CHAPTER - 1

INTRODUCTION

This chapter includes a brief introduction to the study area describing its location, climate, drainage, topography, socio economic conditions, soil, geology, ground water and natural vegetation. A summary of the previous work relevant to concept and methodology of land use evaluation and to the research problem carried out by various researchers and organizations in and around the study area is also included in this chapter.

RESEARCH AREA

LOCATION

The area of interest of this study includes the area around Chandigarh, lying in newly formed district Mohali (also known as SAS Nagar). The study area lies between North latitude- 30°44'27" - 30°50'00" and East longitudes- 76°40'00" - 76°51'03" falling in Survey of India Toposheet No. 53B/9, 53B/10 and 53B/13. It covers an area of 132.5 Square km, about 30% of which is hilly terrain (part of Siwalik foot hills) which are covered with different vegetations. It includes around 59 villages. The area is approachable by all- weather metalled roads from Chandigarh (Map - 1).

CLIMATE AND VEGETATION

The climate of the study area is characterized by general dryness (except the rainy season from July to September when south-west monsoon pours heavy showers), a hot summer and a bracing cold winter. The year may be divided into four seasons, November to February is the cold season, summer season from March to about the end of June, monsoon season commences late in June and continues up to about the middle of September and mid-September to the middle
of November constitutes the post-monsoon or transition season. The temperature ranges from minimum of 4°C in winter to 45°C in summer. About 78% of the annual rainfall is received from June to September and the remaining 13 percent in the cold season. The amount of rainfall during the period 2001 – 2007 in the area has relatively increased during 2001 – 2004 from 954.6 mm to 1243.4 mm and then decreased marginally in 2005, 3/4th in 2006 (sharp decrease) and then retrieved to a value close to the 2005 in year 2007. The area got minimum monsoonal rainfall in 2006 and experienced maximum rainfall during 2004. Monthly rainfall data for the period 2001 – 2007 of the study area is given in Text Table – I.

Text Table - I: Monthly rainfall (in mm) in the study area for the period 2001 – 2007.

<table>
<thead>
<tr>
<th>Month</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
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<th>October</th>
<th>November</th>
<th>December</th>
<th>Yearly Total</th>
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<td>January</td>
<td>35</td>
<td>10.4</td>
<td>97.2</td>
<td>103.9</td>
<td>33.4</td>
<td>23</td>
<td>Tr</td>
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<td>1141</td>
<td>1243.4</td>
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<td>69.7</td>
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<td>32.2</td>
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<td>0</td>
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<td>114.5</td>
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<td>19.6</td>
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<td>58.6</td>
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<td>215.2</td>
<td>89.6</td>
<td>120.6</td>
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<td>July</td>
<td>334</td>
<td>71</td>
<td>261</td>
<td>96.1</td>
<td>411.1</td>
<td>227.7</td>
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<td>December</td>
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<td>0.4</td>
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(Indian Meteorological Department, Chandigarh), *Tr*: Rainfall less than 1 mm
Map.1: LOCATION MAP OF THE STUDY AREA

Himachal Pradesh
Chandigarh
KlCStW*

DRAINAGE MAP OF RESEARCH AREA

CHANDIGARH

Map.1: LOCATION MAP OF THE STUDY AREA
The sandy loam soil deposited by the streams to which the study area is exposed helps in maintaining profuse greenery and two distinct crop seasons are availed – kharif and rabi. The kharif extends from May to October and rabi from November to April. The main crops in the area are rabi (Wheat and Grams) and kharif (Paddy, Maize, Groundnut, Pulses). The plain areas, having rainfall between 60-80 cm, contains subtropical evergreen species of which the commonest timber is Kikar (*Acacia arabica*), Neem (*Azadirachta indica*), Jamun (*Syzygium jambolana*), Shishum (*Dalbergia sissoo*) and Mango (*Mangifera indica*), trees are also commonly found particularly near the hills. Shishum (*Dalbergia sissoo*), Eucalyptus and Phulai (*Acacia modesta*) have been planted along roads and canal bank.

The region has dry deciduous type of vegetation. Natural vegetation is limited and highly localized. The hilly region has typical species of Chir Pine (*Pinus roxburghii*), Sal (*Shorea robusta*), Chal (*Conocarpus latifolia*).

