CHAPTER I

INTRODUCTION

Ghera Sinhagad Land system
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1.1 Introduction

Land evaluation is a vital link and is a firm basis for sustainable management of land resources. The primary objective of land evaluation is the improved and sustainable management of land for the benefit of the people. Land evaluation is primarily the analysis of data about land and its soils, climate, vegetation, land use and land cover, etc. (FAO, 2007) Land evaluation provides essential information on land resources.

Land evaluation is formally defined as 'the assessment of land performance when used for a specified purpose, involving the execution and interpretation of surveys and studies of land forms, soils, vegetation, climate and other aspects of land in order to identify and make a comparison of promising kinds of land use in terms applicable to the objectives of the evaluation' (FAO, 1976).

The principal objective of land evaluation is to select the optimum land use for each defined land unit taking into account both physical and economic considerations as well as the sustainability of environmental resources.

The first step of the land evaluation process is land classification, which is the grouping of similar land elements in a hierarchical subdivision of three different levels can be identified, in a growing scale order: the site, the facet and the land system. Each one can be considered as a land unit or a portion of the Earth as it has been delineated on a map and described in a map legend.

The 'site' is the smallest holistic unit, which shows homogeneity of at least one of its attributes, and it is the chosen location of the relevé, the sampling punctual unit during the fieldwork. Its characteristics are then extended to the whole land system.

The 'facet' is a portion of land formed by a combination of sites, related both spatially and in terms of land attributes, for at least one land attribute (typically geomorphology). Generally it shows
homogeneity in the soils as well as in management practices. Facet is a key concept for land evaluation.

Land system concept is an integrated survey approach that is used for describing ‘regional landscapes.’ Each land system is comprised of relatively homogeneous landscape components known as land units. Land units may be too small to map individually and may be common to two or more land systems.

The land system is a combination of land facets together, forming one convenient mapping unit on a reconnaissance scale (Zonneveld, 1972). Thus, a land facet is made up of geomorphologically and geographically associated land facets, which form recurrent patterns; whose boundaries coincide with those of some discernible geological or geomorphologic feature or process (Ongaro, 1998). While the site is a real unit on the territory, both the facet and the land system are mapping abstractions, whose limits and extension depend on the surveyor’s interpretation of landscape evidence. The scale of the final map must be carefully considered, as it determines which kind of land units can be displayed on the map. At the scale of reconnaissance maps (1:50,000 - 1:250,000), and in particular at scales smaller than 1:100,000 it is possible to map land systems, while land facets are often impossible to be identified. Thus, our final map, being at the scale of 1:50,000 will show information on land systems. The map scale also determines the dimensions of the minimum mapping unit, the smallest area that can be meaningfully delineated on the final map.

Land facet is the central concept for resources inventory and land evaluation. Facets are what is observed and described by the surveyors on the field.

Land system surveys contain a wealth of information relating soil features and landform patterns at small scales. Land systems are not soil units, but composite patterns of landform, vegetation and soils. They incorporate smaller non-mapped entities called facets or units, which are related to specific landform elements and soil and
vegetation features. The distribution of facets within land systems could be mapped if landform elements can be spatially identified thus producing large-scale information on soil features pertinent to land managers.

Land system mapping is very useful in the evaluation of land resources. Land facets/land unit method is powerful in the map preparation for the land evaluation as well as land resource management and land use planning. Land system mapping can easily be done using GIS and remote sensing.

Land units are areas of land with specific characteristics. They are normally represented within a boundary on a map in order to create visually a geographical framework, but land units can also be stored invisibly in computer memory, in terms of location and description.

Land units, or land-mapping units, are areas with and qualities that differ sufficiently from those of other land units to affect their suitability for different land uses.

