CHAPTER I
INTRODUCTION

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CHAPTER I
INTRODUCTION

This chapter deals with the concept of land, land use and land cover, types of land use and land use changes particularly in agricultural land use. It comprises choice and significance of the study, review of literature at international, national and local levels. It includes aims, objectives and general information of the study area. It also includes the three steps of database and research methodology and these are pre-field interpretation, preliminary interpretation and post-field verification and interpretation of data. At the end of this chapter the arrangement of chapters is given in research scheme.

1.1 Conceptual Background :

The study of land use and agricultural land use changes is studied in detail by considering the concept of land, land use, land cover and land use changes. These concepts are discussed here in short.

1.1.1 Land:

Land is the basic, fixed and limited natural resource. Land plays the key role in the determination of man’s economic activities as well as social and cultural progress. All agricultural, animal and forestry productions depend on the quality and productivity of the land. The entire terrestrial eco-system which comprises of soil, water and plant are survived on the land resource. It meets the demand of food, energy and other needs of livelihood. Singh, Jasbir (1997) has classified the five most natural land resources entities, namely the terrain, climate, soils, water resources and forest cover. Climate, relief and geological formations of the land are very stable resources. Soils and water are moderately stable resources while the vegetation and related biological features are relatively unstable resources. It shows that all the natural resources are associated to the land resource. The growing pressure of population and the increasing variety of demands being completed on land resources. Therefore it is necessary to know the existing use of land at micro level in order to plan the optimum use of land.
1.1.2 Land Use (LU):

The term land use is used to describe the use of an area of land of a certain time is put to. It is related to the human activity associated with a specific piece of land. Land use by definition is the use of land, usually with emphasis upon its functional role with respect to economic activities. Land use refers to “Man’s activities and the various uses which are carried on land” (Clawson and Steward, 1965). Land use is a primary indicator of the extent and degree to which man has modified the land resources (Vink, 1975). Land use is the surface utilization of all developed and vacant land on a specific point at given time and space (Mandal, 1982). It is mainly related to the optimum use of limited land between the alternative major types of land use. It is the result of a continuous interaction between available resources and human needs acted upon by human efforts. It is necessary for human survival and man has a definite role in managing and transforming his physical environment. As a result scientific knowledge of land use is essential to solve the number of problems associated with land use.

The general land use of region is the end result of physical, economic and social factors. These factors play a significant role in shaping the general land use. The geographic aspects mainly physiography, climate, soil and the socio-economic aspects such as population, irrigation, urbanization, industrialization, transportation etc. play significant role in shaping the general land use. The land use patterns reflect the character of the interaction between people and environment.

1.1.3 Land Cover (LC):

Land cover is the physical aspects at the surface of the earth. Land cover refers to the material present such as natural vegetation, water bodies and rock or soil, artificial cover and other features resulting due to land transformation. Land cover describes, " the vegetational and artificial constructions covering the land surface" (Burley, 1961). Land cover correspond to a physical description of space, the observed (bio) physical cover of the earth’s surface (Di GREGORIO and JAMSEN, 1997).

Land use and land cover represent the integrating elements of the resource base. There is minor difference between these two concepts. Therefore land use and land cover being closely related and interchangeable.
1.2 Land Use Change:

Land use change is a major issue of global environment change. Land use is the modification in the purpose of the land which is not necessarily only the change in land cover but also changes in intensity and management \((\text{Verburg, 2000})\). The pattern of land use is not uniform but it changes from place to place and time to time. The changes in land use are studied by conventional as well as the modern methods. It is useful to prepare integrated plans for optimal utilization of natural resources, their planning for development of the region.

Agricultural and non-agricultural are the two major types of rural land use. Agricultural land use means the proportion of area used to grow different crops during the year which is the core study of Agricultural Geography. It is a diversified activity which includes horticulture, grazing and forestry, but changes over space and time. It serves not only a primarily economic purpose of procuring scare materials of human needs but also to fulfill regional, national and social functions. It is also used for recreational functions. The essential purpose of agricultural land use is the cultivation of plants or agricultural crops. Agricultural land use study has acquired special significance in the present day by many scholars and researchers. Therefore, it has been attempted to know the agricultural land use changes in agricultural circles of Khed Tahsil during 1990-91 and 2009-10.

Agriculture is the oldest and most important economic activity of India. It is not only the most leading activity but also the source of food to the people. It is the agent of economic development and productive employment in rural area. Khed Tahsil is not an exemption to this observation. Agriculture in Khed Tahsil is almost traditional type as in all over in India. As per 2001 census, 62 percent population of Khed Tahsil was involved in agricultural activity. It is influenced by the physical and socio-economic factors such as undulating topography in the north-western part and the older plain region in the south-eastern part, hot climate, brown or reddish soil to medium or deep black soil, transportation, expansion of industrialization and urbanization, availability of irrigation, growth of population etc. As a result, agricultural land use in Khed Tahsil has been changing nowadays.
1.3 Choice and Significance:

Khed Tahsil of Pune district is selected for this study. As the study area is located in the east facing slopes of the Sahyadri ranges and extends north-west to eastward, it has a lot of diversification in terms of physical and socio-economic conditions. Hilly to plain diversified physiography, climate, drainage system, soil distribution, population growth and density, migration, transportation network, market distribution, urbanization and industrialization, expansion of Chakan Maharashtra Industrial Development Corporation (MIDC), Special Economic Zone (SEZ), proposed International Airport factors are responsible to divert the land use change chiefly in agricultural land use. As a result, the variety of cropping patterns is observed in Wada, Pait, Khed and Chakan agricultural Circles of Khed Tahsil.

