the city's surface temperature has risen, and a prominent island of urban heat is created in and around the settlement areas.

III. ROLE OF EVALUATION IN REAL ESTATE

The land is also an important source of resources and provides a necessary physical condition for human health [25]. The quality of a tract of land for particular purposes is defined as land suitability [26]. Environmental disputes may be resolved by segregating conflicting land uses by land appropriateness appraisal. The determination of appropriateness is a critical pace in national land-use policy [27]. The most suitable geographical model for expected land use can be determined based on the basic necessities, desires, and projections of specific actions [28], [29]. Knowledge about human usage and physical data are important sources in determining suitability for land usage.

Anderson [30] surveyed numerous land-capacity / suitability research approaches varying in numerical and analytical complexity rates. Lewis [31] stated that it is necessary to develop a common description of the intent and nature of the land aptness study and a comparative review of available land use assessment methods. Land suitability assessment may also be a planning method by segregating conflicting land uses to prevent environmental disputes [32].

Land suitability is determined by both land quality for a specific purpose as well as by stakeholder principles and preferences in an area. The aim of land appropriateness appraisal is to help people in determining the most suitable locations to achieve the stakeholders' goals. It helps to make decisions by land managers and draw up policies for the exploitation of specific land regions. Suitability refers to a particular use or procedure, and the strategies of suitability are important for informed strategic decision-making [33].

There are two types of approaches to determining the capable land. The primary one is the qualitative techniques of evaluating the potential of land on a global scale which is used as a basic tool for further inquiry. The results of the qualitative evaluation may not be described by the numerical ratings but expressed in terms of consistency like extremely desirable, reasonably desirable, etc., and undesirable. The second one is the quantitative technique of systematic method using parametric variables requiring more complex land characteristics and allowing for specific statistical analyses [34]. In most research, the recent trend is to merge the comparative and empirical methods in the land suitability evaluation phase of the hybrid technology, which involves experience, statistical model, and GIS (Geographic Information System) [35].

Overall, the land suitability assessment method is composed of three phases. Picking the regulating factors and rating the factor weights with comparative values is the first step. After which merging the maps with the database using the GIS are the second step. The final step is measuring the score of suitability for every land parcel according to the use and charting the appropriateness for the property. Relevant land suitability maps are the primary outcome of a land suitability assessment and have a major impact on plan design. A compilation of land use suitability maps is very useful in making nuanced choices for urban planning and economic competition for land use

developers and property managers [36]. Malczewski [35] performed a land suitability analysis in GIS using the idea of fuzzy quantifiers. The developer can't focus on an assessment method for determining the suitability of the residential property. Most tests for certain forms of land suitability assessment are focused on the experts' expertise and review of literature on the basis of the specific situation to the research field, according to a standard guide.

Sesli [37] stated that understanding the evaluation of real estate through taxation is a significant contributor to the revenue of the developed countries such as Turkey. He pointed out that the current structure is unable to view the real estate analysis on technical measures yet, which leads to different problems in applications about land evaluations, including court surveillances, expropriation, assets tax, and vital productivity failure. So he generated real estate evaluation maps in Turkey based on tax with the legal legislation scope. These evaluation maps are fast, up-to-date, and dynamic that can be treated as a basis for taxation to the land values. He found that the proximity of real estate with industrial infrastructure and public equipment areas and their types positively or negatively affect real estate ratings and create local benefit to real estate. He also determined the position of areas like major transportation, green places, commercial zones, and city centers that could affect real estate valuations. The geographical data were monitored and analyzed to come up with proximity-based decisions of the GIS data. The collected records were disclosed to required analyses in the appropriate tools of GIS software that helped to standardize the components impacting the valuation for every parcel and attempt to create land appraisal maps based on the appraisal result of selected factors as dynamics. Vector-based cadastral maps were imposed on generated maps to determine the parcel-based real estate evaluations. In his study, a raster real estate appraisal map was produced through the scoring system within unstructured parcels of a sample environment and with the support of MCDMA (Multi-Criteria Decision Making Analysis) using environmental and public components. His method assisted in questioning and analyzing the features of parcels and their rapid modification according to system variations.

The underlying cost method value theory assumes the importance of the cost of building the property is inherent in the purchase of land and constructing costly wear and tear and degradation [38]. Sibel [39] said a number of property appraisals are needed market play positions, including real estate agents, appraisers, brokers, real estate developers, investors, industry experts, consultants, advisors, and other professionals.

Chiu et al. [40] used traditional land appraisal model analyses of impact components through factor analysis, cluster analysis, and regression model to build the relationship between influence factors and land price. Partial of that analysis did append the capability of computer-aided power, but most of the data collection and manipulation still count on analog input, which is not the only process complicated but also time and labor-

consuming. GIS plays an important role in efficiently extracting spatial variables and lesson labor and time input. They applied the existing model as the criterion of land appraisal practice for Taichung city. The function such as buffer, intersect, and overlay from the GIS technique were served as land appraisal simulation support. The model considered the nearby road width, proximity to central business districts, grocery stores, parks, and medical facilities as the impact factors for land appraisal practice. Their results demonstrated the improvement in the mapping and data input process. The average time saving and the enhancement of accuracy are the major outcomes of the study since the GIS reduces the possibility of human error and increases the exactness. However, the cost of building the database is higher in this GIS technique when compared to other techniques, but it showed an economic incentive for the land appraisal market. The datasets which are used for objective-based land suitability assessment by the researchers in the different periods were given in table (1) [41].