Decreasing land availability per capita is a big challenge to meet the basic requirements of the growing world population. The situation in Asia is alarming. This calls for an optimal and sustainable use of land resources to meet increasing food demand without reducing productivity potentials of land. It is also important to reduce the offsite effects of inappropriate land uses. With the help of Remote Sensing and GIS, it is easier to adopt the available land evaluation and land use planning methodologies to develop viable land use options for better management of land resources.

1.2 Need of the land resources management

It is a realized fact that, the proportion of arable land in India is decreasing at an alarming rate. The estimates showed that it has decreased to 0.56 ha per capita in 2005 (Gautam, 1998). These estimates are self-explanatory and indicate to give a due attention on available land resources management.
The increasing of the population and human activities are also ever-increasing the pressure on the limited land and soils resources for food, energy and many other needs.

Study of land resources for economic development has been recognized as an essential component of development planning. It has assumed much greater importance in India now with acceptance of multilevel regional planning. (Sunil Gaikwad, 2003).

Any land management can only derive from a correct land evaluation that can be based on the analysis of the continuous variations of the land. The logical chain that leads from the analysis of the land to its evaluation and successful management can be considered. (Ongaro, 1998)

A proper sustainable land management is considered a standing point in any human activity (e.g. in agriculture for food or non-food production, in landscape planning, in nature conservation, in erosion control). Sustainability can be briefly described as the way to exploit and preserve natural resources in a way by which future generations will inherit an environment at least as valuable as the one we inherited from the previous ones.

The present study is mainly attempted to undertake field surveys at micro level (village level) pertaining to detail examination of soil resources, in accordance with geology and geomorphic units within the land system.

Land evaluation, as it is intended for LU/LC analysis, erosion risk assessment, land capability and suitability classification of land resources for various purposes. Major theme of the present research is thus focused on reclamation of various land facets for their optimum utilization.

1.3 Significance of the study

In Maharashtra, particularly in hilly tracks of western Maharashtra it is observed that, most of the land facets have been degraded to their maximum due to lack of Best Management Practices (BMPs) and it is also revealed that if proper steps in view of the land
resource management are undertaken these land units can be reclaimed for optimum utilization.

Such kind of work in this area has not yet been intended by any NGO's, government or any agencies in this region. The major significance of the present study therefore stands to prepare an action plan for land resource management through Best Management Practices (BMPs) as well as to represent and incorporate effective use of RS and GIS technology in preparation of village level inventory of every geomorphic aspect as a basis for regional development of entire area. The most important natural resource, upon which all human activity is based since time immemorial, is land. Man’s inexplorable progress towards development has, however, considerably damaged our land resource base. Further, land also suffers from various kinds of soil erosion, degradation and deforestation.

Geographic Information System (GIS) can be used in tangible applications ranging from resource assessment to land evaluation and land use planning, using tools such as data visualization, data analysis and evaluation of scenarios. (FAO, 2007)

Important definitions:

a. Land evaluation

- Van Diepen et al., 1991; Rossiter, 1996: Land evaluation is the process of predicting land performance over time according to specific types of uses.
- Dent and Young, 1981; Land evaluation is the process of estimating the potential of land for alternative kinds of use.
- Austin and Basinski, 1978: Land evaluation is the assessment or prediction of land quality for specific use, in terms of its productivity, degradation hazards and management requirements.
- Beek et al. 1997: Land evaluation assesses the suitability of land for specified land uses.
- Hirekerur et al (1989): Land evaluation refers to assessment of land and soils for their potential for different uses involving matching the land qualities and requirements of the landuse.
b. Land resource management

(FAO, 1991) Land resource management is the actual practice of the land by the use of the land by the local human population, which should be sustainable.

c. Land system:

Dent and Young 1981; FAO 1983: A land unit with relatively uniform climate and with a recurring pattern of landforms, soils and vegetation. A land system may be divided into land facets.

Anon 1954: Land systems define as ‘areas of the country in which there is recurring pattern of soils, vegetation and topography.’

