# Analysing Ecology as a Tool for Sustainable Planning and Development of Gurgaon, India

**Rachna Rani[1], Tejwant Singh Brar[1], Mohammad Arif Kamal[2*]**
[1] Sushant School of Art & Architecture, Sushant University, Gurugram, India
[2] Architecture Section, Aligarh Muslim University, Aligarh, India
DOI: 10.32629/aes.v3i4.1050

**Abstract:** All human activities and settlement development draw upon the environment's resources for their sustenance and, in the process, generate a continuing impact on the environment at a comprehensive level. When the impact exceeds the manageable limits and becomes irreversible, the environment can no longer sustain the intense human activity, which leads not only to the degradation of the natural environment but also consequentially affects the functioning of the urban system in social, economic, and physical terms. Planning of self-sustaining environments is possible with the establishment of principles of development in harmony with nature. Tools from the field of applied ecology need to be utilised to establish urban environments. The planning of the urban environment is possible with the application of the ecological method, which involves the determination of selected natural features of the area, their interpretation, and evaluation within a value system. The natural factors of the area to determine suitability for urbanisation with the aim of preservation and efficient utilisation of natural resources have been analysed. The persistency of the carrying capacity of the land based on the constraints has been studied. The paper also attempts to establish the ecologically sustainable planning of the town of Gurgaon in the national capital region of India. Gurgaon is one of the nearest satellite towns of New Delhi, the capital of India. It was envisaged as an area with tremendous potential which could alleviate the pressure on the capital.
***Keywords*:** ecology, environment, sustainable planning, development, Gurgaon

## 1. Introduction

The study of ecology is vital for the environment. The loss of green spaces as a consequence of urbanisation challenges us to consider the importance of urban nature more closely. Although urban nature in industrialised countries is not typically a livelihood resource for residents, it does provide essential ecosystem services, including direct use, as environmental. There is a need to consider ecological aspects while planning a process to preserve green spaces and ecosystem services. The environment is a valuable resource that is inherently linked to the existence of all life. The natural environment, as we see it today, has undergone a tremendous change. Natural ecosystems have been drastically altered, affecting the functioning of not only humans but also plant and animal life. Man's natural disposition is to adopt a satiated attitude till a disaster or calamity has struck. So, in the name of growing more food, forests have been fleeced. Industrial growth has polluted the rivers and seas, heated up the globe, and depleted the ozone layer that shields the planet. However, stringent steps have now been taken to restrict the activities. Over time, human intervention in the natural ecosystem has achieved a scale and level of impact that is threatening the life support system, both locally and globally. Indiscriminate interference has resulted in a drastically altered state where nature is unable to recuperate and there is an irretrievable loss of certain resources These actions ultimately stem from a general attitude of irreverence, of detachment from nature, of a short-sighted outlook while establishing priorities and objectives. An awareness and understanding of the ecological system is required in order to take appropriate steps to maintain a balance in the ecosystem. The relationship within an ecosystem is fragile, and an attitude that does not respect this relationship is the cause of its degradation (McHarg, 1995)

## 2. Need for ecological sustainability

### 2.1 Man in the natural environment

It is the scientific analysis and study of interactions among organisms and their environment, such as the interactions organisms have with each other and with their abiotic environment. An ecosystem is made up of a community (a group of animal and plant populations living together in the same environment) and its abiotic environment (a non-living or physical environment), including climate, soil, water, air, nutrients, and energy. The word "ecology" is derived from the Greek word "Oikos", meaning "house" or "place to live. Literally, ecology is the study of organisms at home. Ecology is defined as the

study of the interactions between living organisms and their environment. To establish a sustainable urban environment, tools from the field of applied ecology need to be utilized. Planning of a self-sustaining environment is possible with the establishment of principles of development in harmony with nature.

## 2.2 Human development in natural world

All human activities and settlement development draw upon the environmental resources for their sustenance and, in the process, generate continuing impacts on the environment at large. When the impacts exceed the manageable limits and become irreversible, the environment can no longer sustain the intense human activity that leads not only to the degradation of the natural environment but also affects the functioning of the urban system in social, economic, and physical terms. There is a realization all over the world that development against nature ultimately results in a degradation of the environment in which we live and is not sustainable. Keeping in view the inevitable impact of development on the environment needs to be established to achieve sustainable development.

The rapid and worldwide urbanisation of the human population raises concerns about the sustainability of cities. Sustainable development is a broad term generally thought to include all parameters while planning and integrating economic and environmental concerns. Urbanization is something substantial that impacts the environment, e.g., through increased air temperature and changed water cycles, and by altering ecological processes. Urbanization results in an environment that is compositionally more amalgamated, geometrically more complex, and ecologically more disintegrated. Many of these services are essential for human well-being and thus an important aspect of liveable cities. The capacity, however, of a city to provide these services depends on the composition of its ecosystems and cannot be taken for granted.