Table 1: Database used in the Land Suitability Assessment for specific objectives (Source: Mu, [41])

Author	Objective	Study area	Database
McDonald and Brown [27]	Urban use, recreation use	Urban fringe areas	Productivity features, employment, degree of environmental disintegration, travel duration, and water supply system
Hu [42]	Residential areain rural	Hefei city, China	Environment, land carrying capacity, land use type, landform, and Soil
Van Ranst and Wandahwa [43]	Pyrethrum cultivation	West Kenya	Administrative regions, elevation, landform, rainfall, and soils
Bydekerke [44]	Cherimoya	Southern Ecuador	Contour lines, depth, ecotypes, mean annual temperature, organic matter, precipitation, relative humidity, and soil type
Shen [45]	Residential area	China	Environment, hospital network, road network, schools network, sewer network, and slope
Bojórquez-Tapia et al. [46]	Aquaculture	Costa Norte, Nayarit	Elevation, landforms, major roads, soil type, urban areas, and vegetation cover
Wu [47]	Paddy field, garden land, construction land	Fuqing City, China	Climate, infrastructure, land from, Land pH value, land texture, land use map, road network, and soil
Chen [48]	Cultivate land, garden land, Forestry	Fuzhou City, China	Elevation, land texture, land use map, pH, slope, and transportation
Thapa et al. [49]	Agriculture	Hanoi peri-urban	Land use map, road, soil salinization, soils, vegetable market, and water resource

Van Lonkhuyzen et al. [50]	Wetland mitigation sites	Illinois, USA	Adjacent vegetation, historic condition, hydrology, land use, soil, and vegetation cover
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IV. FACTORS INFLUENCING THE LAND VALUE

Evaluating the properties of a particular land is known as land valuation. It can be defined as a careful assessment of the value of the land and property on the basis of skill and decision. Though, the purpose of a land valuation is to resolve the cost usually given by terms of promoted cost or profit price. Commonly, annual economic rent and capital value are considered as the monetary value of land [51]. Practically, a property appraisal is a trained finding that includes information and features of the land with its market value and nearby buildings, renovation costs, and existing planning permits [52].

However, the major and particular purpose of the valuation method is to find out “value” [53]. The most widely accepted valuation method is the open market value by the comparison technique, which needs sufficient records of transactions [54] but owing to trade confidentiality, shortage of data, property tax structure, and temporary data distribution, evaluators are unable to collect data regularly on similar properties. It is very difficult to keep track of all transactions and track of all procurement costs. Many facts affect the value of a particular rigid asset [55].

Determining the land parcel value is based on a number of physical and economic attributes that have to be carefully considered in the land valuation process. Few of the mentioned attributes are inherent to the property, and others are outer ecological factors. Through an objective way, we can determine these factors; however, there will always be a definite level of bias that is hard to measure in the evaluation process. Location impacts are considered to be the most important in asset value, although their inclusion in valuation systems is often indirect. Uncertainty in the number of land valuation factors makes it difficult to determine the exact value for a unit of land. To find the importance of these components in an asset that must be calculated mathematically so that the result of every evaluation component could be traced to the whole property [56]. In fact, it is not possible to determine the exact value of a parcel of land, but the valuation of the property is feasible.

Several recent articles in the valuation discipline have raised the question of a research agenda. Crosby [57] discussed that various practices, including the synchronization of international valuation criteria, appraisal approaches based on the use of financial models within the land valuation, and the relationship between promoted value and asset value, may have an impact on research practice. Communication with clients and client impact, including valuation variance and precision, and reporting distribution of values versus a single point estimate are all behavioral aspects of valuation.

Ratcliff [58] suggested a re-establishment of the principle of valuation. Such valuation is a prediction of unpredictable human behavior. He was arguing

transaction zones finding out that one of a number depends on the negotiating skills prices may be the product of a sales process. Kimberly [59] said that physical and environmental research factors for an overview of the real estate market support financial research in a variety of ways of doing. A detailed study of the physical and environmental determinants of the site gives detailed estimates of construction costs. It could allow the owners and developers of the property to better known the financial viability of any project. The study also permits owners to make stronger financial statements pro forma because they understand the conditions which ultimately affect rental rates in the neighborhood. Pay attention to the property's physical and environmental factors will benefit the owners and developers.

A. Environmental Factors

Land value depends not only on the physical properties of a building but also on the built environment around that building. The production of a healthy environment is very important to present all kinds of needs of human society socially, physiologically, and psychologically. The rise in living standards globally has increased the individual's expectations for a high-quality exterior. The quality of the environment also adversely impacts the land values that many researchers have argued in their many studies. In these studies, researchers agree that the concept of urban access, which generally participates in the parameters of urban quality, has a significant impact on real estate values [60], [61].

Criterion is any attribute or aspect used to determine the status of a specific site and represent the general category of details related to the site being measured. Factors frequently included in land compatibility studies are natural, physical, and environmental factors (slope, height, drainage density, normalized difference vegetation index, geology, geomorphology, ground cover, etc.), constructed environmental factors (existing land usage, road connectivity, provision of public facilities, air pollution, water quality, etc.), social factors (population present, facilities available, etc.) and economic factors (e.g., property valuation, tax rate, etc.).

Zróbek et al. [62] aimed to recognize factors for the choice of land buyers of residential location with apartments and homes for a family of single in Poland. His research work is designed to analyze the consumer desires based on their individual occasions to help the most consistent assessment of the unique characteristics of a housing place. The authors developed a questionnaire and filled by 269 Polish inhabitants from three regions. Residents assessed and identified their residential environmental quality and factors that can affect their wellbeing. Statistical processing of obtained data reveals that cost is considered as a major factor followed by housing locality of alternatives. The additional factors recognized by residents contain safety and peaceful vicinity. The moderately important factor is high scenic values, although its importance was known by most of the inhabitants.