Zonneveld, 1972: The land system is “a combination of land facets together, forming one convenient mapping unit on a reconnaissance scale”

Christian 1958 “Land systems are an area or group of areas throughout which there is a recurrent pattern of topography, soil and vegetation”.

d. Land facet:

FAO 1983: A land unit with climate, landforms, soils and vegetation characteristics that, for most practical purposes may be considered as uniform. A land facet is a subdivision of a land system.

IDWG/LUP 1994: Land units usually contain several land facets, and a number of land units are usually contained in a land system.

Ongaro, 1998: land facet is made up of geomorphologically and geographically associated land facets, which form recurrent patterns; whose boundaries coincide with those of some discernible geological or geomorphologic feature or process.

e. Land unit:

IDWG/LUP 1994: an area of land defined in terms of land qualities and characteristics that may be demarcated on a map. A hierarchy of land units might consist of land provinces, land systems, landforms and terrain units.
f. Land mapping unit

* FAO 1976: An area of land demarcated on a map and possessing specified land characteristics or qualities.

1.4 Review of Literature:

A. Land Evaluation, Land Resource Management & Land use Planning

Anderson et al, in 1967 developed a hierarchical land use and land cover classification system for utilization with remote sensor data which has been adopted by the U.S. Geological Survey for 1:250,000 and 1:100,000 scale for land use and land cover mapping of the United States. During the last two decades, numerous studies have been published concerning accuracy assessment of land cover classification (Congalton1996, Rosenfield 1986 and Foddy, 1992).

FAO 1976, published a framework for land evaluation. In this guideline FAO outlined, potential uses of rural land as a prerequisite to sound land use planning. The main framework has framework of philosophy and principles upon which procedures for the sound evaluation of land potential could be developed.

Dent and Young, 1981, have been identified and described three types of land evaluation i.e. qualitative, quantitative, physical evaluation and economic evaluation.

Wood and Dent, 1983 developed a computer based ‘Automatic Land Evaluation System, model for discover physical and economical land suitability for land use planning.

M. Sambasiva Rao (1982) carried out a research work on, flood intensity and land evaluation in the Cauvery delta, Tamil Nadu, applying modern Remote Sensing techniques. An area of about 7500 km covering Cauvery delta has been studied from airphotos (1:60,000), Landsats (1:250,000) and survey of India topographic sheets (1 :100,000) with a view to delineate various landforms, soils, land use, hydromorphic units, drainage, and flood intensity of the delta.
Manchanda et al. (1982) done a work of ‘Soil, land use and land evaluation studies of Patna area-Bihar (India). A soil and landuse survey was conducted in Patna area, Bihar, using aerial photos of 1:25,000 scales. In which, three major systems, Ganges, gandak and interfluvial plain, have been identified in the area.

Pande et al. (1983) used Aerial Photo-interpretation techniques for land evaluation of a part of Bolangir district, Orissa.

FAO (1983-1985) published following documentation of series for land evaluation criteria

- 1983, Procedures for land evaluation for rain fed agriculture area.
- 1984, Land evaluation procedures for forestry.
- 1985, subsequently published a report describing procedures for land evaluation in irrigated agriculture.

FAO, 1986 organized, the recommendation of a workshop ‘Qualified land evaluation need for further methods are representative and very informative’. The International Society of Soil Sciences (ISSS) together with FAO and the international institute organized the conference for aerospace survey and Earth Sciences (ATC) in Washington, April 1986.

Ive, (1985) has been mention that, agriculture land evaluation fulfils two main tasks. One is identifying the most suitable location for a specific agriculture use and second is identifying the most suitable agriculture use for a specific location.