## 2.3 Defining sustainable development

The language of sustainability has been around for some time. It emerged from forestry practices in the 18th and 19th centuries when foresters realized they needed to plant enough trees to ensure the wood lost to harvesting was replaced. Therefore, right from the beginning, sustainability showed a distinct affinity with the notion of limits. Following the development and environmental crisis of 1980, the World Commission on Environment and Development took on the task of developing strategies for environmental conversation, utilization, and management in order to achieve sustainable development. It explored the interwoven nature of economic development and environmental concerns In 1991, UNESCO issued a report titled "environmentally sustainable development" which distinguished between economic growth and economic development. which distinguished between economic growth and economic development, which involves qualitative growth without increasing the total consumption of energy and materials beyond a level that is reasonably sustainable. They attempted to formulate action plans to conserve natural resources and alleviate poverty at the Earth Summits in Johannesburg and Rio de Janeiro in 2002 in order to achieve long-term sustainable development. Sustainable development is a development that meets the demands of the present without compromising the ability of future generations to meet their own needs of ecologically sustainable development.

- efficient utilization of resources is achieved with in a maximum sustainable limit keeping in mind the natural resources
- tranquil the population size and growth with changing productive potential of the ecosystem
- equal distribution of natural resources
- conserving the plants and enemies species
- regeneration and natural growth for renewable resources
- control on rate of depletion, emphasis on recycling and economy of use ,direction of technologies for minimizing depletion, search for viable substitute in case of non-renewable resources
- minimization of the adverse impacts on the quality of air, water and other natural elements to sustain system's overall integrity

## 2.4 Planning for ecological sustainability

Nature is not uniform but varies as a function of historical geology, climate, physiography, soil, plants, animals, and consequently-intrinsic resources and land uses. Nature is a process. It interacts, responds to laws, and represents values and opportunities for human use, with certain limitations and even prohibitions on certain of these parameters. The ecological perspective provides invaluable insight into achieving sustainability. Natural processes can be identified and constituted within the value system where the degrees of value and tolerance levels are identified. This data can be combined with the conception of fitness. As a result, ecosystems can be viewed as suitable for certain prospective land uses in a hierarchy. The more intrinsically an environment is fit for any of these, the less work of adaptation will be required. It is then a maximum benefit and minimum cost solution. The most valuable application of this model is the determination of locations for land

uses in the process of urbanization.

## 3. Ebenezer Howard theory

The garden city was the ideal of a planned residential community as suggested by the English town planner Ebenezer Howard basically the idea of garden city emerged when there was prerequisite of improvement in quality of urban life which was vanishing by overcrowding and leading to deterrent circumstances due to the rampant growth since industrial revolution. He also published a book 'To-morrow: A Peaceful Path to Real Reform' (1898) it was reappraised in 1902 and the title given was 'garden cities of tomorrow'. Figure 1 shows the three magnets-the town magnet, the country magnet and the town-country. The most preferred one was the town-country magnet (Howard, 1898).

