DYNAMICS OF RURAL URBAN FRINGE IN HARYANA: A CASE STUDY OF HISAR CITY

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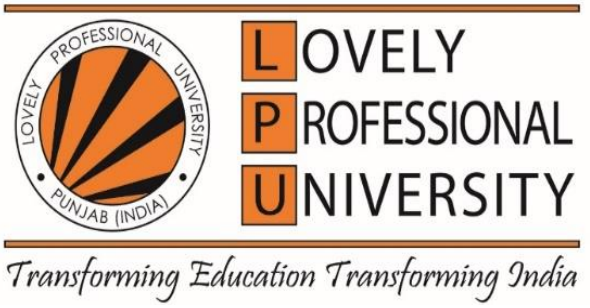

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DECLARATION

I, hereby declare that the work mentioned in the thesis titled "**DYNAMICS OF RURAL URBAN FRINGE IN HARYANA: A CASE STUDY OF HISAR CITY**" in fulfilment of the degree of **Doctor of Philosophy (Ph. D.)** is outcome of research carried out by me under the supervision of Dr. Sajad Nabi Dar, Assistant Professor in Geography, School of Liberal and Creative Arts (Social Science & Languages) Lovely Professional University, Phagwara, Punjab, India. In keeping with general practice of reporting scientific observations, due acknowledgements have been made whenever work described here has been based on findings of other investigator. This work has not been submitted in part or full to any other University or Institute for the award of any degree.

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CERTIFICATE

Certified that this work entitled **"Dynamics of Rural-Urban Fringe in Haryana: A Case Study of Hisar City"** is the original research work carried out by **Mr. Inder Kumar,** Ph.D. Research Scholar in **Department of Geography,** School of Liberal and Creative Arts (Social Science & Languages) **Lovely Professional University, Punjab.** This work has been carried out under my supervision, has not been submitted anywhere else, and is being submitted for the first time to Lovely Professional University. The candidate has fulfilled all the statutory requirements for the submission of the thesis for the award of the degree of Doctor of Philosophy.

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ABSTRACT

DYNAMICS OF RURAL URBAN FRINGE IN HARYANA: A CASE STUDY OF HISAR CITY

The modern era is the era of urbanization, urbanization is at its peak in the whole world, whether it is a developing country or a developed country. Urbanization is increasing rapidly in all the countries. As the cities are increasing, the population of the surrounding rural area is getting influenced by them and is being attracted towards them. The city is not able to meet the requirements of the population itself, due to overcrowding in urban areas and being affected by high prices, this population starts settling in the surrounding areas, which has led to the creation of the Rural Urban Fringe.

Rural-urban fringe is an area which not only possesses urban characteristics but also reflects the characteristics of a rural area. It has always been denied in the name of development due to its position in the middle of both rural and urban administration. For this reason, the need for a detailed study of the area has always been evident. Efforts have always been made to study the fringe region in the western countries and various aspects of its study have been highlighted.

The conditions of Indian cities are also not different from foreign countries because India is a developing country and is experiencing rapid urbanization. Due to large-scale migration and other circumstances have given rise to the concern of the study of the fringe region. During the last few decades, Indian scholars have also made significant and commendable efforts in the study of fringe regions.

The present research work is also an effort in the discipline of urban geography to identify and delineate the rural urban fringe area of Hisar City and highlight the various aspects associated with it. In this research, several aspects, traits, and attributes of the rural-urban fringe of Hisar City have been attempted to be explained geographically utilizing various urban geography principles.

Fringe is a dynamic zone of this influence. With the growth of the city, the fringe also expands outward. The characteristics and socio-economic development of the

fringe area vary from a purely rural area. These characteristics show the gradual transformation of the fringe area into the urban phase. It reflects the effect of the urban area on the fringe region. The city works as a nodal point for the socio-economic needs of the fringe population. The city of Hisar also works as a focal point for its surrounding countryside. It provides educational services, banking services, health services, transportation facilities, etc. In return, the countryside facilitates agricultural goods and different types of labor work. Thus, there is a two-way relationship between the urban area and the surrounding fringe region. In this study, an attempt is made to demarcate this area of influence.

After reviewing the literature, it has emerged that studies related to the rural-urban fringe have been done from time to time. Almost all scholars have tried to delineate the surrounding fringe region from the city's urban area on the basis of characteristics of the rural-urban fringe. The most significant criteria to delineate the rural-urban fringe observed from different studies were occupational and demographic attributes. During the literature study, it was found that most scholars used these attributes to define the fringe zone of various foreign and Indian cities. Land use land cover pattern is also a major feature to depict the transformation from rural to urban environment. Many scholars of urban geography have discussed and analyzed the land use land cover pattern of the fringe zone in their studies. These attributes enable researchers to effectively depict the evolving patterns of land use and land cover in the peri-urban areas adjacent to the city's core. After reviewing the views of different scholars on land use land cover, the present study has also attempted to classify the land use land cover pattern of Hisar City with the help of present-day innovative techniques like Geographical Information Systems and Remote Sensing. Thus after reviewing the literature, different studies and views of foreign and Indian scholars have been taken into consideration to demarcate the rural urban fringe of Hisar City.

The present research work tries to attain the following objectives:

1. To demarcate the rural-urban fringe of Hisar city.
2. To find out the land-use/land-cover pattern in the fringe area.

3. To examine the demographic attributes and occupational structure of the fringe area.
4. To assess problems related to future growth and development of the city and suggest remedial measures.

The present study answers the following research questions:

1. What is the extent of the rural-urban fringe of Hisar city?
2. What changes occurred in the land use/land cover pattern of the fringe area of Hisar city?
3. What is the demographic and occupational profile of the fringe area?
4. What problems are related to the future growth and development of the city and remedial measures?

Research Methodology

- For the delineation of the rural-urban fringe available existing maps, remote sensing images and base maps of field surveys, land revenue records, has been used. To determine the extent of the rural-urban fringe a comprehensive survey is conducted on the following indicators:
- **Occupational determinants**
  - Ratio of non-agricultural workers
- **Demographic determinants**
  - Population density
  - Literacy
  - Sex ratio
  - Household density

Following statistical techniques has been used upon data collected from the above-discussed indicators to draw out a clear picture of the rural-urban fringe

I. Standard deviation

II. Mean

Sr. No.	Categories	Range Of Values
1	PRIMARY/INNER FRINGE	MEAN + 1 S.D. TO MEAN + 3 S.D.
2	SECONDARY/OUTER FRINGE	MEAN TO MEAN + 1 S.D

To determine the growth of cultural development on surrounding agricultural land above above-discussed indicators has been plotted on the map of Hisar City. The villages which fall immediate outside of the city limit and show the value between MEAN + 1 S.D. TO MEAN + 3 S.D. of the above indicators has been included in the primary/inner fringe. The villages which fall between the primary/inner fringe and purely rural areas limit and show the value between MEAN TO MEAN + 1 S.D of the above indicators has been included in the secondary/outer fringe.

(1) Inner or Primary fringe

(2) Outer or Secondary fringe

Inner fringe: It is categorized with maximum interaction with the city in terms of socio-economic and cultural aspects.

Outer fringe: It is categorized with minimum interaction, low level of urbanization, highly agricultural orientation and marketing facilities.

Data Source

During this study, a number of different types of data sources were used. This study used both primary and secondary sources of information. Authentic government sources were used to obtain secondary data. The secondary data were obtained from published sources as well as from official government websites. Government institutes were also visited to obtain relevant data. For population data, the census of India site has been visited, and the statistical abstracts of Haryana were also used. The primary data has been compiled with the help of a questionnaire. District Gazetteer has been used to present a detailed physical, socio-economic and cultural landscape of the city of Hisar. Primar data from the field survey (2023) also used to understand the present situation of the fringe area.

Reference year

In this study, data from the census 2011 has been obtained. To analyse the socio-economic and demographic profile of the study area, data from 1991, 2001, and 2011 census have been used. In land use land cover classification data has been obtained from three decades 2003, 2013, 2023.

Organization of the study matter

The present research work has been organized in sequential order with the help of various chapters. The various chapter schemes are the following:

Chapter 1: **Introduction**

This chapter introduces the study and lays down various aspects of the present study. This chapter represents the concept, meanings, and definitions of urban geography. This chapter also includes the origin and evolution of the urban fringe. It discusses the conceptual background and classification of the rural-urban fringe. The concept of fringe and its development in India also discussed. In this chapter, there is a discussion on the research problem, research objectives, research questions, methodology, data, and literature review.

Chapter 2: Geographical Appraisal

The second chapter of the proposed study is 'Geographical Appraisal' of the study area i.e. Hisar City. This chapter discusses location, history, climate, rainfall, physiography, soil, drainage, economic resource, population and settlement, economy, occupational structure and trade and commerce of the study area.

Chapter 3: Delineation of the rural-urban fringe

In this chapter, the demarcation process of the fringe zone has been discussed. For the delineation process, various parameters have been taken into consideration such as (Non-Agricultural Workers, Density, Sex Ratio, Literacy, Population growth, and Household density) For this secondary data of Census 2011 were collected, tabulated and analyzed to draw some conclusions on the fringe area of Hisar city. With the help of Arc GIS 10.8 software, the spatial distribution of these parameters was analysed and mapped. This analysis provides some useful knowledge of the Rural-Urban fringe.

Chapter 4: Land Use Land Cover Classification

In the fourth chapter, land use and land cover classification and fringe area analysis are discussed. The classification process was conducted using multi-temporal data acquired for Hisar City and its surrounding regions, spanning three distinct time periods: 2003, 2013, and 2023. The process of land use land cover mapping and monitoring involved the utilization of both primary and secondary data sources. The collection of fundamental data is derived from a physical on-site investigation conducted to determine the location of a particular site. Landsat images were obtained from Earth Explorer, a platform provided by the United States Geological Survey (USGS). The Arc-GIS 10.8 software was utilized to execute multiple image acquisition functions.

Chapter 5: Socio-economic and demographic profile of the rural-urban fringe

The fifth chapter of the proposed study is 'Socio-economic and demographic profile of the rural-urban fringe, of the study area i.e. Hisar City. This chapter discusses the impact of the changing socio-economic pattern of the area around the city. It is also reflected in the socio-economic characteristics of the adjacent villages. This chapter analysis various socio-economic attributes such as Occupational structure, Literacy, Sex ratio, Population density, Public amenities, and Land-use data of the selected sample villages. For this study 9 sample villages have been selected, 3 from the primary fringe and 6 from the secondary fringe. After villages were selected on the basis of purposive stratified sampling, the above-discussed attributes were discussed for every sample village from the census 1991, 2001 and 2011. A comparative analysis has been attempted to discuss the change. Now-a-days, the increases in the non-agricultural workers, rise in literacy rate with higher educational level mainly improve the socio-economic condition of inner fringe areas as compared to the outer fringe area at present.

Chapter 6: Characteristics of the rural-urban fringe

This chapter of the study includes various characteristics of rural-urban fringe and their changing value with distance. In this chapter distance zones have been created based on every 2 km i.e. 4-6,6-8,8-10,10-12,12-14,14-16,16-18. Based on these

distance zones, various characteristics such as Density, Sex ratio, Non-agricultural workers, and literacy were analyzed in three census data i.e. 1991, 2001 and 2011. This study was conducted on the primary fringe and as well as on the secondary fringe. With the help of a line graph and correlation anysis the trend of these characteristics has been discussed in this chapter.

Chapter 7: Problems and Future Prospectus

In this chapter, various problems related to the fringe zone of Hisar City and the improvements that can be made in the future have been discussed.

Chapter 8: Summary and Conclusion

The chapter presented the summary and conclusion of the study. This chapter discusses the contributions of the findings in a global context and outlines the study's limitations along with directions for future research.

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Inder Kumar

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF MAP

LIST OF ABBREVIATIONS

AOI	Area of interest
ArcGIS	Aeronautical Reconnaissance Coverage Geographic Information System
CT	Census Town
D	Dispensary
ERDAS	Earth Resource Data Analysis System
ETM	Enhanced Thematic Mapper
GIS	Geographical Information System
GPS	Global Positioning System
H	Hospital
HAU	Haryana Agricultural University
HP	Hand Pump
KAVAL	Kanpur, Agra, Varanasi, Allahabad, Lucknow
KM	Kilometer
KML	Keyhole Markup Language
LULC	Land use land cover
LUVAS	Lala Lajpat Rai University of Veterinary and Animal Sciences
MCI	Municipal Council / Municipality
MCW	Maternity and child welfare centre
MLC	Maximum Likelihood Classification
N.C.R	National Capital Region
NV-RNF	Non-village, Rural Non-farm
OG	Out growth
OLI	Operational Land Imager
PCO	Public Call Office
PH	Phone
PH	Primary Health center
PO	Post Office
POI	Point of Interest
RH	Relative Humidity

RMP	Rural Medical Practitioner
RUF	Rural Urban Fringe
SAR	Synthetic Aperture Radar
SD	Standard deviation
SPO	Sub Post Office
SPOT	Satellite Pour l'Observation de la Terre
S.P.S.S.	Statistical Package for the Social Sciences.
SST	Slow Sand Filter Tank
T	Tank
T max	Maximum Temperature
T min	Minimum Temperature
TIRS	Thermal Infrared Sensor
TM	Thematic Mapper
TW	Tube Well
USGS-	United States Geological Survey
VH	Veterinary Hospital
W	Well

LIST OF APPENDICES

Appendices	Title
1	Questionnaire for Socio-Economic Survey for rural urban fringe sample villages
2	Copyright certificate of conceptual framework for the delineation of the rural urban fringe
3	Research paper - Assessment of Land Use and Land Cover Dynamics in the Rural-Urban Fringe of Hisar City

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Cities are the most vivid manifestations of human habitation and socio-spatial change. Cities, formerly confined by administrative boundaries, are now expanding at an alarming rate into their rural surroundings, creating new, changing landscapes **(McGee, 2009)**. This outward expansion, driven by population growth, economic diversification and infrastructural development, creates a unique spatial phenomenon called the rural-urban frontier **(Simon et al., 2006; Taccoli, 2003)**. These areas are characterized by mixed land uses, socio-economic diversity and overlapping rural and urban functions **(Narain & Nischal, 2007)**. Rapidly growing urban population and migration continue to expand the outer boundaries of urban areas towards rural areas. If considered from a historical point of view, the process of urbanization is the result of industrialization all over the world and it is seen in India after independence. It is only after these processes that the attention of various geographers has been seen to be attracted to urban geography, land use patterns and planning. As a result of increasing urbanization, expansion is mainly visible along the roads in the form of residential areas, industrial units; educational centers retail centers, etc. The main reason for this pattern is the problem of land availability in an urban area. There are not enough opportunities available in the urban area for the expansion of these activities. The growing urban population accelerates the residential demand, which in turn increases the acquisition of agricultural land, and economic activities such as factories, amusement parks, commercial complexes, etc. also bring about gradual transformation in the land use patterns of the marginal area. Thus increasing urbanization changes the cultural values of the surrounding rural areas as well as land use patterns, creating a transitional zone known as the rural-urban fringe. It continuously emerges at its outskirts. In this context **Mark Jefferson (1931. p 454)** pointed that "Cities depend on surrounding rural areas to facilitate the necessary functions within their geographical boundaries. The growth and development of cities are not self-sustaining and require support from surrounding rural regions."

The relationship between the city and the countryside is central to the process of urban transformation, with rural areas gradually being absorbed by the urban system **(Champion & Hugo, 2004)**. This is explained by the urban transition theory, which is a spatial, social and economic change in which urban power redefines rural livelihoods, land-use systems and cultural identity **(McGranahan & Martine, 2014)**. In the world's fastest growing economies such as India, rural-urban migration, industrialisation and infrastructure development are accelerating these changes, leading to unplanned rural-urban fringe development **(Allen, 2010; Shaw, 2012)**.

Globally, rural-urban fringe studies have been identified as both sites of opportunity and stress, where agricultural land is being replaced by residential or industrial development, informal settlements are growing and governance is often challenged **(Allen et al., 2015; Phelps & Wu, 2011)**. This change is particularly noticeable in the rural-urban fringe areas of medium and large cities in India, where agricultural landscapes are transforming into complex mosaics of built-up areas, commercial areas and fragmented green spaces **(Narain, 2019; Sreekumar & Dey, 2021)**. Although these rural-urban fringe areas have become increasingly important, they have been understudied in Indian urban geography, especially in terms of their spatial boundaries, demographic structure and land-use processes **(Pradhan, 2013)**.

The present study places itself in the emerging field of urban geography by focusing on the city of Hisar in Haryana, which is a rapidly growing urban centre that exhibits strong rural-urban interconnections. The rural–urban fringe of Hisar provides an appropriate setting for examining urban transition and spatial change where agricultural lands and rural settlements are increasingly integrated into the economic and infrastructural network of the city **(Census of India, 2011; Goel, 2011)**. While the early researcher has discussed the trends of urbanization and land-use change in metropolitan cities like Delhi and Mumbai **(Kumar et al., 2007; Shaw, 2012)**, empirical analysis of secondary cities like Hisar is limited, even though the city plays a central role in the regional urban structure. Therefore, this study aims to fill this gap by defining the rural-urban fringe of Hisar in terms of spatial and socio-economic dimensions. It focuses on analysing land use and land cover changes, as well as demographic and occupational transformations occurring in this transitional zone. In

doing so, this study contributes to a broader understanding of urban growth and rural-urban fringe transformation in the semi-arid North Indian context, thus fitting in with current discussions on urban transformation theory, spatial planning, and sustainable urban-rural integration **(McGranahan et al., 2023; UN-Habitat, 2022)**.

1.2 URBAN GEOGRAPHY

Every person living on earth is connected in some way or the other with urban life or the urban system. Rapidly growing city regions and their inhabitant human beings have had close relationships with each other since ancient times as urban development has influenced all aspects of the socio-economic, political, and religious development of human life. Cities and man have always had a functional and institutional relationship and it is the basis of the modern economy. In this way, there has been an exchange of goods and ideas from one area to another through cities and there has been a close relationship between them. Large urban central are found in different regions and have human settlements of various sizes and quite complex structures. The population and density of rural areas are very less compared to the city region. Where in rural areas, the economy mainly depends upon agriculture, and the majority of the work force is engaged in agriculture and related activities, but in urban areas majority of the population is working in the manufacturing or service sector for their earnings.

Urban geography is known as the geography of cities and urban settlements. In the literal sense, it is the study of cities and urban settlements in the geographical context. Urban geographers have traditionally been of interest within areas that have been centers of high population density. They form the regional system of places. There are different types of interrelationships between these areas and the people living within these areas. This element occupies the most important place in the study of urban geography. The famous sociologist 'Nelson Anderson' has said that urban life is a center of creativity, having definite aptitude and structural strength. Urban geography is deeply concerned with urban studies, which include applied studies as well as local encampments. Local position is given an important place under geography. **Mayer (1960)** has explained the nature of urban geography by stating that it is the study of

patterns and interpretation of relationship that exists within the urban area. The city is a situation related to such a system-

- Population density is found to be higher than the general population.
- The majority of the work force is engaged in secondary and tertiary activities.
- Local Status Provides administrative, cultural, and economic service within the periphery area

Urban geography is the product of a long history. Its ideology has emerged from the period of their changes from the time of the ancient period to the present. Urban geography, like other subjects, has had to undergo a continuous development trend in different periods and special thinkers. These thinkers have changed its definition continuously. Urban geography is described as a distinct branch of geography as a part of settlement geography. Urban geography has the same relation to settlement geography as economic geography is to human geography. Some scholars have also said that human settlements are leading on one side and the other end is urban geography which studies the complexity of human settlements i.e. cities both in size and function.

1.2.1 Meaning and Definition according to various scholars

L.D. Stamp (1960), "In reality, urban geography is the comprehensive study of towns and their evolution in all of their geographical characteristics."

R.E. Dickinson (1951) explained that "Urban geography is concerned with examining the physical, social, and economic aspects of urban life, as well as the growth and development of cities. This field of study seeks to understand how the organization and operations of urban areas impact the lives of their inhabitants."

According to **R.E. Murphy (1966)**, "Urban geography is concerned with the spatial characteristics of urban development and non-urban regions in relation to cities. The goal is to determine the areal pattern linked with urban centers and to explain how they are organized."

According to **G. Taylor (1945),** "Urban geography includes location assessment, urban modeling, and classification".

Such settlements whose residents earn their livelihood through secondary or tertiary occupation are called urban development or towns. Cities have a denser group of population and dwellings; their residential area is more spacious and more complex internal structure than the village. Cities are generally more advanced and better organized with respect to the socio-economic conditions of human life. From a socio-economic standpoint, they are usually considered more developed regions than their rural counterparts. Urbanization has led to significant changes in cultural life and social practices. Urban centers function as important hubs of education, entertainment, arts, culture, communication, transport, industry, and technological innovation, and thus continue to serve as key nodes of economic and commercial activity. The development of human civilization is well connected with the development of cities, so the statement is quite apt that the city is as ancient as the people living in the cities since the early period of human civilization, through their efforts and scientific thinkers have affected the economic and social development of mankind. The industrial and technological development of the present century has been related to cities. Due to this importance and multifaceted contribution, this city geographer has been very famous among sociologists. Due to this, the development of many branches of urban geography, urban social and urban planning has also been possible.

1.3 RURAL-URBAN FRINGE

1.3.1 Rural Urban Fringe: Conceptual Background

The main features of modern cities are the discontinuous area of mixed land use between entirely urban and rural areas, but this demarcation between rural and urban characteristics is difficult. The rural-urban fringe is commonly associated with urban regions and is acknowledged as a heterogeneous land utilization zone within the agricultural hinterland. The rural-urban fringe is situated in the intermediary zone between the uninterrupted urban built-up region and the exclusively rural settlement, whereby a rapidly growing population finds residential areas; the land-use mix is increasingly exposed. The analysis of the ecological characteristics of the fringe area helps in defining the fringe region as an area of invasion of land by a high-density population.

On a historical basis, there is a lot of literature related to the study of rural-urban fringe from 1940 to 1960, which tries to define this phenomenon on a different basis such as;

The term ***"rural-urban fringe"*** was initially coined by **Galpin** in 1915 to denote the rural region undergoing a transformation from a rural to an urban setting. Along with this, the view about the rural-urban fringe was stated by **Von Thunen** in 1928. He presented the idea of a city that had surrounded from all around concentric zones. These zones were based on market demand and the most important supply belt was just outside the city. **Jonasson** in his work expressed his views about different European cities in 1925. In his theory of land use, he proposed that the most important supply belt lies just outside the city. Some other sociologist also proposed their views about the fringe area. Mackay in 1928, in his work '***The New Explanation***' discussed that the city is growing towards the outskirts and taking the surrounding cultivable land under their control, which is mainly used for building bungalows, godowns, billboards, filling stations and restaurants, etc. He represents the term ***'metropolitan invasion'***. In the 1940's scholars such as **Homer Hoyt, Mackenzie,** and **Colby** in their work on the surrounding of the city proposed many concepts related to the rural-urban fringe. **Colby** in his article in ***'American Geographical Magazine'*** stated that centripetal and centrifugal are two forces that helps in the determination and creation of fringe areas.

T.M Smith 1937 firstly used the term rural-urban fringe in his work related to urban studies. After that, it was famously used in urban geography literature. He used this term to study the population of the built-up area of the US city of Louisiana. He named the rapidly growing build-up areas outside the city's administrative boundary as the fringe zone. He found that there is a special type of land use pattern consisting of tourist camps, filling stations, residential buildings, etc. extending along with the roads.

In 1940, **Salter** provided the initial definition and classification of the rural-urban fringe region as an area characterized by a mixture of rural and urban land use patterns. The author conducted an analysis of the urban land use pattern and characterized the outskirts of the city as a circular band surrounding the urban center.

He further proposed that this area is suffering from various problems and some planning is needed for it.

In the 1940s, there was a great boom in the US, in the field of rural-urban fringe studies and it came out that where the city of Buffalo and New York developed only one percent as a city, whereas suburbs of these cities grew up nearly 33 percent. In the same case, the population of Willington, Charleston, and Carolina decreased, while their suburbs were growing at a rate of 45 to 50 percent.

According to **Wehrwein** (1942) the fringe areas in the United States can be characterized as an "***Institutional Desert***." He talks about problems and future probabilities. He explained that the fringe zone can be identified and analyzed by monitoring the changing land use patterns outside the expanding boundary of the urban area. He suggested that the fringe zone represents an inter-mixed land use pattern of agricultural and non-agricultural activities. He stated that there are three belts in the rural-urban fringe

- The less productive area between agricultural land and pastures
- Cut-overs area between forests and farms
- Suburbs belt between farms and city.

Andrews (1942*),* in his study ***"elements of urban fringe pattern,"*** made an attempt to differentiate between rural-urban and urban fringe. According to him, the rural fringe represents the urban expansion of the economically built-up city, whereas the rural-urban fringe, on the other hand, refers to the area nearest to the urban margin. The purpose of this research is to discover land use characteristics of the fringe zone. He purposed that, "the adjoining area of the urban fringe represents intermixing of agricultural and urban land use characteristics".

Chauncy D. Harris (1943) in his article 'Suburbs' termed the fringe area as a 'Climax area'. In his study, he prepared a population map of a metropolitan and established that 60% of the population of this city lives in suburbs. He explained that there are some small urban and semi-urban pockets in the transition belt of the fringe area, and he defined them as suburbs. He classified the suburbs into the following categories:

i. Industrial fringe suburbs,

ii. Industrial suburbs,

iii. Industrial suburbs are more important mixed areas,

iv. Residential suburbs are more important mixed areas,

v. Might residence suburbs,

vi. Mining and industrial suburbs.

H.H Balk (1945) used the term urbanization to explain the development of the fringe areas. The study looks at how urban growth influences and is shaped by economic forces and spatial relationships, as well as how urbanization affects the economic structure of the Werester region. He emphasized how urban centers and the rural areas that surround them have a dynamic interaction. He highlighted the interconnectedness of the urban and rural economies by talking about how cities rely on their hinterlands, or umland, for labor, agricultural goods, and other resources.