**DRAINAGE**

The Siswan Nadi, Jainta Devi Ki Rao and Patiali Rao are the three major streams flowing in the research area (Map – 1). These streams start from Siwalik Hills to the Northwest of Chandigarh and run several kilometers before joining the main river. Siswan Nadi is an important seasonal stream. Initially, it flows north-east to south-west, but gradually turns north-west to finally merge with the Satluj near Khizarpur village after traversing a distance of about 40 kilometers over the plain. Jainta Devi Ki Rao and Patiali Rao are the two southern streams which flow in Northeast to Southwest direction and ultimately merge with the Ghaggar River.

These seasonal streams of the Siwalik hills are ephemeral in nature and prove an economic liability (Plate - 1a.). Their gushing waters, which suddenly swell with rains during monsoon and dry up soon after, frequently break low banks, bring flood and spread sand and gravel over the agricultural land along their courses. The low productivity of the Siwalik hills and the adjacent foothill plain is attributable among other factors to the action of these streams.
TOPOGRAPHY

The research area is occupied by three topographic units' viz. Hills, Piedmont Plain and Alluvial Plain.

Hills: Entirely constituted by Siwalik hills (Plate – 1b) with height ranging between 300-560 m above mean sea level, these hills often attain a height up to 500 m above the immediate surroundings. The Siwalik range trending from NW-SE forms the north eastern boundary of the research area. The hill tract present a highly dissected bad land topography created by ephemeral streamlets. The easy erodibility and abrupt rise of these hills from the fore-land has given rise to a number of small seasonal streams which cause extensive erosion in the plain.

Piedmont Plain: (Dissected & Rolling land) - The area between Siwalik hills and Alluvial plain consist of Piedmont plain locally known as ‘Kandi Belt’. This is highly dissected undulating plain running along the length of Siwalik hills. It is 7-10 km wide and ranges in elevation between 300 m and 380 m above msl. It has an average gradient of about 10m per km from hills towards upland plain and is transverse by a number of closely spaced seasonal streams locally called the Choes, Raos and Nalas. Many of these choes terminate in the area without joining any major stream/river. The Piedmont soil is a mixture of sand and gravel and minor amounts of loam and is known to be less productive. The deposits are young and highly stratified.

Alluvial Plain: This unit is present as southern extension of Piedmont plain. They are formed by deposition of sand, silt and clay along river courses. These have higher permeability because of the presence of sandy loam soils, coarse drainage density and abandoned channels of a large number of ephemeral streams. The soil cover is favorable for the recharge of rain water and return flow irrigation water, thus making it an agriculturally productive part.
LEGEND
- Drainage
- Road
- Railway Line
- Major Settlements
- District Boundary

Map prepared through visual interpretation of IRS 1D/P6 USS III satellite data (2002-03)

Prepared by: PUNJAB REMOTE SENSING CENTRE, P.A.U. CAMPUS, LUDHIANA
SOCIO-ECONOMIC CONDITIONS

The economic condition of Kandi area is poor. The main part of the total population is formed by cultivators, others are mainly agricultural laborers. A larger part of above 2 categories is male which are normally the earning members. There are more male literate members than female in families of the area. Mostly male dominate the area of transport, trade, manufacturing; the number of females involved is very less. Most of the female are non-workers and deals in daily household work. The major occupation of the inhabitants of Kandi area is farming. Agriculture constitutes the single largest source of employment of livelihood. The land holding are small and fragmented. There are 2 principal crop seasons, Kharif (Sawani) and Rabi (Haari). The farmers plough their own land by use of bullock and tractors. Land is leased out to other farmers who either have no land or have small holdings of land on contract (theka) or crop share (batai) basis. Contract system is gaining popularity due to benefits occurring to both land owner and tenants. Crop share system which was popular in the past is, however losing its importance due to less share falling to the lot of land owner. Farmers are increasingly taking to cultivation of cash crop. This district is quite important for vegetable cultivation as Chandigarh and Mohali provides a good market for all types of vegetables locally grown. The wells, pumping sets and tube wells are the principal source of irrigation. The sizeable area under cultivation is however rain fed and if there are timely rains, these lands are highly crop productive.