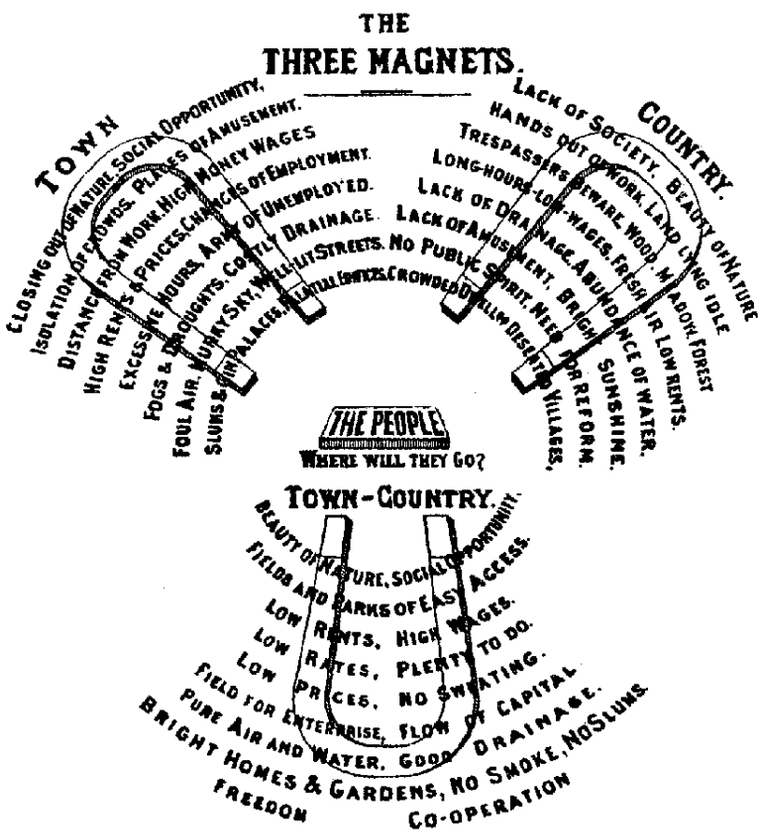


**Figure 1. The Three Magnets: the Town Magnet, the Country Magnet and the Town-Country.**

### 3.1 The town magnet

Generally people travelled a lot to reach their destinations, isolation of crowds, most of the people were unemployed least were the chances of employment for a better living everyone needs a sustainable environment but in the town there was all in mess the air was fetid, due to spillage public squalors were created it was a shanty town, no proper drainage or sewage patterns if they wanted to have proper sanitation system it would have cost them exorbitant. High rents were to be paid but the wages were too low to meet the needs.

### 3.2 The country magnet

The populous dwelling's demand of work was high but same as above the wages given were low due to squalors the environment was again not sustainable improper drainage and sewage, but the area had beauty of nature in some parts, there was a lack of beguilement there was no sense of solidarity and integrity, the villages were deserted, water resources were in opulence. The optimum use of land was not happening.

### 3.3 The town-country magnet

The most attractive magnet as it was the amalgamation of both town and country Accessibility of public transport now people have to travel least to their destinations, environment sustainability was there proper drainage and sewage patterns were running no public squalors were generated, pleasant and amusing environment fabricated, sense of unification among

the individuals.as the demand was growing simultaneously the wages were expanded, social juncture was blooming there was a boost in ecological as well as economic conditions .

## 3.4 The objectives of Ebenezer's theory

- To find work for industrial population
- Environmental sustainability
- Legitimate employment
- Marginal population (32000) in 6000 acre of land

## 3.5 Vision of Garden City

- The settlement should be environmentally sound
- Integration of settlement with open/green belts
- Interlinked transit system
- Segregation of industrial area with the rest of the settlement as this was the priority because the key roots of developing a garden city was a resultant of industrial revolution
- He discouraged the idea of metropolitan straddle which in lieu were creating deteroiting circumstances
- His vision catered the needs of farmers also so he suggested the integration of agricultural belt also so that the city has all assets of both urban and rural lifestyles in order to overcome all the conflicting issues that makes everyday living difficult.
- The city would attract the most despondent inhabitants of British strangle industrial cities.

## 3.6 Garden City concept

The architects involved in the planning of garden city were B. Parker and R. Unwin. The garden city was an example of urban planning, and the architects rejected the original Howard design in planning of this town. It was a self-sustaining town. It had a population of 16000. It was the first to have land use planning (Figure 2). The main principles which were incorporated in the plan are:

- Planned on organic unity- interdependency of sectors
- It had a grid pattern
- Segregation of industrial sector
- Emphasize on open/green spaces
- Providing recreational and commercial areas for the development and growth of economy
- Provision of transit system
- Integration of settlement with green belts