Walter Fierly (1946) in his study suggested that accessibility is mainly responsible for the expansion of fringe outside the city limit. He proposed that ***"The urban fringe is considered a peripheral zone for land use, not due to its physical characteristics such as place of origin, terrain, or soil composition, but rather due to its level of mobility towards a central mobility point in comparison to other land use".***

Rodeheaver (1946) in his work on Madison and Wisconsin suggested that there is a strong pull factor that works on the urban migrant population to the central city for many purposes for their daily needs such as work, shopping, church and social activities. He described a fringe area as a transitional zone between a rural agricultural setup and an urban environment. His work ***'The Fringes as a two directional'*** proposed that there is a two-directional movement in the fringe zone, one of the rural population towards the city for job purposes and another of the urban population to the rural areas to fulfill their residential needs. It develops mixed landscapes of rural and urban land use.

Myres and Beagle (1947) in their work related to the fringe of Detroit and termed it as a '***true and partial fringe***'. They develop a method of fringe study related to one

factor, the concentration of the non-village-rural nonfarm (NV=RNF) population. They included a 36-square-mile township.

Roterus and Hughes (1948) examines a range of administrative and policy challenges that arise in the urban periphery, defined as the transitional zones where established urban centres interface with the surrounding rural hinterland. During a time of fast metropolitan expansion in the United States, suburbanization and the rise of metropolitan peripheries like Flint and Michigan made concerns about urban planning, governance, and service delivery more pressing, draw out the sequential pattern of the expansion of rural-urban fringe. The study also examination of issues with service delivery, governmental fragmentation, and the necessity of coordinated planning.

Richard Dewey (1948) proposed that the fringe area embodies a hybrid land use pattern that combines elements of both rural and urban features. In addition, he proposed that the urban population finds fringe areas more suitable for residential purposes instead of the noisy and busy atmosphere of the city region. They find the fringe area a calmer quiet and clean environment to live in.

Blizzard and Anderson (1952) in their work related to the fringe zone were more precise and they specified a relevant definition "***The rural-urban fringe denotes an area characterized by a combination of occupancy patterns between the predominant urban region services and the exclusively rural agricultural land use****"* On the basis of these features, they determined the boundaries of the inner and outer fringes.

Martin (1952) in his study of Eugene and Oregon describes that the population of the fringe area considered themselves as urbanites. His work was based on the urban land uses and encroachment of agricultural land for residential purposes.

Mc Kain and Burnight (1953) partitioned the rural-urban fringe into two distinct segments, namely the broader fringe and the more restricted fringe. In this layout of fringe bifurcation, the limited fringe occupies the area that begins just outside the city boundary, and the wider fringe area comes into existence at the point where the limited fringe ends.

Duncan and Reiss (1956) in their work on the Chicago fringe belt stated that there are three different types of fringe i.e urban fringe, rural non-farm, and rural farm. He used the term 'urban fringe' for population suburbs outside of the city. He included the urban fringe within the city region

Kurtz and Eicher (1958) in their study used the term fringe for explaining the mixed urban land use characteristics of a transitional belt lying just outside the city region.

Mayer and Kohn (1959) in their work on Chicago suburbs classified it into two parts based on differential growth rates. This study includes an old municipality with a 35 percent growth rate and industrial municipalities with a higher growth rate, which are used as night-staying buildings. A mix of residential and commercial operations, higher population densities, and higher property tax rates are characteristics of the older municipalities, which have slower growth rates. The industrial municipalities, on the other hand, are distinguished by a concentration of manufacturing enterprises, lower population densities, and lower property tax rates, as well as greater growth rates. In addition to helping us comprehend suburban development in the Chicago metropolitan area, this classification provides information about more general trends in suburban expansion and development in other metropolitan areas.

Goledge, R.G (1960) in his analysis of the Sydney Metropolitan region, the researcher delineated a geographical area characterized by diverse land utilization patterns, which have contributed to the development of an urban complex and termed it as '***geographical no man's land***'. He explained the evolution of the fringe zone in the following lines. ***'The nature and structure of urban fringe are determined by the influence of rural and urban interaction on land uses.'***

Conzen (1960) acknowledges that rural-urban is an important part of urban morphology. It reflects not only the growth in the Metropolis but also the temporal growing influence of fringe towards the urban front.

Russwurm (1960) explained the fringe area as the discontinued marginal land between urban areas and villages. He called it transitional land use after the corporate limit of the city, which is not yet claimed by the city. This is an outer build-up area with low density and mostly population engaged in non-agricultural work. He

surveyed the Ontario area in London and studied the non-farming activities in the properties of landlords of around 200 acres.

Wissink (1962) has defined the fringe area of '***great differentiation***' in terms of land-use pattern. It is an area of two expressions based on a variety of uses and is particularly included in the urban complex. The outward development of the city cannot be clearly marked; rather it spreads around in the form of concentric zones in an unplanned manner. Urban development shows haphazardly movement, which is sometimes unidirectional and more along one point, not much development is rarely seen in other directions. As a result, inconsistent growth is seen in all four directions of the city, which represents the fridge.

Lewis Keeble (1964) in his work defined the urban fringe as ***'The area around the city does not come under direct urban administration but has a significant urban impact related to the land-use patterns'***.

Pastaland (1966) aimed to close the conceptual gap between the practical requirement for planning tools to manage periphery areas and theoretical understandings of urban expansion. He goes beyond generalizations to provide a quantifiable and operational definition of the Rural-Urban Fringe (RUF). He highlights the zone's transitional character, both physically and functionally, and contends that the conventional divisions of ***"urban" and "rural"*** are insufficient to capture the intricate relationships taking place at the periphery. Land-use patterns, changes in occupational structures, infrastructure development, and commuting behaviour are among the characteristics listed in the study for defining the RUF. Given that the RUF represents a hybrid socio-spatial fabric influenced by both urban and rural traditions, he promotes the incorporation of socio-economic indicators in addition to spatial ones.

Whitehand (1967) in his work described the fringe area as a ***'heterogeneous region'*** because of various definitions. There are no fixed elements of a fringe, but it is operated by different types of land use. The integrity is governed by the constituents of the morphological elements which were located near the build-up area of the fringe zone. He stated three types of fringe belts:

1. Lower rural-urban fringe belt
2. Middle rural-urban fringe belt
3. Outer rural-urban fringe belt

K.V Sunderem (1968) in his work finds out the difference between satellite towns and urban fringe. He called the fringe the third part of the city and also told that the limit of this is determined based on agricultural land use and land lying vacant for urban-rural land use.

Pryor (1969), in his study, suggested that the quantitative analysis of census data and land-use configuration provides help in defining the fringe zone into two separate parts rural fringe and urban fringe. He made a distinction between the urban fringe and the outer suburbs, suggesting that the latter is a unique spatial entity characterized by a fusion of urban and rural traits rather than just a region of suburban expansion. He presents a zone of transition concept, highlighting the fact that functional land-use patterns, demographic traits, and economic interactions—rather than rigid administrative borders—define this edge area. Both quantitative and qualitative markers, including changes in land use, commuter patterns, population density gradients, and infrastructure development, are used in the study to define the urban periphery.

Carter (1972) the primary catalyst for the emergence of the fringe is attributed to dispersion, which results in a gradual expansion towards the periphery of the urban area. The development of the urban region results in the expansion of the fringe areas.

R.L Singh called it urban erosion. **Om Parkash** had described it as Peri-Urban Area, a circumference belt that is like a beach encircling an island that gradually merges into the sea.

K.N Gopi (1978) in his work figure out that the development of the fringe area was caused by some secondary cause or impulses. And this cause has been the same viz rapid growth of the city.

R. Ramachandran (1989) in his work proposed that the fringe area represents mixed land use pattern. The fringe zone starts from the dominant agricultural land use is

visible and extends to the area where urban land use is visible within the village and some people who live in the village are commuting for work or other purposes to the city.

Manju Pandey (2005) proposed that the rural-urban fringe is a geographical area that is indicative of current and prospective urban expansion.

Scott et al. (2013) defined as the rural–urban fringe (RUF), which is the area where rural and urban growth converge, is frequently one of the most valued and challenged segments of society. Despite being complicated and frequently seen as ***"messy,"*** this area offers a lot of opportunity for policy and decision-making procedures. The RUF, as a unique and significant geographical unit, is still not well understood and is fragmented, receiving little specific focus for its sustainable management.

Yang et al. (2019) stated that the mutual evolution of landscape types has been hastened by the fast growth of metropolitan areas. Reasonable planning of urban land resources can be facilitated by analyzing and modelling the spatiotemporal dynamic aspects of the urban landscape.

Zhao et al. (2021) emphasized the critical concerns about sustainable land use in the rural-urban fringe area. These problems were actually caused by the ease of access to public utilities and the labour market, which further widened the disparity in living standards between rural and urban areas.

Pénzes et al. (2023) suggested that the rural-urban fringe was highly dynamic, particularly in post-socialistic European cities. The administrative area under suburbanization has altered as a result of massive migration from the hinterland to the metropolis.

Sun et al. (2024) identified rural-urban fringe based on the flow of ecological, living, and production activities, which in fact show the space-behaviour activities. According to their research, there is a lower intermediate level of flow from the urban to rural area, or the rural-urban borderline area.

According to **Wang et al. (2024),** the main cause of the rural-urban fringe area is the rapid urbanization and expansion. This region was connected to an urban area with a

mixed land use and a population of both cultures. Social structure, economic growth, and policy implementation all brought about changes in this sector.

Zong et al. (2025) defined the the rural-urban fringe area is an ambiguous outer boundary zone of the urban area that is sensitive and prone to ecological changes due to complicated demographics, uneven economic growth, and major land use changes.

Ning et al. (2025) also classified it as a complex human-land conflict zone, a frontier place, and a protective barrier for the circulation of urban-rural factors. Three stages of the rural-urban fringe area's history were identified by the study: the slow gestation phase, during which there was little urban and rural development. Rapid urban expansion and the emergence of rural-urban fringe areas that moved toward urban areas characterized the second phase of development. Both units' components were joined, stabilized, and made ready for future growth as a single unit during the final stage, known as the stable reconstruction phase.

1.3.2. Characteristics of Rural- Urban Fringe

The rural-urban fringe is a region on the periphery of the city that has undergone significant changes in its physical, economic, cultural, and morphological aspects. This area is characterized by a mixture of rural and urban land use, making it a transition zone. The rural-urban fringe is a geographically adjacent area to a city that exhibits urban characteristics and features in terms of its physical and morphological attributes. If we talk about the definition of rural-urban fringe, from time to time many scholars have represented many definitions related to it and from their study, it is clear that the rural-urban fringe is neither completely urban nor completely rural. It is a reflection of rural characteristics, rather this area exhibits mixed characteristics and characteristics of both these areas.

Wehrwein (1942) In his study of the fringe area in the United States, lists several elements of this region as slaughterhouses, junkyards, and whole sale oil storage, as well as public services such as sewage facilities and cemeteries.

Walter Firey (1946) in his study underlines the following characteristics of the fringe area:

1) The encroachment of productive land.

2) The randomly scattered plots of lands, factories, and residential areas.
3) For better public amenities high taxes system should be there but factories and shops do not have adequate abilities.
4) The emergence of modern buildings hiking the price of land and in turn agricultural activities becoming less attractive.
5) The demographical aspects show changing scenarios as more youth and children dominate the population structure. It shows a high dependency on the urban area for daily needs.

Golledge (1960) in his work on Sydney fringe, points out seven characteristics:

1) Changing pattern of land occupancy.
2) Small farm size.
3) Intensive agriculture.
4) Low or moderate density and high population mobility.
5) Residential occupation of land.
6) Lack of public amenities.
7) Speculative building type.

Thus it is clear that the above-mentioned characteristics outline the conditions of the rural-urban fringe and it attracts youth from rural areas to the fringe area based on the speculative type of houses and incomplete public facilities. **Golledge** also recognizes small farm size and intensive crop production, which are probably linked to urban demand.

R.E. Pahl (1956) in his study summarizes four characteristics of fringe zone that was also proposed by **Golledge** in his earlier work.

1) ***Segregation:*** It is a phenomenon that is very prevalent in the fringe. The ability to buy a new house on its basis is the main reason for this. Thus the population was segregated based on ***'classes'***. It becomes a status symbol in a residential context, popular to live in.

2) ***Selective Immigration:*** The rural-urban fringe attracts ***'mobile middle-class commuters'*** that live in a fringe area and work in the city region. So they commute every day from the fringe to the city center. They are different from other permanent resident social groups in many aspects. They show a tendency to return to the urban area on regular basis**.** ***Kurtz and Smith*** in their study of Lansing, Michigan found that urban migrants living in the peripheral zone tend to frequently visit their former homes.

3) ***Commuting:*** Another important characteristic is commuting; people work in the city region and commute every day back home in the fringe area.

4) ***The Collapse of Geographical and Social Hierarchies:*** This is one of **Pahl's** most intriguing results, and it expands the notion of a unique fringe. The allocation of individuals to distinct urban areas for specific services results in a modification of the service provision within peripheral settlements. They are not obligated to maintain an extensive inventory of products and services commensurate with their customer base, but may instead focus on particular niches.

5) **Pryor (1968)** in his work suggested some different sets of characteristics such as land use transition and social and demographic characteristics.

   i. Build up urban and sub-urban areas.

   ii. The rural hinterland.

These two zones have some distinct defined characteristics as follows:

i. Absence of non-farm dwellings.

ii. Unplanned growth and unorganized zoning or planning regulations,

iii. Expansion beyond the political boundary of the central city.

iv. A sharp Increase in population density, but lower than that of the city region and above of surrounding rural area.

v. Inadequate public amenities.

Giggs (1979) work-related in Nottingham proposed that there is a basic difference between the north and west side of the city that was built up and industrialized in the 19th century; on the other side south and east parts are considered fringe areas. 78 parishes and 15 variables were included in the cluster analysis, including population growth, age structure, housing features, socioeconomic position, employment, workplace, and mode of movement and reliance. Significant variations were discovered during the research, and four sets were discovered.

1. Modern Mining Settlement,
2. Large residential suburbs,
3. Small residential suburbs,
4. Small village – unmodified villages.

The author arrives at the conclusion that ***the primarily residential areas in the suburbs consist of old residential properties, council assets, and miners' residences. These estates are separated from one another in the surrounding natural environment, and private estates are found in close proximity to the village score. Land that has been meticulously developed has been allocated for commercial, educational, and institutional purposes.***

Carter (1975) suggested that the urban fringe shows different characteristics ranging from the ancient rural residential area to the present-day residential estates. There is a variety of commercial establishments such as shopping centers and industrial areas located at convenient distances from the city.

Dr. Sudesh Nangia (1976) had a study related to the Delhi Metropolitan fringe area and underline the following characteristics:

1. The fringe zone includes huts, slums and illegal occupations. These settlements are unplanned and unorganized.
2. The land-use is mixed in nature.
3. Decreasing agricultural practices and land –use.
4. Inadequate public amenities.

5. Scattered types of settlements and lack of budget to provide amenities.
6. Represent mixed forms of the rural and urban way of life.

M.M.P. Sinha (1980) in his work on Patna Metropolitan stated that rural-urban fringes act as a connecting point between the expanding urban regions and the exclusively rural areas.

Many scholars in India as well as at the International level publish their works related to the fringe zone and figure out that the mixed land use of both rural and urban characteristics is the soul of the fringe area. The evolution of western and Indian cities may be different, but the fundamental process of urbanization and its related modification in land use has remained similar. The development model of Indian cities established after independence resembles the development model of cities in western countries in which the informal sector plays a significant part. The main feature of the Fringe area of the pre-independence Indian cities was the cantonment zone and the airstrips, which were gradually replaced by other features after post-independence such as a brick kiln, godowns, big factories, graveyard, sewage plants, garbage stores, and periodic markets, etc. The other significant aspect of the rural-urban fringe is the opening of various informal sector units such as 'gimti' 'chat corners' grocery and retail shops. The residential pattern of the fringe region reflects that most of the residents of rural areas live here, who are unable to afford expensive lands in the urban area, but want to reside near urban areas. Over time, the lack of land and development of commuting in the urban area has also developed the interest of the urban population towards the fringe areas.

According to scholars, agricultural activities are considered a rural activity in western countries, but in India, such activities are considered as the inner boundary line of the fringe region. Thus, if the agricultural activities occur within the municipal boundary, then the beginning of the fringe is considered to be from the inner part of the city. This phenomenon can be witnessed in many Indian cities (e.g. Greater Mumbai), whose limits have been deliberately defined to include some agricultural land. Revenue village, in India, contiguous with the city municipal boundary with urban land use, deemed to be included in the city boundary. A revenue village with mixed land use is considered a part of the fringe area. Thus, the different characteristics of the fringe region in India can be summarized as follows:

1. Presence of factories within the village or at the boundary of the village.
2. Presence of brick kiln, timber yard, warehouse, air ports, bus and truck mechanic shops.
3. Presence of different kinds of shops on both sides of the road leading from the village to the city.
4. Growth of the different unplanned residential areas, developed by the people who came from the villages or from the city itself.
5. Emergence of different colleges, hospitals, dispensaries, etc.
6. Establishment of water works, sewage plants, crimination or burial grounds and slaughter house.
7. Development of stadium and playground.
8. Growth of different residential flats by builders and corporate houses.

Thus the fringe zone represents mixed characteristics in terms of land use pattern. Fringe is a dynamic zone of this influence. With the growth of the city, the fringe also expands towards the outside. The characteristic and socio-economic development of the fringe area varies from a purely rural area. These characteristics show the progressive evolution of the peripheral countryside into an urbanized stage. These findings illustrate the influence of the urban area on the interface between rural and urban areas. The city works as a nodal point for the socio-economic needs of the fringe population. The city of Hisar also works as a focal point for its surrounding countryside. It provides educational services, banking services, health services, transportation facilities, etc. In return, the countryside facilitates agricultural goods and different types of labor work. As a result, there is a strong interrelationship between the metropolitan region and the areas that surround it. In this study, an attempt is made to demarcate this area of influence.

1.3.3 Origin of Rural Urban Fringe in India

Although the concept of rural-urban fringe is not there in India, with industrialization in western countries, the study of rural-urban fringe is believed to have started. Even before 1950, the rural-urban fringe did not exist in the major cities of India. **K. Sidhartha and S. Mukherjee (2001)** explained that the main reason for this was that

at present the growth of the population in the cities was very slow and if the population growth was happening then it was happening only within the residential area. The emergence of this phenomenon in India is seen as the effect of the Green Revolution during the 1965s. The higher level of interaction between the city region and its adjoining rural area plays an important role in the development of the fringe zone. In ancient times, cities were not connected to their surrounding country side due to being surrounded by walls on all sides. Walls, moats, and other structures were the main physical features of the city limits. **S. Qureshi (1998)** represents that there was a marked boundary line that lies between the urban and rural areas. Thus, the rural-urban fringe is a phenomenon that is visible near rapidly growing urban areas.

The development of new cities during the British period was limited to the establishment of cantonments and civil lines. After independence, this scenario changed, as rapid developed in the field of industrialization and urbanization started and new cities started emerging. The population increased rapidly in India and the number of cities with populations of 1 lakh to 10 lakh started growing rapidly; in the coming decades, their population showed a growth of more than 50%. The effect of the rapidly increasing population in India began to be visible in the city region zones. This is the outcome of the uncontrolled movement of the rural population toward the city region, the cities were no longer able to take the burden of the population and gradually the population started moving toward the surrounding rural areas. As a result, the rapidly growing urban population came in the form of the acquisition of cultivable land from the surrounding rural areas. Gradually, the land use pattern of agricultural land in rural areas adjoining the city started changing. Migrants coming from the village slowly started settling towards the city's periphery and the periphery of the ancient city started moving towards the center and a new periphery started developing. In this way, the inclusion of rural elements and ingredients is still seen in the old cities. However, **Sorokin** and **Zimmerman** explained that rural areas can be distinguished from urban areas in terms of size, occupation, density, social mobility, social and notarization, and social works of life. Thus, due to the physical development of the city, there is a change in the effect of different types on the socio-economic and cultural aspects of the surrounding rural areas. Gradually this change can be seen in the form of cropping patterns, land use, and development in the form of a semi-urban society. This can be seen as a transformation from a rural to an urban

background. **Sen (2016)** explained the growth of rural-urban fringe area in the Bangaluru based on the existing workers using location quotient. The area has a distinct edge when it comes to the development of new areas because of its excellent connectivity via intermediate roads, national highways, and satellite town ring roads. Nonetheless, the north eastern rural outskirts of Bengaluru are primarily characterized by agricultural land uses that are steadily declining.

1.4 LITERATURE REVIEW

1.4.1 Identification of Fringe

As the first effort in 1826, **Von Thunen** in his land-use model proposed how agricultural land use affects spatial patterns in rural areas. It represents four concentric zones around the city, e.g. as transportation cost increase agricultural land use also change outside the center of the city.

In **(1923) Burgess** proposed his classical model of concentric zones. In this model, he suggested a concentric zone around cities. These zones explain the urban social structure. This theory indirectly talks about the fringe zone. But separately fringe zone was not designated.

T. L. Smith (1937) was the first person that develops the concept of rural-urban fringe. He identified the build-up area outside the city limit as a fringe.

Andrews (1942), in his study ***"elements of urban fringe pattern,"*** made an attempt to differentiate between rural-urban and urban fringe. According to him, the rural fringe represents the urban expansion of the economically built-up city, whereas the rural-urban fringe refers to the area nearest to the margins of the urban fringe. The objective of this study is to determine the land use characteristics of the periphery area. He purposed that, ***"the adjoining area of the urban fringe represents intermixing of agricultural and urban land use characteristics"***.

Wehrwein (1942) in a study proposed that the fringe in the USA is an ***'Institutional Desert'***. He talks about problems and future probabilities. He summarizes that the fringe zone can be identified and explained by analyzing the land use pattern outside the municipal limit of the urban area. He suggested that the fringe area represents mixed land use patterns of different agricultural and non-agricultural activities.

Garnier and Chabot (1967) focused on the continuous built-up town. He suggested that the built-up area outside the city resembles as suburbs. The author provided a definition wherein a residential zone comprising domiciles and diminutive gardens exists, functioning as accommodation neighborhoods, wherein over fifty percent of the working inhabitants are employed in urban areas.

Pastalan (1967) specified a practical explanation of the rural-urban fringe as a transitional area characterized by a combination of rural and urban land utilizing patterns.

Oosthwizen (1969) introduced the terminology ***"rural suburbs"*** and ***"quasi-urban area"*** or ***"quasi-urban township"*** in his study. The term ***"quasi-urban"*** or ***"urban township"*** refers to agglomerations of inhabitants and relatively uninhabited residential zones. These areas are not legally accepted by the concerned authority. They are located outside of the main inhabitant area and recognized by place name.

Pryor (1969), in his study, suggested that the quantitative analysis of census data and land-use configuration provides help in defining the fringe zone into two separate parts rural fringe and urban fringe.

Rajbala (1985), in his research article claimed that the process of expansion of urban areas intensifies the city's outer expansion, which has an impact on the social-economic and political characteristics of people living immediately outside the urban region. Urbanism also impacts land use/cover, resulting in notable changes in agricultural prices in some locations.

1.4.2 Linkage

The interplay between the urban and rural areas in terms of societal, economic, cultural, and managerial responsibilities is a recurring theme in the discourse of urban geographers. To find out bilateral links between urban and rural regions, several authors attempted many studies and employed different terminologies. Many researchers utilized varied techniques to identify the functional interrelation from time to time. They conducted several investigations in order to analyze and identify hidden features of these connections.

Allix (1922) introduced the term ***'Umland'*** to describe the distinct financial organization of the inland city region in contrast to the hinterland of the port city.

Jefferson (1931) in his study identified that the countryside produce a considerable influence on the extension of city limits. The city performs variety of activities assigned by its countryside.

Walter Fierly (1946) in his study suggested that accessibility is mainly responsible for the expansion of fringe outside the city limit. He proposed that ***"The urban fringe is considered a peripheral zone for land use, not due to its physical characteristics such as place of origin, terrain, or soil composition, but rather due to its level of mobility towards a central mobility point in comparison to other land use"***.

Smailes (1947) analyzed that towns do not maintain their existence alone. They have a close relationship with bigger towns or cities than themselves. They grow in terms of interdependent ways. There is no well-defined separation line between them. They have hierarchical relations. There are small towns linked with bigger towns and bigger ones with next-level cities and so on.

Balk (1957), proposed that accessibility is the main process behind the extension of the rural-urban fringe. He proposed a new term 'urbanization' for the fringe zone.

Sinclair (1967) n his study analyzed the impact of the urbanization process on the countryside. He points out that rural land encroachment is indirectly related to urban growth. The growth of urban areas leads to the encroachment of land in rural areas. It is a kind of propositional relationship. As the growth of urban area increase, encroachment on rural areas also expands.

Srivastava and Ramachandran (1974) in their study they proposed the factors which carve out the present form of Delhi. This study develops a ***"stage model"*** to depict different phases that villages around the city pass through. The villages ranked on the basis of land use pattern, occupational structure, urban amenities, locational factors, and relationship with the urban area.

Phadke and Sita (1981) in their study have analyzed the impact of Bombay's urban agglomeration on the spatial pattern of the countryside. They proposed that

accessibility is an important factor in the diffusion of urban characteristics. He added that geographical distance is not a major factor.

Das (1985) in his research work related to the rural-urban interaction in Orissa points out the importance of centrifugal forces in the process of development of the rural-urban fringe. But if these forces fail to show their impact in the peripheral area, they give rise to spatial disparity.

Bunker and Holloway (2001), in their work on the fringe region in Sydney, proposed that the fringe zone of the city is moving outside as the growth of the urban area is intensified. They proposed that both the internal and external limits of the rural-urban fringe should move closer to their corresponding suburban and urban limits. The workforce living in the fringe area shows a high level of commuting in search of work in the labor market of the metropolitan area.

Singh (2006), ***"Small and Medium Towns: A Geographical Perspective"***. In his work author tries to explain the prevalent urban structure of Haryana in terms of its size, growth, spatial distribution, transformation in functional characteristics, development of infrastructure, and interconnectivity between three medium and small towns with other surrounding settlements for the period of thirty years from 1961to 1991. At the present, research works on various cities and their relationship with their surroundings are some famous topics of urban studies and are published in India and abroad regularly.

Learner and Eakin (2010) employed the term ***"Hybrid"*** to refer to the periphery region and the examination of evolving livelihood practices and their interconnection with the adjacent rural communities. The study endeavors to elucidate the alterations in the standard of living, land utilization, and means of subsistence.