According to Samsinar [63], it would be a significant feature of the apartment determinant of preference of residence for a household. This study provides further insight into attributes regarding the three important factors (viz. price, location, and quality). Nasar and Manoj [64] have a recent review by the present authors analyzed real estate investor conduct when making investment decisions, such as related personal and behavioral factors that affect their purchasing decisions. Kathirvel and Vimalagracy [65] studied the factors such as high demand, low distribution, and limited income that affect real estate purchases, especially for salary class consumers. So it is necessary for property marketers to recognize the actions of property marketers' prospects and the factors that affect consumer decisions starting from new one's growth.

B. Anthropogenic Factors

Some of the key factors affecting developer performance are related to cash flow, communication, competitor, consultants, contractors, cost, culture, mobilization, procurement, quality, security, time, and training [66]-[69]. Contractors assign a portion of the project works to the subcontractors shows the incapability of the contractors and is a major issue. The availability of skilled and semi-skilled workers is the most prominent factor [70]. Due to the unavailability of labor on construction sites, it is becoming increasingly hard for developers to finish the projects in a given time. This whole process makes gaps in the communication between the subcontractors, contractors, and developers, leads to delay in projects [71], [72].

Hired consultants create floor plans, layouts, designs, and construction drawings to show their importance in the whole construction process. Hence developer's performance depends on the consultant's work. Quality affects developer's performance and causes long-term damage to their image, which is an important factor. Quality controls require many economic, manpower, and practical resources to fix all the barriers. One more factor that greatly affects the developer's performance is related to the cost and schedule. The environment of the economy, many small and medium enterprises closure, financial institutions' reluctance in the real estate sector to allocate funds, high job turnover, low savings, and a decrease in tourists compared to preceding years are the common factors that adversely impact the performance of a developer. These factors make it complicated for developers to sell their properties to local and global buyers and also create a vacuum in the industry [73].

Wyatt [74] stated that property value reflects its ability to perform a purpose. With respect to industrial property, the functional characters are positional impacts such as access to the business place, proximity to raw material suppliers, car parks, railway stations, and open space as important nodes, physical characteristics such as condition shape, size, and age, legal factors including restriction in contracts and leasing terms, planning and economic factors of planning barriers, permissible use and possibilities to change usage).

Topcu [1] discussed the important advantages of knowing the factors affecting the land values in predicting the future of urban development with anticipating possible changes from a housing perspective. He proposed a methodology to find which accessibility factor affects mostly among many factors affecting housing land values with reference to Istanbul metropolis. He used the GIS database, statistical and syntax approaches to create the spatial configuration integrated with local and global parameters. Data with 18 different variables were collected from the analysis of 403 streets in Istanbul and entered in GIS for the statistical analyses. His analyses show that proximity from the seashore is the most relevant factor affecting housing land values which are followed by the distance from the central commercial zones, values of spatial integration, facilities such as universities, and sanitations are the most influencing factors in calculating the residential land values.

Pandya and Patel [75] evaluated the key factors influencing real estate development results and found changeable with market alterations in the Ahmedabad city that led to most of the major buildings facing outdated, redesigned, and spatial redundancies. They also found that the property acquisition procedure employed by the government in urban implementation has productively promoted public purpose land banking but has also contributed to the unified land value assessment. The rankings based on the Analytical Hierarchy Process (AHP) show that surveyed training developers prioritize positional factors like neighborhood attributes, land availability above land use auctions, and land use zones. Along with these factors, the ratio of floor area, road width reduction, and the road front of the property is given high score than the design of the building. Funding availability, a project taken the time, and developers' previous project knowledge are at the top of the list in the professional practice category when compared to speculation and brand value.

Unel et al. [76] investigated through a survey to know the dependency of age as criteria or not that impacting the plot value change in three major cities of Ankara, Konya, and Kayseri, which are the Central Anatolian Region of Turkey. Respondents were selected from people who could be agents for buying and selling property using the simple RS (Random Sampling) method, and questionnaires were prepared on a five-point liker level. There was a total of 82 questions made up with two main topics as a location with 64 criteria and neighborhood with 18 criteria features excluding population questions. The respondents were categorized into six different groups based on their age. The ANOVA test was conducted to know if the mean of the criteria was significantly different depending on the age range. Several criteria were used to distinguish the age groups.

Protopapas and Dimopoulos [77] sought to identify major factors affecting land prices in the major manufacturing areas within Nicosia, the largest district in Cyprus. This study was initially aimed at improving the knowledge of all property shareholders about commercial property prices in Nicosia but then went one step ahead by

determining the major components impacting the commercial property prices. The variables can be classified into four main areas; economic indicators, location characteristics, physical and legal characteristics determined through the extensive literature review. The significance of all variables varies very much between localities and regions, and yet, there are clear themes that apply to all commercial spaces around the globe. After recognizing these factors, primary and secondary data around all commercial property transactions for the period 2008Q1-2018Q2 were collected. All source data were analyzed, filtered, and processed before being finally used within multiple regression analyzes with the IBM SPSS application. The analysis allowed the identification and measurement of the primary variables with the application of regression models, resulting in a predictive formula with 68.7% precision.

V. PREDICTIONS AND ANALYSIS

Quigley [78] argues that even though economic essentials determine the price of a home, such variables leave a significant proportion of unexpected changes in real estate prices. Farlow [79] said effective markets include the basic determinants of house prices such as jobs, interest rates, residential stocks, population changes, availability of credits, and the tax system. In single-family homes, Case and Shiller [80] found a strong serial correlation. Furthermore, information regarding actual interest rates should be significantly decisive, and they conclude that it is not included in the home price.

Bardhan et al. [81] studied globalization's impact and the transparency of nation on land rentals. Since rentals are strongly linked to the price, their study can also be used to assess the price. Hamid and Tian [82] had given proof of how people in a growing market perceive environmental comfort in the home buying Sense. Primary data were collected from a questionnaire survey in order to recognize significant viewing variables. The effect of that view is the most important aspect of the environmental facility, which affects the cost of housing in the study area.