Burrough, 1986 has written a book on GIS for land evaluation and highlighted the main activities in a land evaluation are as follows

- Initial consultations, concerned with the objectives of the evaluation, and the data and assumptions on which it is to be based
- Description of the kinds of land use to be considered, and establishment of their requirements
- Description of land mapping units, and derivation of land qualities
- Comparison of kinds of land use with the types of land present
- Economic and social analysis
• Land suitability classification (qualitative or quantitative)
• Presentation of the results of the evaluation

The concept of the geographic information system emerged during the 1960's and 1970's as new trends arose in the means in which maps were being produced and used for resource assessment, land evaluation, and planning. (Burrough, 1986)

M.S. Kuhad et al., 1987 ascertain land evaluation studies in semi-arid central alluvial plains area in district Rohtak, Haryana. The study deals with making land evaluation for sugarcane, wheat and paddy cultivation in the semi-arid central alluvial plains in district Rohtak, Haryana. The special feature of this study is the use of soil survey data obtained from the interpretation of aerial photographs (1:25,000) with limited field checks for making soil classification.

Tomilin 1990, present a coherent and rational method of spatial analysis with many examples in land use planning.

Reddy et al. 1990, studied on ‘utility of satellite data for land evaluation in land use planning for a part of northern Karnataka’. The study reported deals with the utility of satellite remote sensing techniques for land evaluation for agricultural land use planning. False colour composite of Landsat imagery in the scale of 1:250,000 were visually interpreted for physiography that formed the base for mapping soil and land resources in the field.

Scott et al., 1992 analyzed the geographical and statistical relationships between landscape parameters indices in the Muddy Fork watershed in Washington county, Arkansas also by utilizing remote sensing and GIS modeling techniques.

Land use planning can help decision-makers 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. (FAO, 1993)

Land evaluation provides essential information on land resources. However this information is often not used in the planning and implementation of land evaluation is defined as the process of assessing the potential production for various land uses FAO, 1993 (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 land use planning.

A. S. Kauzeni, S. A. Mohamed et al, 1993 outline the baseline information on natural resources needed for effective development planning is conventionally provided by surveys, research has focused on examining the resource assessment method and land use planning procedures used both in past and currently in developing countries from national to village levels, and assessing the extent to which different methods have been pertinent and effective.

Bronsveld et al, 1994 explained how 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.

Foti et al, 1994, a primary component of mapping land use and land cover is adopting or developing a land cover classification system. Many current land use and land cover classification systems are designed specifically for use with remotely sensed data. Many of
these classification systems often resemble or incorporate other classification systems in order to maintain cohesiveness and allow for data integration. A hierarchical framework is often implemented within a classification system. This type of framework allows the level of detail to vary for different project scopes and for the creation land use and land cover categories that are compatible with other classification systems.

Rodriguez 1995, described, planning is a decision making method that leads to the transformation of current situation into a more acceptable future situation by distributing scarce resources among multiple objectives in order to minimize costs and maximize benefits under a dynamic social equilibrium.

Scott and Hofer, 1995 focused on the spatial and temporal analysis of the morphological and land use characteristics of the Buffalo river watershed employing remote sensing and GIS modeling techniques.

Wall 1996, further reiterated the analysis of Scott and Hofer (1995) in Searcy County, Arkansas and linked the impetus for the recent forest to pasture conversion to increased small-scale cattle production by private landowners.

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.

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).

**Hans Hurni, 1997;** he has published a research article in the ITC Journal 1997-3/4, and elaborates the concept of sustainability land management and suggested SLM offers solution, that go beyond technological recommendations by including aspect of social participation and policy dialogue. He has also described, Geo-Information has the potential to be an important tool for negotiating settlement of land use conflicts.

**R. M. Harish Selvanathan, 1997,** completed his doctoral research work on topic of 'land resource, utilization, evaluation and management of Pondecherry region and its environs.' He is carried out detailed literature survey in the field of land resources its management, land use planning and land evaluation.