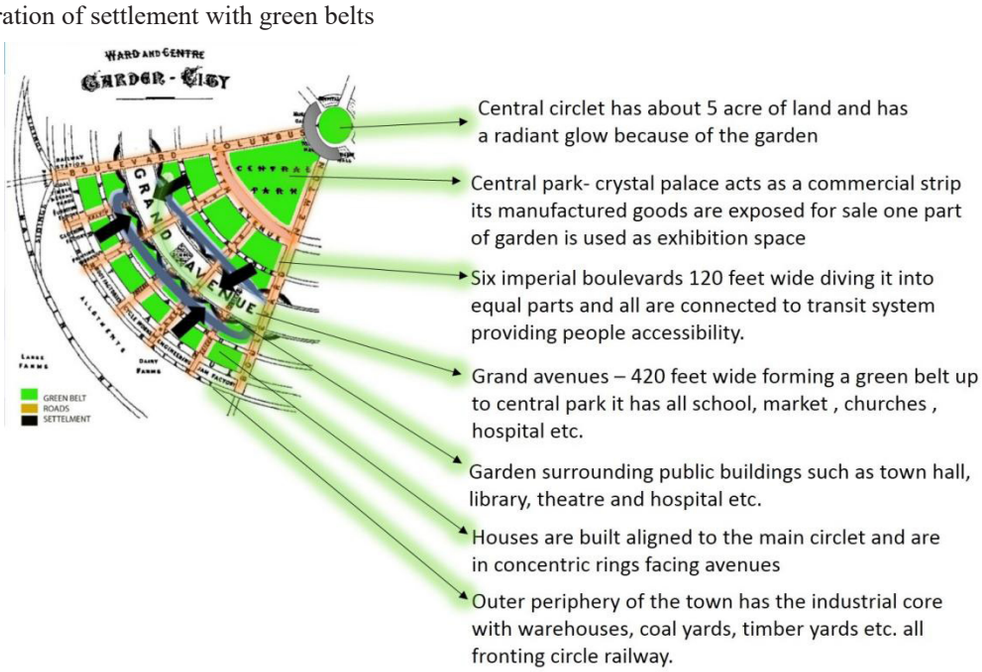


**Figure 2. The ideal Garden City planning by Ebenezer Howard**

### 3.7 Letchworth Garden City

The Letchworth garden city is Located in Hertfordshire,UK which is situated 30 miles away from London (Letchworth, 2020). The plan explained the different land use that should have the back and front gardens (Figure 3). The plan had following characteristics:

- Central town square which embody all the administrative blocks
- From the central town square had radiating axes and also highlighting the grid pattern
- The square also forms the public garden
- The tree lines radiating from the square town provides a visual rapport and the garden at the centre of the square creates a perceptible cored zone
- Most of the religious shrines were located at the corners
- Many species of plants and trees are planted to make environment more sustainable