Fasakin et al. [83] studied the land pricing in the form of residential density in Akure, Nigeria. In this research, the residential density pattern in Agure, especially as a result of land price details around the city, was examined with GIS and IKONOS Imagery. Three housing areas were arbitrarily chosen, and the total number of buildings identified in selected estates is 5,104, of which 10% represented 510 buildings. The results of correlation matrix analysis show a positive correlation ($r=0.30$) between the land price and land purchased year. Positive correlations were obtained between growth, land area, owners' income, and household size. It is found from the results that there is significant variation in land prices with the magnitude of the residential density pattern in Akure, Nigeria. Land pricing sets a new line of residential density arrangement in Nigeria's urban centers.

Ceh et al. [84] compare multiple regression-based hedonic models commonly used to analyze forecast performance for estimating apartment prices in the

Slovenian capital, Ljubljana, to a random forest machine learning technique. Transaction records of 7407 apartments representing real estate sales from 2008 to 2013 were used to evaluate the comparative performance of the forecast on these models. The demerits of these models include the nonlinear trend of the forecast assignment task; Input data based on transactions occurring during a period of major price changes in Ljubljana, which show a 28% decline for six consecutive tests years due to the multifaceted urban form of the case study area. However, performance measurements of R2 values, sales rate, coefficient of dispersion (COD), and mean average percentage error (MAPE) revealed notably better results than the predictions obtained by the random forest technique, which confirms the future of this machine learning technique in the prediction of apartment prices.

Bhargava [85] used the hedonic price model to describe price variation based on different functional nature of various attributes in determining property values in Jaipur, India. His model is constructed with the support of regression analysis on the basis of the latest transaction details of a selected property to calculate the ratio of the total value considered by the property's individual characteristics. However, his model is very challenging on both assumptions and data. In urban regions, property values are controlled by physical, environmental, and psychological factors. The relative contribution of these factors on housing property prices is explored by his study. Distance to amenities can be measured to reveal the range of influences on selected property costs. He further explored the influence of two-level spatial measurements using distance to the urban center, highway networks, environmental attributes of land use and workplace, the neighborhood environment, nearby transportation facilities, road width, and traffic congestion. Third property level factors added are the number of bedrooms with toilets, built-up area, and construction methods.

Trojanek [86] studied the use of the income approach in real estate valuation in Poland. His approach is applied to find out the market value of assets that can earn income. It can be useful in the process of assessing the non-market value of an asset, such as the value of the mortgage loan. According to him, estimating market value with the use of a material approach is like evaluating the market value of the precise to obtain unlimited income flows. However, the accuracy of the estimations depends on an accurate estimate of rates of capitalization, discount, rental and other parameters that represent the market division denoted by the valued asset.

A. Geographic Information Systems

Rodriguez et al. [87] described the technological advancement and applications of GIS that enable the users able to improve the real estate analysis. They used GIS to find out the algorithm of shortest-path that gives a location attribute better than the conventionally used straight-line proximity attribute. Their model provides pragmatic facts of a statistically considerable association between housing

sales prices and the added information derived by the variable generated by GIS.

Approaches based on GIS to land use research trace their origins to the use of hand-drawn overlay methods employed by ALA (American landscape architects) during the end of the 19th and at the beginning of the 20th century. A technique was then introduced for mapping details on natural and man-made characteristics of the area and then displaying this knowledge on independent, transparent maps using light to dark gradients (more suitable to less suitable) and superimposing independent, transparent layers on each other to create total maps of suitability for each land usage. GIS enables a detailed evaluation to be carried out because it is capable of incorporating spatial details on both environmental and socio-economic factors. One of GIS's most important tools for urban planning and management is land use compatibility modeling research. The purpose of the study is to define the most suitable spatial pattern for potential land use based on particular criteria, expectations, or predictors of certain behavior. Over the past few years or so, land use application questions have been gradually conceptualized in the form of GIS-based multi-criteria assessment practices [88].

One of the inputs of the GIS program is land compatibility testing. GIS applications have been used to determine the requirements for assessing land suitability. GIS, in combination with qualitative and quantitative approaches for the study of appropriateness, offers the required instruments for the convergence of societal and environmental data into a functional record. The GIS-supported spatial aptness evaluation is focused on the weighting of related variables (or map layers in the GIS database). GIS-based suitability strategies have gradually become components of local, national, and environmental planning practices over the past twenty years [89].

Pereira and Duckstein [90] used expert expertise and GIS in determining land suitability. Many land suitability appraisal methods include a multiple requirements examination method for the evaluation of aquaculture, forestry, ecological resources, and biodiversity, integrated GIS, and multi-criteria analysis (MCA). GIS and MCA will help the developers prevent resistance and minimize protests which are necessary prerequisites for the social approval of land design procedures.

Hall et al. [91] applied a multivariate land suitability appraisal framework based on GIS with a public involvement basis. Their research covers geographical layout, and overlapping land uses that incorporate the expert framework with the GIS for determining land suitability. During the visual processing and examination of the photos, the consumer may retrieve the desired details for the intended application. Remote sensing (RS) is designed to help the consumer overcome a specific challenge by exposing the relevant and unique knowledge about the target from the photos.

Superimposing practices are very important in various GIS implementations, including approaches at the forefront of developments in land-use suitability study, such as Multi-Criteria Decision Analysis (MCDA),

Artificial Intelligence approaches (AI), Simulation Methods, and Web-GIS. In the past 4 decades or so, GIS-based strategies for land use have gradually been an important part of urban, national, and environmental planning practices. The developments of electronic hardware technologies and the scientific advancements of space sciences are the two main influences that led to the growth of GIS in the 1950-the 60s. These advances let the growth of automated technologies for stocking, manipulating, and visually presenting geographic data [92]-[95].