**Civco and Hurd, 1999,** land use and land cover mapping has long been an area of research. Area-wise land use and land cover mapping projects (Civco and Hurd, 1999) have utilized multi-temporal and multi-resolution remote sensing data (Zhou and Civco, 1998). Recent efforts have addressed improved methods for LULC change detection (Hurd et al., 2001), and hierarchical image segmentation and object oriented LULC classification. These have included post classification change detection (Hurd et al., 1992), multidate classification change detection, cross correlation analysis (Hurd et al., 2001)

**Sunil Gaikwad, 2003** have been carried out a work on the geomorphic significance in the land evaluation for land resources. He has focused on, importance and significance of geomorphic study in the assessment and evaluation of land resources. He has also examined various aspects of land evaluation by generating a data on
Geomorphology such as basin morphometry, pedo-geomorphology, hydro geomorphology etc.

**Jamal Bani Neamech, 2003:** He had worked in Iran on the topic of land evaluation for land use planning with special attention to sustainable fodder production in the Rouzeh Chai catchment of Orumiyeh area-Iran.

**Instituto Agronomico Perliltremare-Italia, 2003:** this institute explains that, FAO is professional masters on geomatics and natural resources evaluation; main goal is to provide participants with ideal skills and knowledge on the application of RS and GIS techniques for natural resources evaluation and the relative application such as land capability and suitability for several purposes. In 2004 this institute completed a project on ‘land evaluation in the Ouled Ramel catchment -Tunisia, study was carried out by course participants who applied theoretical knowledge and practical tools and skills, acquired in the first part of the 24th course ‘geomatics and natural resources evaluation, along with their personal skills, cultural and professional background.

**Van Luiz Lilli Bacic, 2003:** submitted his Ph. D. thesis to Wageningen University on the topic entitled ‘Demand – Driven land evaluation.’ In this work, he have been carried out land evaluation case studies using FAO’s land evaluation guideline in Santa Catarina, Brazil.

**Dennis van Gool et al, 2005** express a report on ‘Land evaluation standards for land resource mapping’. This describes the standard method for attributing and evaluating conventional land resource survey maps in the south-west agriculture region of Western Australia so that strategic decisions about the management, development and conservation of land resources can be based on the best information available.

**Juan Comerma and Rey, 2007;** published a paper on conceptual and operational needs in land evaluation for sustainability in venezuela.
Klass Jan Beek, et al, ITC, 2007; were used land evaluation framework of FAO 1976 for sustainable land management, sustainable development and also land use planning. They were also used decision support system for land use planning (FAO 1995) and developed a sustainable land management model for three hierarchical land levels, i.e. land use system level, holding level and local, regional, national & global level.

FAO, 2007 suggested the following set of principals as a basis for revised framework principles of land evaluation.

- Land suitability is assessed and classified with respect to specified kinds of use and services.
- Land evaluation requires a comparison of benefits obtained and the inputs needed on different kinds of land to assess their productive potential and environmental services, and the social equity (sustainable livelihood) of the land use.
- Land evaluation requires a multi-disciplinary and cross-sectoral approach.
- Land evaluation should take into account the biophysical, economic, social and political context as well as the environmental concerns.
- Suitability refers to use on a sustained basis. The sustainability concept includes productivity, social equity and environmental aspects.
- Land evaluation involves a comparison of more than one kind of use or service.
- Land evaluation needs to consider the needs, preferences and views of all stakeholders.
- The scale and level of decision-making needs to be clearly defined prior to the land evaluation process.

B. Land system, Land Facets, Land Unit

Iyer H. S. & Srinivasan T. R. (1977), have been worked upon a study of ‘Land resource inventories for integrated land use planning
with special reference to the catchment of Pohru river in Jammu & Kashmir state'. In this study they were used landscape units for the proper land resource management. The following mapping legends were formed for the catchment:

Himalayan mountain  (H)
  Northern slopes  H1
  Southern slope   H2
Foot slopes  (F)
  Northern aspect F1
  Southern aspect F2
Karewas  (K)
  Tops K1
  Side slopes cultivated K2
  Side slopes under forest K3
  Mid slopes & toe slopes K4
Old flood plain   P
Recent alluvium    R