1.4.3 Rural-urban relationship

According to Jefferson (**1931**, p. 453) ***"cities do not grow of own, it performs various activities assigned by its countryside."***

Bertrand et al. (1958*)* proposed the nature and type of different rural-urban relations that transforms social structure in rural areas and delineated these relations based upon interactive nature.

Epstein (1978) presented the idea of a diverse kind of modern institutional diverse impact on differently endowed villages.

Chauhan (1990) examined urban-rural interconnections in the Indian environment and stressed the cultural, political, and economic factors involved in the process.

Kaur (1995) examined the regional pattern of rural-urban relationships in India and proposed that these relations are more developed in agricultural and industrial advanced areas, whereas areas with physiographic obstacles have low intensity in terms of rural-urban relations.

Kabra (1997) and Joshi (1997) studied rural-urban disparity and proposed that both rural-urban areas depend upon each other and represent a complementary not competitive relationship. This provides an opportunity for integrated development.

Lin (2001), in his case study of the Peral River Delta, analyzed that the major metropolitan centers exhibit the geographical extent and functional attributes zone and this zone plays a significant role in handling the increasing urban population due to industrial and commercial development.

Kaur (2007) studied urban-rural relationships on an empirical basis in light of regional development to find out the impact of various phases of the emergence of a planned city like Chandigarh on the urban-rural relationship.

1.4.4 Characteristic Features (Socio-Economic and Demographic)

The demarcation of the fringe areas has always been a topic of interest in the field of urban geography and urban geographers from time to time carved out many studies in this field to delimit the fringe zone of many important urban regions. For the delineation process, many parameters related to rural-urban characteristics have been used such as socio-economic, demographic, cultural, and land-use patterns, etc.

Alpake (1942) conducted a research study entitled ***"Land Use Control in the Rural-Urban Fringe of Portland Oregon."*** tries to identify the influence of the fringe area. During his study, he concludes that the fringe zone is the region where the cultural characteristics of central cities show their influence on agricultural activities and reflect dominance on their molding.

Green (1950) in his research work delineates the urban hinterland of England and Wales based on public transport such as bus service. He finds out that there are many hinterlands established in the urban area such as commercial, industrial, professional, and administrative, but these never coincide with each other.

Singh (1955) investigated the fringe region of the great holy city of Varanasi. He observed that it is a kind of outward extension of the city itself. He analyzed that fringe area has a dependent kind of relationship with urban centers for urban facilities.

Ellefson (1962), in his study, delineate the zone of influence related to the five Metropolis of the Indian subcontinent. The five metropolises are Bombay, Delhi, Madras, Hyderabad, and Baroda. For the delineation process, some characteristics such as population density and commercial population have been taken. He also suggested that distance-decay is a very crucial factor in deciding the city's influence.

Dikshit and Sawant (1968) in their research work, analyze the impact of Poona City on its hinterland. For this study, they have taken some variables such as commuting, newspaper circulation, bus service, distribution of essential commodities, post office, and telegraph services, etc.

Alam and khan (1972) in their work related to the Hyderabad Metropolitan region, analyze various characteristics such as total persons, retail trade, transport, commuting, drinking water supply, electricity utilization, and postal, and telecommunication service. Besides these characteristics, five other parameters such as electric consumption population variation, density, sex ratio, and non-agricultural workers are also taken into consideration. During this study, it comes out that the influence of this city region forms a zone of 40 miles circumference from the city center. There is also a zonal structure as it includes; the metropolitan core, the peri-urban, and the rural hinterland. The region of metropolitan dominance spreads to a radius of 40 miles from the central city.

Lal (1973), in his attempt to study the Bareilly fringe, has purposed that the fringe zone is a part of an important development process, but the word is not yet standardized owing to its vagueness. However, the unnecessary and unplanned developed pattern of land because of the outward growth of the city can be chosen as the fringe's representative.

In **1978, Gopi** demarcate the suburban centers of Hyderabad district. The main parameters are daily commuting and the supply of essential services.

Sita and Phadke (1985) in their study try to delimit the fringe of the Bombay Metropolitan Region. They have used demographic indicators such as population density, sex-ratio, growth rate and percentage of the non-agricultural workforce. In this study, they cover 925 settlements.

Das, A. S. (1997), in his study related to the demarcation of the fringe region of Mysore city. In this study, the main parameters included are distance, transportation, population density, literacy rate, population growth, sex ratio and the ratio of non-agricultural workers.

Mahon (2005), has studied the fringe areas in the West of Ireland (Lakeside, Riverview and Woodland). In this attempt, he tried to identify the places situated on the urban fringe. He also takes into consideration the economic and social change in these places. His main focus was on the residents of these places for establishing understanding and perception towards the rural and urban fringe

Clark and Sharp (2008) examined fringe areas in Ohio, highlighting key features that define these transitional zones. They focused on suburbs and rural areas. They have also examined the sequence of related contrasts that explains the features of the rural-urban fringe. They have analyzed the ecological, occupational and socio-cultural characteristics of fringe to determine similarity or dissimilarity from the suburbs or rural areas. They determined that the scope of the rural-urban fringe differs from that of urban and suburban areas. The inner components of the fringe area dominate the outer section.

1.4.5 Application of G.I.S. and Remote Sensing

With the growing field of Remote Sensing and G.I.S, it attracts the attention of urban planners to use these new technologies in the planning of rapidly growing urban centers.

In the present-day world, urban areas are spreading like living organisms. Urban areas not only acquire changes within themselves but also affect their surroundings. Peripheral regions of expanding cities witness significant changes in their social, cultural, demographic and land transformation. Remote sensing and G.I.S. not only help in mapping and detection of this unplanned growth but also provides the basis for

future planning. Data can be obtained frequently and it provides quantitative and qualitative information on changes that occur in the fringe area.

Martin and Howarth (1989) in their work related to visual interpretation of multi-date images used the SPOT images for carving out the best overall images. The task of classifying images was executed with an accuracy level of roughly 80 percent. This helps in change detection and supervised classification. In the process of supervised classification of multi-date images, they achieved 60 percent change detection accuracy.

Gastellu- Etchegorry (1990) in their work related to digital analysis of the near-urban land cover was done using SPOT XS and Landsat MSS data. The panchromatic band had a spatial resolution of 10m, while the XS bands had a resolution of 20m. The utilization of SPOT data is frequently observed in the development of land cover maps pertaining to the interface between urban and rural areas. These lands cover maps aid in providing appropriate input for future planning.

Goong and Howarth (1990) in their work, asserts that a 76.6% accuracy rate was achieved in the cartographic representation of 12 distinct land cover classifications in the peri-urban areas surrounding Metropolitan Toronto, Canada.

Charbonneau et al. (1993) utilized three Landsat MSS pictures in his work to map and track the urban growth of Montreal, Canada. The results of the automated categorization of the data ranged between 5- 30%. It is more accurate and trustworthy than official figures.

Li and Yen (1998), in their study conducted on the metropolitan expansion of the Pearl River Delta in China concluded that the area is marked by unregulated growth owing to insufficient management. The assessment of urban expansion intensity and the spatial configuration of urban sprawl were conducted through the utilization of TM satellite imagery captured on various dates. The scholars employed the entropy approach to assess and track the growth of urban regions by incorporating satellite imagery and geographic information systems (GIS). It was suggested that curtailing unplanned building operations would enhance the prospective economic progress of the region.

Nigam (2000) in his research work investigate of the peri-urban area of Enschede City. Netherland expounded that the phenomenon of urbanization is poised to escalate the pace of urban demographic growth. The author conducted an analysis of land-use change dynamics during the period of 1993 to 1998, utilizing high-resolution satellite data and computer-aided GIS techniques. Datasets were generated by merging COSMOS data from 1993 with TM, and IRS PAN Data from 1993 with LISS-III. The findings indicate that significant alterations in land use occurred during the specified duration, leading to the conversion of a substantial portion of agricultural land into construction sites. The investigation additionally examines an increase in the utilization of land for residential and industrial purposes.

Gulch (2002) in his study incorporated two types of texture analysis at the super pixel level, specifically at a resolution of 3 by 3 pixels. The individual has established a threshold that is customized by the user to evaluate the feasibility of constructing or deconstructing a super-pixel. The individual employed both SPOT-PAN and aerial photographs. During the course of the study, it was determined that texture analysis using SPOT-PAN alone is sufficient for distinguishing between constructed and un-built features.

Kumar, Pathan, and Bhandari (2007), in their research, they employ remote sensing and GIS tools to track urban expansion through time. They employ Shannon entropy to calculate the effects on the peripheral area. The categorization of urban sprawl into four distinct zones has been delineated through ongoing research. Each zone denotes the percentage of urban built-up density evaluated across varying temporal intervals. Subsequently, the study area was partitioned into circular rings using the GIS methodology. The analysis of the impact of expanding infrastructure on urban growth takes into account the density of roads in different zones. The inference can be drawn that the periphery is impacted by unplanned urban expansion.

Rajesh et al., (2010) Land use and land cover concept is dynamic in nature. Recent studies based on watershed resource management has been universally accepted and recognized as a most effective approach in LULC classification and analysis. Modern

geographical tools like GIS and Remote Sensing are very popular in resource management, evaluation and planning.

Hansen and Loveland (2012) the images obtained from earth observation satellites are very significant in the application of LULC classification and analysis.

Liu C et al. (2016) in their research work performed LULC analysis on the basis of fusion of SAR and optical images in the spatial and transform domain.

Zakeri et al. (2017) in their work performed supervised and unsupervised LULC analysis using WT. but during this classification wavelets produce insufficient higher frequency coefficients. And that is why higher level of classified information is not included in classification process.

Dutta et al. (2019) Continuous mapping and monitoring of LULC is essential in today's rapidly changing world to assess the uncontrolled and fastely growing population in result of economic and industrial development, especially in developing countries characterized with dynamic LULC.

1.4.6 Fringe and future planning

The contemporary era is distinguished by the escalating populace residing in metropolitan regions. The issue of uncontrolled and unregulated development prevails as a significant challenge in the context of swift urbanization. The phenomenon of urban encroachment in peripheral areas is resulting in a transformation of the occupational, demographic, cultural, and socio-economic structure in the fringe region. The dynamic alterations in land use and land cover within rural areas have garnered the interest of professionals in the field of urban planning. The assessment and surveillance of this metamorphosis are imperative. The major causes of urban sprawl are population increase, the economy, accessibility to resources, and basic services. It is a challenging task for scholars, planners, and environmentalists to overcome these phenomena and provide a better solution.

McKenzie (1997) discussed rural exurban policies and responses to these policies in Australian circumstances. He concluded that the execution of these policies has some difficulties. He suggested that to overcome these difficulties one has to find out the dynamics and long-term impact related to exurban development.

Johnson (2001) in his research finds that the urban sprawl is associated with a range of ecological consequences that differ based on the affected stakeholder community, the level of human risk, and the distinction between aesthetic and physical effects. While certain impacts may be relevant to the layperson, it is crucial to articulate them in a manner that is comprehensible to policymakers, analysts, and the broader public.

Gallent and Shaw (2007) have emphasized the significance of geographical planning and space initiative plans in the context of the rural-urban fringe. This area has been identified as the ***"last frontier"*** of planning, and policymakers are currently focusing their attention on it. The individuals possess the capacity to connect geographical planning principles with the necessity for comprehensive, transformative, and comprehensive measures in the field, which enables policymakers and planners to contemplate and oversee the peri-urban areas in a more holistic manner**.**

Goel (2011) that the development of the rural-urban fringe involves a transition from traditional rural lifestyles to emerging urban lifestyles has resulted in a variety of land-related issues such as an increase in non-agricultural land use, haphazard urban expansion, high land acquisition costs, and a variety of other land-related issues that have a significant status in the field of urban research.

Saxena & Sharma (2015) proposed that the phenomenon of peri-urbanization entails the gradual expansion of urban areas into the surrounding rural regions, ultimately leading to the emergence of large metropolitan centres in the future. Consequently, it is imperative to engage with individuals at a young age and provide them with proper guidance and education to prevent potential negative outcomes in the future.

1.5 RESEARCH PROBLEM

Hisar is one of the major and largest districts in west-central Haryana. The data from Census 2011, (Table 1.1) represents that the population of the district is 1,74,3931 persons, but in the census year of 1961, it was recorded as 577,887 persons. It shows a 202 percent growth in the past 50 years. The Rural population shows an increase of 148 percent from 480,365 in 1961 to 11,90443persons in 2011. The Urban population increased from 97,522 in 1961 to 5, 53488 persons in 2011 showing a growth of 467 percent more than three times than the rural population. The research considered

Hisar as study area because of its distinct combination of institutional, demographic, economic, and physical features. Having a population of about 307,000, Hisar is the most populated non-NCR city in Haryana, coming in second only to Faridabad, Gurgaon, and Rohtak. It is an important urban center for researching urban expansion patterns and their effects on nearby rural areas because of its demographic dominance.

Table 1.1: Population of Hisar 1961-2011

District Hisar	Census years		Absolute increase in population	Percentage increase in population
	1961	2011		
Total population	5,77,887	17,43,931	11,66,044	202
Rural	4,80,365	11,90,443	7,10,078	148
Urban	97,522	5,53,488	4,55,966	467

Source: Census of India 2011

Renowned institutions including Haryana Agricultural University, Lala Lajpat Rai Veterinary University and Guru Jambheshwar University as well as other national research facilities are located in the city, which also serves as an institutional and economic center. These organizations foster innovation and education while also creating jobs and transferring knowledge, which act as catalysts for rural-urban connections. Economically, Hisar is home to 3,675 small-scale businesses and 46 large and medium-sized businesses, which greatly boost employment and promote economic integration between the urban and rural areas. Through active commodity trades that promote social and economic contacts, Hisar, a significant hub for trade and commerce in central-west Haryana, enhances the interdependence between rural and urban areas. The city's peri-urban and periphery areas have seen significant changes in land use and land cover (LULC) due to its fast urbanization. These changes include urban sprawl, ribbon development, and the conversion of agricultural land into commercial, industrial, and residential purposes. This change has produced a transitional area where urban and rural elements coexist, which is perfect for examining the causes and consequences of periphery development. The city also undergoes socioeconomic

changes as a result of rural-to-urban migration motivated by the desire for improved living, working, and educational opportunities. The peri-urban settlements' changing infrastructural needs, occupational structures, and population trends all reflect these changes. With 81 settlements divided into primary and secondary fringe zones, Hisar's rural–urban fringe exhibits differing levels of rural and urban integration. The city's administrative importance, strategic location, and excellent connectivity make it an ideal location for a thorough examination of the social, economic, and geographical changes taking place along the rural-urban interface.

1.6 RESEARCH OBJECTIVES

1. To demarcate the rural-urban fringe of Hisar city.
2. To find out the land- use /land- cover pattern in the fringe area.
3. To examine the demographic attributes and occupational structure of the fringe area.
4. To assess problems related to future growth and development of the city and suggest remedial measures.

1.7 RESEARCH QUESTION

1. What is the extent of the rural-urban fringe of Hisar city?
2. What changes occurred in the land use/land cover pattern of the fringe area of Hisar city?
3. What is the demographic and occupational profile of the fringe area?
4. What problems are related to the future growth and development of the city and remedial measures?

1.8 METHODOLOGY AND DATA

Research methodology can be defined as the procedures and steps that are helpful for achieving the objective of research work by accepting or rejecting the hypothesis. According to the definition provided in Webster's Collegiate Dictionary, research refers to the systematic investigation or exploration that is directed toward the

identification and analysis of facts. It may also involve the modification of existing theories or laws in light of new facts or the real-world implementation of such new or revised theories or laws. For attaining the objective of the present research work a sound and substantial methodology have been formulated for assessing the determinants for the demarcation of the rural-urban fringe of Hisar city and adjoining areas. An attempt has been made for finding out relevant information. Various methods, techniques, and resources have been put into operation for this piece of research work.

For the delineation of the rural-urban fringe available existing maps, satellite images and base maps of field surveys, land revenue records, have been used. To determine the extent of the rural-urban fringe a comprehensive survey has been conducted on the following indicators:

1.8.1 Occupational determinants

- Ratio of non-agricultural workers

1.8.2 Demographic determinants

- Population density
- Literacy
- Sex ratio
- Household density

Following statistical techniques have been used upon data collected from the above-discussed indicators to draw out the extent of the fringe area.

- Standard deviation
- Mean

Table 1.2: Rural-urban fringe analysis

Sr. No.	Categories	Range Of Values
1	PRIMARY/INNER FRINGE	MEAN + 1 S.D. TO MEAN + 3 S.D.
2	SECONDARY/OUTER FRINGE	MEAN TO MEAN + 1 S.D

To determine the growth of cultural development on surrounding agricultural land above discussed indicators in Table 1.2 have been plotted on the map of Hisar city. The villages which fall immediate outside of the city limit and show the value between **MEAN + 1 S.D. TO MEAN + 3 S.D.** of the above indicators have been included in the primary/inner fringe. The villages which fall between the primary/inner fringe and purely rural areas limit and show the value between **MEAN TO MEAN + 1 S.D** of the above indicators have been included in the secondary/outer fringe. (Table 1.2)

(1) Inner or Primary fringe

(2) Outer or Secondary fringe

Inner fringe: It is categorized with maximum interaction with the city in terms of socio-economic and cultural aspects.

Outer fringe: It is categorized with minimum interaction, low level of urbanization, highly agricultural orientation, and marketing facilities

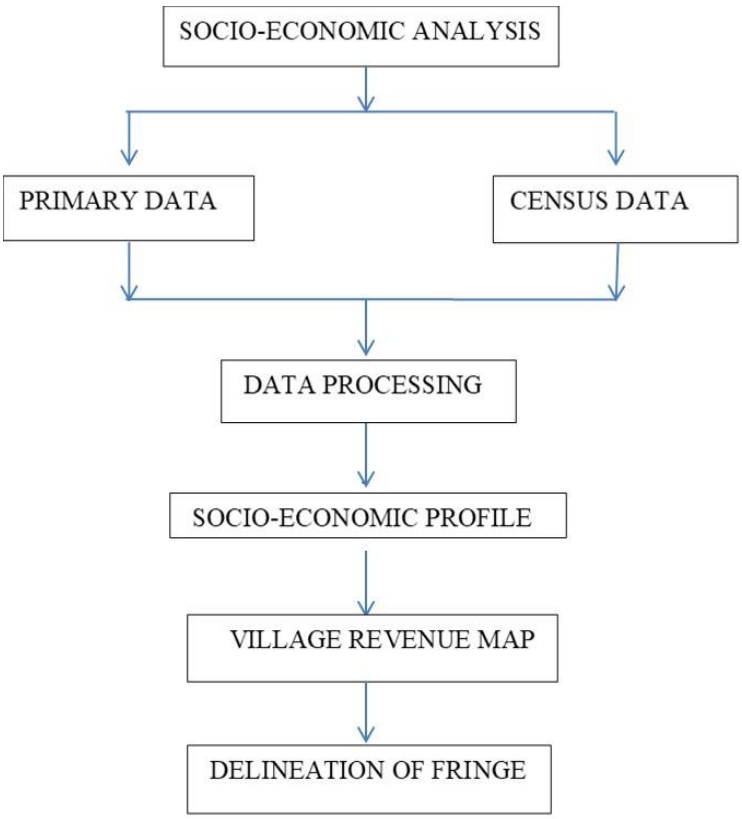


Fig. 1.1: Flow Chart Showing Delineation Process

For analysis of land patterns in fringe areas data regarding land use/ land cover have been collected by using revenue records. GIS tools/software has been used to prepare the base map of the study area. The base map of the study area has been prepared with the help of GIS tools/software. Landsat-7 and Landsat-8 images have been used and processed in Arc G.I.S. 10.8 software for LULC classification. Some common categories under which this analysis have been done can be following

- Cropland
- Fallow Land
- Built-up
- Water bodies
- Vegetation

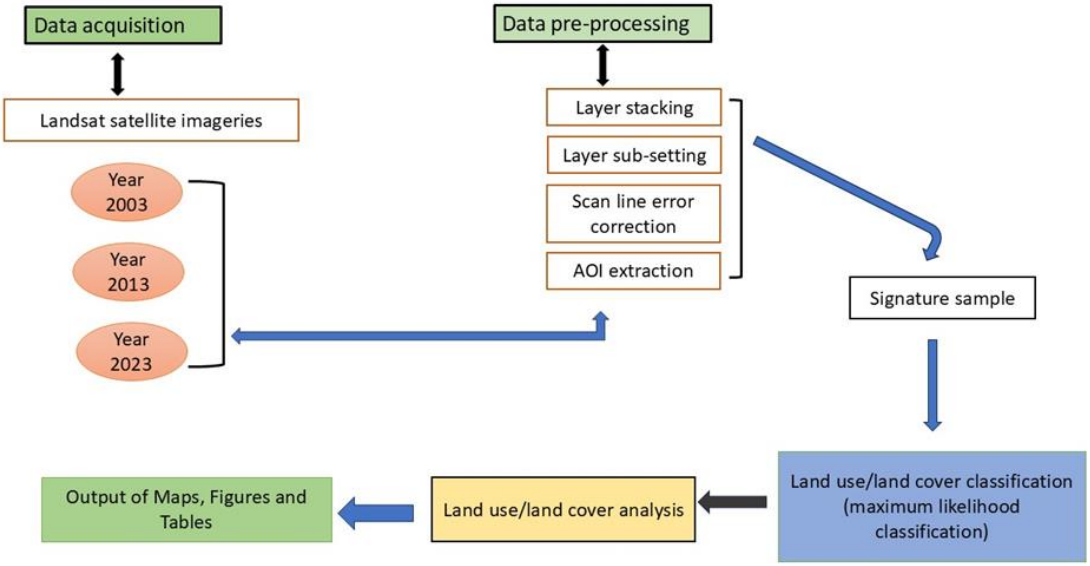


Fig. 1.2: Flowchart Showing Land-Use Land-Cover Classification Process

To examine the demographic and socio-economic attributes primary and secondary data have been analyzed. Primary data have been collected by conducting interviews, field surveys, etc. Census data have been processed using statistical methods and techniques. The graphical representation has been used to facilitate analysis.

- Occupation
- Literates

- Illiterates
- Educational facilities
- Medical facilities

These variables have been analyzed in relation to the distance from the city towards the surrounding area. Statistical techniques using SPSS 20 like Correlation, Mean and percentages have been used. Descriptive and comparative statistical methods have been used for the conclusion.

The derived information of major determinants for finding out rural-urban fringe has been put into GIS and maps have been generated for displaying and further analysis. This information can be used for future planning and policymaking.

CHAPTER 2

GEOGRAPHICAL APPRAISAL

2.1 STUDY AREA PROFILE

Haryana is a north Indian state with a geographical area of around 44212 sq. km. It came into existence on 1st November 1966, after being separated from the state of East Punjab on the basis of the Punjabi and Hindi-speaking population. For this purpose, the Indian government formulates a commission under the leadership of JC Shah on 23 April 1966. This commission leads the separation process and determines the dividing line between the two states based on Punjabi and Hindi languages. The latitude and longitude extent of Haryana is 27°39'N to 30°35' N and between longitude 74°28'E to 77°36' E. In terms of physiography, most of the surface of Haryana is plain with isolated hills and ridges. The altitude of Haryana is between 700 to 3600 feet above sea level. **Monica (2019)** It is a landlocked state and shares a border with Punjab, Rajasthan, Uttar Pradesh, Himachal Pradesh, and Uttrakhand. There are six administrative units, 22 districts, 6 divisions, 80 subdivisions, 94 revenue tehsils, 49 sub-tehsils, 143 community development blocks, 154 towns, 6,841 villages, and 6,222 village panchayats, Haryana Statistical abstract (2023-24).

2.1.1 History and Origin of Hisar City

The history of Hisar city is around 800 years old. It was founded as a fort in 1354 A.D by the Firoz Shah Tughlaq. 'Hisar' word originated from the Arabic language which means 'Fort'. The original historical name of Hisar is 'Hisar-e-Firoza'. It means 'Fort of Firoz'. With time, the word 'Hisar-e-Firoza remains only as 'Hisar'. During the Mughal period, the city was known as 'Sirkar' which was designated as the headquarters of the revenue division **(Singh,1978)**. The historical background of Hisar city is very rich as the oldest Harappan civilization sites were found in its surrounding areas. Agroha, Banawali, Kunal, and Rakhigarhi are some of the famous Harappan sites. After several years of excavation, Rakhigarhi emerges as the biggest site of this civilization **(Bhan,1972)**. The Aryan people were believed to be settled near the Drasdvati River somewhere near Hisar. The Jains mythological scripts reveal

that the earlier name of Hisar city was Isukara and it was a town in Kuru state. The historical records revealed that the Kingdom of Hisar had provided their support to King Chandragupta Maurya in the war against the mighty Greeks. As evidence, several pillars related to the Ashoka era were found near Hisar. Later it came under the rule of The Kushans and The Gupta Empire. The great emperor Prithvi Raj Chauhan made a fort at Hansi near Hisar. It also served as a capital city and strategic place for him until his defeat at the Tarain war in the hand of Guari **(Habib et al., 1970).** The construction of Hisar city was started in the year 1354 A.D. and completed in 1356 A.D. It is constructed as a fort by Firoz Shah Tuglaq for administration purposes. In the middle of the fort, there is a palace named Firoz Shah Palace. A beautiful garden was established around this palace. Another beautiful palace was built near his place for his wife Guzri as Guzri Mahal. Some other important buildings were Baradari, Lat ki Masjid, Dewan-e-Aam and Shahi Darwaza. It still stands firm as majesty as it was built. The architectural style of Guzri Mahal is a mix of Hindu and Jains temples. It is very impressive and has the uniqueness of that era. He constructed gates surrounding the fort, including the Delhi and Mori gates in the east, the Nagori Gate in the south, and the Talaqi Gate in the west. There was a ditch around the fort wall. This ditch was filled with water to protect the fort. It has been constructed with the help of stones brought from the hills of Narsai. The fort was built with lime and burnt bricks. The fort finally came to its full form in two and a half years **(Phadke, 1990)**.