GIS has been applied as a geographic decision-making tool by taking an automated approach with a technical framework program dealing with the use of the applicable geospatial data, user awareness, and statistical information. Zeng and Zhou [96] published the research on optimum spatial decision-making using GIS and concluded that the position is a key factor influencing the valuation of real estate.

Anselin [97] proposed a research framework required to supplement the established GIS system, perform a state-of-the-art spatial study of real estate markets, and concluded that there are currently not designed approaches to a broad variety of real estate management and business applications issues. Alternatively, there is a growing need to create specialized frameworks to conduct spatial data analysis between current GIS technologies and mobile applications.

Gatheru and Nyika [98] investigated the application of GIS in property valuation. They investigated the association between land value and the factors controlling it by adopting the descriptive research design. Data collected through the questionnaires were used in a multilayer regression model to combine independent variables with a dependent variable. The resulting Hedonic Price Model (HPM) indicated that land value could be estimated using the following key characteristics; Land size, access to the bypass, access to primary school. They proved that the GIS technique is a powerful tool that can store and retrieve the geo-database of all the properties of each parcel of land in one button. It is suggested to use HPM and GIS to do the land appraisal though each parcel's values are presented as illustrations, so they have prepared an appraisal map for quick decision making.

Alshuwaikhat and Nassef [99] established a systematic framework using a GIS-based decision support method to help urban planners evaluate site capacity and establish a trail site management strategy. It uses three integrated frameworks, beginning with the Potentiality Model for Urban Development (PMUD), to evaluate empty and developed land and define potential land for growth. The Land Use Suitability Model (LUSM) is then used to determine the relative suitability of each location for each type of land usage. Ultimately, the Assignment System for Land Use Distribution (AMLUA) is used to automate land use distribution, taking into account all supply and demand.

B. Analytical Hierarchy Process and Fuzzy

AHP is an approach to decision-making developed in 1980 by Thomas L. Satty. As an easy-to-use and very realistic method focused on a basic principle, AHP is capable of collecting feedback from various experts and policy makers and is primarily relevant to addressing issues occurring in an unpredictable situation where numerous appraisal requirements occur. The AHP is used to systematize complex things and separate certain variables from various directions into specific layers. A systematic review is performed via the quantification process to assist decision-makers in choosing suitable proposals. Several considerations need to be taken into account when operating the evaluation process. AHP is focused on four steps: question modeling, weight estimation, weight accumulation, and sensitivity analysis. The test utilizes AHP to create a hierarchical framework for all contributing factors and, through pair-wise comparison, acquires each factor's weight. The weight distribution achieved is more quantitative than weight calculation for particular reasons. AHP has the benefit of having a structured requirements system that allows users a clearer perspective on particular weight distribution requirements / sub-criteria [100].

The most frequently asked question for a series of activities in MCDA is how to determine the weights according to meaning. Place options such as alternative population rankings are concise multi-requirement judgments, allowing for the prioritization of multiple criteria. Saaty [101] has exposed that this weighting of MCDA functions can be interacting with using a metric theory in a hierarchical configuration. The AHP is an ample, rational, and systemic construction that enables difficult decisions to be properly understood by breaking down the issue into a hierarchical system.

The inclusion of all applicable parameters for decision taking and their pair-wise analysis helps decision-makers to evaluate the trade-offs between goals. Such issues with multi-criteria decisions are characteristic of the selection of housing sites. It not only helps decision makers by allowing uncertainty and order of judgment but also helps to integrate objective and subjective criteria into the decision-making process [102].

The AHP approach is another multi-variable technique that was introduced into the GIS land-use suitability procedures. A recent development in land suitability analysis is the integration of the spatial AHP approach as one of the widely used forms of Spatial Multi-Criteria Analysis (SMCDA) with GIS. It could be used in the GIS setting in two distinctive ways. First, it can be used to reduce the weight associated with matching map layers attribute. So the weights should be mixed in a related manner to the linear additive mixture approaches with the map layers of the attributes. This method is most suitable for problems involving numerous alternatives expressed by the raster data model, where a pair-wise alternative cannot be compared. Second, it is feasible to use the AHP concept to sum the requirement for all levels of the hierarchical system with the alternatives. In this situation, it is important to consider a fairly limited number of

alternatives. Also, this method is more suitable for vector-based GIS implementation. It should be found that in circumstances including a committee or collective decision-making, AHP may be used as a confidence-creating mechanism. AHP is better in weight determination relative to other techniques, and the GIS methodology has more versatility and precision for urban land use planning. A combination of the AHP approach with GIS has become a recent development in land use planning, and his analysis suggests that other researchers' results may be a strong mix to use for land use planning [103]-[107]. Duc [108] carried out land-use suitability research in Lam Ha City, Viet Nam Province of Lam Dong, and concluded that the AHP approach is superior in weight determination relative to other approaches as it can cope with contradictory decisions and gives a measure of the incoherence of the respondents' decision. The GIS is considered to be a methodology that offers greater versatility and precision in the handling of digital spatial details. The integration of the AHP approach with GIS appears to be an effective combination to use for the careful study of land-use suitability. Garg and Katti [109] used AHP to assess the usability index by using fuzzy logic to include planning and development guidance for Surat city.

Beigbabayi et al. [110] applied AHP-based MCDA and modeling to perform spatial data analyses to investigate the function of climate elements in identifying suitable sites for autumn canola cultivation in Adabil Province and concluded that the proposed methodology allows detailed spatial and concise knowledge to be discussed. GIS-based models offer a valuable method for assessing suitability because of their ability to process and interpret various levels of spatial data, and urban land-use planning models should be focused on GIS for the proper and efficient distribution of urban growth land.