The area faces severe problems relating to soil and water. It is prone to excessive runoff, flash floods and frequent droughts due to high fluctuating and erratic distribution of rainfall over the years.

Cattle and buffaloes play an important role in the economy of the area. These are not only a major source of drought power in agriculture and transport but also yield milk. The farmers are becoming increasingly conscious about the quality of their cattle stock. The quality is not preferred to number. The ever increasing demand for milk and the opening of modern dairies in the area have created quality consciousness among the farmers. The fast development of
urban centers like S.A.S Nagar (Mohali) and Chandigarh provide excellent market for milk, poultry and meat products. This has put animal husbandry in the state of flux. Modern dairy farms, poultry farms and modest sized piggeries have come up in the area. Cattle fairs and shows are held every month at Kharar where farmers sell and purchase animal according to their requirements.

Sand and gravel used for construction of buildings etc is taken out from choe and river bed at various places.

The area is lucky in having good network of roads. In spite of large increase in the number of vehicle the principal mode of transportation is bicycle. The area is well served with transport service through a fleet of buses operated by private operators and Chandigarh transport undertaking. The number of road links between Chandigarh and Mohali has increased during the decade under review and this ensures better employment opportunities for the people in the area.

The quality of telephone exchange is being improved as manual exchange is being replaced with electric exchange. The number of post offices also increases. The area was once regarded as educationally backward but has now improved in this field.

There is also acute shortage of drinking water, fodder and fuel. A significance progress was made in the protected drinking water supply to scarcity villages. The kandi watershed development organization was quite active in this area as it was able to take up the construction of earthen dams at Parch and Jainti villages in the Kandi area. These dams are bound to prevent ravages of floods on the one hand and ensure supply of much needed water for irrigation of crops on the other. This revolutionizes the backward economy of kandi area, which had suffered in the past.

The forest is generally confined to the Siwalik Foothills. The most common types of trees grown in the forest are: Shisham, Kikar, Eucalyptus, Khair, Chhal, Jihingan, Mango etc. The common type of grasses grown is: Palwan, Sariala, Jheuri, Khavi, Bhabbar etc. Bhabbar variety is commercially the most important one and is used for making pulp for paper and ropes.
SOIL, GEOLOGY AND GROUND WATER

Soil

The soils of the study area vary in texture generally from loam to silty clay loam except along the choes where some sandy patches may be found. The soils are low to medium in organic carbon and available nitrogen and respond to the application of nitrogenous fertilizers. The soils have high water retention capacity.

Geology

The area under consideration comprises two distinct types of geological deposits, viz. the Siwalik Rocks (Middle Miocene to Early Pleistocene) and the Indo-Gangetic plain (Pleistocene to Holocene).

The Siwalik-The Siwalik sequence of the area comprises the Upper Siwalik Formation which is divisible into two distinct lithofacies namely the Sandstone Facies and the Conglomerate Facies. The Sandstone Facies which forms the lower part of the geological sequence is dominantly composed of thick beds of poorly to moderately indurated light grey, pale grey, grayish white and pale brown pebbly sandstones of fine to very fine grain size (Gill, 1983).

The Indo Gangetic Plain - These deposits have been differentiated into two litho-units viz. Terai and Bhabar. Based on the principle of lithology and presence or absence of calcium carbonate concretions as envisaged by Wadia (1953) for the classification of Indo-Gangetic Plain.

GROUND WATER

Ground water resources of the research area have recently come under threat due to extended uncontrolled urbanization. The area, which is a part of Kandi tract along the Siwalik foot hills has been under dire need for water resource management. Due to heterogeneous nature of aquifers, the water levels fluctuate frequently in throughout the area.
The ground water occurs at moderate depth and in general it is deepest in piedmont area. The groundwater in general is alkaline and is suitable for domestic and irrigation purposes. The higher angle of slope gradient also does not allow the surface water to percolate down. The texture allows the recharge of water resources from rainwater and return flow of irrigation waters. (Tuli et al, 2004).