Many researchers have studied Khed Tahsil from different aspects and angles, but the comprehensive research work on land use / land cover and agricultural land use changes has not been done yet. It was necessary to study the spatio-temporal changes in general land use and agricultural land use changes in Khed Tahsil. The temporal agricultural changes in circles of Khed Tahsil have been studied by taking into account the period 1990-91 to 2009-10.

Village-wise and tahsil-wise accurate and up-date data is meagerly available. This type of data storing and preserving is also tedious work. As results, such type of data is not easily available for the purpose of planning and research work. To overcome this problem, recently information technology and Village Information System (VIS) is the latest, innovative and pioneering concept. It is computer based information system and has the capacity to store huge data in digital format. Such information system is useful for local people as well as for government officers to the planning and development of the region. By taking into consideration the significance of VIS, it has been attempted to create the information system for Khed Tahsil with the integration of Remote Sensing (RS), Geographical Information System (GIS) and Global Positioning System (GPS). It is the study of Khed Tahsil at core level and it is designed to store and analyze reliable, accurate and up-to-date database. It comprises the circle-wise and village-wise population, general land use, agricultural land use, village-wise Kharif and Rabi crops area, principal crops etc. This timely and reliable spatial and temporal
data provides the present conditions of general land use patterns and changing agricultural land use patterns in 2009-10. It helps to procure accurate information in the form of table, maps, graph etc. It will helpful to prepare the future plans, agricultural policies and plans, resource planning and management for the development of the study area. Thus with a great scope and importance, the topic is selected for the research work.

1.4 Review of Literature:

The studies of general land use and agricultural land use / land cover, their changes have been completed by many researchers in different parts of the world. The related research work is grouped under the international, national and state level categories. A brief account of review works is given here.

1.4.1 International Level:

Land use has been an important subject of geography since 1930s, when the first Land Utilization Survey was carried out by L. D. Stamp in Britain. After the success of this survey, the International Geographical Union has appointed a commission to study the World Land Use Survey in 1949. Valkenburg S. Van (1950) worked as a chairman of this commission and he put forward the concept of World Land Use Survey. This commission had constructed the world land use maps of 1:1000,000 for regional development planning by employing the pilot survey and aerial photographs. They classified the world into nine categories. These were settlements and associated non-agricultural lands (dark and light red), horticulture (deep purple), tree and other perennial crops (light purple), cropland (brown), improved permanent pasture (yellow), unimproved grazing land (orange and yellow), woodlands (different shades of green), swamps and marshes (blue) and unproductive land categories (gray).

Uyanga, J. (1978) conducted a study of correlation of agricultural inputs, land use, productivity and population change of South Australia during the period of 1961–1971. He concluded that there is a correlation between relative productivity and farm depopulation. Davidson, D. A. and et. al. (1986) studied the land resource information system to produce soil and land evaluation maps for Scottish land use planning and management. The variety of different sources such
as published maps, air photos, satellite imagery, field data, census and statistical sources were used to form land resource information system. *Nguyen-Huu–chiem (1994)* published a paper of former and present cropping pattern in the Mekong delta. He studied the agricultural land use and cropping pattern in relation to landforms, water conditions, soil and traditional methods of rice cultivation.

*Yukio Himiyama (2001)* conducted a study on “Land use and cover change studies in Japan – an interim review and proposals” to prepare Land Use Information System (LUIS). He discussed the trend and major achievements of land use and cover change studies in Japan and suggested priority themes and direction in land use change for the future study. Such LUIS has been applied to ecology, climatology, agronomy geography and regional planning. *Kuhlman, Tom (2003)* made an attempt to find out agricultural land use changes in Netherland. He prepared the special model to demarcate the changes in agricultural land use.

*Mohamed Ait BELAID (2003)* conducted a research on “Urban rural land use change detection and analysis using GIS and Remote Sensing technologies” to investigate the effects of urbanization on agricultural lands of Baharin. Multi-date composite image method, image comparison methods, spatial analysis methods were adopted. He concluded that climatic factors, decrease of ground water table, rural settlements and growth of urbanization are responsible for the declining agricultural land. *Zubair, A. O. (2006)* made an attempt to evaluate the change detection in land use and land cover of Ilorin and its Environs in Kwara State, Nigeria. He concluded the rapid growth in built-up land is one of the reasons of changing the land use and land cover during the period 1972 to 2001. *Yichun Xie and et.al (2007)* examined the temporal and spatial changes in land use through RS and GIS in the city of Beijing. This study revealed that population growth and the central government controlled Fixed Capital Investment (FCIN) were the primary factors for urban land use changes.