In the weighted overlay model, the weight reflected the relative value of each feature of the element and was focused on expert analysis. The weights were calculated using Delphi methods, and the pair-wise analysis was introduced by the AHP system. The pair-wise contrast AHP was commonly employed in a variety of land aptness case studies [111]. When measuring scores and weights for all factors, the rating or metric was the numerical quantity of land suitability calculated. As described by Pereira and Duckstein [90], every thematic map represents an assessment criterion, and grid cells were assessed for their land use quality. Thus, the first step involved the assignment of the initial fitness class rating and weight to land attribute for the calculation of the suitability ranking. The score for each position was used as a measure for comparing its suitability with other locations.

Agastheeswaran, [112] In this analysis, the details of spatial satellite imagery, land use maps, and administrative zones were first digitally inserted into the GIS and then overlapped with each other. Based on the above details, the minimum unit of measurement is verified and stored in the GIS spatial database. The MCDA and AHP were then introduced and used to devise the evaluation method. For alternate choices, MCDA may

incorporate all regional data and the desires of stakeholders into one-dimensional meaning. The MCDA approach is particularly helpful when the parameters are broad.

Combining cartographic simulation and map algebraic techniques with a computer-aided map is a significant development in land use compatibility methods. Overlay analysis is important for the map algebraic approach to solving land use compatibility problems. Boolean operations (BO) and weighted linear combination (WLC) are two common approaches to land suitability study. Such approaches are common as they are both simple to comprehend and can be quickly applied inside the GIS setting while utilizing map algebra operations that are intuitively appealing to decision-makers. The approach is sometimes used without any transparency in the definitions of two important WLC components: the weights assigned to the attribute maps and the procedures for obtaining the corresponding attribute maps. The main critique of the modern map overlay system is linked to inadequate approaches to standardize compatibility maps and untested claims of equality between compatibility parameters [113].

Heywood et al. [114] addressed several forms of inappropriate usage of processes. Arguments of conventional BO and WLC approach exaggerate the problems of a mechanism based on land use planning issues by believing the facts (which are difficult to interpret in the computer system) rather than a grouping of accurate values and value results (which are difficult to explain in the GIS system) in general and GIS in particular. This can be controlled by combining GIS and MCDM processes. Such approaches include specific declarations of desires provided by decision-makers. These expectations are expressed by various numbers, weighting schemes, restrictions, goals, resources, and other parameters. The formal review was carried out in these approaches to help judgments by alternate alternatives, characteristics, performance requirements, goals or priorities, and restrictions. Specific site selection issues were addressed using MCDM. Nevertheless, they presume homogeneity within the field of analysis, which is impractical for issues with site selection.

Laaribi et al. [115] described the MCDA option as quite critical as it has a direct impact on the end product. Characteristics and properties of MCDA will be consistent with the particular essence of the topic of judgment. While many MCDA strategies, for example, easily handle the overall set of parameters and parameters of a single domain, some MCDA approaches may only accept a limited number of unique alternatives. But for coping with heterogeneous parameters, they are more important.

Malkzewski [35], in his study, conducted an analysis for land use compatibility tasks using GIS-based multi-criterion estimation, which incorporates the concept of fuzzy (linguistic) criteria by order of weighted averaging (OWA), including the regular GIS-based Boolean overlay functions and weighted linear combination technique. Kiker et al. [116] looked at the implementation of a multi-criteria decision framework to environmental decision-

making and proposed a general decision analysis approach to show the required elements for more structured and practical environmental decision-making. He concluded that MCDA provides demonstrable advantages and that the combination of MCDA concepts and methods with current strategies contributes to more accurate, reliable, and credible decision-making.

C. Artificial Neural Networks

Yalpir et al. [117] presented a study that compared the model's price with market price by producing a valuation assessments model including the most sophisticated techniques in the immovable valuation of ANN (artificial neural networks) and making applications by using MRA (Multiple Regression Analysis). Geographical information systems (GIS) were used to spatially analyze the obtained results from the models. ArcGIS10.0 software was used to integrate the GIS-based value maps to create an algorithm via ANN and MRA methods that were applied to find the immovable valuations according to the results. The performances of the built models were calculated using RMSE, R2, and trend line equations, and the derived valuation maps were correlated to ensure the accomplishment of the models.

The pictorial view of a simple ANN model was shown in Fig 2. With the advancement of computing power, the field of artificial intelligence has grown at a breakneck pace. Artificial intelligence refers to a computer's ability to mimic the human brain's intellectual functions. Expert machine, neuro-fuzzy, fuzzy logic, ANN, genetic algorithm, and other artificial intelligence techniques are among them. Where the aim is to develop a model openly from a collection of dimensions of a system's performance, data-produced AI models with qualitative outputs are preferred. The thesis examines the use of different techniques in value forecasting and their outcomes [118].

For residential apartment properties in Singapore, Tay and Ho [119] applied the back-propagation ANN model to calculate the selling prices and compared it to the standard MRA model. The ANN model had an absolute error of 3.9 percent, while the MRA model had an absolute error of 7.5 percent. Evans et al. [120] investigated the precision of neural networks in calculating housing land values in England and Wales. The researchers looked at the impact of removing outliers from the data set on the average prediction error and found that neural network models had an average absolute error of 5% to 7%. Nguyen and Cripps [121] compared these techniques' predictive performance for single-family residential properties and discovered that neural networks outperformed them. Back propagation neural networks were used by Xin and Runeson [122] to construct four separate residential cost models by changing the influencing variables and comparing their output in Hong Kong. The effect of the variables' relevancy on the model's predictability was shown by the varying results for these models.

The use of MCDA and GIS has been recommended since the 1990s for use in resolving spatial issues in community design, forest management, and site recognition. There are

two major types of MCDA techniques in GIS: Boolean overlay procedures and weighted linear combination (WLC) processes. Such approaches for land-use suitability research are the most widely employed. Such methods may be extended within the context of the ordered weighted average (OWA) [29].