**PREVIOUS WORK**


Land use planning can help decision-makers (such as government or land users) to use land in such a way that current land use problems are reduced and specific social, economic and environmental goals are satisfied (sustainability, income generation, self-sufficiency, etc.). The main objective of land use planning is to identify the uses that best satisfy specific goals for different tracts of land and the formulation of projects, programmes or management plans to implement these uses. Land use planning becomes important when the government or land users feel that there is a need for land use change. This requires not only the political will and the ability (instrument, budget, manpower) to support and implement the plan. It is also essential that the planned changes are acceptable to the people and land users involved (FAO, 1993).
Land evaluation provides essential information on land resources. However this information is often not used in the planning and implementation of better land use systems or land use practices, for a number of reasons. Firstly, the information produced is frequently incompatible both to government’s objectives and/or the preferences of the local people. Secondly, data processing is inadequate, resulting in low quality information. Thirdly, land evaluation is based on a top-down approach; such an approach does not take sufficiently into account the aspirations, capabilities and constraints of the local land users. Added to which, land use plans tend not to consider sufficiently the limitations of interventions (subsidies, policy prices, input supply, extension, credit etc.) (Bronsved et al, 1994).

Land evaluation is defined as the process of assessing the potential production for various land uses (Beek, 1978). This approach is based on the matching of qualities of different land units in a specific area, with the requirements of actual or potential land use. The results of land evaluation should be useful for rational land use planning (FAO, 1993).

Burrough (1996) states that in the top-down approach to land evaluation, the direction of reasoning is always from resource base to land utilization, a perfectly adequate approach where there is plenty of land, and the market is unconstrained. In general the conditions for agriculture will be initially created by the modification of the natural physical resources. This may be done by irrigating, fertilizing and other practices; as the cost of inputs increases, however, physical land resources become less important and factors such as access to the market, infrastructure, skilled labour and organization are more important. Added to this are other aspects concerning social habits and traditions. For example in Mexico, ‘almost all farmers grow maize because their culture requires it (any maize is better than none)’ (Corbett, 1995).

Rossiter (1996) discusses a theoretical framework for the classification of
land evaluation models and concludes that there is no single land evaluation modelling approach. The choice of technique affects the reliability and scope of the application, and also the predictions and purpose. Rossiter added that predictions on land performance are useful only if they are used by decision-makers to make better decisions. ‘We should take a step back, away from the question “What predictions can we make with the data we have?”’, i.e. a data-driven approach, to the question “Who are the decision-makers, who actually affect land use, how are they making their decisions, and how could their decision be better informed?”, i.e. a demand driven approach (Rossiter, 1996, p186).

Burrough (1996) states that we need to look more at the interactions between how the various tools for land evaluation can be used in different circumstances, and how physical, economic and social factors can be combined. A demand driven approach to selecting a land evaluation method would help to reveal what predictions are really needed and at what level of certainty.

The process of land evaluation could be improved in several ways. Firstly, by involving local users in the plan formulation, so that their preferences and constraints are taken into account. This would include both the assessment of the impact of interventions by market or government, for example, and of inputs (input supply, extension, credit), as well as the economic, social and environmental outputs of the implementation of the land use plans. Secondly, using existing data but changing the methods of data processing by the use of more flexible data processing methods. Thirdly, by the optimal use and better integration of the existing data like remote sensed data and field data. Finally, by a clear presentation of land evaluation and land use plans in non-technical terms (Bronsveld et al, 1994).

A GIS has been defined as a computer assisted system for the acquisition, storage, analysis and display of geographic data according to user-
defined specifications (Laurini and Thompson, 1992). It has a digital database management system designed to accept large volumes of spatially distributed data from a variety of sources (Jensen and Christensen, 1986). The most powerful characteristics of GIS centre on their ability to analyse spatial data based on descriptive attributes. The use of GIS software can help to eliminate data integration problems caused by the different geographic units to which different data sets are related (Burrough, 1986). GIS allows overlaying of maps with different thematic data (e.g. soil and land use, watershed, district, village maps) and thereby facilitates map integration and analysis. GIS distance modelling makes it possible to assess the interaction of (potential) land uses, and the physical infrastructure and market. It also permits the combination of maps with data generated by models (Bronsveld, et al, 1994). In short, the primary goal of a GIS is take raw data and transform it, via overlay and other analytical operations, into new information which can support decision-making processes.