*Selcuk, Reis (2007)* has conducted a comprehensive study of land use and land cover changes occurred in Riz, North - East Turkey between 1976 and 2000 by using RS and GIS. The land use changes were analyzed according to slope and altitude. He observed that the agricultural areas are increased in low sloping lands near coastal sections while forest areas were decreased in the same rate.
Vanwambeke, S. O. & et.al. (2007) carried out the research on rural transformation and land use change in northern Thailand. They analyzed the role of landscape in land use changes. They concluded that agriculture in northern Thailand is dynamic and all changes are oriented towards cash cropping, production and marketing networks. Ningal, T. & et. al. (2007) assessed land use change in the Morobe Province of Papua New Guinea using topographic maps and LANDSAT images. They concluded that there was positive and strong correlation between total population change and total land use change.

Rahman Atta–Ur (2009) has carried out his research on “Environmental impacts of Chashma right bank canal on the land use and agricultural resources of Dera Ismail Khan District, Pakistan”. He studied the environmental impacts of Chashma Right Bank Canal (CRBC) on the land use, physical and socio economic environment and agricultural resources of D. I. Khan District. The agricultural land is decreased due to the settlements, growth of industries, construction of roads and canals. The positive changes are occurred in Kharif crops like rice, sugarcane, pulses, orchards and vegetables and the negative changes were registered in sorghum, millet, oilseed, barley and maize. He found that after CRBC cultivated land had increased particularly in the CRBC command area. Tomas Ayala – Silva & et. al. (2009) have published the research paper on “Use of satellite data to study the impact of land – cover and land use change in Madison County Alabama, USA”. They employed LANDSAT TM Images, unsupervised and supervised classification of RS technique to assess the magnitude and distribution of land use changes and its impact on environment of Madison County Alabama. The study found that the agricultural land, vegetation, water and wetlands decreased in order to meet increasing demand for real state land. The residential and industrial area increased due to heavy demand for the land of industries, schools and university and relocation of government agencies to Madison County.

Grindell, C. E. has conducted a project on “Land use and Land Cover of the Lummi Nation: Integrating Remote Sensing and GIS Data at the Local Scale”. He applied the Landsat TM data and Coastal Change Analysis Program (C-CAP) to determine land use classes and detect the changes in land use of Western Washington. Shpetim Tafaj and et.al. (2011) have carried out the comprehensive research work on the “Modeling of land use through Land Information System
(LIS) to village level in Albania”. They focused on the land use changes during 1991 to 2009 by applying the GIS technology and land information database. They came to the point that the GIS based decision support system would provide the valuable tool for all aspects of the land use planning process. It is also concluded that agricultural land use has been declined in Albania due to the urbanization in the study period. Cruz, R. B. prepared a land use information system for the Naga City, Philippines to support and manage land use process. He concluded that the Information System is a tool for analyzing the land use planning, decision-making and for improving public services. Thus, at international level most of the research work has been completed with the help of RS and GIS.

1.4.2 National Level:

Several geographers and researchers carried out the study of general and agricultural land use / land cover changes in geography at national level. Some important research work is reviewed here. Mukharjee, B. N. (1942) was the first geographer who made an attempt to study the agricultural regions of Uttar Pradesh. The remarkable and comprehensive works related to agricultural land use patterns were completed by Dayal (1950), Shafi (1960), Bhatia (1965), Singh, J. (1967) and Saxena (1968).

Gupta, A. K. (1963) measured the changes in cropping pattern in all states by taking into consideration the average percentage over the previous year. It was analyzed that the area under cereals had declined whereas the area under cash crops had increased due to irrigation and fertilizers. A book, “Agricultural Land-use in Punjab: A Spatial Analysis” of Gosal, Gurudev Singh & et.al. (1967) have paid special attention on the current land use in Punjab and recent agricultural land use changes therein during 1951 and 1961 with reference to socio-economic variables such as irrigation sources, size of agriculture holding. Roy, B. K. (1968) discussed the world land use survey classification for mapping of land use in the arid zone of Rajasthan and presented the outline of land-use condition of the arid zone of Rajasthan. The research on “Changes in Land use pattern in Punjab” by Giri (1969) attempted an analysis of the recent changes in land use pattern in different districts of the composite Punjab State. He found out that the rising
population, construction of buildings, roads, factories and extent of canal irrigation are the driving factors of the loss of arable land.

_Jalal, D. S. (1970)_ has completed a comprehensive study of agricultural problems and trends of land utilization with the help of Kharif and Rabi crop pattern in Baman Gao (Kota Dun), UP. He concluded that proper planning of land use and cropping pattern can solve agricultural problems. _Singh, K. N. & et. al. (1970)_ analyzed the land use cropping patterns and their ranking in Shahganj Tahsil, Jaunpur district of Uttar Pradesh. He proved that present land use pattern is an outcome of the interaction of physical and socio-economic factors. _Noor, Mohammad (1973)_ explained the cultural causes of agricultural land use changes in his research on “A Study in Agricultural Land Use (1951-1970)”. These are consolidation of holdings, growing population, developed irrigation facilities, improved varieties of seeds, chemical fertilizers and manures and awakening among the cultivators. _Giri, H. H. (1976)_ in his book “Land Utilization Survey: District Gonda” presented a comprehensive study on land utilization patterns, its distribution, land use regions and factors affecting its utilization with reference to a district, Gonda, Uttar Pradesh. He concluded that physical and cultural landscape plays an important role in land utilization of the study area.