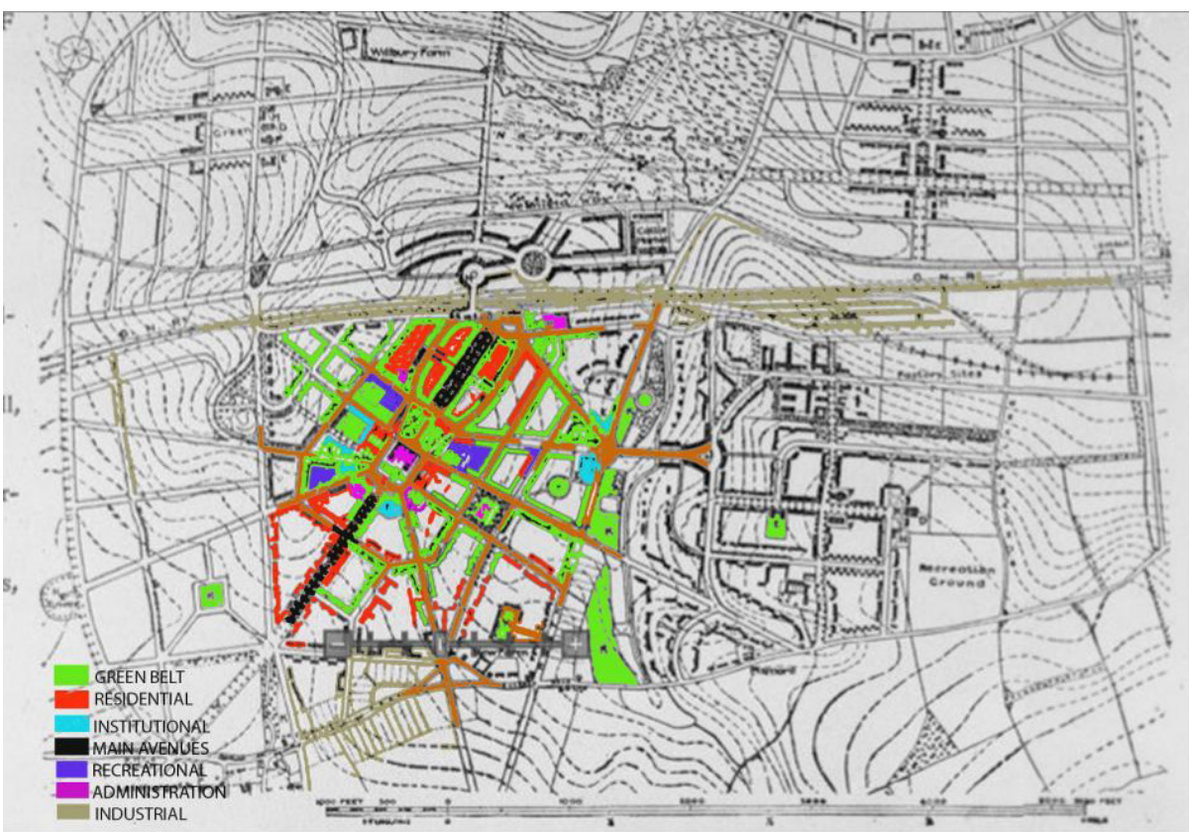


**Figure 3. The plan of letchworth Garden City**

## 4. Ecological consideration in urban planning

The concern about environmental quality and the long-term liveability of urban areas is now a driving paradigm for planning. Within this paradigm the incorporation of ecological knowledge is regarded as strategic to protect and restore the availability of a wide pattern of critical environmental resources. The ecological and environmental principles play a major role in planning. The principles states that structure and functions of ecosystem are constant flux.it has important implication of planning and management ,the key element in maintaining the environmental benefits is maintain the ecosystem healthy that can persist and can be adjusted in future for demand. The land has the potentials for transferring energies to the environment but it's not been utilized. On the other hand if we develop it without testing it ecologically, we built a green settlement on it, then the area is of no use. The conceivable area is not utilized .identification of major physical and biological activities is necessary that involves the structure of the area application of major land use is necessary those are conservation recreation (it involves active and passive) and settlement (it involves commercial, industrial and residential) .the ecological method as applied by Ian H.McHarg for derivation of land use suitability for assessing the urbanization potential of land. The basic proposition implied is that any place is sum of historical, physical and biological processes-these areas are dynamic, each has an intrinsic suitability for certain land uses and finally, the application of the ecological method for determination of

urbanization potential involves:

- Mapping and compilation of the identified basic data: historical geology, surficial geology, soils, plant ecology and hydrology.
- Interpretation of data and reconstitution within a value system.
- Arrangement of factors in a hierarchy according to importance.
- Analysis of factors in terms of suitability for certain land uses
- Evaluation of above selected factors with reference to various land uses

The major land uses are classified:

- Conservation
- Recreation
- Settlement: commercial, Industrial, Residential

# 5. Factors determining the land use in ecological planning

The following factors selected are evaluated with reference to various land uses.

## 5.1 Pedology

The soil drainage i.e. the permeability of soil as indicated by water table, foundation conditions-compressive strength and stability the particle are gravelly to stony, sandy loams. Conclusion- the land is suitable for conservation, active recreation, residential development, industrial development. Erosion-least susceptibility have steep slopes, includes any slope on gravelly sandy to fine sandy loam, moderate slopes. It is concluded that it is suitable for conservation, active recreation, residential development and industrial development.

## 5.2 Vegetation

The existing forest have excellent lowlands and uplands, relevant marshy areas uplands are poor in forest type and also they are moist marshy areas are mostly filled up, It is concluded that it is suitable for conservation, active recreation, passive recreation, residential development and industrial development.

## 5.3 Wildlife

The existing habitat, intertidal species, water associated species, urban-related species survive on the quality of environment based on intensity of shore activity, forest quality is also kept in mind. It can be concluded that it is suitable for conservation, active recreation, passive recreation, residential development, but industrial land use is not preferred in this category and also water associated species are not preferred for any of the land use.

## 5.4 Landuse

The features of unique, educational and historic value, features of scenic value and existing and potential recreation resources. Existing public open spaces and existing institutions, potential non urbanised recreation areas and urbanized areas. It can be inferred that it is suitable for conservation, passive recreation, residential development, commercial and industrial development.

## 5.5 Climate

If the area has air pollution then the area is not preferred for conservation, conclusion- suitable for recreation, commercial, industrial land uses.

## 5.6 Geology

The features of unique scientific and educational value has only conservation and passive recreation

## 5.7 Hydrology

In marine channels only industrial development and passive recreational activities can be done. Aquifers recharge zone suitable for conservation purposes. Conclusion-no residential development can take place.

# 6. Sieve mapping through Geographic Information System (GIS)

The features of historic value, high quality marshes, bay beaches, streams, water associated wildlife habitats, unique geological features, unique physiographic features, scarce geological associations. The laying of one map over another reveals the relationships between spatial distributions of different phenomena. Process of Sieve Mapping as a planning tool, indicating that it 'constituted a most valuable means of summarising and analysing survey data'. The sieve map is a

composite map showing characteristics of land which render it unsuitable for a particular purpose; such characteristics are termed constraints. In a computer based GIS amendment is relatively easy and perfection of registration is only limited by the accuracy of digitising for each overlay. In the United States of America sieve mapping developed under the title of Land Suitability Analysis, particularly in the field of landscape architecture (Kuta et al., 2016). McHarg's book Design with Nature synthesizes and generalizes his ecological wisdom in informing landscape planning and design. It was especially influential in advocating the identification of physical factors affecting development, the mapping of spatial variations in each factor and the overlaying of the maps to produce a land suitability map (McHarg, 1969). The use of overlaying is illustrated in a study of watershed management and ecological balance in the Berchtesgaden area in southern Germany (Schaller, 1994). The process of sieve mapping is illustrated in the diagram below (Figure 4).