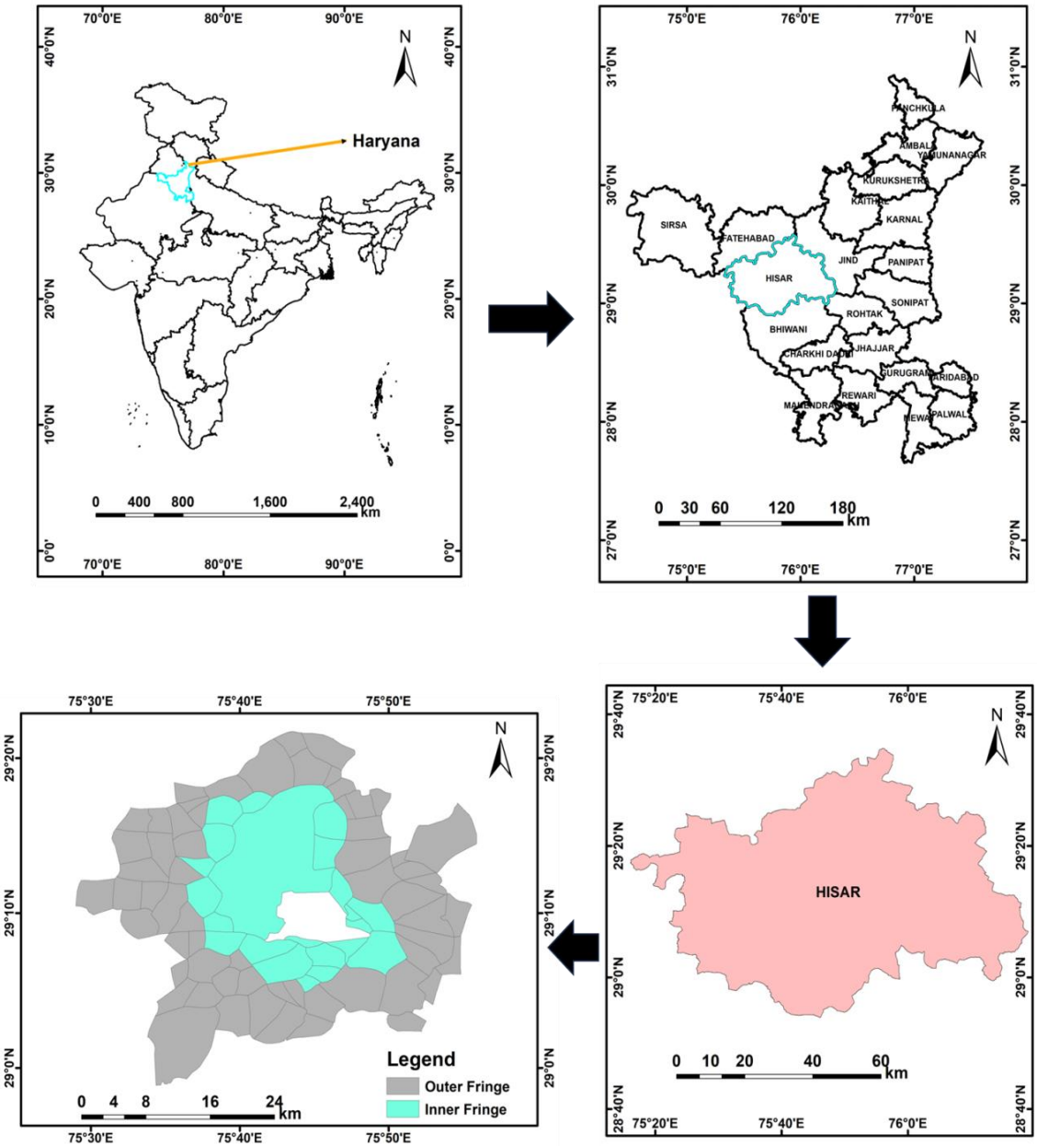
With the passing of time, Hisar comes under the rule of some rebels during 1408. But it was Muhamad Tuglaq who recovered the city again. In 1411, the nearby town Hansi was conquered by Khizar Khan and later he became the first Sultan of the Sayyid dynasty in Delhi. During the Lodi dynasty (1451-1526) Hisar was gaining recognition as Hisar of Haryana. In the reign of Bahlol Lodhi, it was gifted as a fief to Muhabbat Khan. After that, it was the Mughals who ruled this area for a long time. After winning the battle of Panipat, Babur gifted the city of Hisar to his son Humayun. In 1540, it was Sher Shah Suri who takes the city under his control. But Humayun once again wins the city by defeating Sher Shah Suri in 1555 and was assigned to Akbar. The country was ruled by Humayun twice, firstly from (1530-1540) and secondly from (1555-1556). He built a beautiful mosque named Jama

Masjid during his first term under the supervision of Amir Muhammad in 1535. During the rule of Akbar (1556-1605), it gained an important place in the north-western part of India. It was made Sirkar (headquarters of revenue division). It remains under the rule of the Mughals till 1760 **(Nizzar, 1968)**. As far as its historical importance, Hisar was called Duke of Wellington. Before British rule, it was under the reign of George Thomas (an Irish adventurer). As an independent ruler from 1797-1802, George Thomas remained an important personality in this area. He constructed two important historical monuments Jahaz Pul and Jahaz Kothi in the east of the city. The Jahaz Kothi acted as a residence for George Thomas After the Irish adventurer, it was Maratha that took the control of this area. On the behalf of Maratha, a French officer, Lt. Bourquien supervised these areas. He told to rebuild the town of Tohana and Hisar. With the dawn of the British Empire, the East India Company became the ruler of the city in 1803. During the 1857 rebellion, the city was conquered by Muhhamad Azim and Rao Tula Ram for some time. They were defeated by British General Cortlandt on 16 November 1857. During the rebellion of 1857, many freedom fighters of Hisar including the Chaudhary and Lambardars of many villages were evicted from their land and properties as punishment for joining the revolution. As a punishment, 368 people from Hisar and Gurugram were either hanged or imprisoned for life in jails **(Sen,1997)**. Hisar city was the center of many important activities during the freedom struggle. Many notable individuals, including Lala Lajpat Rai in 1886, Subhash Chander Bose in 1938, and Jawaharlal Nehru in 1946, visited Hisar. Thus the people of Hisar city actively participated in the freedom of the country. After the freedom on 15 August 1947, the city also witnessed the curse of partition. There were many relief camps for these people in the city. With the passing of time as India took a part in the progress process, the city also emerged as a major urban center **(Chandra et al., 1989)**.

2.1.2 Location and Situation

The city of Hisar is situated in the west-central part of the state of Haryana (fig. 2.1). It is one of the largest urban areas in Haryana. It shares a border with Rohtak in the east, Fatehabad in the west, Jind in the north, and district Bhiwani in the south. The Hisar city is the administrative headquarter of the Hisar district. The study area

extends between 29° 9’ North latitudes and 75° 45’ East longitudes. The Hisar city stands first in Non-N.C.R cities in terms of population. Only three N.C.R Cities i.e Faridabad, Gurgaon, and Rohtak has more population than Hisar city **(District Gazetteer, 1987, pp.1)**.



Map 2.1: Map of Hisar City

Source: Census of India, 2011 & District Census Handbook, 2011

The Hisar is a Class-I city with a population of 307,024. The total area of Hissar city is 49.43 sq. National Highways No. 9 and 52 pass through the city. The city has a

strong socio-economic connection with Fatehabad, Sirsa, Kaithal, Rohtak, Jind, Bhiwani, Rajgarh, Delhi cities, etc. Mostly it is developed along with National Highway No. 9 (Hisar to Delhi road). Hisar city is a part of the Hisar division. There are four tehsils (Hisar, Hansi, Namaund, and Adampur) in the Hisar district. Hansi-I, Hansi-II, Agroha, Barwala, Adampur, Narnuad, Uklana Mandi, Hisar-I, and Hisar-II are nine community development blocks. It consists of 269 villages and four statutory towns namely Hisar, Hansi, Barwala, and Uklana as per the 2011 Census. There are 31wards in the city and Haryana Agriculture University and Mini Secretariat (OG) come under ward 32 **(District Census Handbook 2011)**.

2.1.3 Climate

As the situation of Hisar city is continental type, it is characterized by extremely hot summers and cold winters. It is situated around 1600 hundred km away from the ocean and it lies on the last end of the monsoon winds. The mean annual precipitation of the Hisar region is 472 mm, which is an arid type of climate. It has a semi-arid subtropical type of climate. It receives rain from the start of the June to middle of September. Thereafter till next June, it receives no rain except for some western disturbances in the winter season. The southwest monsoon contributes approximately 80 percent of the yearly rainfall. The rainfall occurred in variable forms, sometimes as thunderstorms and sometimes as no rain for a long time. In terms of temperature, the Hisar and surrounding areas represent extreme conditions. In summer the maximum temperature rises to almost 45-47 degrees and in winter it drops below 1-2 degrees. Sometimes it drops down to minus in January and February (Source: www.climate-data.org). With clear seasonal fluctuations throughout the year, the fig 2.2 displays the average monthly daytime and nighttime temperatures of the last 20 years. December and January are the coldest months, with daytime highs of 21–23°C and overnight lows of 10–12°C. Temperatures gradually increase starting in February and reach their highest point in May and June, the hottest months, with average daytime highs of 42°C and nighttime lows of 29–31°C. As temperatures somewhat drop and the day-night difference narrows in July and August, a modest decline is noted, most likely as a result of monsoon effect. Daytime and nighttime temperatures gradually drop throughout the post-monsoon months of September through November. The dry months of January and April have

the largest diurnal (day-night) temperature variance, whereas the humid monsoon months have the smallest. A typical continental climate with hot summers, chilly winters, and moderate monsoon conditions is generally reflected in the data.

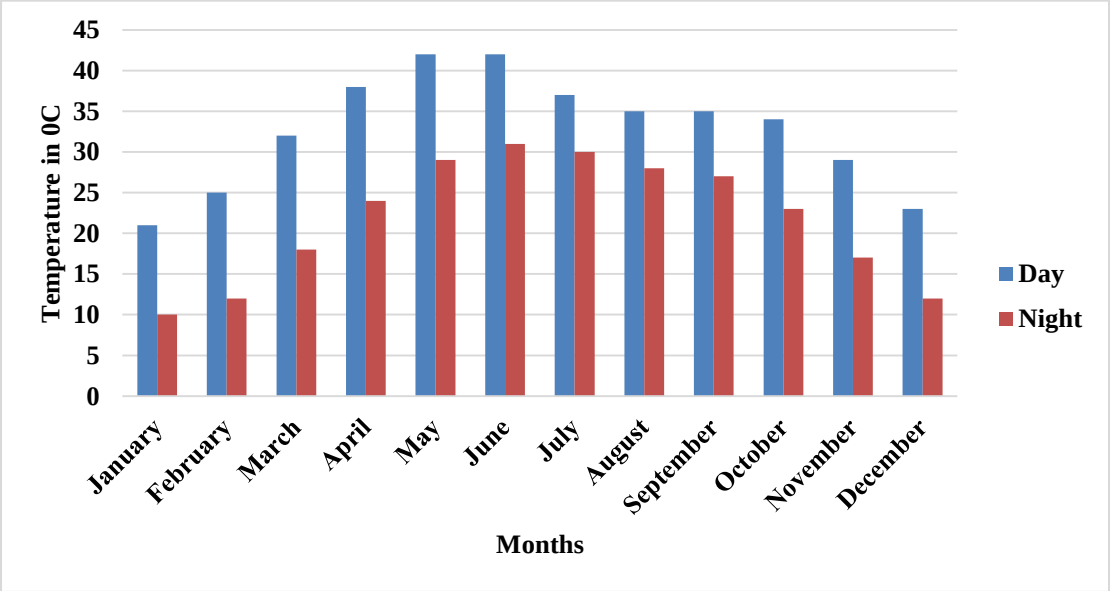


Fig. 2.1: Montly average day and night temperature of Hisar City

Source: www.climate-data.org

2.1.4 Rainfall

As it was discussed earlier, the Hisar region gets maximum rainfall from the southwestern monsoon. The rainy days start from the start of June and to the mid of September. After the monsoon season, some rainfall is received in the form of western disturbances. The monthly rainfall situation can be better understood with the help of the following table (www.climate-data.org). The fig. 2.3 indicates the average monthly precipitation levels (in cm) over a period of last 20 year indicating a seasonal pattern: Rainfall is generally low throughout the winter and spring months from January to April (average rainfall is between 6 to 12 cm) indicating limited precipitation. There is a slight increase in rainfall observed from April to May (16 cm), which then sharply rises in June (38 cm) indicating the beginning of monsoon season. Lower rates of precipitation are generally seen in January-April (6-12 cm) as but peak rates are generally seen in July (130 cm) and August (131 cm) during both months being basing their weather on being associated with the Southwest Monsoon

in India. Precipitation levels progressively decrease from September (56 cm) and sharply drop from October (9 cm) to December (5 cm) showing a monsoon retreat and the resumption of dry conditions. This demonstrates an example of typical monsoonal climate where there is a wet (monsoon) and dry (non-monsoon) season and a majority of precipitation occurs at certain times during the summer months.

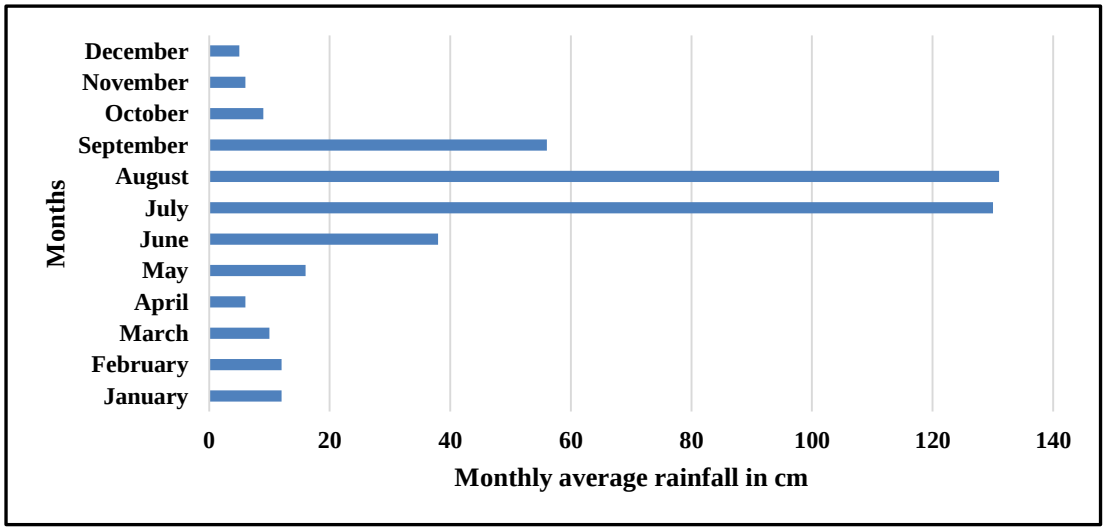


Fig 2.2: Annual Rainfall (in mm) in Hisar

Source: www.climate-data.org

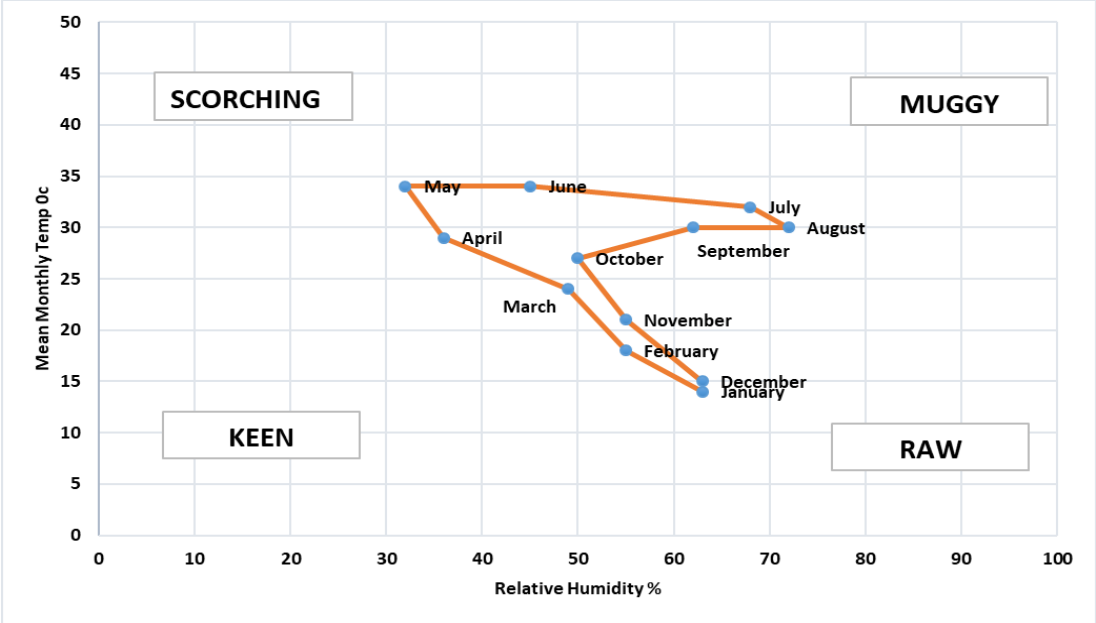


Fig. 2.3: Climograph of Hisar

Source: www.climate-data.org

According to the fig. 2.4, May and June, which are both in the Scorching quadrant (high temperatures (~34–36°C) and low humidity (35–40%), no rain) are characterized as hot and dry. July and August which are in the Muggy quadrant (high temperatures (~30°C) and sometimes very high humidity (70%+), peak of monsoon season) are hot, humid and uncomfortable. December and January are in the Raw quadrant (low temperatures and low humidity), providing cold/dry conditions. February, March, November, and October are between the Keen quadrant and Raw quadrant suggesting cool to mild temperatures and moderate humidity. To illustrate, the temperature and humidity fluctuate between the extremes of the Keen and Raw quadrants and this occurs throughout all the months in Hisar, so they are transitional month, for example, when transitioning between a) hot dry (high temperature low humidity) to b) monsoonal moist, (high temperature high humidity) back to c) cool dry (low temperature low humidity). This figure is depicting the thermal-humidity perception of any month, especially during the peak of summer and the peak of the monsoon month.

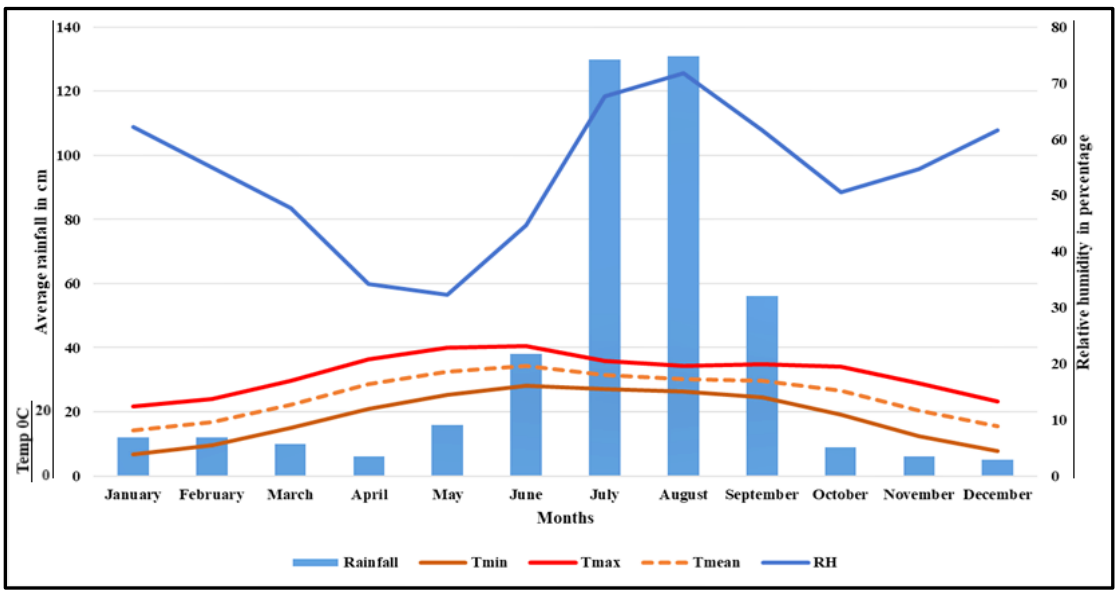


Fig. 2.4: Climate graph of Hisar

Source: www.climate-data.org

The climate graph (fig. 2.5) shows the monthly fluctuation of rainfall, temperature (minimum temperature (Tmin), maximum temperature (Tmax), mean temperature (Tmean)), and relative humidity (RH) for Hisar. The rainfall curves show a clearly

defined monsoonal rainfall. There is little rainfall between January and May, followed by an increase to 38 cm in June, a peak in July to 130 cm, and August to 131 cm, and then reduction in precipitation to 56 cm in September. There continues to be low rainfall from August and through the rest of the year. Temperature trends rise steadily from January, reaching a peak from May to June (when Tmax is reaching around 40°C), and then falling from July onwards. Tmin and Tmean followed a similar trajectory, where the hottest period is just before the monsoon begins. The RH is lowest between March and May (30–40%), then increases sharply during the onset of the monsoon, which has a peak RH of about 75% in August, then falls again from September onwards. Therefore, the figure indicates a typical north Indian climate where there are hot, dry summers, humid monsoons, and cool, dry winters. The peak temperatures of summer combined with humidity occurring suddenly in July denotes the arrival of the southwest monsoon, where rains dominate the remainder of the wet season.

2.1.5 Physiography

The city of Hisar is situated in the west-central part of the state of Haryana. It mostly consists of the Yamuna sub-basin of the Ganga basin. Most of which is a part of the Ghaggar-Yamuna alluvial Plain. There is no natural drainage system in the district. The natural slope of the Hisar district is from north-east to south-west and on the west side, the gradient is 1 in 400. The mean altitude varies from 210 to 220 meters. The topographic pattern of the district shows clear signs of past geomorphic processes related to the arid climate. The western and southern parts mark a gradual transition into the Thar Desert. This part is rather plain characterized by undulating slopes and sand dunes or tibias. The district is divided into the following physiographic unit:-

1. **Sub-Recent Alluvial plain**
2. **Late Quaternary to sub-recent sand dunes area**
3. **Plain with sand dunes**

Sub-Recent Alluvial plain

It is the Flood plain of Gaghar and Joiya (a non-existing river). Both rivers developed this plain as the long deposition process. The slope is gentle and trending north-east to

south-west. This plain has experienced a revolution in terms of population and agriculture. This part of the plain is very fertile in terms of agriculture.

Late Quaternary to sub-recent sand dunes area

This part can be classified as active and non-active sand dunes and fossils. The active and moving sand dunes are a prominent feature on the western side of the district. This part is known as Bangar. There is no vegetation cover here and trees and plants are also rarely seen. Due to excessive grazing within the area, the vegetation cover is being removed and due to this, the cover of sand is gradually increasing. The powerful winds from the southwest blow sand from here and carry it for long distances. The sand keeps on transferring from one place to another. Through this process, dunes move from one place to another, and what was fertile a little while ago eventually is covered by the dunes. Active sand dunes can be classified as sand cover, sand hummocks, and transverse dunes. Some of these can be of 2-meter height. The active and inactive sand dunes are sub-recent in age.

Fossils and sand dunes are important geomorphological features in the south-west part. The specialty of the desert of Hisar is that the sand here is very fine. The thickness of sand particles varies from 0.13 to 0.16 mm. Fossil sand dunes profile carries buried profile. The soil of this type is dark brown to reddish. It is decalcified and acidic. The concentration of these fossil sand dunes is in the south and south-east. The south and south-eastern part represent the boundary of the fossil dunes. The best example of fossil dunes is found in Tosham Tehsil adjoining the district. Depending on the morphology, these sand dunes are quite varied and some of them are traverse type and some have a very wide base. Their elevation ranges from 3 to 12 meters and some of them are as long as 12 kilometers in the form of a ridge. Fossil dune ridges are found 6 to 15 kilometers in length in the south of Fatehabad. These ridges are up to a height of 2 meters but are found anywhere from 5 to 7 meters in height. They are also found in the south and west areas of Jamalpur to a height of more than 6 meters.

Plain with sand dunes

This part of the field is known as Hariana. Hisar is an important part of the district which comes under its eastern region. The eastern region of Hisar tehsil and almost the entire Hansi tehsil is included under it. Sand dunes and hills are scattered here and

there broadly undulating in character. Older Alluvium patches are found here and there under shallow sand cover.

2.1.6 Soils

The soil of Hisar district ranges from light to loam type. The soil of Hisar city can be divided into three divisions:

1. **Heavy Loam or hardish loam (rausli)**
2. **Light sandy soil (bhur)**
3. **Heavy clay (sotar)**

The rausli type of soil is found in Hisar tehsil, Hansi tehsil, and the adjoining part of Fatehabad district. This soil is very fertile on the availability of rain and irrigation and gives a good yield. The Bhur type of soil covers most parts of Hisar district and is predominantly found in the western and south-western part of the district. This soil is the permeable type and has low water holding capacity. Sotra type soil is found in adjacent areas of the Fatehabad district. These soils are very fertile and are used for intensive agriculture. According to the **United States, Comprehensive Soil Classification System (1960)** the soils of Hisar can be divided into the following three types:

1. **Arid Brown Solinized** – (in the northeastern part of Narnuand and Uklana Mandi blocks.)
2. **Sierozem** – (in most of the district)
3. **Desert soils** – (in the south-western region of the district including Adampur and Hisar – II blocks) (District Gazetter, Hisar, 1987).

2.1.7 Drainage

Hisar district is largely covered under the Ghaggar basin. It has no natural drainage system. There are 36 artificial drains in the district, which cover a length of about 126 km. There are two major drains under this area that pass through the blocks Bass, Hansi II, Barwala, and Narnaund. There is no major river under the district in the name of a large natural source of water. This district acts as a water divider between the Ghaggar and Drishdawati rivers. Drishdawati is an extinct river and its former

channel is occupied by the Hansi branch of the Yamuna river. Many types of natural drains appear on the floodplain of Ghaggar when it rains. Due to the lack of rainfall, there is a network of canals and artificial drains in this area that meets the need for irrigation. Tube wells, artificial wells, and ponds also help in irrigation. Bhakra and Western Yamuna Canal are major sources of irrigation in the district. The Gorakhpur, Pabra, Subra, Badhawar, Panihari, Nara, Masudpur, Kharkhari, Rana, Balasmand sub-branches, Hisar major, Petwar, Sunder, and Deva branches are the main irrigation support for the district. About 76.83% of the district is under canal irrigation and 23.17% is covered by groundwater. **(District Gazetter, Hisar, 1987)**.