GIS was introduced into developing countries during the 1980’s, the key agents of delivery being various UN agencies. The approach adopted in the use of GIS was essentially top-down, with ARC/INFO used on mini-computers as the principal schema. As GIS developed, however, more inexpensive systems were introduced using micro-computers, e.g. ILWIS from ITC and IDRISI from Clark University. As these various GIS systems were taken up by both universities and research centres, so a change took place in the application of GIS, with bottom-up approaches being developed, (Taylor, 1991).

The introduction of GIS, whether top-down or bottom-up, has usually come from outside and so far GIS has been only marginal to the solution of development problems. Hence Taylor (1991) argues that it is a necessary first step for indigenous scientists to gain a greater degree of knowledge and control of this technology.
There are several restrictions to the implementation of GIS for planning in developing countries. Firstly, few attempts have been made to apply GIS in deriving planning scenarios, in allocating regional investment and in evaluating development proposals. Secondly, the state-of-the-art in planning has not advanced much in relation to how planners could employ GIS in conjunction with new planning. Thirdly, the acute shortage of manpower and training has greatly restricted its use. Fourthly, there is a dominance of GIS technocrats in the use of GIS. Finally, there is an over concentration of GIS development and technology at a few key universities and research centres and finally, developing countries need GIS most, but generally do not have the necessary funding to acquire it. (Yeh, 1991).

Yeh (1991) added that in developing countries it is necessary to improve the institutional arrangements and the application of GIS rather than the technology, and that successful implementation of GIS will depend upon a clear understanding of the functions and needs of planning that are translated to system applications.

The utilization of GIS for research, planning, and project evaluation, in the mode of “top-down” data creation and expert “policy making” empowers the powerful and disenfranchises the weak, where it is being used in a planning and/or decision making capacity. GIS can be integral to defining and implementing agency decision and often reflects the internal rules and value systems of the agency controlling it. Decisions regarding what issues to address, what data to obtain and how the data should be classified and analysed, and what interpretations are drawn from them, all suggest that value-neutral GIS do not exist (Weiner et al, 1995).

GIS as part of a “rational planning discourse” can be a technical legitimisation of historical power relations (Aitken and Michel, 1995; Harris et al., 1995; cited by Weiner et al, 1995). GIS, it is claimed, produces representations
tied to the discourses of the status quo (Taylor, 1991; Pickles, 1993; Goss, 1993, cited by Weiner et al, 1995). The digital landscape becomes a terrain for elite planners to negotiate social differences and territorial conflict. In the process, workers, minorities, women, poor peasants and the unemployed become even further distanced from decision-making processes (Weiner, et al 1995). Moreover, due to lack of equitable access to GIS data and technology, small users, local governments, non-profit community agencies and non-mainstream groups are disadvantaged in their capacity to engage in the decision-making process (Edney, 1991).

Weiner et al (1995) in the construction of a GIS in Kiepersol, South Africa argued that it is concerned with multiple realities and the politics of resource access and the use of different scales of analysis. The GIS production process is informed by two bodies of literature that are not generally associated with GIS and remote sensing: political ecology and post-developmentalism. Political ecology encompasses a number of loosely configured areas of scholarship (Thrupp, 1993; Bryant 1992; cited by Weiner, 1995).

For Blaikie and Brookfield (1987) the operationalization of regional political ecology (RPE) follows a chain of explanation which starts with local land managers and land use practises. Specific social relations of resource use are then contextualized more broadly in terms of their relations with each other and other land users within the state and the world economy.

Regional political ecology is therefore concerned more with connecting scales of analysis than with the regional scale per se. Other important RPE concerns include the politics of resource use, environmental knowledge production and representation, the agency of nature, and multiple meaning and practice of sustainable development (Weiner et al 1995).
With participatory GIS the structural distortion can be reduced by the inclusion of local knowledge from socially differentiated communities whose everyday lives are tied to local conditions. This requires an approach to complement more traditional planning methodologies with the expertise and knowledge of communities who have a long standing relationship with the land (Weiner et al, 1995).