_Malhotra, S. P. et. al. (1976)_ carried out a detail study on land utilization and agricultural situation in Bikaner and came to the conclusion that the land use pattern is inferior and land utilization, cultivation, size of land holding and growth pattern of principle crops were the natural limiting factors in the development of agriculture. _Vats, P. C. (1977)_ conducted a case study on the influence of micro geomorphological units on the land use of village Dundli, State of Rajasthan and classified the study area into shallow aggraded older alluvial plain, shallow saline depression alluvial plain and sandy undulating aggraded older plain with the help of Aerial Photographs (AP). This study reveals that geomorphology controls the distribution of soils, surface and subsurface water, vegetation and cropping pattern.

_Dugal, S.L. (1978)_ prepared a research work on “Crop Maturity Index for Classification of Dry Agricultural Lands”. This research work is based on plot wise data available from village patwaries. Crop Maturity Index (CMI) is a simple method for the functional classification of dry cultivated lands. The CMI and land
capability classifications were adopted in respect of Kharif and Rabi harvest which represented the important aspect of land use in a balanced way. *Nageshwar, Prasad & et. al. (1978)* have carried out the study of land use pattern and changes in Boreya Rural centre near Ranchi. *Sen, A. K. (1978)* conducted a comprehensive study of land use classification system and prepared a standard classification system for arid areas on the basis of aerial photo interpretation. *Tawade, M. D. (1978)* attempted to study the impact of geomorphology on agricultural land use planning. He highlighted geomorphological patterns of a region and their related processes are acquired significant role in the land use planning.

*Noor, Mohommad (1978)* in his book “Agricultural land use in India- A case study” presented a detailed study of agriculture land use in Ghagara-Rapti Doab and examined the impact of relief, drainage, climate and soil on the present utilization of land. *Mandal, R. B. (1982)* explained in detail the basic concepts of land use, factors of land use, it’s principles, techniques, approaches, classification, methods of land capability classification and crop combination etc. *Rai, P. K. (1981)* analyzed the hill slope element like crest, scrap, debris and pediment and its impact on land use around Sagar, Madhya Pradesh and came to the conclusion that different methods of soil conservations help for planning of land use. *Mahalakshmi, K. B. & et.al. (1985)* carried out land use research of Asifabad and Sirpur talukas in Adilabad district, Andra Pradesh. They found that landforms, soils, water resources are the controlling forces of the land use and land cover. *Datt, D. (1988)* studied the general pattern of land use of the Bino basin, its utilization and changes with considering the physical and cultural factors. He concluded that altitude plays a very dynamic role in influencing the land use in the Himalayan region. *Thakur, Binda’s (1991)* book of “Land Utilization and Urbanization” is examined the pattern of land utilization in the rural urban fringe. He focused on the silent cultural features of Darbhanga. According to him the changes in land use pattern is a result of urban impact, population growth, land values, agricultural practices, non-agriculture activities and public utility services.

*Kaur, Dhian (1991)* described the spatial pattern in agricultural land use changes in the Bist Doab from 1951 to 1980 and analyzed the role of distance from the market town, village settlements and the irrigation sources in agriculture in his
book “Changing Pattern of Agricultural Land Use (A Spatial Analysis of Bist Doab Punjab)”. Tamilarsan, V. (1993) wrote a research paper entitled “Impact of Rainfall on Irrigation and Cropped Area in Tamil Nadu” and concluded that the impact of rainfall is high on irrigated and rain-fed crops and proportion of area irrigated to the net sown area. Gopalkrishnan, K. S. & et. al. (1996) carried out the study of soil physiography relationship in Kodayar River basin of Kanyakumari District for the proper management and planning of land use. They concluded that the detail study of soil is essential for optimum utilization of the agricultural potentialities and planning of land use in the area.

Jha, Mrityunjay Mohan (1999) has carried out a comprehensive project work entitled “Application of GIS and RS in the study of “Population growth and its impact on land use in part of Western Doon Valley”. He employed the ERDAS Imagine, ILWIS and Arcinfo GIS softwares to find out the changes in land use and land cover. He came to the conclusion that vegetation exploitation, population growth, farming activities is the major causes of reduction in land use and land cover. Rama Krishna, & et. al. (1999) studied relationships between physiography and soil formation and it’s influence on land use planning in Dungarpur district, Rajasthan with the help of Aerial Photographs (AP) and RS. They suggested that physiography played a significant role in the soil formation and land use planning.

Shahab, Fazal (2000) has conducted a study of the urban expansion and loss of agricultural land of Saharanpur city, India. He studied the loss of agriculture land from 1988 to 1998. He observed that there has been rapid conversion of agricultural areas to non-agricultural uses due to the value of land and urban land market operations. Jha, V. C. & et. al. (2001) employed RS Technique to prepare land use and land cover map of Deoghar upland. They observed that Deoghar upland has insufficient development because of the occurrence of large amount of wastelands and agricultural land.