2.1.8 Economic Resource

2.1.8.1 Forestry

The forest of Hisar falls under the category of Tropical Thorny species. They are mainly Xerophyte types. The only regular forest area in Hisar and Hasni is the Bir area. The district is not very rich in terms of natural flora. It is scantly and sparse. Trees are only found in forest areas, cultivated land, wastelands and habitats. The main types of trees in this area are ***neem, kikar, jand, roheru, imly, banna, shisham, bakain, gulmohar, kachnar, siris, pahari kikar, amaltas beri, lasura etc.*** These trees are planted along roads, canals, railway lines, govt. and private institutions and habitats. Eucalyptus was planted under agricultural and farm forestry schemes. To check desertification in the south and south-west areas jand farash, khairi, castor, kana and ruhera have been planted by govt initiatives. These trees help to cut down the speed of the wind to slow down erosion. The main types of shrubs are hins, panwar, babool, mallah, karir, phoa, khip, and ak. Medicinal herbs found in the district are bansa, indirain, aswagandha, glo, kharuthi, bhakhra, dhatura etc. But these are available in scattered form and not very economical. There is a variety of grass found in the district as anjan, dhaman, dub, kana and dabh. Uncontrolled grazing is destroying anjan, dub, dhaman types of grass.

2.1.8.2 Minerals

The hard rocky surface of the district is covered by alluvial and Aeolian deposits. These alluvial deposits belong to the Quaternary Age and are of both new and old

types. The northern part of the district is an active flood plain consisting of sand, silt clay, and gravel. Calcareous stones mixed with other ingredients are also included in the deposits. These deposits are very heterogeneous and are found on metamorphic and igneous base rock sloping towards the northeast. Aeolian deposits are found in the southwestern part of the district, which is mainly deposited by wind gusts from the Thar Desert. These are in the form of sandy flats, mounds, and ridges. The main minerals of the district are the following:-

Kankar: These can be found in various portions of the district's sandy terrain. It is used in road and building construction.

Salpetre: It is a kind of thin whitish-yellow, brittle deposit over the soil. It is can be seen in the basement of Kacha construction in old and deserted villages. Bloating usually appears from April to June and resolves during the rainy season. With the runoff, nitrate got denitrified. It is only concentrated on the topsoil. It is used for making potash and nitrate. Many saltpeter refineries are established in the district. The refined products are used in fireworks, gunpowder, and agricultural fertilizers. (**Source: Hisar District Gazetter, 1987)**

2.1.9 Population and Settlement

Hisar is one of the major and largest districts in west-central Haryana. In the 2011 census, the population of the district was recorded as 1,74,3931 persons, but in the census year of 1961, it was recorded, as 577,887 persons (Table 2.1).

Table 2.1: District Hisar: Growth of population, 1961-2011

District Hisar	Census years		Absolute increase in population	Percentage increase in population
	1961	2011		
Total population	5,77,887	17,43,931	11,66,044	202
Rural	4,80,365	11,90,443	7,10,078	148
Urban	97,522	5,53,488	4,55,966	467

Source: Census of India 2011

It shows a 202 percent growth in the past 50 years. The Rural population shows an increase of 148 percent from 480,365 in 1961 to 11,90443persons in 2011. The Urban

population increased from 97,522 in 1961 to 5,53488 persons in 2011 showing a growth of 467 percent more than three times than the Rural population.

During the last 50 years, the population of the district increased about 3 times. It is far more than the state average which is 2.3 times. Thus the district population growth is faster than that of the state. In terms of the rural-urban population, a little less than one-third (31.7%) live in urban areas, and around (68.3%) live in rural areas. The urbanized population in Haryana state is around 34.8%. Thus the urbanization process in Hisar is slower than that of the state as a whole.

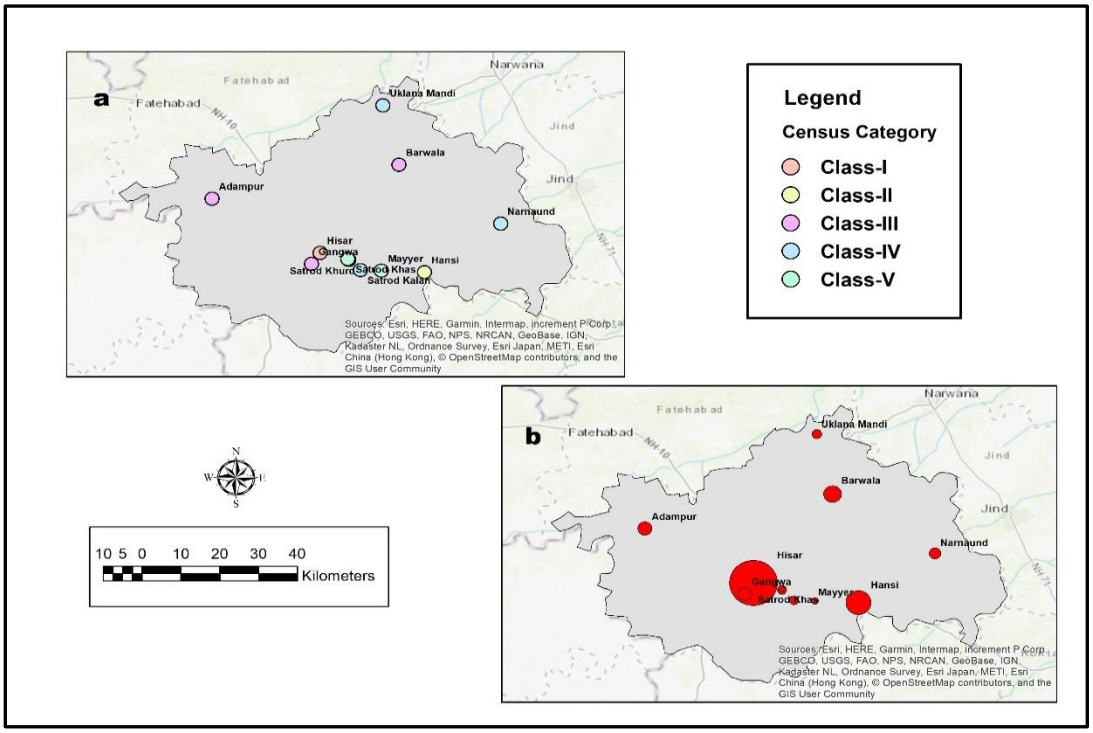


Fig. 2.5: Size and census categories of UBs, 2011

Source: Census of India 2011

In 1961, there were only three towns (Hisar, Hansi, and Uklana) in the Hisar district. This number increased to 5 towns in 2011. Most of these towns are located in the eastern part of the district. The above figure 2.6 shows the census-defined categories of various urban agglomerations and towns in the district in 2011. The largest urban agglomeration group in the district is Hisar city (M.C.I and its outbreak) with a population of 307024 people. It is the only class I city with a population of one lakh people. The second-largest agglomeration is nearby Hansi town. It has a population of

around 86770 persons. It comes under the category of Class II (50000-99999) town. There are three towns Barwala, Gangwa CT, Adampur comes under the category of Class III. The population of these three towns is respectively 43384, 25847, 25531. Narnaund (17242), Uklana Mandi CT (13219), Satrod Kalan CT (11932), Satrod Khas CT (10932) are coming under the size of Class IV. The remaining two towns Mayyar CT (6039) and Satrod Khurd (5568) come under the size of Class V.

When it comes to the rural population of the Hisar district, the Pabra village is the most populous with a population of 26331 persons and Tharwa village is the least populated with a population of only 54 persons. Only three villages are having a population above 20000. There are 9 villages with population ranges between 10000-20000; 70 villages rages between the population 5000-10000; 166 villages range between the population 1000-5000; 21 villages range between the population below 1000. Thus the large villages in terms of population are more in the district. They serve as the service center for small villages.

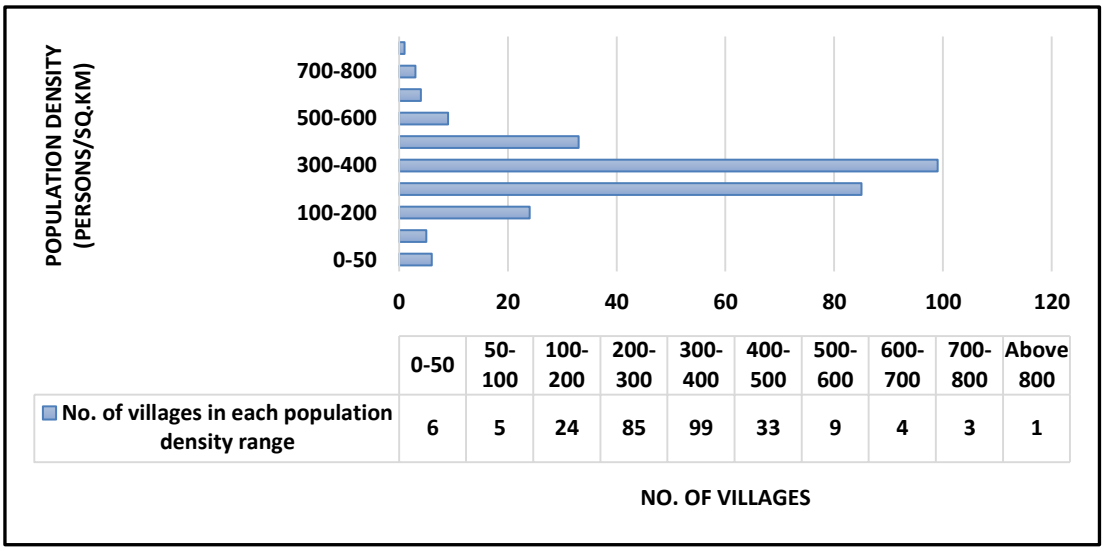


Fig. 2.6: Distribution of villages in different population density ranges, 2011

Source: Census of India 2011

The average density of 269 villages of the Hisar district is 302 persons per sq. km. 6 villages fall under the category of 0-50 persons per sq. km. 5 villages fall under the category of 50-100 persons; 24 villages fall under the density range 100-200 persons; 85 falls under the category of 200-300 persons per sq. km; 99 villages fall under the

range between 300-400 persons; 33 villages fall under the category of 400-500 persons and 9 villages fall under the category 500-600 persons. Only 4 villages fall under the category of 600-700 persons per sq. km. 3 villages fall under the category of 700-800 and there is only one village with a population density of 1745 people per square kilometer (fig. 2.7).

The analysis of the data from the above mentioned figure, It is clear that the a large proportion of the villages in the Hisar district have a population density of 301-400 people per square kilometer. The sex ratio of the Hisar district is 871 in 2011. It is less than 6 numbers of the state average which is 877. In 1961, the sex ratio in rural areas was recorded as 876 in comparison to 817 in urban areas. In 2011, the sex ratio in rural areas was recorded as 876 and in urban areas, it was 860. Thus in rural areas, the sex ratio is higher than that of urban areas (Table 2.2). It can be because of the intensive migration of the people living in the rural area towards the urban area. But it is also an evident fact that during the last few decades because of the development of transportation facilities, commuting becomes much easy from rural to urban areas. And that is why the gap between rural and urban sex ratio is narrowing down.

Table 2.2: District Hisar: Sex Ratio 1961-2011

Sr. No.	Sex ratio	Census year		Differences
		1961	2011	
1	Rural	876	876	0
2	Urban	817	860	43

Source: Census of India 2011

In 1961, the overall literacy rate of the district was 21.2 percent. In rural areas, it was 15.3 percent, whereas in urban areas it was 46.3 percent. With government efforts and initiatives in the education sector, tremendous change has been witnessed during the last 50 years. In the 2011 census, the literacy rate of the district was 73.2 percent. It was 70.0 percent and 80.1 percent in rural and urban areas respectively. In terms of state statistics, the values are less. The average literacy rate of Haryana was 76.6 percent, and 72.7 and 83.8 percent in rural and urban areas, respectively. The ongoing effort of the government may be in coming future can be able to reduce this gap.

2.1.10 The economy of the Hisar District

The economic system of the Hisar district depends primarily on the agricultural sector. The figure 2.8 shows the distribution of agricultural development indicators of Haryana. It is the dominant economic activity with a waste area of fertile plain and irrigational facility by Bhakara canal, West Yamuna Canal, and personal, private, and govt owned tube wells. The establishment of Haryana Agricultural University and Lala Lajpat Rai Veterinary University trigger the agricultural development in the district as well as in the Haryana State. These reputed institutions with their ongoing research in the field of agricultural and allied activities transform the conventional methods into the innovational stage. With these efforts, the district is not only self-sufficient in the food grain but also helping the other parts of the country to achieve this target. It is a major exporter of food grain, cotton, gram, oilseeds and other agricultural commodities. It is also very famous not only in India but in the world for the Murrah breed of buffalo known as Black Gold **(District Statistical Abstract, Haryana, 2023-24)**.

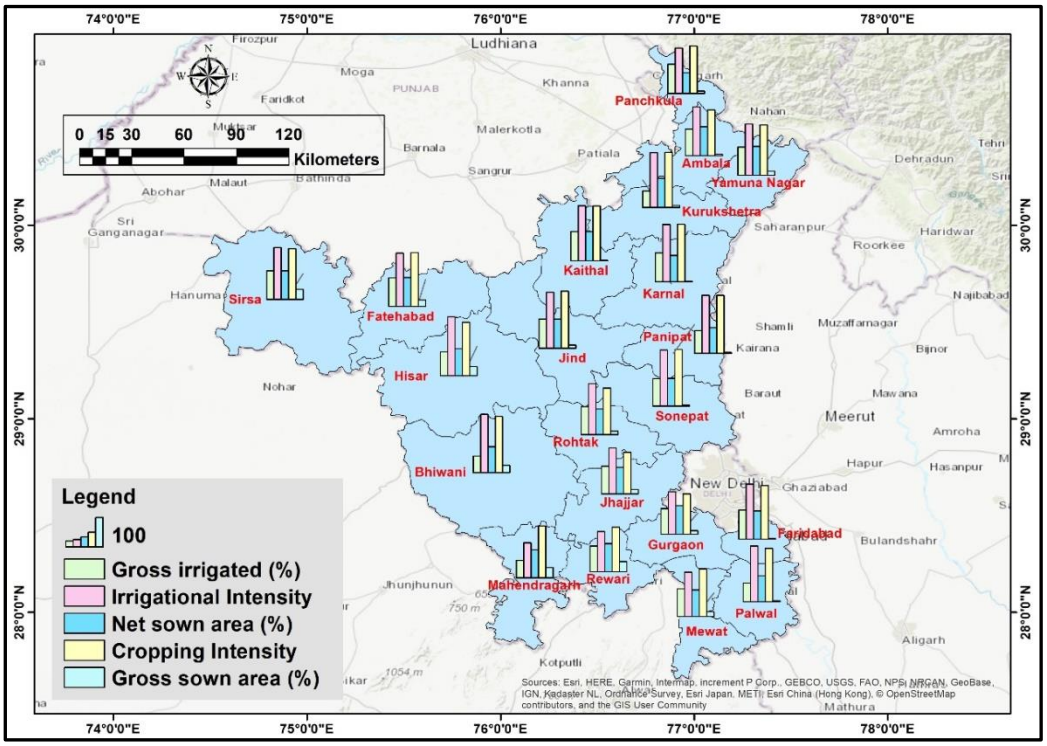


Fig. 2.7: District Hisar: Selected indicators of agricultural development, 2018-19

Source: Compiled from District Statistical Abstract, Haryana, 2019-20

Livestock rearing also increasing with the growing demand for milk products in the districts. It is at the commercial level with the help of ongoing innovational efforts in the collaboration of HAU and LUVAS. To cater the demand for poultry products, a significant number of poultry farms are settling up in various places in and around the city. The district administration with the help of HAU is providing technical help and subsidy for establishing allied agricultural activities such as Bee-Keeping and fisheries in the district. These efforts at the administration level intensified the process of agricultural commercialization and diversification in the district. it also increases the mutual relations between the city and the surroundings **(District Statistical Abstract, Haryana, 2023-24)**.

2.1.11 Industry

The Hisar district historically depends upon the primary activities mainly agriculture for providing a base for its economy. But with time, the establishment of different types of industries gives a boost to the industrial-based economy. The crude saltpeter, coarse country cloth, oil pressing and embroidered woolen sheets are primarily rural-based household industries in the 19th century. Traditional caste-based activities such as black-smithy, shoe-making, and cloth weaving were prominent in every village in the district. The Hansi town was famous for a handloom woven named known as ***Hansi Check.*** After independence, with a focus on agricultural development, many agro-based industries were set up in the district. The first large-scale textile industry was established in Hisar city in 1955. In 1963, a steel pipe manufacturing industry unit was set up in the city. After the creation of the state of Haryana, the industrial revolution took place in the city as many large and small-scale industries were set up in the city. In the coming decades, it evolved as an industrial hub in west-central Haryana. It's about 46 large-scale and 3675 small-scale registered industries were established in Hisar and Hansi towns. These units are involved in the production of agricultural implements, flour mills, cotton ginning and pressing, oil and dal mills, light engineering, steel fabrication, steel wires, aluminum and stainless furniture and utensils, paper products, chemical, rubber, printing, woodwork, leatherwork and ice making. The surrounding countryside provides labor for these industries. It enhances rural-urban interactions and strengthens the mutual bond between the two. **(District Statistical Abstract, Haryana, 2023-24)**.

2.1.12 Trade and Commerce

In the 19th century, Hisar city emerges as a central place for the surrounding countryside. The Hansi town has also become a principal market for the collection centers for different commodities. People from different villages came to these towns and obtained their necessities like clothes, utensils, groceries, home appliances, agricultural goods, etc. In times of shortage and sky-hugging prices of food grains and other commodities, local farmers and sellers use to visit other local markets in the adjacent areas of Punjab for buying and selling Till the 20th century both the town maintains its status as a major marketplace for surroundings. After independence, an ongoing effort in the agriculture sector gives rise to the production of agricultural products. Many large and small-scale industries were set up in the district. The main export items from the district were cotton, grams, oilseeds, steel pipes and tubes; whereas the import items are salt, gunny bags, kerosene, and raw materials for iron and steel industries. With passing times growth in trade and commerce strengthens the rural-urban relations and in turn growth of the fringe area intensified. For providing better sale purchase facilities to the farmer many agricultural-oriented markets were set up in the district. Hisar (1941), Hansi (1941), Uklana Mandi (1951), and Barwala (1971) were the main markets for this purpose. During 1971-72, the main commodities coming from rural areas were gram, cotton, mustard, wheat, maize, bajra, potatoes, gur, chilies etc. During 2000, the main agricultural commodity markets in the district were Hisar, Hansi, Adampur, Uklana, Barwla, and Narnaund and six sub-yards were established in the different parts of the district. This commodity exchange strengthens the mutual relations between the rural and urban areas **(Department of Industry and Commerce, Haryana 2024)**.

2.1.13 Occupational structure

Historically the Hisar district was mainly an agricultural district, where mostly the workforce was engaged in primary activities. In 1961, around 79.6 percent of the workforce was involved in agricultural activities. But in 1991, this figure comes down to a 69.1 percent workforce designated as agricultural workers and that has been reduced to 58.6 percent in 2001. (cultivators and agricultural laborers). But the

percentage of marginal workers is still very high (72%). In 2011, the main workers were 30.46 percent, 9.20 percent were marginal workers and 60.34 percent were non-workers. According to the available data, the proportion of cultivators among the total workforce (including both Main and Marginal workers) is 37.8 percent, while the percentage of agricultural labourers is 20.9. Additionally, 2.3 percent of the workforce is comprised of HHI workers, and the remaining 39.1 percent are classified as other workers **(District Census Handbook, Hisar, 2011)**.

2.1.14 Transport and Communication

In terms of transport and roads, the district has a well-developed network. The district is a major railway junction. It connects many important educational, historical, cultural, and economic centers in the surrounding areas. In the 19th century, the main connected roads are from Delhi to Hisar and Hansi to Bhiwani. Railway networks were established in the first quarter of the 20th century. National Highway that passes through the district is no.9 from Malout to Pithoragarh (the old segment of National Highway No 10.) Another national Highway 52 (Sangrur to Ankola) passes through the district from north to south direction. State highway No. 10 (Gohana-Jind-Barwala-Agroha-Adampur-Bhadra road), State Highway No. 12 (Karnal-Assandh-Jind-Hansi-Tosham-Sondhiwas road), State Highway No. 14 (Panipat-Safidon-Jind-Bhiwani-Loharu road), State Highway No. 17 (Nizampur-Narnual-Mahendergarh-Chakri Dadri-Bhiwani-Hansi-Barwal-Tohana up to Punjab border) passes through the district. Other important roads Hisar-Tosham-Bhiwani ; Uklana-latani-Uchana ; Hansi-Uchana ; Hisar-Balsmand-Burak ; Uklana-Daultpur-Barwala-Hansi-Data ; Hansi-Julana. To enhance physical accessibility, metalled roads were constructed to link the surrounding villages with the district headquarters and to improve connectivity among the villages themselves.

There are three Broad Guage railway lines i.e Rewari-Hisar-Bhiwani-Sirsa; Hisar-Jakhal Mandi and Hisar- Siwani. Hisar city has an airport serving the Haryana state and India. It is located in the northeast direction on National Highway No. 9. The first strip for flights was constructed in 1948. In 1965, it developed as an aviation club.. Under the UDAN regional connectivity scheme, the airport has been licensed

for commercial operations, with Alliance Air operating scheduled services to destinations such as Delhi and Ayodhya, thereby improving air connectivity for Hisar and adjoining districts. It can be developed as a counter magnet of Indira Gandhi International Airport. The Haryana Government is planning to develop it as an aviation hub.

CHAPTER 3

DELINEATION OF THE RURAL-URBAN FRINGE

3.1 The Delineation of Urban-Rural Fringe

The fringe zone of a city is a kind of dynamic area that surrounds the city. It shows a significant change and growth in its characteristics with a period. With the development of the city, innovations take place, which in turn also affects the fringe area **(Nuissl, Siedentop, 2021)**. As the city grows outward, the fringe also expands and gets interwoven with the city in such a way that the demarcation of the two becomes a very difficult task. Many attempts have been made in the past in this regard but only to a certain extent. Many articles have been published related to this phenomenon, but so far as a systematic approach to define and delineate this outward growth is concerned, they are very few. Many Indian and foreign authors did a remarkable job to fulfill the investigation motives in this field of knowledge. With insight into these works, the following discussion ensues:

Census-based delineation methods:

Wehrwein (1942) delimited the fringe area of Indian Polis city. This study considered the population density variable. The criterion was that the density should not exceed 150 per sq. mile.

Mayers and Beagle (1947) in their study related to Detroit city, tried to delineate the rural-urban fringe based on Non-village, Rural Non-farm population (NV-RNF). The settlements of surrounding areas having NV-RNF population 50% or above were considered as "Rurban Fringe. But if it is between 25%-50%, then it is considered as partially fringe.

Rodehaver (1947) in his study related to the fringe region of Medison city, points out the demographic, social and cultural characteristics. His parameters of the study were:

1. The ratio of non-farm families and total families in a section.
2. Non-farm population density per sq. mile.
3. The valuation of land and buildings per acre.

Blizzard and Anderson (1952) in their work related to the delineation used automobile reconnaissance and inspection methods and demarcate the fringe area of Williamsport-Pennsylvania urban regions. They conclude that the starting point of the inner boundary of the fringe is the ending point of the corporate boundary of the city and services related to the city are not fully functional. Further, the outer boundary of the fringe area starts with some kind of yielded farms, non-farm type houses among farms, and farming and forest land use.

Smith (1937) identified four types of indicators for the delineation process.

i) The land which Sub-divided in two parts, but not recorded and developed by the Planning Board

ii) The farmland available to be sold for non-agricultural land use.

iii) Land under non-agricultural use as unusable or for tenant farming.

iv) Farmland with a higher value than ordinary farmlands assessed by local assessors.

The international Urban Research Unit of California University concluded that the fringe area should be delineated on the basis of available work force data. If 65% of the labor force is working in secondary activities, then it should be included in the urban fringe.

Russwurm (1969) in his study related to the fringe demarcation of London (Ontario) was more precise and detailed. He classified each 200 acres plot based on their owners or tenants engaged in non-agricultural activities. Based on the classification, he underlined those areas of the fringe zone where half of the population i.e. 50% of families were involved in non-agricultural types of activities.

Kurtz and Eicher (1958) worked out five parameters for defining "Rural-Urban fringe", which distinguished it from the suburb. They suggested location, land-use, population growth, density, occupational structure, and governmental structure. They presented that the suburb develops from the inner side of the fringe towards the city.

Martin (1953) in his work of delineation of the fringe area of Eugene spring field (Oregon) used the probability area sampling method. He determined the location of

single-family residence outside the corporate boundary and natural barrier, both of which included in the study for the delineation process of the fringe area.

In India,

U. Singh (1966) delimited the rural-urban fringe of KAVAL towns with the help of maps based on five geographical factors—(1) build-up areas and houses, (2) street patterns and types, (3) occupation distribution, (4) sites available for different institutional activities and industrial units, and (5) presence of brick kilns.

In 1978 **Gopi (1978)** delimited the suburban centers of Hyderabad district based on daily commuting and supply of essential services.

Singh and Rao (1979) in their work related to the urban fringe in Great Plains considered the following determinants for the demarcation— (i) newly set up public institutions, (ii) topography permitted by girdle of brick kilns, (iii) extensive area covered by residential houses, (iv) bungalows and juggins handing, (v) haphazardly growing urban function, (vi) lack of urban amenities, (vii) village enclaves that shelter low paid workers and new migrants stand out as islands, (viii) maximum speculations of land value due to private and semi-public agencies, (ix) uneven density of population ranging from very low to very high.