**V. Raghavswamy and R. Vaidyanadhan (1980)** have been studied, morphology and land systems of a part of Visakhapatnam district, Andhra Pradesh. They published this research article in Photonirvachak, journal. They are prepared a land systems map of part of Visakhapatnam district of Andhra Pradesh. They were also mentioned about similar method adopted by Cooke *et al* (1974), lyer and Srinivasan (1977), Subramanyan (1978) and by the division of the land use research, CSIRO, of Australia. The area was divided into four land systems based on the concept that similar landforms, land units, and land use reflect similar patterns on aerial photographs. Each land system was further divided into its component elements, land units sections indicating various land units across selected sample spots of each land system are drawn from 1:25,000 topographic maps of 1973-74. Four land systems recognized in the Visakhapatnam district i.e. hills and hillocks, rolling plains, fluvial plains, coastal zone.
Manchanda M.L. et al. (1982) classified land systems of the Patna area Bhar in India for soil, land use and land evaluation studies. They are classified the land system based on genesis and same land system has divided into different land unit based on soil taxonomy. Three major land systems have been classified into sub land unit for Patna area. i.e.

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<tr>
<th>Land system</th>
<th>Land unit</th>
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<tr>
<td>1. Ganges system (G)</td>
<td>1. Levee (G1)</td>
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<td></td>
<td>2. Plain (G2)</td>
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<td></td>
<td>3. Upper part (G21)</td>
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<td>4. Middle part (G22)</td>
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<td></td>
<td>5. Lower part (G23)</td>
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<td></td>
<td>6. Paleochannels (G3)</td>
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<td></td>
<td>7. Flood plain (G4)</td>
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<tr>
<td>2. Gandak system (K)</td>
<td>1. Levee (K1)</td>
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<td></td>
<td>2. Very gently undulating plain (K 2)</td>
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<td></td>
<td>3. Upland (K21)</td>
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<td></td>
<td>4. Mid land (K22)</td>
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<td></td>
<td>5. Low land (K23)</td>
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<td></td>
<td>6. Flood plain (K3)</td>
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<tr>
<td>3. Interfluvial plains (I)</td>
<td>1. Recent deposits (I 11)</td>
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<td></td>
<td>2. Point bar complex (I 111)</td>
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<td></td>
<td>3. Levees (I 112)</td>
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<td>4. Sub-recent deposits (I 12)</td>
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<td></td>
<td>5. Plain (I 121)</td>
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<td>6. Oxbow (I 122)</td>
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<td>7. Levee (I 123)</td>
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<td>8. Old basinal plain (12)</td>
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<td></td>
<td>9. Flat plain (121)</td>
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<td>10. Basin (1 22)</td>
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<td>11. Oxbow (122):</td>
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</tbody>
</table>

'Photo-interpretation and site assessment survey'. He is used the term soil facet and described 'A soil facet is a portion of a landscape having similar soil characteristics & qualities'.

**McDonald et al, 1984** developed methods of classifying landform, lithology, soil and native vegetation are those of the Australian soil and land survey field. Climate is used as a differentia for land zone only.

**Dhavalikar Laxmi (2001)** completed her Ph. D. on research work of the assessment of land facets and the geo environmental status of villages on Vengurla coast of South Konkan, Maharashtra. She has been carried out a detail literature survey regarding land system, land facets, and land unit.

**M.J. Grundy, B.K. Slater, and M. Bryant**, this team of Queensland department of Natural Resources Brisbane, Australia outline a work on mapping land units within land systems in central Queensland using a fuzzy expert system and terrain models; Land system surveys contain a wealth of information relating soil features and landform patterns at small scales. Land systems are not soil units, but composite patterns of landform, vegetation and soils. They incorporate smaller non-mapped entities called facets or units which are related to specific landform elements and soil and vegetation features. The distribution of facets within land systems could be mapped if landform elements can be spatially identified thus producing large scale information on soil features pertinent to land managers.