For Chambers (1994) the reality of most rural people is local, complex, diverse, dynamic and uncontrolled (LCDDU). It leads to questions about how we learn about, and respect, the values, priorities and preferences of those that are deprived and weak. Faced with LCDDU realities, universally valid policy conclusions are difficult to draw. The point of these realities is that each set of conditions needs to be examined in its own right. Chambers proposes differentiating local conditions, and following different policies in different places according to different local priorities. He suggests approaches and methods which can cost less, take less time, and yet remain credible. Moreover, CESS (1991) states those development strategies hardly consider the micro-level variations in terrain, climate, geology and socio-economic factors apart from land holding. A development approach that considers these variations must be built at a grass roots level and should be based on evaluation and response/appreciation of local users and resources. But land, water and socioeconomic conditions are not uniformly distributed. There is also a high cross correlation between availability of useful resources, climate, soil fertility, water, landform and socio-economic conditions. Considered in totality as a matrix the diversity of these types of natural regions can ensure a highly diversified production array. Land use has to be planned to conform to such variations and an intervention strategy can be worked out only if the status of natural resources along with their spatial distribution is understood fully by the planners, the land owner and the users. The evaluation of the available resources and the mapping of the existing land uses and assets would lead to a desirable development strategy evolved through a series of action plans with the people's participation.
Participatory Rural Appraisal (PRA) is a family of approaches and methods to enable rural people to share enhance and analyse their knowledge and conditions to plan and to act (Chambers, 1994).

Many traditional agricultural systems are adaptations to long-term ecological and economic forces (Bartlett, 1980). Thus the transition from “traditional” to more “developed” farming practices is a transition to a different framework for decision making. New politics can change the dominant relations of production, the whole structure of income opportunities and necessary access qualifications and hence the land use decision-making process (Blaikie, 1985). The political economy thus both determines and provides the changes in the agrarian structure that is reflected in the change of circumstances of the land manager. This change may also alter land use and management (Blaikie and Brookfield, 1987).

Blaikie (1985) proposed a bottom-up approach for the understanding of decision making, the focus being placed on land, land users and the causes of the studied process, starting with the actual people making decisions on how to use land. The scheme conceives of individual decision-making units each of which chooses a form (or forms) of income generation to fulfil some objective function. The income opportunities are expressed in terms of alternative land uses such as specific cropping patterns, communal grazing lands, and other uses. Blaikie and Brookfield (1987) proposed a land use decision-making approach for land management based on the cumulative land decision approach of Blaikie (1985) and outlined above. It focuses on a different set of decisions and provides a simple decision-tree that traces through the stages in decision-making. They propose that a number of social-environmental data form the initial desiderata for land use and management practice. The data consist of the socio-economic characteristics of the decision-makers and their access to resources. The intrinsic properties of the land system (soil, fertility, slope, etc.) are also
essential elements. These models are concerned with present investments to maintain or enhance a future income stream (Blaikie and Brookfield, 1987).

Though there is limited work done on land evaluation in India, yet a good amount of publications are available on land use and planning and other related topics. Some of the significant contributions include Kalra et al. (1998), Jaiswal et al. (1999), Srinivasan (2001), Joshi and Suthat (2002, 2005), Kumar (2003), Soni and Loveson (2003), Mohan (2005), Singh (2005) and Joshi and Suthar (2002).

A few workers have paid attention to Punjab, Haryana and Himachal Pradesh for study of land use pattern, land use planning and land use evaluation. Punjab Remote sensing Center has undertaken two projects viz.

1) Soil, Drainage and Landuse and Land capability mapping on 1:10,000 scale in seventeen watersheds in Kandi belt of Punjab.

2) Drainage and Landuse mapping in twenty watersheds in Punjab.

Chopra and Sharma (1993) made an attempt to analyse different landforms and geomorphological features and to evaluate their ground water potential in the Bist Doab Tract of the Punjab. In this tract, occurrence of ground water is controlled by geological and geomorphological features. The geomorphological units identified by them include linear ridge, structural hills, alluvial fans, piedmont plain, alluvial plain, sand dunes, flood plain, seasonal rivulets and braided river channels. The palaeochannels, ox-bows and meander scars have prominent shallow aquifers of good quality with excellent yield. The low lying alluvial plain is cropped extensively due to more moisture and/or shallow aquifer. Tapping off the flood plain for groundwater can be easy and cheap as these are potential sites for artificial recharge. The runoff and recharge zones in Bist Doab have been identified from satellite data.