Rajan, K. S. & et. al. (2001) employed a GIS based integrated land use and land cover change model to study the changes in agricultural and urban land use. The authors have developed Anthropogenically Engineered Transformations of Land use and Land cover (AGENT-LUC) Model. The bio-physical crop yield, rural income, urban land use and agent decision models were applied to study the
changes in agricultural land use and general land use. Bisht B. S. & et.al. (2001) studied the land use and indicators of a watershed in arid region of Western Rajasthan with the help of RS and GIS.

Mishra, B. N. & et. al. (2001) carried out the study of relationship between the pedological structure and agricultural land use pattern in Handia Tehsil of Allahabad district, Uttar Pradesh. They concluded that pedological structure and the agricultural land use pattern are positively correlated. Dhal, N. (2002) conducted a comprehensive case study on the Land Information System (LIS) for Angul district of Orissa which was known as Angul–Nalco Project. He applied the modern techniques LIS and came to the conclusion that the LIS is one of the tools of land use planning. Jaykumar, S. & et. al. (2003) undertook a study to evaluate the land use and land cover mapping and change detection in the part of Eastern Ghats of Tamilnadu. It was concluded that population growth, crop land mismanagement, faulty land use practices, underutilization of potential crop land mis-management, intensive fuel wood exploitation and cattle grazing are the major driving forces of land use changes.

Singh, R. & et. al. (2004) studied the fluvial and denudational landforms, their occurance, lithology, hydro-geomorphology, ground water quality. They assessed the present land use and demarcated geomorphic units and suggested agricultural land use development. The research entitled “Land Use and Land Cover Changes near Hazira Region, Gujrat Using Remote Sensing Satellite Data” was written by Chauhan, H. B. & et. al (2005). They studied the rate of agricultural and forest area decreased due to industrialization and the development of port. Mahajan, S. & et. al. (2005) carried out a study of land use status of Ashwani Khad watershed over a period of 20 years by using IRS I-D, LISS III FCC satellite data and GIS techniques. They observed that altitude and slope are the main affecting factors of the agricultural area. They came to the conclusions that mid-latitudes, mid slopes and irrigation facilities are favourable factors to increase the agricultural land. A research on “Land use and land cover mapping in the coastal area of North Karnataka using remote sensing data” was completed by Shamsudheen M. & et. al.(2005). They applied IRS ID LISS III images, supervised maximum likelihood method and stratified sampling methods. The
physiographic units such as pediments, river alluvial plain and coastal alluvial plain are the features of the land use changes.

A research on “Land use and land cover identification in an alpine and arid region (Nubra valley, Ladakh) using satellite remote sensing” was prepared by Joshi, P. K. & et. al. (2005). They studied various vegetative and non-vegetative classes in study area by using the enhancement techniques such as contrast stretching, Normalize Difference Vegetation Index (NDVI) and Principal Component Analysis (PCA). The topographic features and lithological characteristics are the major factors of land use and land cover changes. The study of “Land transformation and land degradation in Dehradun district, Uttarakhand” carried out by Velmurugan, & et.al (2009) to assess the land use changes during 1990 to 2006 with the help of IRS LISS III FCC and TM satellite data. The rapid size in population and population growth rates, urbanization are the main reasons of changes in agricultural land use. V. Hema Sailaja and et. al. (2011) created a mandal level information system to assess the standard of major basic infrastructure by using RS and ArcGIS for the Addanki Mandal of Prakasam District, Andhra Pradesh.

1.4.3 State Level:

In Maharashtra, most of the work of land use, agricultural land use and related factors have been carried out by scholars at the state, district, tahsil and village level. Datye, V. S. & et.al. (1981) studied the micro level analysis of landholdings and agricultural practices with the help of case studies and concluded that the variation in agricultural pattern is the result of the size and pattern of land holdings and their relationships. Karmarkar, P. R. (1981) studied the agricultural land use and its changes in the Western Districts of Upland Maharashtra for the period 1964-65 to 1974-75. He applied the cluster analysis and classified the study area into backward, potential and developed regions with considering the selected land use parameters. Pawar, C. T. (1981) carried out a geographical analysis of irrigation and its impact on agricultural land use in upper Krishna basin of Maharashtra. This study revealed that irrigation plays an important role in the changes, distribution of land use and cropping pattern. Datye V. S. (1983) carried out his research work on the spatial analysis of agricultural land use in Poona
district and assessed the effect of physical and socio-economic factors on agricultural land use.

Jagtap, S. B. (1983) studied the spatial and temporal variations in the agriculture land use of Purandar Taluka, Western Maharashtra. He concluded that the rainfall variation, maximum profit approach, transport development, electrification, irrigation development, use of high yielding varieties, fertilizers and pesticides are the main factors of agricultural land use change. Jadhav, J. A. (1985) applied simple correlation matrix and Weaver’s crop combination methods to examine the spatial distribution and variation in agricultural land use of Indrayani basin, district Pune. He came to the conclusion that relief and climate are the major affecting factors of land use. Dagade, S. N. (1985) highlighted the changes in general land use and agricultural land use pattern in Panchganga basin. This study analyzed the impact of electricity on agricultural land use from 1960-61 to 1980-81.