**Smalley, Glendon et al. (2006)** explained description of a land classification system and its application to the management of Tennessee's state forests.

**New South Wales department of Land and Water (2007)** developed eleven land systems in Barkindji Biosphere Reserve, Australia. i.e. Riverland system, Arumpo land system, Bulgamurra land system, Canally land system, Murrumbidgee land system, Mandleman land system, Menilta land system, Over Newton land system, Roo land
system, Victoria land system, Wentworth land system, Ned’s corner station land system. Every land system has different geomorphic, soils and vegetation characteristics.

**Martin D. & Saha S. K. (2007)** estimated the soil productivity for different land unit and also estimated the soil loss for the same unit of the Ason river watershed. For preserving the ecological balance between natural resources development and conservation, the concept of watershed is assumed to be a very important land unit, particularly in fragile and heterogeneous hilly ecosystem (Sharma et al., 1992). Soil mapping, soil erosion estimations using the integration of remote sensing and GIS techniques could identify the areas that are at potential risk of soil erosion and also provides quantitative soil erosion loss at different scales (Saha et al., 1992), these techniques can also be used for qualitative and quantitative physical land evaluation which was demonstrated earlier by several researchers (geek et al., 1997; Merolla et al., 1994; Rao et al., 1996).

**Leduka R. C. (2008)** published a research paper entitled on the two facets of Lesotho’s urban land law and implications for planning urban forum.

On the basis of above literature survey it is clearly indicate that, land system, land facet and land unit for different land evaluation and land resource management, land mapping, resource inventory, soil resource assessment, soil erosion assessment, agriculture land evaluation etc advocates the similar theme of land evaluation as well as land resource management.

**1.5 Major objectives of the present study**

Following are the major objectives of the present study.

1. To systematically explore the application of RS and GIS in the designing of methodology for land evaluation, this in turn is a basis for land resource management.

2. To perform land classification into different geomorphic units/land facets for the entire Ghera Sinhagad land system and...
thereby to assess potential of terrain & soil with respect to land capability, suitability classification & soil productivity assessment of the land facets for their optimum utilization.

3. To detect the change of land use / land cover in the study area using Remote Sensing and to infer the trend of present land utilization in the study area. Moreover this is necessary as basic input parameters in estimating surface runoff and soil loss, which forms the very basis of land evaluation.

4. To identify the high priority erosion risk zones based on land degradation assessment and to suggest compensatory conservation measures in the study area, to minimize the surface runoff and soil loss.

5. To study & prepare a village level land resource inventory for proper utilization of land resources at root level.

6. To prepare a land facet wise land resource management plan for present agricultural cropping system which will be helpful in enriching the agro-ecosystem within a framework of land system approach

1.6 Text arrangement

The present research work is outlined in eight chapters.

Chapter First introduced about research topic, introduction to land resource management, need and significance of the present study. This chapter also explores review of literature land evaluation and land resource management at the local, national and international level from micro to macro regions.

Chapter second describes overview of geographical set up and introduction to the study area. Methodology of study and database is also outlined in this chapter.

Third chapter describes and quantifies description of land facets in and terrain characteristics of Ghera Sinhagad land system; it illustrates relief, slope and basin morphometry of the study area.
Chapter fourth deals with soil characteristics, soil survey and soil analysis, physical and chemical characteristics analysis, results, soil mapping and result interpretation in terms of land evaluation report of the study area.

Chapter Fifth describes applicability of NRSC (SCS) runoff estimation model and USLE model in a study area to know the land degradation for evaluation of land resources.

Chapter Sixth quantifies and described land use, land cover pattern and change detection analysis and statistical land use data.

Chapter Seven explains main focus of this research in land evaluation for land resource management i.e. land capability classification, land suitability classification, soil productivity analysis mapping and data interpretation.

Chapter Eight summarizes discussions, conclusion of the research work and provides suggestions of the study.