Alam and khan (1972) in their work related to the Hyderabad Metropolitan region, they analyze various characteristics such as total persons, retail trade, transport, commuting, drinking water supply, electricity utilization, and postal, and telecommunication service. Besides these characteristics, five other parameters such as electric consumption population variation, density, sex ratio, and non-agricultural workers are also taken into consideration. During this study, it comes out that the zone of influence of this city region stretches over 40 miles from the city center. There is also a zonal structure as it includes; the metropolitan core, the peri-urban, and the rural hinterland. The region of metropolitan dominance spreads to a radius of 40 miles from the central city.

Srivastava and Ramachandran (1974) in their study proposed the factors which carve out the present form of Delhi. This study develops a “stage model” to depict different phases that villages around the city pass through. The rank of the villages

were based upon the land use and land cover pattern, occupational engagement of the working class, mutual relations with the city region, available urban amenities and locational parameters.

Lal (1973), in his attempt to study Bareilly fringe, has proposed that the fringe zone is a crucial part of the urban development process, but the word is not yet standardized owing to vagueness. However, the unnecessary and unplanned developed pattern of land because of the outward growth of the city can be chosen as the fringe's representative.

Jyotsana Pandey (2010) in her delineation process of the rural-urban fringe of Varanasi considered the following criteria:

i) Spatial Determinants

ii) Occupational structure: the ratio of non-agricultural workers

iii) Demographic determinants: density of population; population growth; sex ratio; literacy,

iv) House type and streets

Zahoor Ahmed Negroo (2011) delineated the rural-urban fringe of Srinagar using the following determinants

a) The ratio of Non-Agricultural workers

b) Sex Ratio

c) Literacy Rate

d) Population Density

In this respect, **Phadka and Sita (1982), Gowder (1981), Kumar (1980), Sinha (1980), and Hyma's** work could be mentioned.

Contemporary methods for delineation:

Wang et al. (2010) used comparable entropy concepts for Beijing from TM images, recognizing fringe zones as regions of highest land use complexity. Entropy-based techniques satisfactorily incorporate the ***"transitional"*** character of fringe zones using quantitative landscape measures.

Huang et al. (2016) illustrated land use entropy has a maximum in the fringe regions because they are typical of containing a combination of urban and rural land covers within the Guangzhou-Foshan metropolitan region. They observed entropy values usually between 0.2-0.6 in urban centers, 0.1-0.3 in new town clusters, and decreasing below 0.1 in rural regions, with the fringe regions having intermediate values.

Dong et al. (2022) employed industry-specific POI density to define the urban fringe of Beijing, with secondary industry POIs being highly concentrated in fringe zones. Their analysis of industry density gradients established distinct breakpoints among urban, fringe, and rural zones.

Zhu et al. (2022) designed a dual spatial clustering technique combining NPP/VIIRS NTL data with land cover information in order to control for spatial heterogeneity within fringe zones. It detected three different urban fringe subzones in Beijing through development intensity gradients. These multi-source techniques are much more advanced compared to conventional single-indicator methods by reflecting the multidimensional character of urban-rural transitions.

Yu et al. (2023) integrates Points of Interest (POI) information with nighttime light (NTL) information from the Suomi NPP-VIIRS satellite to produce a composite index that incorporates economic activity intensity (via POI density) and human settlement patterns (via NTL). The integration process resulted in greater accuracy (93.2%) than using either dataset exclusively (84.2% for NTL only), given that it addresses issues such as light saturation in city centers and limited POI distribution in the countryside.

Li et al. (2023) also suggested a fringe extraction model tailored to small- and medium-sized urban regions by integrating Sentinel-2 imagery with Open Street Map data using a random forest classifier. Such AI-based methods hold special promise to tackle the nonlinear relationships present in urban-rural transition.

Yin et al. (2024) built upon this economic view with their ***"Scene-Object-Economy"*** framework, combining remote sensing imagery, POI data, and economic census data. This three-pronged method enabled simultaneous analysis of physical environments, functional facilities, and economic activities along the urban-rural continuum.

Above mentioned methods are more applicable for the broad study unit like metropolitan city due its spatial resolution. The study only focused on the census based indicators for avoiding the spatial resolution related issues in a smaller study are.

3.2 FRINGE DELINEATION OF HISAR CITY

The above-stated discussion of different studies of different scholars reveals that effort had been made at different time periods in past to delineate the fringe zone of various urban areas and city regions. The rural-urban fringe is kind of a peripheral outgrowth of the urban area with some specific characteristics. Based on these characteristics scholars delineate and demarcate the outskirts of the urban area. For this purpose, certain predefined indicators or determinants are decided in advance. With the help of these identified criteria, the determination of the rural-urban fringe becomes easy. But these indicators of the delineation process cannot be advisable in Indian conditions. The socio-economic and cultural condition of western cities or urban areas is very much different from that of Indian cities. India is a developing country, and urban growth in India is characterized by haphazard and unplanned development. That is why to determine the outgrowth of Indian cities scholars analyzed applicable socio-economic and demographic factors. Many Indian scholars take a challenge of this task and with their remarkable works tried to demarcate the rural-urban fringe of Indian cities. But yet a comprehensive and more effective methodology is missing. With the growth of modern geographical technology, new methods and demarcation techniques are evolving in the field of urban geography. This may facilitate the demarcation process of rural-urban fringe in urban areas.

Hisar city is located in the west-central region of the state of Haryana. It serves as the administrative center for the Hisar district. Firoz Shah Tughlaq established it as a fortress in 1354 A.D. During the Mughal period, the city was known as ‘Sirkar’ which was designated as headquarter of the revenue division. This city had a key position during British rule and after independence as well. It grows more rapidly due to favorable government policies and industrial establishments. The city stands first in Non-N.C.R cities in terms of population. Only three N.C.R Cities i.e Faridabad, Gurgaon, and Rohtak have more population than Hisar city. National Highway No. 9

and 52 passes through the city. The city has a strong socio-economic connection with other cities like Fatehabad, Sirsa, Kaithal, Rohtak, Jind, Bhiwani, Rajgarh, Delhi etc. Mostly, it is developed along with National Highway No. 9 (Hisar to Delhi road). Hisar city is a part of Hisar division. There are four tehsils (Hisar, Hansi, Namaund, and Adampur) in Hisar district. There are nine community development blocks—Hansi-I, Hansi-II, Agroha, Barwala, Adampur, Narnuad, UklanaMandi, Hisar-I, Hisar-II. It consists of 269 villages and four statutory towns namely Hisar, Hansi, Barwala, and Uklana as per the 2011 Census. There are 31wards in the city and Haryana Agriculture University and Mini Secretariat (OG) come under ward 32. Hisar is also the major trade and Commerce center in Central-West Haryana. Commodity exchange between rural areas and the Hisar market also strengthens the rural-urban relationship. As the most important town in Central-West Haryana, the growth of Hisar city is comparably higher than other nearby towns. It provides employment opportunities, medical facilities, quality education, housing, and better living standards. All these facilities act as a pull factor. This intensifies the process of migration of population towards the urban area and in turn, the city-region expands towards the countryside. Linear expansion can be seen along Hisar -Siwani road, Hisar –Tosham Road, Hisar- Hansi road, Hisar-Barwala Road, Hisar-Agroha road, and Hisar-Balsamand road. Keeping in view the above discussion in mind it can be justified that Hisar city provides a proper ground for examining the rural-urban fringe in a spatial-temporal framework.

For the delineation of the rural-urban fringe of Hisar city, the study mostly relies on the census based indicators which are align with the administrative boundaries for local planning. These are following:

3.2.1 Occupational determinants

- *Ratio of non-agricultural workers:* this indicator serves as a key economic fringe marker. **Fang et al. (2022)** they used this indicator for delineating fringe area in Beijing and reported that non-agricultural employment rate ranges between 60-80% in fringe zone compared to urban core and rural areas. Therefore, this indicator reflects the economic transition.

3.2.2 Demographic determinants

- *Population density:* Multiple studies identify population density as a fundamental fringe indicator. The Wuhan study found fringe areas typically had intermediate population densities (2556 persons/km²) between urban cores (>5000 persons/km²) and rural areas (<1000 persons/km²) (Yu et al., 2023). Population specialization methods, as demonstrated in Guizhou Province, can effectively bridge census data with spatial analysis **(Wang et al., 2024)**.
- *Literacy:* Education attainment shows distinct urban-rural gradients, with fringe areas often exhibiting intermediate values. Studies note that fringe zones frequently have higher literacy rates than rural areas but lower than urban cores, reflecting their transitional status **(Yu et al., 2023)**.
- *Sex ratio:* Demographic studies note distinctive sex ratio patterns in fringe areas, often showing higher masculinity ratios due to labor migration patterns **(Fan, 2003)**. These demographic characteristics can serve as ancillary fringe indicators.
- *Household Density:* **Haldar (2023)** reports that peri-urban areas in India display considerable variation in household density, land subdivision, and infrastructure availability. Areas with moderate household densities are particularly subject to high development pressures, where agricultural land increasingly exists alongside growing non-farm and built-up uses. The study emphasizes that effective planning and policy measures must consider these spatial differences in household density to preserve agricultural resources while addressing the demands of a growing population.

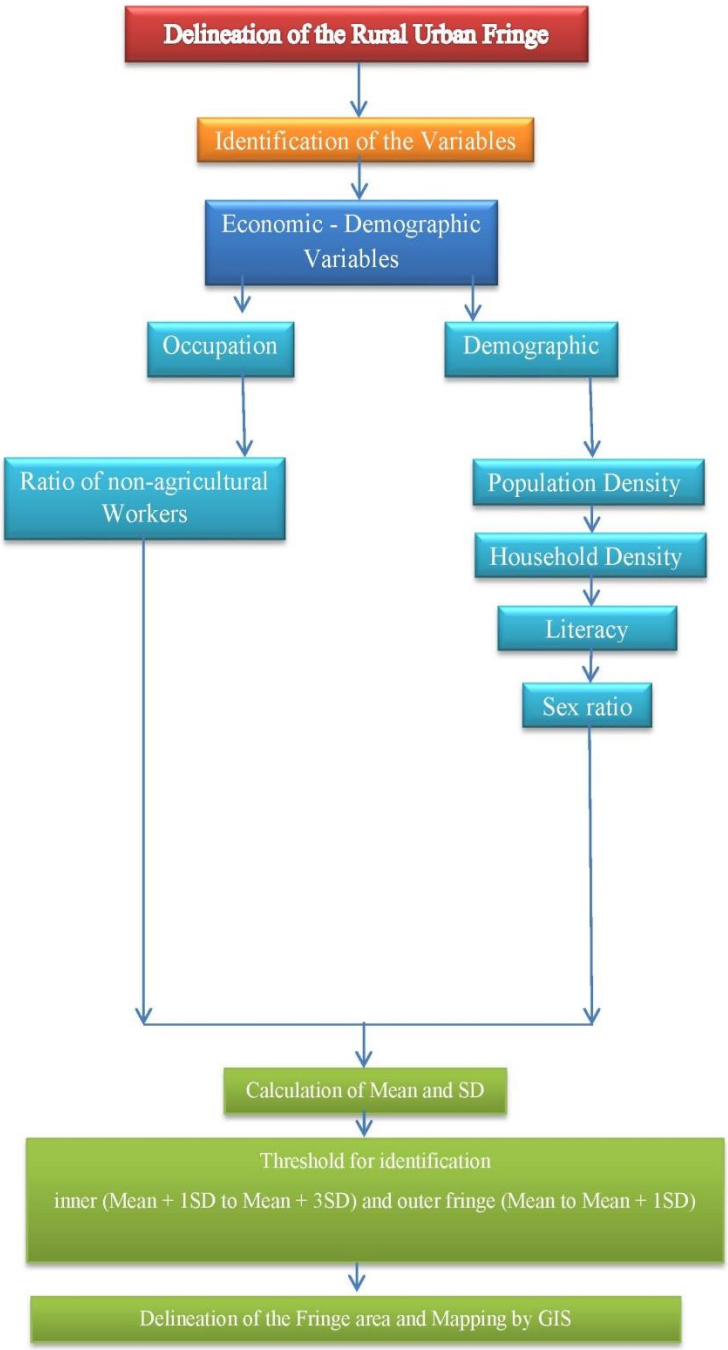


Fig. 3.1: Methodological Framework of Rural–Urban Fringe Delineation

3.2.3 Occupational determinants

3.2.3.1 Ratio of non-agricultural workers

It is the most significant variable to determine the occupational structure of villages. The socio-economic characteristics of these surrounding villages are significantly

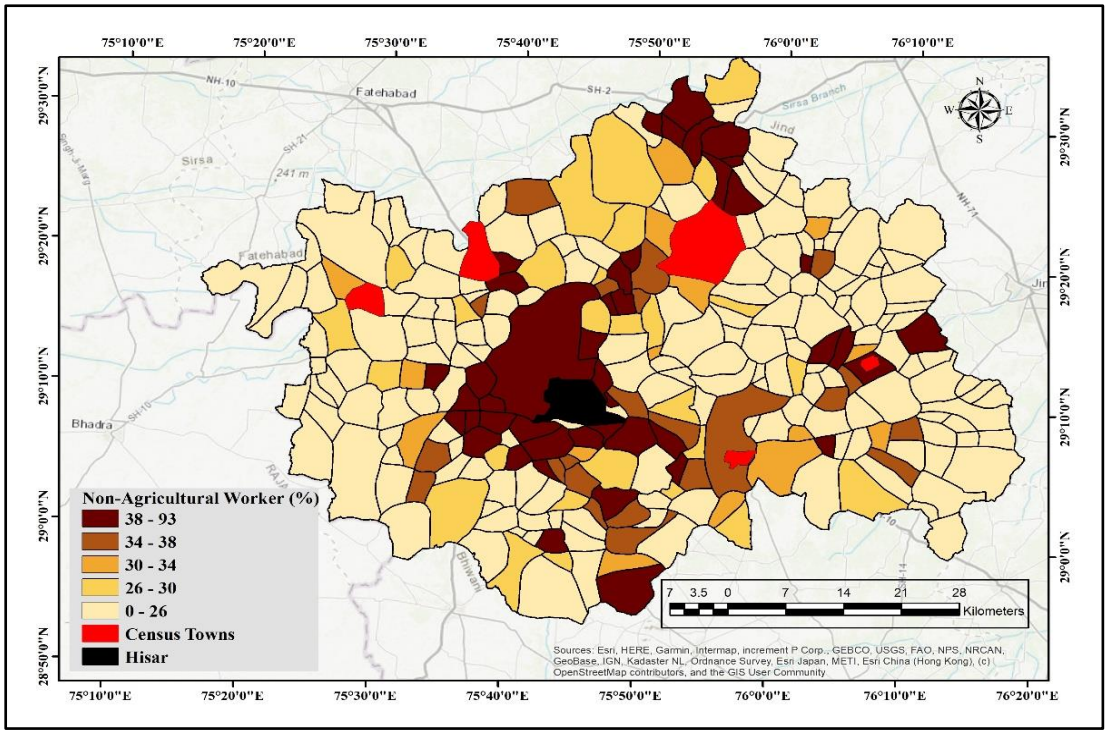
influenced by urban centers. The ratio of non-agricultural workers tends to be high in adjoining rural areas of urban influence. The majority of the people in these rural areas are employed in the household, manufacturing sectors, construction, trade-commerce, transportation, and other services. The mean percentage of total non-agricultural workers engaged in the Hisar district is 26.43%. Those villages having more value than average show urban influence and are included in the rural-urban fringe. The Villages that attain the value of less than the mean considered as peripheral rural areas. Thus, the lower limit of rural-urban fringe coincides with the mean percentage of non-agricultural workers. The standard deviation method has been taken for grading the intensity of determinants. Villages showing value between Mean (26.43) to Mean + 1S.D (26.43+ 4.03) included in rural fringe. Villages showing value between Mean + 1S.D (30.46) to mean + 3S.D (38.53) are included in the urban fringe.

Table 3.1: Range of values for Demarcating Ratio of Non-Agricultural Workers

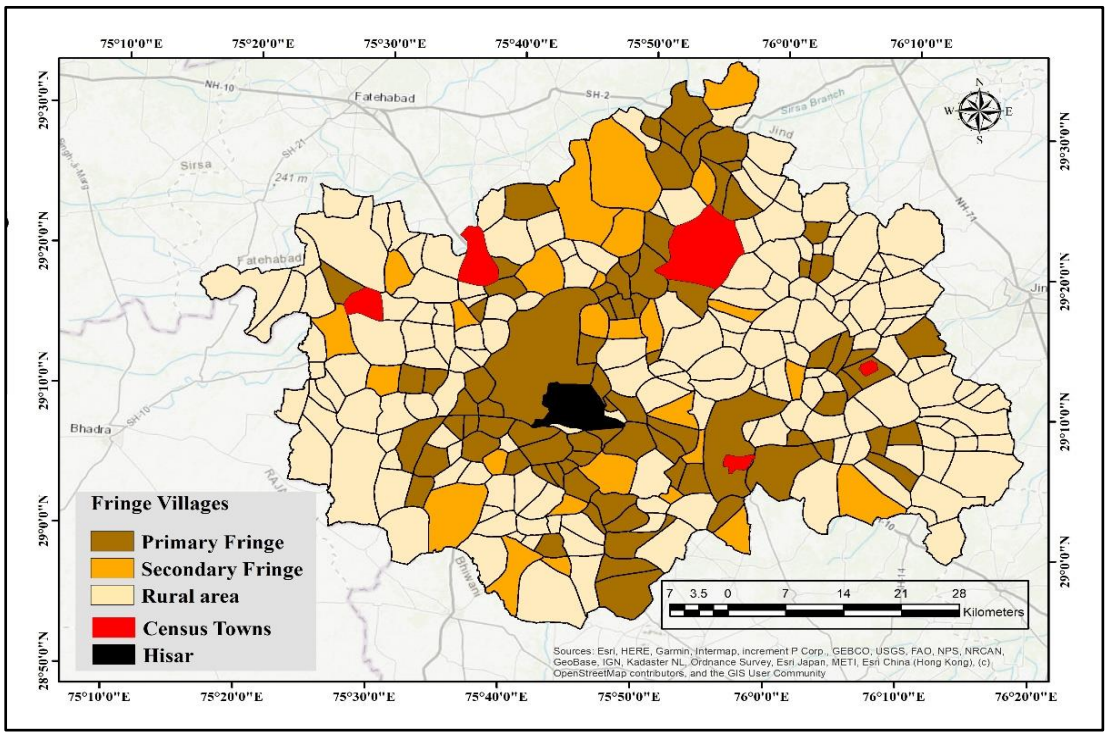
Sr. No.	Categories	Range Of Values	Value	No. of Villages
1	PRIMARY/INNER FRINGE	MEAN + 1 S.D. TO MEAN + 3 S.D.	30-38 & Above	81
2	SECONDARY/OUTER FRINGE	MEAN TO MEAN + 1 S.D	26-30	32

Compiled by the Author

Based on the analysis in above Table 3.1, 81 villages are included in the primary fringe, meaning their value related to the non-agricultural workers falls under the mean + 1 S.D. to the mean + 3 S.D. Similarly, 32 villages with values between mean to mean + 1 S.D. come under the secondary fringe category. Rest of the villages which are not satisfied any of the above mention category included in purely rural area. The following Map 3.1, represents the distribution of non-agricultural on the above mentioned criteria. Map 3.2 represents the villages of primary and secondary fringe based on non-agricultural villages.



Map 3.1: Non-Agricultural Workers Rural-Urban Fringe, Hisar 2011



Map 3.2: Primary and Secondary Fringe Villages Based on Non-Agricultural Workers, Hisar 2011

Source: Census 2011

The villages with values above the non-agricultural worker mean show more urban influence. Qualitatively, this urban influence can be explained by some interrelated reasons. First, closeness to the urban center improves employment opportunities in non-agriculture industries like manufacturing, service, trade, and transport. Second, improved infrastructure links in terms of road and public transport provide for easier daily commuting, dissuading dependence on agriculture. Additionally, land use change also occurs in these villages, with farm land being used for residential, industrial, or commercial activities, thus promoting further non-agricultural employment. Other social factors like greater levels of literacy, contemporary desires, and access to urban living conditions also push the labor force towards non-farm occupations, supporting urban features. Conversely, villages with values above the mean continue to be peripheral rural places. Qualitatively, such villages are characterized by low connectivity, few industrial or service-sector firms, and dominance of agricultural livelihoods. Established social structures, restricted access to urban markets, and infrastructural shortfalls constrain occupational diversification in these places. Therefore, the lower boundary of the rural-urban fringe corresponding to the mean proportion of non-agricultural workers marks this socio-economic transition zone. Villages above such a threshold show functional and occupational integration with urban systems, while those below remain largely rural in nature.

3.2.4 Demographic determinants

3.2.4.1 Population density

The mean population density in Hisar district comes near 480 persons per sq. km. This average density is considered as the lower limit for the delineation of the fringe zone. Further, the high value of standard deviation (963) shows that there is heterogeneity in population density. Villages showing value between Mean (480) to Mean + 1S.D (480+241) are used to denote the outer or secondary fringe zone. Villages showing value between Mean to 1S.D (480+241) to Mean + 3S.D (480+722) are included in the inner fringe.

Table 3.2: Range of values for Demarcating of Population Density Zone

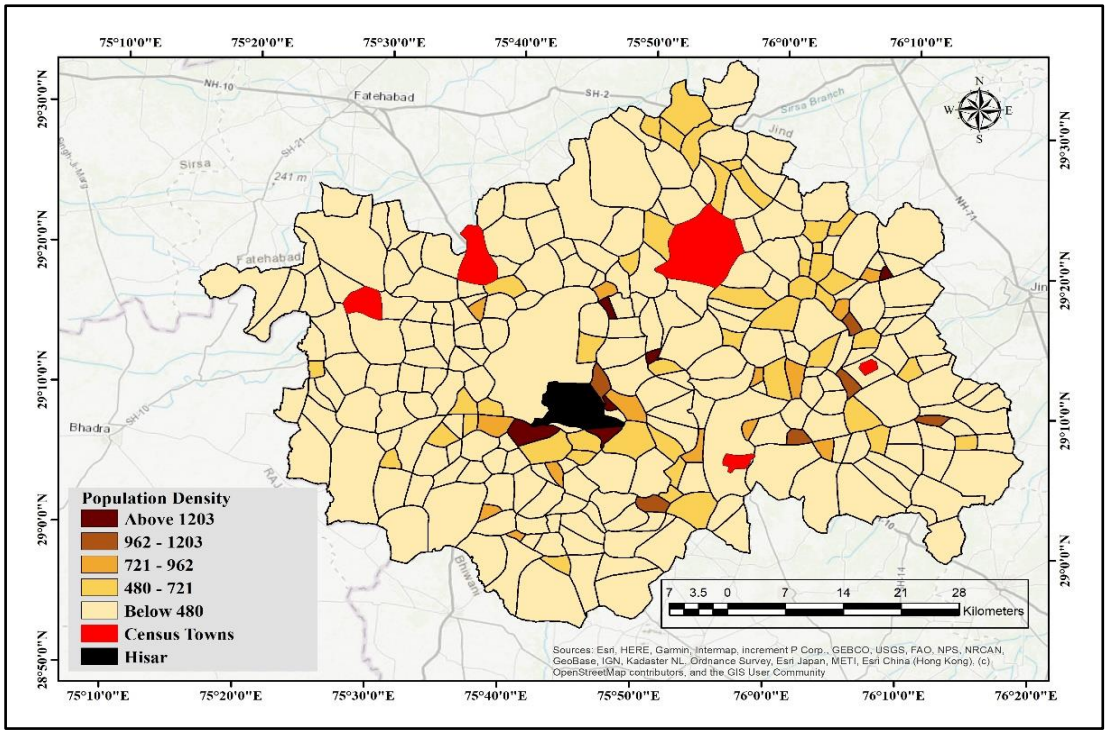
Sr. No.	Categories	Range Of Values	Value	No. of Villages
1	PRIMARY/INNER FRINGE	MEAN + 1 S.D. TO MEAN + 3 S.D.	721-1203 & Above	26
2	SECONDARY/OUTER FRINGE	MEAN TO MEAN + 1 S.D	480-721	45

Compiled by the Author

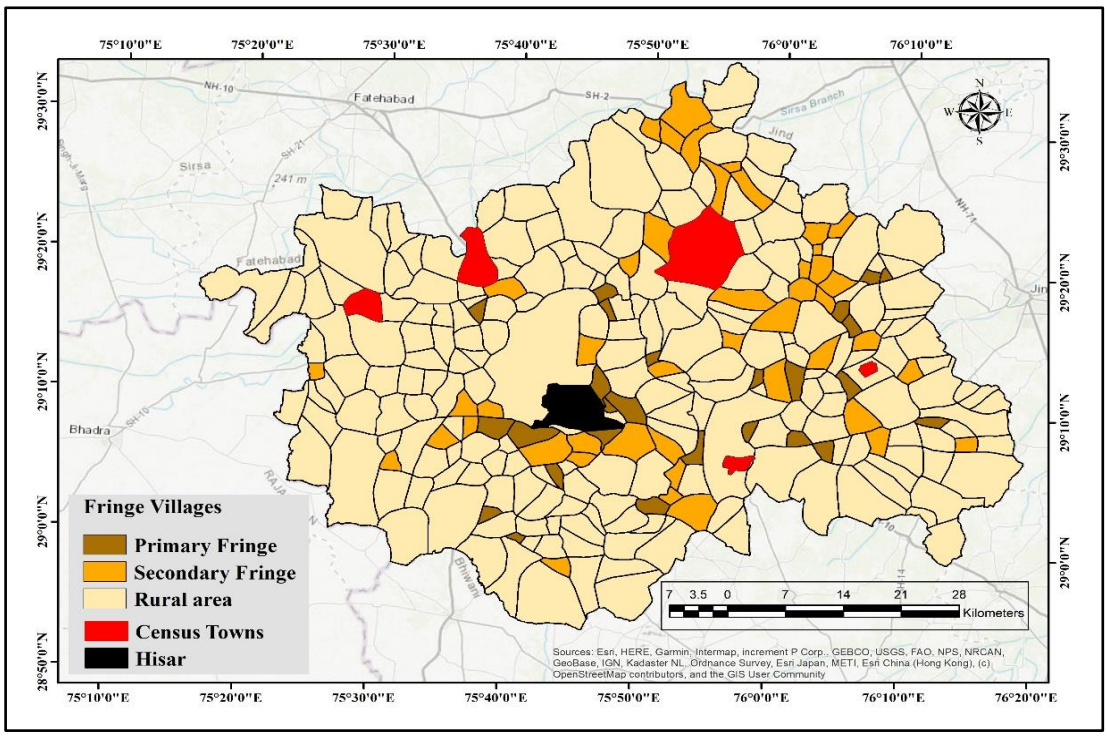
On the basis of Table 3.2 analysis, 26 villages are included in the primary fringe, meaning their value related to the non-agricultural workers falls under the mean + 1 S.D. to the mean + 3 S.D. Similarly, 45 villages with values between mean to mean + 1 S.D. come under the secondary fringe category. The population density value shows a gradual decline from the primary fringe to the secondary fringe and rural areas. The following Map 3.3 and 3.4 represents the population density distribution on the above mentioned criteria.