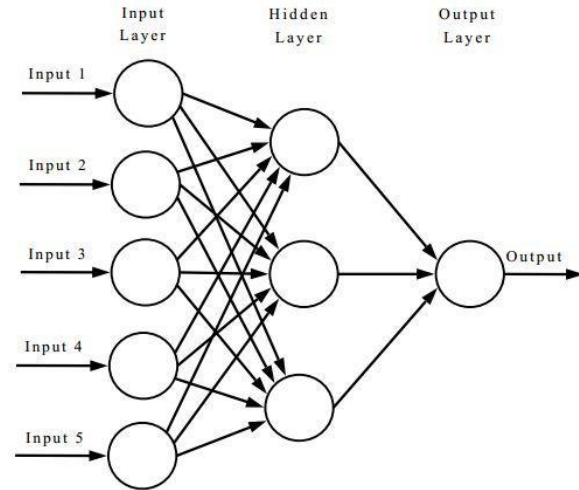


Fig. 2 Illustration of a simple ANN model

Since the 1990s, the application of MCDA and GIS has been advocated for use in the resolution of spatial problems in community design, forest management, and site recognition. There are two main types of multi-criteria assessment methods in GIS: Boolean overlay procedures (non-compensatory combination rules) and weighted linear combination (WLC) processes (compensatory combination rules). Such approaches for land-use suitability research are the most widely employed. Such methods may be extended within the context of the ordered weighted average (OWA) [29].

The procedures include the use of spatial data, the expectations of the decision-maker, and the interpretation of data and desires in compliance with the rules defined for the decision. Therefore, two aspects are of vital significance for spatial MCDA: (i) the data collection, preservation, processing, interpretation, and analysis capacities of the GIS, and (ii) the capability of the MCDA to integrate geographic data with the desires of the decision-maker into the one-dimensional value of the alternative decision. A variety of multi-criteria judgment guidelines for addressing land-use suitability concerns have been applied in the GIS setting. Decision rules can be categorized into decision-making methods that are multi-objective and multi-attribute. The multi-objective solutions are model-oriented forms of mathematical computing, while forms of decision analysis with multi-attributes are data-oriented. Multi-attribute strategies are often mentioned as discrete approaches since they presume that the several options or plans are clearly specified, whereas alternatives may be created in multi-objective methods; for example, they are found through solving a problem of multiple objected based mathematical programs [35].

Mendoza [123] researched multi-criteria GIS solutions to land use suitability evaluation and distribution. His

thesis discusses two important problems of land use planning is suitability and distribution. The goals of his research are to establish multi-criteria methods in the evaluation of land use appraisal and to use various metrics of land use appropriateness as guidelines for the optimum distribution of property to the most relevant uses. Throughout its methods, various MCDM and GIS strategies are built to incorporate considerations in the suitability study of land for future land usage. The report notes that the GIS-based hybrid model allows for both strategic preparation and management of land use decisions at various stages. Tienwong et al. [124] used MCDM combined with the 1976 FAO system to determine land suitability for the production of certain economically significant energy crops in the province of Kanchanaburi, Thailand. The evaluation of the hazardous waste disposal site in Mansoura Town, Egypt was performed using MCDM along with AHP and weighted linear combination to evaluate the suitability rating on a ranking scale of 1-5 (least to most suitable) and found that the approach provided describes the study simply and explicitly and concludes in a readily readable manner and helps to gain support from the public [125].

Multi-objective approaches describe the collection of alternatives in terms of a judgment model containing two or more objective functions and a collection of restrictions based on the variables of the judgment. In terms of judgment factors, the process indirectly describes the alternatives. The multi-objective structures are mostly solved by translating them into single-objective problems and then solving the issue using regular integer and linear programming methods [126].

Patterson et al. [127] showed the scope for incorporating linear programming and illustrated how it could be applied to refine spatial land-use trends, establish various planning scenarios and evaluate the mutual connection of decision variables and task constraints. The fast-growing problem scale, particularly if the allocation decisions are specified as the integer variables, is perhaps the main barrier that prevents the faster adoption of GIS optimization. One potential approach is to use heuristic algorithms to solve this issue. One such algorithm was developed by Eastman et al. [103]. The algorithm is helpful in addressing very broad problems surrounding land management decisions. Although the heuristic does not guarantee an ideal solution, the proposed distribution is virtually adequate in most situations, and even greater problems can be easily addressed as is feasible in the standard linear and integer programming style.

Cromley and Hanink [128] proposed that heuristic methods are only fitting if they have near-optimal alternatives, only if an equivalent technique cannot be configured to work under available limits of computational technique. They have anticipated a simpler project layout for a survey of land-use appraisal in the raster GIS context. A benefit of the linear modeling approach is the potential to chart the area rent and opportunity cost trends in combination with the ideal formula for land suitability. Such empirical knowledge will be used to assess the robustness of trends of land

suitability and to classify areas; changes may be rendered without substantial effects.

Another concern with current multi-criteria methods to land use suitability research is that various forms of land use do not guarantee a geographic structure of contiguity or compactness of land allocations. Several solutions have been suggested for this problem, including heuristic methods. The additional restrictions preserving contiguity and compactness further amplify the technical difficulty of suitability models for land use. Computation sophistication is one of the explanations why it is challenging to apply multi-objective optimization approaches in the GIS setting. It took significant work to create mathematical programming algorithms or to implement commercially accessible solvers for optimization and GIS. Multi-attribute solutions (especially for the raster data model) are much simpler to apply in GIS. Consequently, there is a large range of GIS multi-attribute frameworks for the land-use suitability study [129].