Ekbote, V. (1985) carried out the research work on the spatio-temporal analysis of agricultural land use in Haveli tehsil, Pune district, Maharashtra for the year 1953 and 1980. She concluded that physical factors as well as the economic factors like transportation system, industrial expansion, process of electrification of villages and population distribution are commonly responsible for particular type of land use. Kumbhare, H. D. (1986) carried out a study of variation of land use pattern in Andhra Basin in Mawal taluka of Poona district. He correlated physical and human factors with land use pattern to find out to what extent the natural environment moulds the agricultural land. Sonawane, V. P. (1986) examined spatial and temporal land use changes in agricultural land use in Sakri taluka, Dhule district with special reference to sugarcane cultivation over a period of 1961-62 to 1983-84.

Chaugule, J. B. (1987) studied the geology, landforms and land use pattern of Varana basin and suggested a spatial model for the study area. Kapadnis, N. R. (1988) studied the major role of physical factors like slope, distance from the crest, irrigation and accessibility factors and their strong influence on the agricultural land use pattern of Baglan tahsil, Nashik district, Maharashtra from 1951 to 1981. Saptarshi, P. G. & et. al. (1993) studied the role of micro-topography in
determining land use of Rashin circle, Maharashtra. This work highlighted the physiographic factors influencing the agricultural land use. Mali B.R. (1994) studied the impact of irrigation on agricultural land use in the Nashik district. Morepatil, K. S. (1995) explained general land use and analyzed the agricultural land use changes since 1951. He also attempted to correlate the land capability and land use pattern by making the case study of Karveer taluka of Kolhapur district.

Shaban and et.al. (1997) discussed the patterns and determinants of land utilization in Maharashtra. This study found out that physiographic and socio-economic factors and the extent of irrigation plays very important role in determining the land use pattern. As a result, land utilization patterns in districts of Konkan and eastern Vidarbha are different from the rest part of Maharashtra. Vaidya B. C. (1997) published a research based book entitled “Agricultural land use in India”. He described and interpreted the pattern of agricultural land use, its spatial and temporal changes in Yashoda basin of Wardha district. Shinde, S. D. (2002) identified the land use and land analysis to classify the land use categories of northern parts of Kolhapur district based on RS techniques. He classified the study area into cropped land, uncultivable waste, fallow land, water bodies, built up land, culturable waste and grazing land categories. He studied the physical characteristics, landforms, land use categories and suggested the optimum land use of the study area.

Kapadnis, N. R. (2002) in his research paper assessed the relationship between the spatial distribution of crops and environmental factors. The findings of the study indicated that the relief, slope, rainfall and irrigation affect the crop land use. Gaikwad, S.D. (2004) carried out a case study of the village Ranjane, tahsil Velhe of District Pune to study the land use and land cover analysis and potential use of land resources. He employed IRS I-D, LISS III FCC image to map and monitor the change detection of land use and land cover and discussed the influence of terrain characteristics and soil fertility on land utilization. He concluded that the decrease in agricultural land is due to the quality of soil. Shekar, Sulocahna (2005) carried out the study of changing space of Pune city and demarcate the urban sprawl by using Geoinformatics and came to the conclusion that RS, GIS and GPS are the most important modern techniques for the capturing and analyzing the spatial data and for decision making.
Agricultural land use pattern in Mulshi Tahsil Pune District was done by Mankar, Ganesh (2008). He applied the Doi’s technique of crop combination to identify crop combination regions and cropping pattern in Mulshi tahsil and concluded that this type of study is helpful for the agricultural planning at village level. Vyalij P.Y. (2009) carried out the comprehensive study of spatio-temporal analysis of crop combination in Nashik district, Maharashtra. He concluded that the physical as well as socio-economic factors of the district are responsible for the cropping pattern of the study area. Desai C. G. & et. al. (2009) studied a case study of land use and land cover changes in Pune metropolis with respect to the growth of urbanization during the period 1992 to 2008 by using the RS and GIS. They concluded that RS and GIS technology provide the necessary input and intelligence for the preparation of base maps, formulation of planning proposals and act as a monitoring tool.

Suryawanshi, D. S. (2010) published a research based book and discussed the important aspects of tribal agricultural land use and regionalization of various crops of Nandurbar district, Maharashtra by employing the GIS techniques. Chaugule, J. B. & et.al. (2011) prepared the information system for the Savali village in Sangli district, Maharashtra and came to the conclusion that information system is a multipurpose tool for planning and administration. Nagrale V. R. (2011) studied the land use pattern in Khed Tahsil of Pune district and concluded that growth of population, urbanization and transportation network are the socio-economic factors change the land use pattern of Khed Tahsil. Aher, S. P. (2012) created a VIS for Sangamner Tahsil Villages of Ahmadnagar district, Maharashtra.

Thus, the land use, agricultural land use/ land cover, the changes in general and agricultural land use were studied by different ways at various levels. The use of Information System (IS) is the recent modern technique which is applicable in all categories. Such types of studies are helpful to give the proper direction to the research work.