The slow decrease in population density from the inner fringe to the outer fringe and beyond to rural regions can be attributed to a number of qualitative reasons. In the inner fringe, the proximity to the city center results in high land use pressures. Individuals prefer to locate there because there is easy access to urban jobs, education, healthcare, and other amenities. Also, the areas are subjected to suburban residential development and peri-urban housing colonies, leading to greater population concentrations.

As one moves towards the secondary fringe, the urban influence begins to weaken. Although some non-agricultural activities and commuting patterns persist, infrastructural development is less intense compared to the primary fringe. Land use remains more mixed, with agriculture still playing a significant role alongside emerging urban activities. Consequently, the population density here is moderate. In the peripheral rural zones, the density is lowest. Here, life is mostly agricultural, non-farm work opportunities are scarce, and infrastructural facilities are minimal.



Map 3.3: Population Density Rural-Urban Fringe Hisar 2011



Map 3.4: Primary and Secondary Fringe Villages Based on Population Density Hisar 2011

Source: Census, 2011

The lack of robust economic pull factors, added to the historical rural dispersal settlement patterns, leads to low density in these zones. Accordingly, the decreasing population density from the outermost fringe to rural areas is indicative of the gradual erosion of urban influence, differences in land use and economic opportunities, and the movement away from urban-centered settlements to agriculturally dominated environments.

3.2.4.2 Literacy

The mean rural literacy in Hisar district comes near 59.90 %. This average literacy is considered as the lower limit for the delineation of the fringe zone. The standard deviation method has been taken for grading the intensity of determinants. Villages showing value between Mean (59.90) to Mean + 1S.D (59.90+1.67) are used to denote the outer or secondary fringe zone. Villages showing value between Mean + 1S.D (59.90+1.67) to Mean + 3S.D (59.90+5.01) are included in the urban fringe.

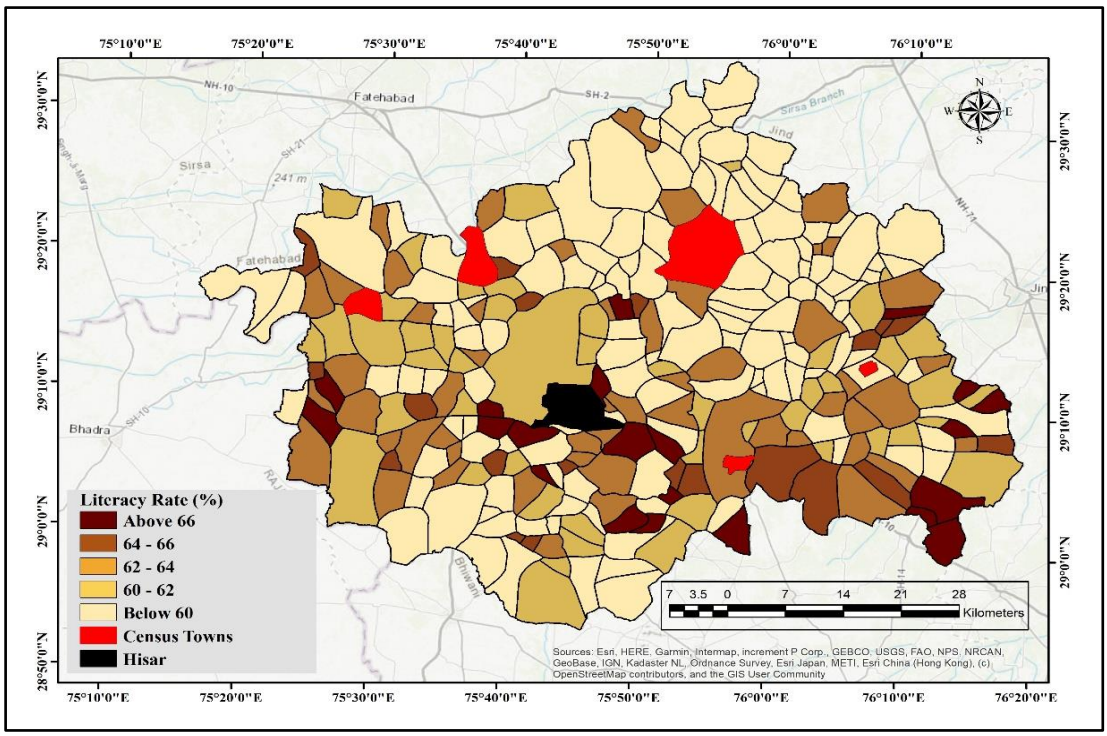
Table 3.3: Range of values for Demarcating of Literacy Zone

Sr. No.	Categories	Range Of Values	Value	No. of Villages
1	PRIMARY/INNER FRINGE	MEAN + 1 S.D. TO MEAN + 3 S.D.	62-66 & Above	68
2	SECONDARY/OUTER FRINGE	MEAN TO MEAN + 1 S.D	60-62	80

Compiled by the Author

The Table 3.3 represents that 68 villages are included in the primary fringe, which means their value related to the literacy rate satisfies the criteria of mean + 1 S.D. to the mean + 3 S.D. Similarly, 80 villages with values between mean to mean + 1 S.D. come under the secondary fringe category. The literacy rate in the primary fringe and secondary fringe represented in Map 3.5 and 3.6, it shows mixed results, but overall analysis shows that high value concentrates near the city region and depicts a downward trend towards the secondary fringe. Some purely rural areas also show high values of literacy rate.

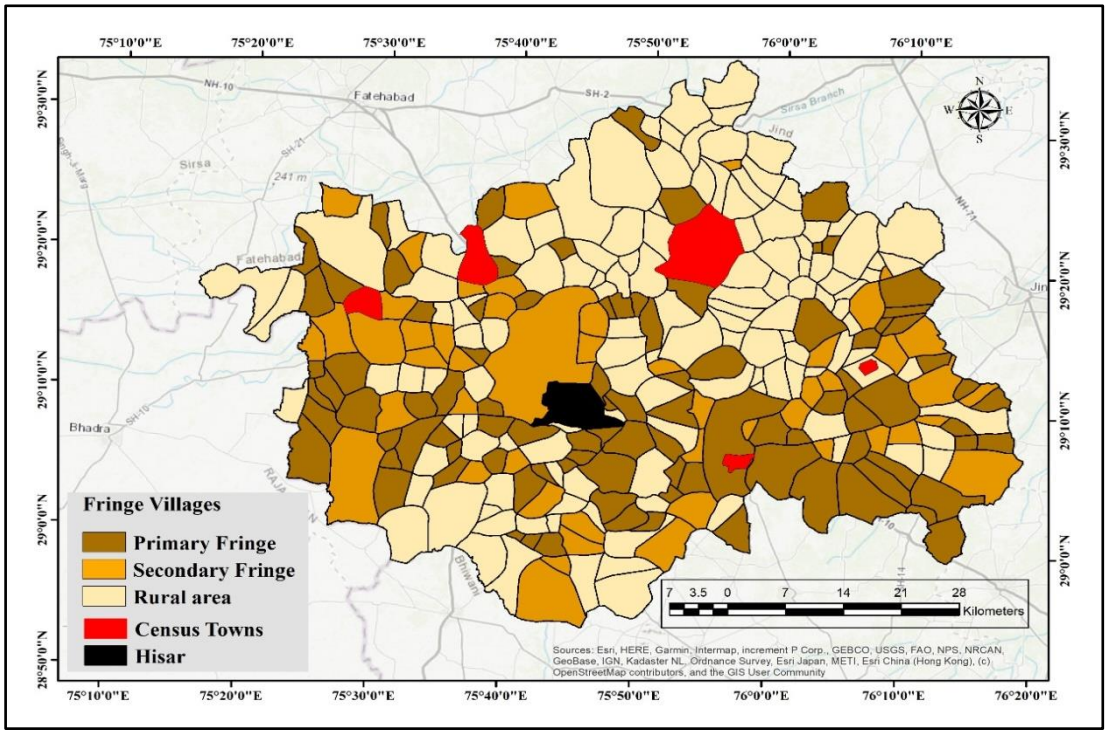
The pattern of literacy rate, with higher values close to the city area with declining trend towards the secondary periphery, is a manifestation of the underlying infrastructural, social, and spatial disparities between more urban-influenced areas and more peripheral rural ones. First, villages near the city have access to better educational facilities, including urban schools, colleges, coaching institutions, and other learning centers. Being nearer to the city increases educational desires and opportunities, thus promoting better enrolment and retention rates of children and youth. Second, urban periphery regions tend to have more exposure to modernity and urban culture, which dictates attitudes towards schooling.



Map 3.5: Literacy Rate Rural-Urban Fringe Hisar 2011

Parents who live in such areas are likely to put a high premium on their children's education as a result of awareness of the competitive urban labor market and the need for education to move ahead. But the varied literacy levels of the primary and secondary fringes indicate spatial differences even within fringe areas. Some villages near highways or main roads might possess improved educational infrastructure, while others which are not connected are deprived of education despite being close to cities. Conversely, as one approaches the secondary periphery and outlying rural

areas, literacy levels are lower because of fewer educational facilities, fewer secondary schools, and lower access to higher education. Agriculture-based traditional livelihoods decrease the perceived value of formal education, as children tend to help with farm and domestic work. Economic limitations, gender discrimination, and social customs also contribute to the limitation of educational achievement, particularly among girls, in these regions. Therefore, the general trend of high literacy near the city decreasing towards the secondary periphery is due to increased infrastructural access, urban exposure, economic incentives, and awareness levels in the primary periphery, but poor facility accessibility, poverty, and customary livelihood habits limit educational achievement in peripheral rural regions.



Map 3.6: Primary and Secondary fringe Villages Based on Literacy Rate Hisar 2011

Source: Census 2011

3.2.4.3 Sex ratio

The mean rural sex ratio in Hisar district comes near 876. This average sex ratio is considered as the lower limit for the delineation of the fringe zone. The standard deviation method has been taken for grading the intensity of determinants. Villages showing value between Mean (876) to Mean - 1S.D (876-16) are used to denote the

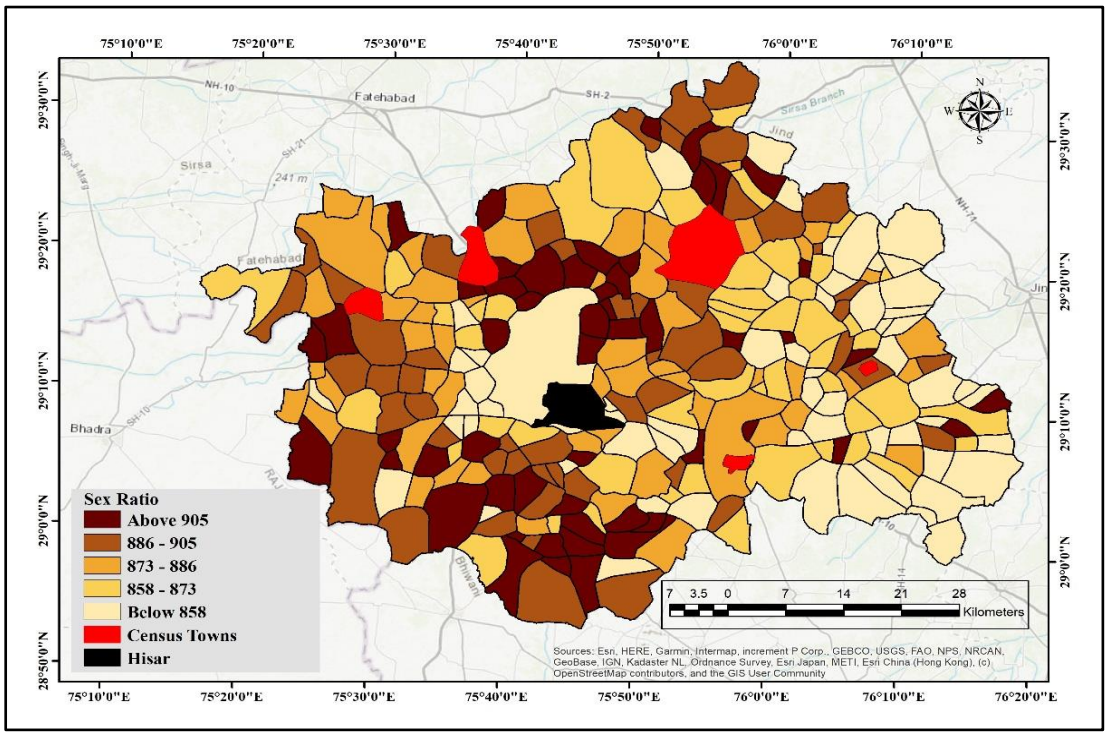
outer or secondary fringe zone. Villages showing value between Mean - 1S.D (876-16) to Mean + 3S.D (876-49) are included in the urban fringe.

Table 3.4: Range of values for Demarcating of Sex Ratio Zone

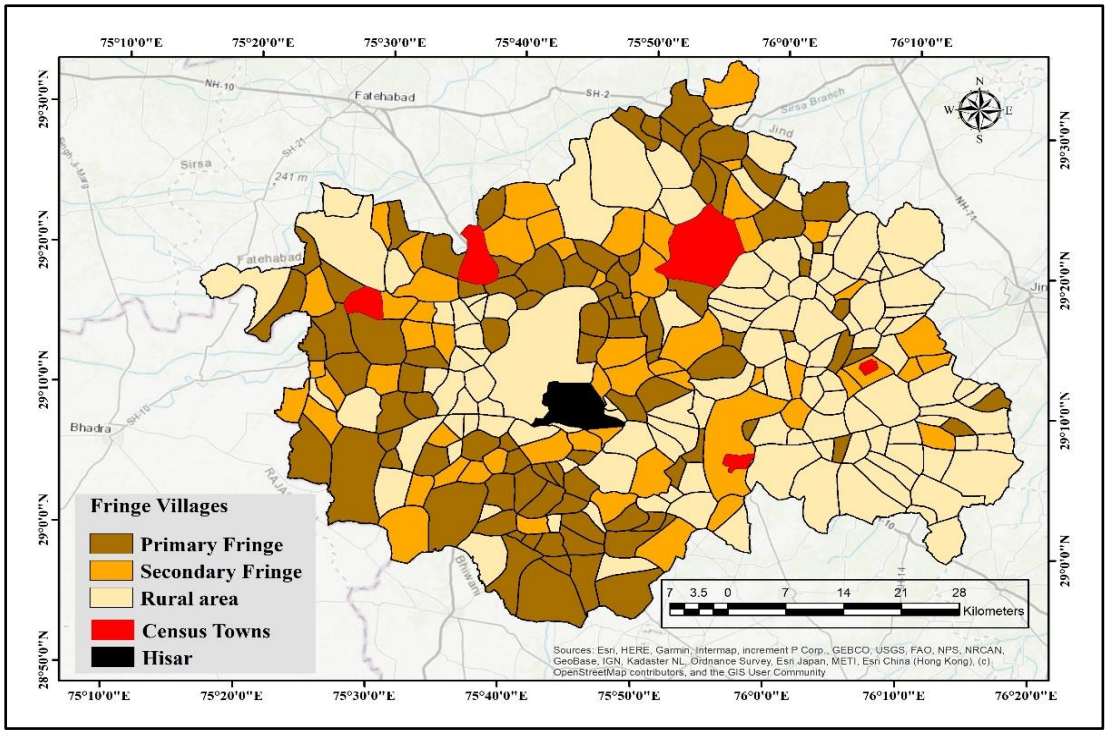
Sr. No.	Categories	Range Of Values	Value	No. of Villages
1	PRIMARY/INNER FRINGE	MEAN - 1 S.D. TO MEAN - 3 S.D.	860-827	52
2	SECONDARY/OUTER FRINGE	MEAN TO MEAN - 1 S.D	876-860	53

Compiled by the Author

Table 3.4 shows that 52 villages are included in the primary fringe, meaning their value related to the sex ratio falls under the mean - 1 S.D. to the mean -3 S.D. Similarly, 53 villages with values between mean to mean - 1 S.D. come under the secondary fringe category. The values of the sex ratio show a negative correlation with distance to the city center, i.e., high values concentrate outside the primary fringe, and it portrayed a low level of sex ratio near the city region.



Map 3.7: Sex Ratio Rural-Urban Fringe Hisar, 2011



Map 3.8: Primary and Secondary Fringe Villages Based on Sex Ratio Hisar, 2011

Source: Census 2011

The negative correlation found between sex ratio and distance from the city center Map 3.7 and 3.8 confirms that towns nearer to the city have lower sex ratios, whereas villages further away from the city have higher sex ratios. This trend can be explained by a number of socio-economic and demographic factors. Firstly, the lower sex ratio near the city region is often a result of male-dominated migration. Urban and fringe areas attract a large number of male migrants seeking employment in construction, transportation, manufacturing, and service sectors. These migrant workers frequently reside temporarily or seasonally in peri-urban and fringe settlements without bringing their families, leading to a skewed sex ratio favoring males. Second, the urban fringe areas are prone to transitional or floating populations with a high proportion of working-age men who wish to reside near their places of work to reduce commuting time and expense. Such temporary settlement tendency contributes to male overrepresentation in the population composition of the main fringe. Conversely, districts outside of the main fringe and further into rural hinterlands have higher sex ratios. The areas are still predominantly agrarian, with family-led agricultural

livelihoods, and hence maintain a more balanced demographic base. Women become more observable in these districts because they are an essential part of household and farm-based livelihoods, and because male rural village-to-urban area outmigration at times results in a feminisation of rural populations. Also, cultural and social elements shape this trend. In rural towns, particularly those distant from the city, the traditional family remains, where both men and women live together. However, in the vicinity of urban centers, the functional population is reconfigured by economic migration patterns.

Thus, the observed negative correlation between sex ratio and distance from the city mirrors trends of male-selective migration, employment-based temporary settlements close to cities, and maintenance of balanced family population in faraway rural areas.

3.2.4.4 Household density

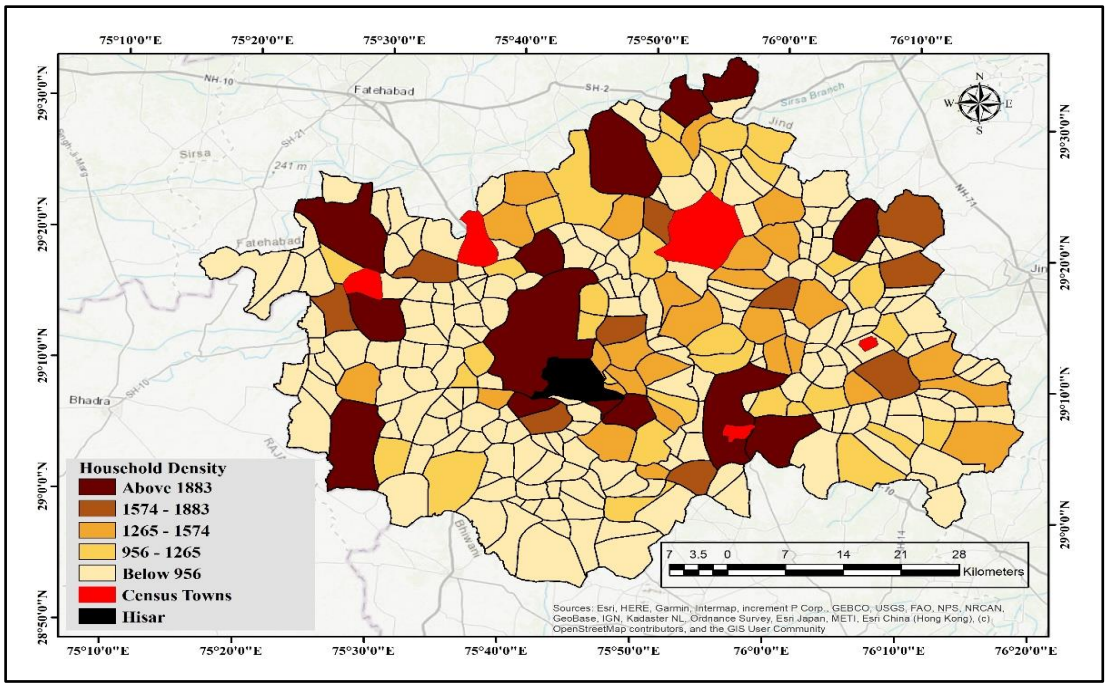
The household density is considered to be an important indicator of the delineation process. It shows close relations with the city's outward growth. The closest village in the city center tends to be denser. That is why data related to this indicator helps to determine the outer limit of the fringe area. The mean household density in Hisar district comes near 952. This average household density is considered as the lower limit for the delineation of the fringe zone. The standard deviation method has been taken for grading the intensity of determinants. Villages showing value between Mean (956) to Mean + 1S.D (956+309) are used to denote the outer or secondary fringe zone. Villages showing value between Mean + 1S. D (956+309) to Mean + 3 S. D (956+927) are included in the urban fringe.

Table 3.5: Range of values for Demarcating of Household Density Zone

Sr. No.	Categories	Range Of Values	Value	No. of Villages
1	PRIMARY/INNER FRINGE	MEAN + 1 S.D. TO MEAN + 3 S.D.	1265-1883 & Above	57
2	SECONDARY/OUTER FRINGE	MEAN TO MEAN + 1 S.D	956-1265	32

Compiled by the Author

Based on the analysis of Table 3.5, 57 villages are included in the primary fringe, meaning their value related to the Household density falls under the mean + 1 S.D. to the mean + 3 S.D. Similarly, 32 villages with values between mean to mean + 1 S.D. come under the secondary fringe category. The household density has high values adjacent to the city center and keeps declining towards the countryside. The Map 3.9 and 3.10 shows a declining trend in the population density as one move away from city center towards the outer countryside.



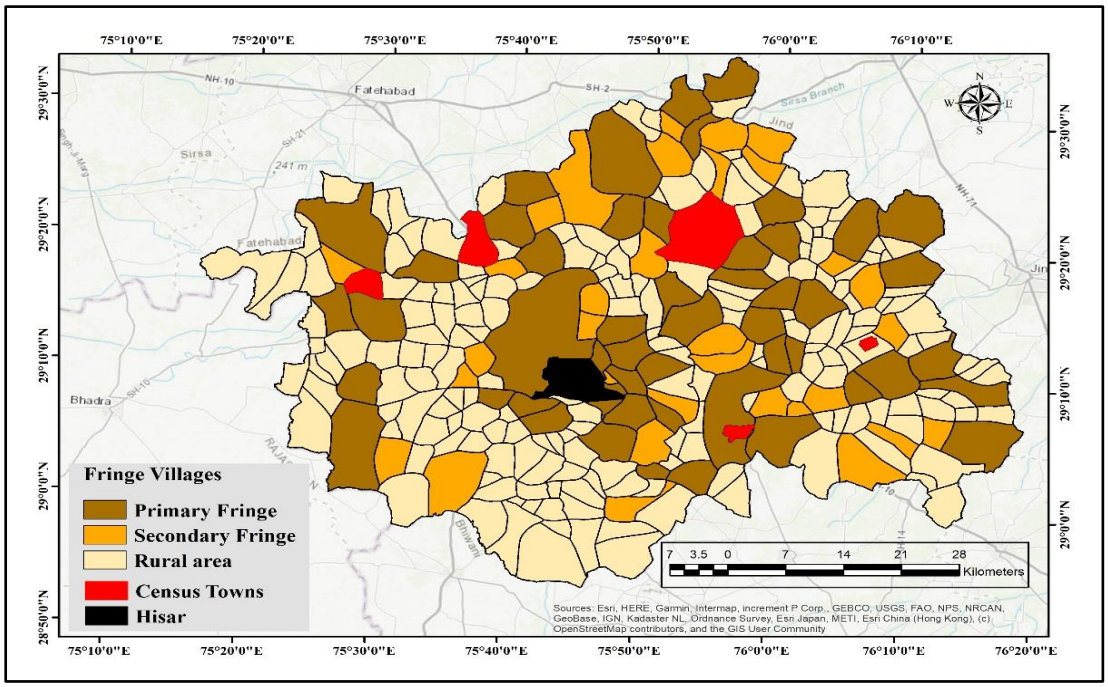
Map 3.9: Household Density of Rural-Urban Fringe Hisar, 2011

The high household density around the city center and then its progressive decline towards the rural areas is due to a combination of connected socio-economic and spatial factors. To begin with, localities near the central city are subject to high household demand as a result of proximity to work opportunities, markets, schools, hospitals, and urban facilities. This results in the aggregation of households within confined spaces, and consequently, often, dense settlements, compact house forms, and sometimes unplanned residential colonies to serve the expanding urban and fringe inhabitants. Second, the urban fringe areas are transitional residential areas, whose land values are relatively lower than that of the city, hence appealing to middle-income and low-income groups. This aspect of affordability promotes more intensive residential development in these areas compared to peripheral rural areas. Also,

infrastructural accessibility like transport linkage, water supply, electricity, and other urban facilities is much higher in the locations surrounding the city. Such an infrastructural advantage enables the growth of dense residential colonies and housing settlements, resulting in increased household densities.

In contrast, as one moves towards the countryside, the influence of urban pull factors decreases. Land availability is higher, leading to dispersed settlement patterns with larger plot sizes per household, typical of agrarian villages. Traditional land use practices, dependence on agriculture, and cultural preferences for spacious homesteads contribute to lower household densities in these areas. Additionally, the unavailability of urban employment opportunities and urban amenities in the far-off rural areas discourages high residential concentration. Population here is stable, controlled by old-settled agricultural families with minimal in-migration.