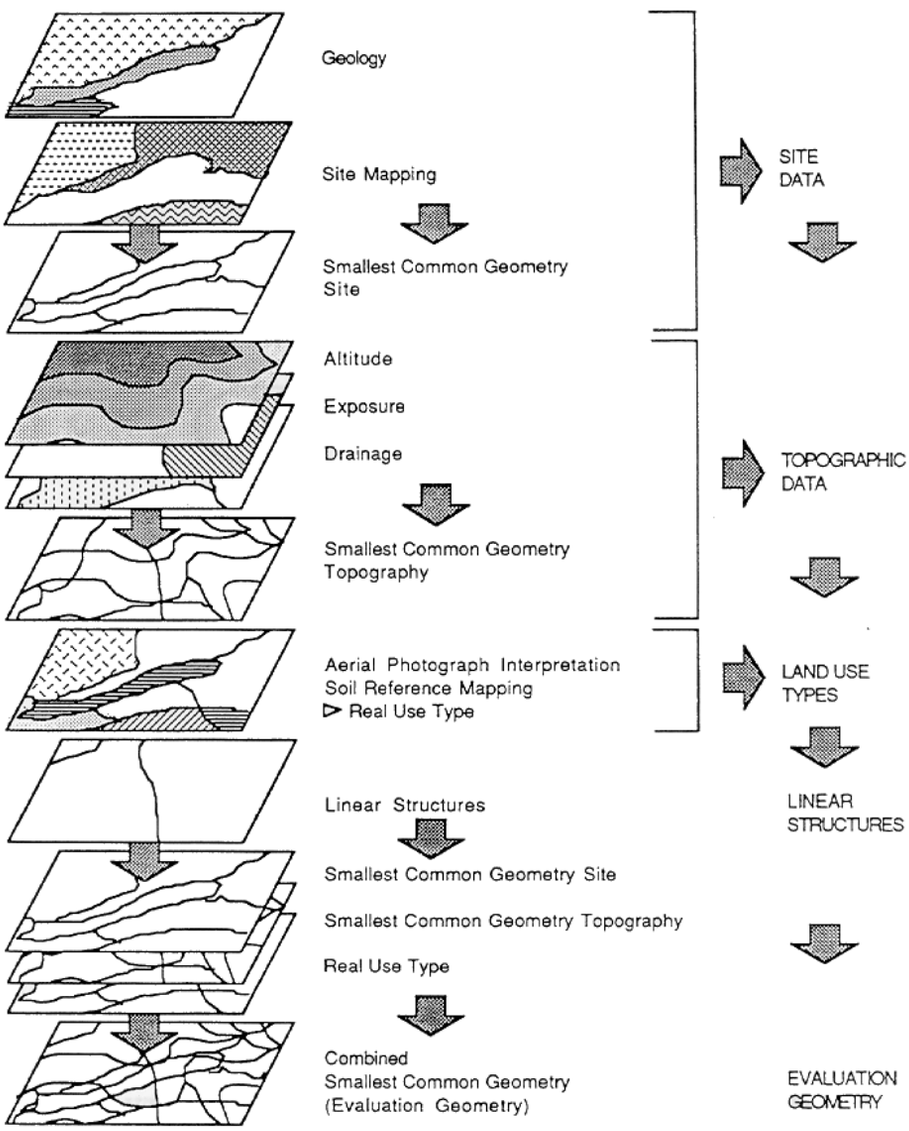


**Figure 4. The process of sieve mapping**

The areas on the composite map shown in their original colours are exclusively suitable for the use associated with the colour. Other areas where constraints overlap have combinations of colours which can be used to interpret the best use, given the constraints (Figure 5).