A variety of multi-attribute assessment processes with WLC and its derivatives, ideal point technique, concurrence analysis, and analytical hierarchy framework have been applied in the GIS setting during the past decade or so. Of such methods, the WLC and Boolean overlay functions like intersection "AND" and union "OR" are deemed the easiest and most commonly hired. The definition of a weighted average is based on the WLC (or basic additive weighting). The decision-maker applies the weights of 'economic value' directly to each layer of map attributes. On each alternative, a cumulative score is then calculated by multiplying the weight of significance set to every attribute by the weighted rating provided to the variables on that attribute and by summing the items over all attributes. When the combined scores for all the variables are determined, the option with the maximum average score is picked. Any GIS framework that has overlay capability will operationalize the process. The overlay techniques allow for the amalgamation of the assessment criteria map layers as input maps to evaluate the composite map layer as resulting data. The methods can be applied in GIS environments both for raster and vector. Some GIS applications have been built into WLC process routines. However, there are certain basic shortcomings related to the usage of such procedures in a making decision process [130].

Jiang and Eastman [126] addressed these drawbacks in-depth and proposed that the Organized Weighted Averaging (OWA) technique in GIS offers an expansion and common usage of traditional map combination approaches. OWA is a subset of operators of multi-criteria with two types of weights: weights of criteria value and weights of order. A provided parameter or attribute is allocated an appropriate weight to signify its comparative value according to the priorities of the decision-maker in the collection of parameters considered for all locations within a study field. The order weights are correlated on an object-by-object or place-by-location basis with the criteria values. They are applied in decreasing order to the attribute values of a place without considering the attribute

from which the value falls. The order weights are the key to procedures for the OWA combination. The variables connected with OWA functioning act as a tool to direct the study of suitability for land-use dependent on the GIS. The ORness test enables OWA's findings to be understood in the sense of behavioral decision-making theory. The OWA operations allow a variety of land-use strategies to be created, varying from a severe distrustful or minimum-type strategy based on the logical AND combination to a moderate neutral-to-risk strategy or corresponding to the traditional WLC to a highly negative strategy or maximum-type strategy on the basis of logical combination. OWA may thus be viewed as an expansion and generalization of the modern GIS mixture procedures.

Spatial multi-criteria judgment complications usually include a collection of geographically specified options from which multiple alternatives are selected in relation to a specific collection of assessment criteria. Spatial multi-criteria research owing to the addition of a specific spatial variable is significantly different from traditional MCDA techniques. In comparison to traditional MCDA research, the spatial multi-parameters approach includes details on criterion values and the geographical position of choices in accumulation to the expectations of decision-makers with respect to a collection of assessment criteria. This suggested that the outcomes of the study depend not just on the spatial distribution of attributes but also on the value decisions concerned in the decision-making process. For spatial multi-criteria decision analysis thus, two aspects are of vital importance, which is the GIS component with data collection, storage, processing, managing, and interpretation capability and the MCDA function with spatial data assemblage and decision-makers expectations for confidential decision-making choice[131].

One of the complications linked with the methods of multi-attributes is the assertion of non-dependency of variables underlying such methods. Any of the problems lack the optimal point solutions. Based on their divergence from an optimal level, such methods carry out a collection of alternatives. This point reflects a potential alternative such as decision outcome that comprises of criterion's most favorable amounts among the alternatives under consideration. The better choice is the one which is nearest to the ideal level. The difference is calculated in terms of a metric interval. A broad variety of decision rules that incorporate the various meanings of separation measures can be created. While the optimal location technique can be used in the vector and raster setting of GIS, the procedure is particularly suited for the GIS raster [132].

VI. SUMMARY AND CONCLUSION

It is derived from the above review that the GDP and Real Estate are mutually connected components of a countries economy. The income that must be saved to procure an asset is the fact arises behind the basic logic of integration real estate and GDP growth; on the other hand, income can be derived directly from the GDP with fewer adjustments. The greater association between property

prices and GDP may not be provided at any time. Current real estate and GDP cycles may not be similar. However, regularly go after their model. Real estate's short and medium-term dynamics are driven not only by the wealth of one country but also by other determinants like demographical changes, construction activity, and urbanization rates which temporarily affect supply and demand.

Studies show that proper real estate evaluation is necessary to the valuation of any selected property. Real estate valuation is very important for various socio-economic agents, particularly to property sellers and buyers for personal gain, real estate brokerage firms for marketing activities, financial institutions for loan policies, and municipalities for tax purposes. Modern technologies and techniques of MCDMA, spatial statistics, fuzzy quantifiers, weighted overlay analysis, and GIS makes the objective-based land suitable assessments as most reliable and gives precise results. According to the reviewed kinds of literature, the property price is reliant on the structural characteristics, land values, location, and land use. It is established by the specific nature of the land, such as land use, aesthetics, location, access, etc. Understanding the factors affecting the land value is very important to estimate the land cost more accurately and reasonably. These factors that affect land value do not provide the exact amount but are comparatively helpful. Various factors that directly or indirectly impact the value of land include physical characteristics, access to economic activity, neighborhood facilities, current and future land use, demand and supply function, location and transport links, land and property records, growth restrictions, building laws, and real estate prices.

GIS provides a standard architecture for combining and interpreting various spatial data sets focused on geographic position and concise attributes. In land suitability research, its primary objective is to turn the raw data into new knowledge to help decision-making processes through overlay and other analytical operations. The key benefits of utilizing GIS are increased simplicity and precision of spatial data, more efficient analysis, and better access to data. Computer-based overlay techniques have been developed in response to manual mapping limitations and the combination of large datasets. The individual variable maps will then be evaluated and merged to produce an overall land value map. Throughout many case studies, overlay land use compatibility structures have been incorrectly implemented with questionable findings because observers (decision-makers) have not noticed or reported these basic assumptions. Hence, an enhanced empirical methodology has to be built with the integration of various statistical, AHP, Fuzzy, and ANN techniques for the evaluation, analysis, and prediction of the land values. An integrated approach of the above-said techniques will give optimal evaluation results that can be used to precisely calculate the land value of any region in the world.

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