1.5 Study Area:

Khed Tahsil occupies northwestern place in Pune district of Maharashtra State. It lies entirely in the Bhima and Bhamas basin and extends between 18° 37’ N
to 19° 05’ N latitude and 73° 32’ E to 74° 15’ E longitudes, comprising an area of 1424.25 sq. km that is 8.96 percent area of Pune District and in area-wise Khed Tahsil ranks 6th in Pune district. It is located on the east facing slopes of Sahyadri hill ranges and surrounded by four tahsils in Pune district and two districts of Maharashtra. This tahsil is confined by Ambegaon tahsil and Thane district to north, Haveli tahsil to South, Shirur tahsil to east, Maval tahsil and Thane District to west. Khed tahsil is divided into four agricultural circles, namely Wada, Khed, Chakan and Pait covering 190 villages. Out of total villages, Bibi and Wanjulvihire villages are inhabited villages. Rajgurunagar is the administrative headquarter, Chakan is the census town and Alandi is the Municipal Corporation.

On the basis of altitude, Khed Tahsil is divided into three physical divisions, namely, western hilly region, plateau region and Bhima-Bhama flood plain. Physiographically, the study area comprises of hill ranges on the western, valleys and depressions between the hilly ranges in the central area, and alluvial plain in the eastern area, forming irregular and diverse nature of topography. Bhimashankar range forms the northern boundary and Tasubai Range and Indrayani River form the southern boundary, Western Ghat form the western boundary of Khed Tahsil. All these ranges are the eastern offshoots of Western Ghats. As a result, this study area is known as a mountainous Tahsil. The slope of this study area is from north-west to south-east. Bhima and Bhama Rivers are the dominating rivers of the study area. The study area experiences typical monsoon type of climate with cool, hot and rainy season. The medium black soil, red and yellow soil appears in this study area.

The Chaskaman, Bhama-Askhed and Arla-Kalmodi are the irrigation projects. The paddy, jowar, wheat, bajara, ragi are the main food grain crops and groundnut, onion and vegetables are the main cash crops. Five types of roadways appear in the study area, namely National Highway (NH) 50, State Highways (SH), Major District Roads (MDR), Other District Roadways (ODR) and Village Roadways (VR). As per the census report of year 2001, total population of the study area was 3,25,649 and the density of population was 230 persons per sq.km.
1.6 Aims and Objectives:

The main aim of the research work is to study the changes in agricultural land use through TIS (Tahsil Information System). The supportive objectives are as follows:

i) To generate database for ‘Khed Tahsil’ of Pune District with the help of GIS.

ii) To summarize physical and anthropogenic factors pertaining to agricultural land use in Khed Tahsil.

iii) To study the general land use and land cover area under respective categories over the period of 1992 to 2011.

iv) To detect the spatio-temporal changes in agricultural land use in the study area.

1.7 Data Base and Research Methodology:

The present study was carried out in three stages. These stages were Pre-Field stage, Preliminary stage and Post-Field Verification and Interpretation of data.

1.7.1 Pre-Field Interpretation:

This stage covers international, national and local level review of literature. The data of general land use of Khed Tahsil is collected through the Socio Economic Review and District Statistical Abstract of Pune District (1993-94 and 2009-10). The circle-wise data of Khed Tahsil about cropping pattern data was obtained from Khed Tahsil Agriculture Office and Pune District Agriculture Office.

The SOI topographical sheets of 1 : 50,000 were used for the detail study of the study area. Village boundaries, contours, drainage, forest, road transportation, market distribution, etc. were digitized from the toposheets. LANDSAT TM and LANDSAT ETM of 1992, 2000 and 2011 were employed to assess and analyze the general land use/land cover of the study area.

Secondary data have been collected from different offices. The data of rainfall and temperature have been collected from Department of Agriculture, Pune. Irrigation data is taken from the offices of Chaskaman, Bhama-Askhed and
Kalmodi Irrigation Department (2011), Pune. Forest data has been collected from the Chakan and Rajgurunagar Range of Forest Department of Khed Tahsil. Data related to MIDC and SEZ is obtained from Chakan Maharashtra Industrial Development Corporation office and SEZ Office, Pune (2009-10). General land use pattern and the basic circle-wise and village wise data of Kharif and Rabi crops have been taken from Tahsil Agriculture Office of Khed Tahsil and Agricultural Office of Pune and Socio - Economic Review and District Statistical Abstract of Pune District (1994-95, 2009-10). The population data has been collected from Village and Town Directory, Pune District Census Handbook (1981, 1991 and 2001). Road transportation data has been received from the PWD Office, Pune (1981-2001).

**CHART NO. 1.1 : RESEARCH METHODOLOGY**

- **Library Work, Review of Literature, Field Visits**
- **Data Collection**
  - Primary –Land use Survey, Field Visits, Observations, Interviews
  - Socio-Economic Data, Census and LANDSAT TM and ETM data, Kharif and Rabi Crops Area, MIDC Area, SEZ area etc.
- **Generation of Tahsil Information System – Application of GIS Softwares, Attachment of non-spatial data, Use of Crop combination and Diversification Methods**
- **Analysis and Interpretation of Data – Creation of Thematic Maps, Presentation of Data**
1.7.2 Preliminary Interpretation:

Socio-economic data, general land use, agricultural land, Kharif and Rabi crops area, markets, irrigation and transportation facilities, MIDC, SEZ etc. were collected and classified according to the agricultural circles of Khed Tahsil.

Field Visits and Pilot Surveys in Kharif and Rabi Seasons, ground truth verification has been done to study the land use changes. Weaver’s (1954) method and Bhatia’s (1976) method have been employed for determining the crop combination and crop diversification of the study region.