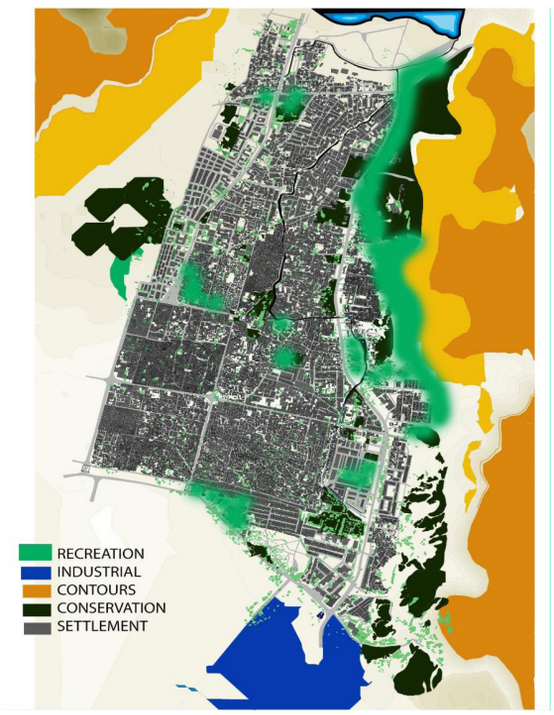


**Figure 5. The landuse map showing the different zones**

The composite map showing land uses, the combination produces two conditions: unitary suitable land uses and either complementary or competing land uses. In order to achieve an environmentally sustainable pattern of development, a systematic analysis of environmental factors is required. The factors identified need to be taken into consideration for identification of the best land suitable for settlement and other land use categories and for efficient utilization of the natural resources of the area to avoid depletion and degradation of the same.

Step 1: Analysis of environmental factors and determination of suitability for urbanization

Formulation of broad land use categories – the land uses for the area of the study were identified: settlement (residential, commercial, institutional, transportation)

- Industrial
- Agricultural
- Recreation

Identification and selection of parameters - environmental factors related to geology, soil drainage, vegetation and ground water quality were selected to arrive at a classification and to anticipate their sensitiveness to various land uses. The following are the environmental factors selected and their classification:

| Geomorphic divisions | Geomorphology | Geo environmental aspects |
|---|---|---|
| Hilly regions | Fault lines | High seismic hazard |
| Denudation | lineaments | Moderate seismic hazard |
| Pediments | Major fault areas | Low seismic hazard |
| Alluvial plain | lineaments | Low seismic hazard |

| Drainage | Surface water | Vegetation |
|---|---|---|
| Major drainage channels | Perennial water bodies | Dense forest |
| Minor drainage channels | Seasonal water bodies | Forest plantation |
| Surface natural drainage | Non perennial water logged areas | Scrub |

| Ground water quality | Fluoride level | Nitrate level |
|---|---|---|
| Fresh | Desirable | Desirable |
| Brackish | permissible | Permissible |
| saline | Not permissible | Not permissible |

Testing of parameters- at this stage parameters are tested against the classified land uses, and suitability is determined for land uses. Also it is the ideal ecological response for the efficient utilization. The grading of land use suitability-degree

of suitability for each of the classified land uses is determined against the identified parameters for efficient utilization of the resources.

# 7. Gurgaon: the study context

The town of Gurgaon is located 30 km southwest of Delhi in the state of Haryana. It is viewed by many as the model for India's global cities of the future. Historically known as Guru Gram Identified in 1962 as a satellite city in Delhi's Master Plan, Gurgaon began to be urbanised in earnest when the Maruti Suzuki car factory opened shop in the early 1980s. The city is a leading financial and industrial centre under rapid transformation from a small-scale agriculture-based settlement to an exclusive hyper urban one, this 'millennium city' is characterised by unbridled urbanisation driven by the growth of commerce and industry (Figure 6). The district is put under national capital region (NCR).the average rainfall is 570 mm.the area is well connected by roadways and railways. National highway No.8 connecting Delhi with passes through the district (Tcpharyana, 2012).


**Figure 6. Location of Gurgaon in India**

## 7.1 Assessment of Gurgaon plan

Among the numerous ecological indicators, the following were chosen to assess the planning of Gurgaon in terms of ecological sustainability

- Geology: features of unique and aesthetic value, hazardous zones, compressive strength
- Soils: depth, permeability, erodibility
- Drainage: water bodies ,major natural streams and their connectivity
- Vegetation: dense forest areas, dense vegetation
- Ecologically fragile areas
- Ground water: quality supply
- Land capability: In terms of agricultural productivity

On the basis of the suitability study for the efficient and appropriate utilization of the natural parameters, the Gurgaon plan would be assessed for its response to the natural parameters. A critical assessment of Gurgaon plan in terms of overall ecological sustainability is done.

## 7.2 Land use suitability table

(1) Land-geology.

| Geo Environmental Aspects | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| High seismic hazard(IV and V) | Not suitable | Not suitable | Most suitable | Most suitable |
| Moderate zone hazard (III) | Partially suitable | Partially suitable | Most suitable | Most suitable |
| Low seismic hazard | Most suitable | Most suitable | Most suitable | Most suitable |

| Geo Engineering Aspects | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| High bearing capacity | Most suitable | Most suitable | Most suitable | Most suitable |
| Moderate bearing capacity | suitable | suitable | Most suitable | Most suitable |
| Low bearing capacity | Not suitable | Not suitable | Most suitable | Most suitable |

| Geomorphology | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| Major fault areas | exclusion | exclusion | Most suitable | Partially suitable |
| lineaments | exclusion | exclusion | Most suitable | Most suitable |
| Fault lines | exclusion | exclusion | Most suitable | Most suitable |