Verma et al (1997) carried out the study of various soil structures in Ropar Kandi tract. It describes the various types of soil found in this area. This study
was undertaken to evaluate the contribution of soil forming factors to the development of soil from different physiographic unit in the area.

Jassal, Sharma and Gill, (1998), studied the piedmont plain soils for their mineralogical character and composition to ascertain the influence of Siwalik rocks on mineralogy of such soils because of their immature profile development. The textural variation especially in soils on steep slopes is primarily due to variations in bed rocks from which their parent material was derived and within and amongst the soils on moderate and gentle slopes, on the contrary is of depositional nature. The soils on steep slopes vary in texture from silt loam, those on moderate slopes loam to sand whereas those from gentle slopes have silt loam to sandy loam texture.

Jassal and Gill (1999), studied the soils of alluvial Piedmont from Punjab for their textural and pedological characteristics and three categories of soil, each from upper, middle and lower segments have been recognized. The soils show a regular fining of particle size down the piedmont slope and sand content decreases and silt and clay content increases from upper to lower segments. Traction, Saltation and Suspension processes have been worked out as dominant mode of transportation in the upper, middle and lower Piedmont soils respectively.

Jassal, Gill and Sidhu (2001), carried out the X-ray diffraction and major element analyses of the upper Siwalik rocks of Punjab exposed between the rivers Sutlej and Beas to assess the clay mineral composition of the rocks. The clay mineral assemblages comprise illite, semectite, kaolinite, chlorite and mixed layer phyllosilicates. For genesis of these clay minerals, inheritance and transformation were recognized as the chief processes responsible.
Subudhi et al (2000) in the study carried out in the city of Ropar (Ward No.5) of Punjab, verifies advantages of the application of CAD over LIS for municipal planning.

Pandey and Nathawat (2002) evaluated the present status of Landuse in Panchkula, Ambala and Yamunanagar districts of Haryana. The main criteria are digital imaging of satellite data. It gives in tabular form various parameters like land, forest, wasteland, water bodies etc in these districts.

Kumar (2003) studied the satellite image of Shimla from 1987-1999 and the trends of population and Urban growth, also the agricultural productivity and area and concluded a mathematical modal to find the situation in 2011 through simulation. Bansal (2005) tells how Baddi and Barotiwiwa the small town in Pinjore 'Doon', have emerges as a highly industrialized areas. But lesser planning for residential area did not allow the town to develop on pattern of Chandigarh.

Gill et al. (2004), concluded that the Himalayan Frontal fault in NW-SE trend is responsible for evaluation of major geomorphic forms due to neotectonic activities and associated deformation and uplift. An uplifted thick pile of Siwalik sediments and undulating piedmont zone to the North and South of HFF respectively exhibits a number of evidences of active tectonics in Bist Doab area of Punjab. The area presents a variety of geomorphic landforms ranging from almost flat plains to the South to steeply sloping Siwalik Hills in the North. The various geomorphic features noticed in this unit include dip slopes, escarpments, gullies, hogbacks / cuesta and badlands. The Siwalik sediments occupy an unprecedented thickness of sandstone and conglomerate facies wrapped along the HFF by virtue of anticlinal folds. The piedmont is made up of coalescing fans with proximal facies of gravel and coarse sand and distant facies of silty, clayey or loamy deposits. The presence of distinctive geomorphic forms characterized by typical neotectonic features such as linear valleys and vertical escarpments in
the hills and sudden shift in stream courses, variable degree of soil development in the plains is suggestive of dominant active tectonic control in carving out the present day topography of the area.

Walia et al. (2004) emphasis on preparation of data related to Soil fertility and ground water quality at tehsil and block level in district Patiala. The Project was undertaken with National Bureau of Soil Survey and Land Use Planning. Joshi and Suthar (2002) describes the use of IRS-ID LISS-III sensor for describing land cover details at Numbra valley, Northern portion of Ladakh. Autonomous Hill council, Jammu and Kashmir (India). This analysis essentially emphasizes in bringing out various vegetation classes (especially Hippophae Rhamniodes and other medicinal plant communities) along the narrow river valleys. Minakshi et al. (2005) studies the land use pattern of Ludhiana Region during past 30 years. The pattern shows increase in wheat and rice agriculture while decrease in cotton, groundnut etc. It also gives data about the decrease in wasteland and increase in non-agricultural land.