1.7.3 Post – Field Verification and Interpretation of Data:

Data was classified into tabular form for the detailed analysis. Rainfall, demographic data, land use data had represented with the help of cartographic techniques and MS-Excel software. ERDAS software was employed to register the LANDSAT satellite images of 1992 and 2011 and supervised classification method was used to classify these images. ArcGIS software was used to attach and link different databases and to prepare the thematic maps. Visual Studio Software was employed to generate the Information System of Khed Tahsil. Circle wise spatial and non- spatial data of general land use, agricultural land use, their changes and trends have been generated through the different GIS software. Corrections have been made to the delineated land use maps after ground truth verification.

1.8 Data Limitation:

The village-wise population data of 2011 is not yet available, hence the data of the previous two decades was used to get the trend of population growth, density, sex ratio, occupational structure, SC and ST population characteristics etc. Two different LANDSAT images of year 1992 and 2011 were applied to analyze magnitude and distribution of general land use of agricultural circles of Khed Tahsil. LANDSAT TM (1992) was used for the study of general land use / land cover as it was available from 1992. The latest LANDSAT ETM 2011 is used to study the changes in general land use.
1.9 Chapter Scheme:

The research work is divided into six chapters. The First Chapter deals with the rational significance and scope of the study, choice of the study area, significance of the study, aims and objectives, review of literature, database, methodology and arrangement of text.

The Second Chapter attempts to present the physiographic profile of study region which contains physiography, drainage, climate, soil, vegetation. The socio-economic profile includes the growth, density of population, sex ratio, literacy, occupational structure, irrigation, transportation and market distribution etc.

The Third Chapter contains the Information System of Khed Tahsil particularly related to the database of physical and socio-economic factors. Design and development of TIS is explained in this chapter.

The Fourth Chapter comprises of the nature of general land use pattern and changes within the agricultural circles of Khed Tahsil from 1992 to 2011.

The Fifth Chapter investigates the Kharif and Rabi cropping pattern, circle-wise spatio–temporal changes over the period 1990-91 to 2009-10 in all agricultural circle.

The Sixth Chapter summarizes the conclusion and makes various suggestions.

1.10 Summary:

Land as natural resource plays the key role in the fulfillment of human beings needs and it determines the economic, social and cultural development. Land use is a primary indicator of the extent and degree to which man has modified the land resources. It is related to use to which the land of a certain time is put. The study of land cover provides the physical and natural state of the study area.

Agriculture is the source of food and it shares the maximum part of economic development. Therefore, agricultural land use study is significant in the present day. As Khed Tahsil of Pune district is located in the east facing slopes of the Sahyadri ranges and extends north-west to eastward, it has a lot of diversification in terms of physical and socio-economic characteristics. As results, the cropping pattern of Khed Tahsil is almost specialized and traditional type.
Land use has been an important subject of geography since the 1930s, when the first land utilization survey was carried out by L. D. Stamp in Britain. Many scholars Valkenburg, S. Van, Uyanga J., Nguyen-Huu–chiem, Yukio Himiyama, Eric Swanson, Kuhlman, Tom Mohamed Ait BELAID, Zubair A. O., Trinidad Metodia M., Yichun Xie, Selcuk Reis, Vanwambeke S. O., Ningal T. and Rahman Atta–Ur and other scholars carried out the comprehensive work on land use at international level.

Mukharjee B. N., Gupta A. K., GosalGurudev Singh, Roy B. K., Giri Jalal D. S., Singh K. N., Noor Mohammad, Giri H. H., Vats P. C., Dugal S. L., Noor, Mohommad, Mandal R. B., Rai P. K., Datt D., Thakur Bindia, Kaur Dhian, Tamilarsan V., Chattopadhya S., Jha Mrityunjay Mohan, Rama Krishna, Jha V. C., Bisht B. S., Mishra B. N. and Dhal N. etc. carried out the valuable research work at National level. In Maharashtra, many scholars also have carried out such research at state, district, tahsil and village level.

The main aim of the research work is to study the changes in general and agricultural land use through TIS. The methodology for the present study was carried out in Pre-Field stages, Preliminary stages and Post-Field Verification and Interpretation of data. The data of general land use, cropping pattern, road distribution, markets, irrigation, MIDC, SEZ etc. were collected and classified according to the agricultural circles of Khed Tahsil. ERDAS Imagine, ArcGIS, Visual Studio softwares were applied to prepare thematic maps and information systems. Weaver’s (1954) method of Crop Combination and Bhatia’s (1976) method of Crop Diversification have been employed for determining the crop combination and crop diversification of the study region.

The study is organized into 6 chapters. The first chapter deals with the introduction to study, second chapter contains physiographic and socio-economic profile of study area, third chapter comprises the Khed Tahsil Information System, and fourth chapter covers the nature of general land use pattern in Khed Tahsil. The fifth chapter attempts to investigate the agricultural land use pattern, spatio–temporal changes in agricultural land use within the circle. The sixth Chapter summarizes and conclusions along with suggestions about the research work.
1.11 References:


Doon Valley”, Dissertation submitted to Geoinformatics Division, IIRS NRSA, Dehradun, India.