(2) Physiography.

| Slopes | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| 1-5% | Most suitable | Most suitable | Most suitable | Most suitable |
| 5-10% | Most suitable | Most suitable | Most suitable | Most suitable |
| 10-15% | Partially suitable | Partially suitable | Partially suitable | Most suitable |
| >15% | exclusion | exclusion | Not suitable | Most suitable |

| Landform | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| Low lying areas | exclusion | exclusion | Partially suitable | Partially suitable |
| Deep valleys | exclusion | exclusion | Not suitable | Partially suitable |
| Prominent ridges | exclusion | exclusion | suitable | suitable |

(3) Land capability.

| Land Capability | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| Prime agricultural land | exclusion | exclusion | Most suitable | exclusion |
| Arable land with moderate limitation | Not suitable | Not suitable | Most suitable | Not suitable |
| Arable land with major limitation | Partially suitable | Partially suitable | Most suitable | Partially suitable |
| Fallow land | Most suitable | Most suitable | exclusion | Most suitable |
| Waste land | Most suitable | Most suitable | exclusion | Most suitable |

(4) Vegetation.

| Vegetation | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| Dense forest | exclusion | exclusion | exclusion | exclusion |
| Forest plantation | exclusion | exclusion | exclusion | exclusion |
| Scrub forest | Partially suitable | Partially suitable | Partially suitable | Most suitable |
| No vegetation | Most suitable | Most suitable | Most suitable | Most suitable |

(5) Water-surface water.

| Surface Water | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| Nearing perennial streams | Most suitable | exclusion | Most suitable | Most suitable |
| Nearing to non-perennial streams | Partially suitable | exclusion | Most suitable | Most suitable |
| Areas around fresh water | Most suitable | exclusion | Most suitable | Most suitable |

(6) Ground water-quality of water for settlement is also analysed in terms of quantity of fluoride, nitrate and arsenic dissolved in ground water.

| Ground Water Quality | Settlement | Industrial | Agriculture | Recreation |
|---|---|---|---|---|
| Fresh water | Most suitable | Not suitable | Most suitable | Most suitable |
| Brackish water | Partially suitable | Partially suitable | Partially suitable | Partially suitable |
| Saline water | exclusion | suitable | exclusion | exclusion |

# 8. Conclusions

The study attempted, by the application of this method, to establish the ecologically sustainable planning of Gurgaon. Gurgaon is one of the nearest ring towns to Delhi and was envisaged as an area with tremendous potential which would alleviate the pressure on the nation's capital. Among the numerous ecological indicators, the following were chosen to assess the planning of Gurgaon in terms of ecological sustainability:

- Geology: features of unique and aesthetic value, hazardous zones, compressive strength
- Soils : depth, permeability, erodibility

- Drainage :water bodies ,major natural streams and their connectivity
- Vegetation: dense forest areas, dense vegetation
- Ecologically fragile areas
- Ground water: quality supply

Land capability: In terms of agricultural productivity

The planning of the urban environment is possible with the application of the ecological method that involves the determination of selected natural features of the area, their interpretation and evaluation within a value system. The natural factors of the area to determine suitability for urbanisation with the aim of preservation and efficient utilisation of natural resources have been analysed.

## References


[1] Howard E., Garden Cities of Tomorrow, (1898) 2nd Edition of 'Tomorrow: a Peaceful Path to Real Reform, 1910', Cambridge University Press, India.

[2] Kuta A. A., Opaluwa Y. D., Zitta N., Ojatah E. and Ugolo E. M. (2016) Application of GIS Sieve Mapping and Overlay Techniques for Building Site Suitability Analysis in Part of FUT, Gidan Kwano, Minna, Nigeria, Indian Journal of Science and Technology, Volume: 9, Issue: 46, Pages: 1-6

[3] Letchworth, (2020) [Online] Accessed 22 March 2022. Available on http://www.letchworth-tc.gov.uk/Uploads/Site867/Files/letchworth_east-2.pdf.

[4] McHarg I., (1995). Design with Nature, Garden City Publisher, New York, USA.

[5] Schaller (1994) Spatial Analysis, Massey University of New Zealand, New Zealand, [Online] Accessed 22 June 2022. Available on: http://gisweb.massey.ac.nz/topic/SpatialAnalysis/lectures/overlaying.html

[6] Tcpharyana, Gurgaon Manesar Urban Complex-2031AD, (2012). Department of Town and Country Planning, Haryana, India, [Online] Accessed 22 March 2022. Available on https://tcpharyana.gov.in/Development_Plan/ColouredCopy/GURUGRAM_FDP_2031.pdf