Chhilar et al. (2006) comments land use planning is necessary for socio-economic development of a country and sustainable use of its natural resources, a qualitative and quantitative land assessment is required for agricultural, non-agricultural, rural and urban-planning.

There is a sizeable volume of literature on Chandigarh as a planned city. Earlier writings during fifties and later till 1966 on this subject were mostly by planner, administrators and architects. In addition, several academicians had a critical look at its planned design and the degree of success it met. (Mayer, 1950; Corbusier, 1961a, 1961b; Boesiger, 1966).

The boundaries of the region were defined primarily on basis of the study conducted by Krishan and Aggarwal (1970). The editorial highlights that the infilling between Panchkula, SAS Nagar and Chandigarh would soon make an
urban nightmare of what was to be a city with a distinctive personality Schnetzer and Wakeley (1974) expressed similar views.

The Chandigarh urban complex was delimited in 1982 as the core of the interstate Chandigarh region. It consisted of 3 towns of SAS Nagar, Panchkula and Chandigarh cantonment, besides Chandigarh. A number of villages came directly under the urbanizing influence of Chandigarh. Sarin (1982) also lamented that with the establishment of SAS Nagar as one of the satellite town of Chandigarh, the functional definition of the City as a purely administrative and cultural centre had been destroyed. Bagha (1985) highlighted the deteriorous effect of the satellite town on the city environment. Sabhiki (1987) observed that the opportunity to build settlement as satellite to Chandigarh should have been used with greater imagination by way of improving upon the existing model.

Vimal (1994) worked on ‘Planned city of Chandigarh: a geographical approach’. He assessed the character of Chandigarh at 4 spatial scales 1) Chandigarh as a growth pole for its surrounding region 2) Chandigarh as a nucleus of an extended urban complex 3) Chandigarh as a demographic, physical and economic entity 4) Chandigarh as functioning at the level of its neighborhood units/sectors. This research exercise establishes that a city built completely on a plan through the course of its implementation.

Singh (1994) worked on ‘Impact and implication of development on Ecosystem- a case study of interstate Chandigarh’. The research had been undertaken with a view to probe the impact of the development activity in the ISCR (Inter State Chandigarh Region) on the ecology of the region encompassing all its constituent ecosystem- Natural Hilly Ecosystem (NHE), Semi-Natural Hilly Ecosystem (SNDE), Heterotrophic Urban-Industrial Ecosystem (HUIE) and Domesticated Agro Ecosystem (DAE). In order to highlight the mechanism of interaction between development and ecology in a system framework the 4 ecosystem had been identified in the ecosphere of the study area on the basis of their primary functional role.Ghezta (1998) worked on
‘Ecology of Chandigarh pond’ which deals with the seasonal fluctuation, species diversity, productivity and monitored the variation of plankton in relation to hydrological characteristic, and the pollution status of the ponds of U.T. Chandigarh.

Deodhar (2000) worked on ‘Growth of modern planned state capital in India – a case study of Chandigarh’. He describes and analyses the temporal and spatial pattern of growth of a modern planned state capital, Chandigarh, in term of the growth of population, its socio-economic characteristics and the morphological attributes, vis-à-vis the plan proposal. Brief comparative references have also been made to the growth of 2 other planned state capitals, Bhubaneswar (Orissa) and Gandhinagar (Gujrat). Gill and Verma (2004) analyzed Semimentology, Morphometery, Bifurcation Ratio and Drainage Density of the Sukhna catchment area.


The planning of Chandigarh, probably India’s most famous post independence project, has generated a lot of interest. Various aspects of the Chandigarh plan, including its principles, plan provision, infrastructures and the planner involved with the establishment of the city have been the focus of a number of books and research publication. A lot of news items have been published on expansion of Chandigarh and its effects on the land. Chandigarh also evoked a great deal of Academic and professional interest among Scholars,
planners, administration and journalists from across the world. But all these works lack in a detailed study of land evaluation.