Therefore, the trend of density of households decreasing from the urban center to the rural areas represents urban pull and infrastructural aggregation around the city, economic prospects compelling dense settlements in fringes, and rural classical spread-out settlement patterns.



Map 3.10: Primary and Secondary Fringe Villages Based on Household Density Hisar, 2011

Source: Census 2011

3.2.5 The rural-urban fringe of Hisar City

The rural-urban fringe is a transitional zone outside the city with mixed characteristics of both rural and urban areas. It represents an area between purely urban characteristics and primary rural activities. It shows cultural developments influenced by urban area, with a sense of traditional rural attributes. For the demarcation of the fringe zone of Hisar city, first of all, determinants of demarcation are plotted on the map of Hisar. Then maps of different indicators are superimposed on each other to determine the actual fringe area. After this process, it is found out where these determinants overlap each other at the same time. There are also some zones where very few variables register their presence. To conclude, the villages that are adjoining to the city and show the presence of at least three variables are included in the primary fringe area. Thus, with the help of pre-decided indicators/variables, the extent of the rural-urban fringe of the Hisar city is determined. This fringe area extends from highly urbanized municipal limits to agricultural dominant rural areas.

After the above-stated delineation process, the rural-urban fringe of Hisar city may be classified into the following two groups.

1) Inner or Primary fringe
2) Outer or Secondary fringe

3.2.5.1 Inner or Primary fringe

The primary fringe zone of the city starts just outside the municipal limit. It has more interaction with the city center. It is highly influenced by urban characteristics and the urbanization process. This zone has a socio-cultural and economic relationship with the city. The land use pattern of the fringe region is in a highly transitional stage from rural to urban. The agricultural land use is transforming into non-agricultural land uses. This zone is dominated by urbanized colonies, brick kiln, manufacturing industries, and essential goods supply to the city such as vegetables, fruits and dairy products. The demographic components of this zone show a high inclination towards urban characteristics. The occupational structure of this zone has a high percentage of non-agricultural activities. Most of the population is going through a transformational stage from purely rural occupation to urbanized types of economic activities. The physical landform of this zone is under influence of urban activities. This gives rise to unplanned

and haphazard development. Public amenities like water, sewage, light etc. are poor and unplanned.

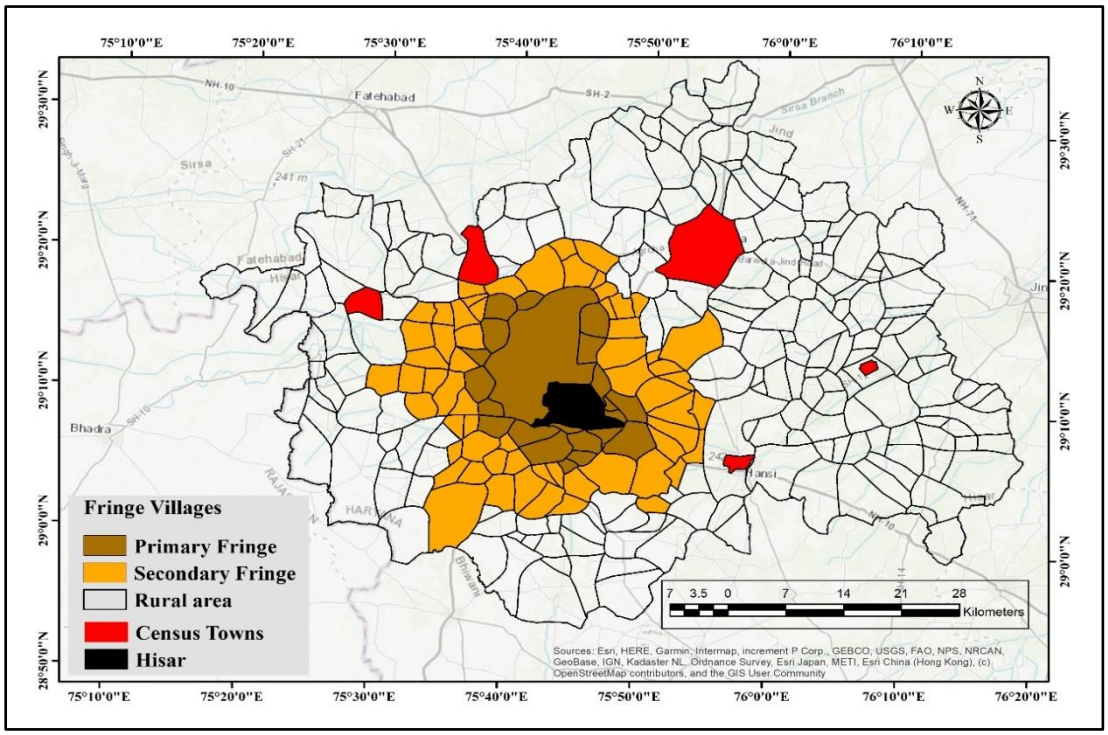
3.2.5.2 Outer or Secondary fringe

The secondary fringe or outer fringe starts just beyond where the primary fringe ends. The rural attributes are dominant in this area. The demographic, occupational and physical characteristics of this zone have rural influence. The percentage of agricultural and allied activities is relatively high. The built-up area is of scattered type and rather discontinuous. Some marketing facilities are available for agricultural products.

3.2.6 The delineation process, extent and shape of the rural urban fringe

Demographic and occupational determinants have played a crucial role in the process of determining the shape and extent of the fringe region of Hisar city. For the present study, fieldwork, as well as secondary data, has been used for the fringe Delineation. Secondary data is acquired from the Census 2011. The data is processed and displayed in tabular and graphical formats with the help of Excel software. Maps are used to depict the geographical distribution. Arc G.I.S 10.8 software is used for the scanning and geo-referencing process of the topographic sheets. These georeferenced toposheets are digitized for making base maps of the Hisar District. Choropleth maps are used to depict the regional pattern. The determiners related to the study are plotted on these choropleth maps. After this, all the choropleth maps were superimposed on top of each other to get a clear result. Then all the villages is compared on the basis of the prescribed scale and the village which is contiguous to the city and attains the high value of at least three variables is included under the primary fringe of the Hisar city. Map 3.11 presents the final delineated rural-urban fringe following the outlined process. Primary fringe starts from the point, where the municipal boundary of the city ends. It shows a higher degree of urban characteristics and inclination towards the city way of life. Those villages which have attains the medium level of value of at least three variables are included under the secondary fringe of the Hisar city. The method has been applied for the determination of the rural fringe and peripheral villages of the Hisar city. The range of the primary and secondary fringe of the Hisar city is between 4 to 16 kms. It is clear from the different studies in urban geography that the shape and form of rural-urban fringe are largely influenced by physiographic characteristics such as site, spacing, and situation. The road connectivity factor has a crucial role in the development of rural areas by connecting

these areas with remote urban regions. The high level of connectivity of the urban area with its surrounding countryside, the high degree of the mutual relationship is found on both sides and the faster the development of the countryside is observed. As a result, the urban influence is increasingly reflected on the various features of the rural areas adjoining the city and they begin to urbanize rapidly.



Map 3.11: Rural-Urban Fringe Hisar

If we talk about the rural urban fringe of Hisar city, then its shape is almost in circular form. The main reason for this is that there is no natural barrier around the city like any river or hill etc. Hisar city is surrounded by a nearly flat plain area which facilitates the connectivity of the countryside with the Hisar city from almost all sides. If we discuss, the extent of the fringe zone of Hisar city, it seems that its expansion is more towards the north and north-west side. On this side, most of the land is under the acquisition of the government and it is used for various types of non-agriculture use. Most of the government offices and various farms have been established on this land. Towards this area, an important national highway No. 9 connects Hisar to Fatehabad, Sirsa, and Punjab, due to which the village of the area is well connected with Hisar. They have intensive interaction with the city and in turn, assimilate its characteristics. Looking towards the South West Side, the expansion of rural-urban print is seen in a

linear form, mainly due to the National Highway No. 52, the village along this highway has a very intensive interaction with the city of Hisar, due to which the urban characteristics are seen in these villages. On the eastern side, an important satellite town is located named Hansi. The area between Hansi and Hisar City is linked by Highway No. 9 and has witnessed a very intensive urban encroachment. In this direction, an important cantonment of Hisar city is also located on National Highway No. 9 and there are intensive non-agricultural activities in this area and many villages of the area are now almost included under urban expansion. Similarly, the linear form of rural-urban fringe is also seen on the northeast side, here also National Highway No. 52 connects Hisar to Chandigarh, and the villages on this side also have urban influence. The land of the area adjoining Hisar is under government acquisition and non-agriculture activities are seen in the area. At present, Hisar Airport is being developed on this road, due to which there is a possibility of increasing non-agriculture activities in this area in the future.

Table 3.6: Number of Villages, Area, and Population of the rural-urban fringe of the Hisar City

Rural-Urban Fringe Zones	Number of Villages	Area in Hectare	Population in 2011
Primary Fringe	21	32600	151370
Secondary Fringe	60	64300	222435
Total	81	96900	373805

Compiled by the Author

After determining the rural urban fringe on the basis of the above analysis, it comes out that 21 villages have been included in the primary fringe and 60 villages have been included in the secondary fringe. Table 3.6 shows that the primary and secondary fringe includes 81 villages with a total population of 373805 and total area covered is 96900 hectares. As far as primary fringe is concern its total population is 151370 persons and total area is 32600 hectares. The secondary fringe total population is 222435 and total area covered is 64300 hectares. Table 3.7 shows the list of delineated villages related to rural urban fringe of Hisar district.

Table 3.7: Name of the villages of the rural-urban fringe of the Hisar city

Sr. No.	Primary Fringe	Sr. No.	Secondary Fringe	Sr. No.	Secondary Fringe
1	Aryannagar	1	Alipur	36	Mangali Surtia
2	Bir Hisar	2	Asrawan	37	Manglai Mohbat
3	Chikanwas	3	Badon Pati Awal	38	Mangali Jhara
4	Dabra	4	Badon Pati Doyam	39	Matersham
5	Durjanpur	5	Bahbalpur	40	Mayyer
6	Gangwa	6	Bhagana	41	Mirzapur
7	Hisar Rural	7	Bherian	42	Mingni Khera
8	Incha Kharkhari	8	Chuadhrywas	43	Mothsara
9	Juglan	9	Deva	44	Muklan
10	Kaimiri	10	Dhansu	45	Nangthala
11	Ludas	11	Dhingtana	46	Nathawan
12	Mangali Brahmnan	12	Dhiranwas	47	Nayana
13	Mirka	13	Fransi	48	Neoli Khurd
14	Neoli Kalan	14	Ghirai	49	Panihar Chak
15	Raipur	15	Hindwan	50	Patan
16	Satrod Kalan	16	Harikot	51	Ramayan
17	Satrod Khurd	17	Jagan	52	Risalu Khera
18	Satrod Khas	18	Jakhod Khera	53	Sandol
19	Satrod Khas (Badi)	19	Kabrer	54	Salemgarh
20.	Talwandi Rana	20	Kajla	55	Shahpur
21.	Thaska	21	Kaluwas	56	Singhran
		22	Kharar	57	Sultanpur
		23	Kharkhari	58	Sulkhani
		24	Kheri Barki	59	Shyamshukh
		25	Khokha	60	Tokas
		26	Kirara		
		27	Kirori		
		28	Kirtan		
		29	Kutubpur		
		30	Ladwa		
		31	Ladwi		
		32	Landhari		
		33	Mahalsara		
		34	Malapur		
		35	Mangali Akalan		

Compiled by the Author

CHAPTER 4

LAND USE LAND COVER CLASSIFICATION

4.1 INTRODUCTION

Urbanization in agricultural settings involves a complex interplay between the demands of growing urban populations and the sustainability of agricultural practices. The increasing urbanization raises questions about the ability to meet the evolving demands for agricultural products while supporting agricultural prosperity and reducing poverty in both rural and urban areas **(Youssef et al., 2020)**. The swift pace of urbanization has given rise to extensive expanses characterized by scattered and sparsely populated development, often referred to as peri-urban zones or the urban-rural fringe (URF). These areas blur the distinction between urban and rural landscapes **(Singkawijaya & Nandi, 2024)**. Projections indicate that peri-urban regions will continue to expand steadily, potentially outpacing the growth rate of urban areas in the years to come **(Li et al., 2021)**.

Land use and land cover (LULC) changes play a significant role in shaping landscapes, determining URF and influencing various aspects of human activities and environmental sustainability. These changes are crucial for understanding the dynamics of urbanization, agricultural expansion, and environmental impacts. Evaluating LULC is essential for addressing environmental issues such as unregulated development, loss of agricultural lands, destruction of wetlands, and wildlife habitats **(Alam et al., 2020; Mishra et al., 2024)**. LULC change is a complex phenomenon influenced by biophysical and socio-economic factors **(Fikadu & Olika, 2023)**. These factors encompass long-term climatic shifts, geomorphological and ecological processes, alterations in vegetation cover and landscape structures, climate variability, and the greenhouse effect **(Alemu et al., 2024)**. Land use (LU) refers specifically to the human modification and application of land for economic purposes **(Long et al., 2021)**. LU reflects the actions taken to shape the land cover and the resulting economic benefits derived. Land cover (LC), in contrast, refers to the continuous natural characteristics of the Earth's surface, such as vegetation, rocks, soil, water and human-made structures **(Alemu et al., 2024)**.

A rapid increase in population and the consequent escalated anthropogenic activities are the core cause of giving rise to a wide variety of alterations in LULC changes. The changes are so profound and penetrative that when different elements of such changes are combined globally, they show considerable ecological implications **(Roy et al., 2022)**. The availability and distribution of various biotic and abiotic resources influenced by LULC changes provide an example of these implications. Additionally, LU classes, defined by human activities on the LC, are closely linked to population distribution, making them effective indicators for demographic and related studies **(Linard et al., 2010)**.

The conversion of agricultural land to urban uses is transforming agricultural production, social structures, and land markets in peri-urban areas, highlighting the need to balance urban development with agricultural sustainability. However, the expansion of urban areas directly impacts available agricultural land, potentially affecting food production and agricultural activities in cities **(Oyinloye et al., 2021)**. This transformation of LC due to urbanization can have profound effects on the natural conditions of the landscape **(Gaur & Singh, 2023)**. On contrary, it has also been observed that land degradation in certain regions can be mitigated by factors such as increasing woodland cover and reducing human pressure and agricultural intensification **(Gebreyesus et al., 2022)**. Information on existing LU is essential for planning optimal utilization of land **(Chaudhary 2003; Clevers et al. 1999; Dhawan 2017; Gupta & Roy 2012; Hooda et al. 1992; Hussin & Shaker 1995)**. The physical results of past human activity, such as vegetation clearance, etc., are included within the concept of LU changes. Land and soil are precious natural resources and are nature's gift to the humankind. The prosperity of a country depends on the richness of these resources. In a country like India, where the population pressure on land is high, rational utilization of the land resources assumes great importance for the optimal and sustained production with minimum hazards. Essentially, this means proper utilization of land and soil. These resources, however, have been most recklessly used by humans in the past to extract more and more from them. This has caused rapid deterioration and degradation of lands. The land resources are limited, as the total geographical area is fixed. Land is, therefore, scarce in supply. It is irreplaceable and not reproducible. While the land is finite, the population dependent

on land and its needs are infinite **(Jacob, 2024)**. These have been increasing with time. Per capita availability of the resources, therefore, has been declining. One of the prime requisites for better LU is information on existing LU and the distribution of settlement, forest, agricultural land, barren land, etc., and they are important to determine land use policy, planning of transportation, and communication services, etc. The present LU is the result of different causes which are related to landforms, soil conditions, irrigation facilities, marketing, communication transport, and socioeconomic conditions **(Yang and Liu 2005; Yonas et al. 2013; Meyfroidt and Lambin 2008)**. Information regarding changes in LULC has become a primary and crucial constituent of research to produce strategies for assessment and evaluation of environmental changes as well as management of natural resources to encourage sustainable use and development **(Twisa and Buchroithner, 2019)**.

Earlier there were many methods to analyze LULC changes but there was limitation also like time consuming methods, the applicability for small area and many such limitations. But nowadays with the help of Remote sensing (RS) and Geographic Information System (GIS) the scenario has changed and this have been acknowledged as crucial and influential tools for evaluation of environmental changes over varied spatial and temporal scales **(Dewan and Corner, 2013)**. The applicability of using space borne imagery to measure LULC changes has been demonstrated by several researchers **(Twisa and Buchroithner, 2019)**. RS and GIS are exceptional at mapping and identifying changes in LULC and LST **(Aboelnour and Engel, 2018; Malik et al., 2020)**. Remote sensing data allows researchers to understand and predict these landscape transformations. The multifaceted impacts of LULC changes encompass a wide range of issues. These includes reduced provisioning services: food, fiber, and timber production, increased disease risks, elevated atmospheric gasses contributing to climate change, diminished biodiversity, life support functions, and agro-biodiversity, soil degradation and altered freshwater hydrology, agricultural water use, and coastal zones **(Alemu et al., 2024)**. Understanding LU changes is crucial for sustainable urban planning, as it provides insights into impervious surface coverage, tree canopy cover, and other land surface dynamics that influence urban development **(Karimi & Sultana, 2024)**. Therefore, the impact of LU change extends to ecosystem services, with consequences for agriculture, settlement patterns, and

economic activities **(Aziz et al., 2020)**. Rapid LU expansion driven by urbanization poses challenges for sustainability and necessitates effective land management policies **(Chaka & Oda, 2019)**.

The rapid pace of urbanization in developing countries presents a complex phenomenon with both opportunities and challenges (Un-Habitat, 2016). While cities offer the potential for economic growth, improved living standards, and social mobility, the speed and scale of urban expansion often create significant strains on infrastructure and social services. In developing countries like Ethiopia, agriculture, the mainstay of the economy **(FAO, 2016)**, is a key driver of LULC change. Ethiopia's agricultural expansion has significantly altered natural landscapes, including forests and grasslands bordering cultivated and grazing areas **(Regasa et al., 2021)**. There are various studies at world level related to LULC change detection or their trends. Urbanization is a significant phenomenon in India, characterized by the expansion of urban areas and the transformation of rural landscapes into peri-urban zones. The URF represents the interface between urban and rural environments, exhibiting diverse LU patterns and socio-economic dynamics **(Sengupta, 2017)**. Since independence, the urban population of India has consistently risen, displaying a growth rate surpassing the national average population growth rate. However, the extent of urbanization varies significantly among states and union territories, exhibiting intra-state disparities as well. Haryana stands out as one such state with elevated urbanization levels, registering 34.88% **(Census of India, 2011)**, notably higher than the national average of 31.16%. This escalating urbanization trend in Haryana is primarily driven by city expansion, ribbon development, and leapfrogging urban sprawl **(Shekhar & Shekhar, 2021)**.

Although there have been various studies in Hisar, Haryana about LULC change detection but the status of LULC changes of urban and rural periphery fringe of Hisar District in Haryana, India remained undocumented. Land is the basic and most important resource in Haryana, as it is true for nearly all other states of the country **(Kumar 2017; Kushwaha and Oesten 1995; Ram and Singh 1995; Rani 2017; Sharma & Kumar, 2023; Toleti 1995)**. In Haryana, rapid population expansion has led to the excessive utilization of natural resources. A complex interplay of

biophysical processes and socioeconomic factors shapes LULC patterns across space and time **(FAO, 2016)**. This study addresses this knowledge gap by analyzing spatiotemporal patterns and key drivers of LULC changes over a 20-year period (2003–2023) for the urban and rural fringe of Hisar, Haryana. This research also aims to assess to identify the key drivers of these changes. Understanding these LULC dynamics is critical for informing the development and implementation of sustainable natural resource management strategies in Hisar District. The present work focuses on the evaluation of trends and patterns of the urbanization in Hisar district with special focus on the urban-rural fringe areas. The study also inculcates the assessment of the changes in the LULC in the district to supplement the objective of evaluating the urbanization. Furthermore, the outcomes of this research will provide valuable insights to decision-makers, enabling them to comprehend the extent of changes in the study area and make informed decisions based on these findings.

4.2 MATERIAL AND METHODS

Geospatial technology plays a crucial role in understanding urbanization and consequent changes in land use and land cover. By utilizing a combination of coarse and fine spatial resolution satellite sensors, changes in land cover due to activities like deforestation in tropical regions and urban expansion can be effectively monitored **(Mashala et al., 2023)**. Geospatial technologies have been employed to map land cover in urban environments using remotely sensed imagery and machine learning classifiers **(Kamusoko, 2021)**. Remote sensing technologies have been highlighted for their potential in acquiring detailed and accurate land-use information crucial for urban planning and management **(Herold et al., 2002)**. The use of Landsat time series analysis has been pivotal in monitoring land use/land cover changes, especially in the context of rapid urbanization and climatic variations **(Zaidi et al., 2017)**.

Geospatial tools have also been essential in sustainable land use planning, providing insights into land utilization patterns and facilitating the detection of land cover changes for sustainable development **(Sonowal & Thakuriah, 2022; SHARMA et al., 2021)**.

4.2.1 Laboratory work

Optical multispectral data from Landsat satellites (Landsat 7 and 8) was utilized for land use and land cover classification, accessible via Earth Explorer and available for complimentary download. In the present study, we analyzed the land use land cover dynamics of the study area. Primary data were acquired from the Landsat satellite with a spatial resolution of 30 m. To prepare the land use land cover maps for the study area, satellite data of different periods, such as Landsat 7 ETM+ on October, and Landsat 8 OLI/TIRS on December, were derived from the U.S. Geological Survey for 2003, 2013, 2023. Table 4.1 shows different data sources for the study.

Table 4.1: Different Data Sources Used For the Current Study

Satellite & Sensor	Bands	Year	Month	Path & Row
Landsat 7	1, 2, 3, 4, 5, 7	2003	October	147, 40
Landsat 8	1, 2, 3, 4, 5, 7	2013,2023	December	147, 40

Compiled by the Author

4.2.2 Image Processing and classification

Geometric and radiometric corrections were performed in the preprocessing stage, aiming to increase the accuracy and interpretability of the features on land surface. Further, dark object subtraction was used to minimize atmospheric scattering effects on the low or zero surface reflectance values in the histogram and to minimize the DN values. Furthermore, techniques to diminish haze were employed for image clarity enhancement. After image stacking and extraction of data for study unit, land use/land cover (LULC) classification was performed using supervised classification techniques based on the Maximum Likelihood Classification (MLC) algorithm.

4.2.3 Extraction of the study area

This operation was done with the help of Google Earth by craving out the KML image. This KML image was open with the help of Arc GIS. In the conversion tool, this KML image was converted into Polygon. After this process the Extract to Mask process to carve out the study area.

4.2.4 Classification of Images

For this process, the supervised classification method was obtained to classify the pre-processed mages. For the classification of images based on the training site (signature) maximum likely hood algorithm and field-based knowledge was used. This software is analyzed based on which pixel values are to select a certain land-use class.

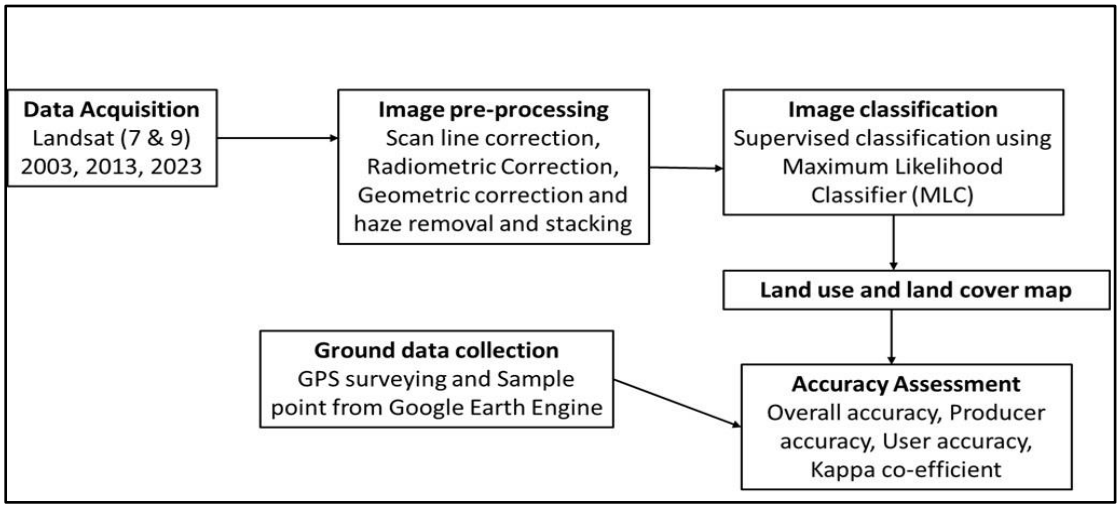


Fig. 4.1: Illustration of the methodological workflow

Figure 4.1 represents the current methodological flowchart. The current work also incorporates the application of these technologies to comprehend the trends and patterns of land use and land cover in the Hisar district. This spatial data pertains to the Landsat series and pre-harvest months have been selected for the analysis.

The scan line error in downloaded imageries was removed and for its correction, the "Landsat toolbox" using "add toolbox" option in ArcGIS 10.8 was done and performed "Fix Landsat 7 scanline errors" tool. Georeferencing and digitizing of the shape file was also done using the same software. The study area was divided into urban and rural fringe zones to investigate the spatial distribution of land-use land cover. After clipping the area of interest, signature samples were created for five categories (cropland, barren land, built-up area, water body, and vegetation) of land use land cover. Supervised classification is a widely used technique in remote sensing and image analysis for categorizing land use and land cover types. This method involves training a classification algorithm using a set of pre-labeled samples, known

as training data, which represent different land cover classes. The algorithm then uses these samples to identify and classify similar patterns in the entire image. In the study, supervised classification with a maximum likelihood algorithm was applied to Landsat satellite imagery from 2003, 2013, and 2023 to create land use land cover maps using the classification tool of ArcGIS 10.8. The process involved assigning over 200 signature samples for five categories: cropland, fallow land, built-up area, water body, and vegetation. This approach allows for accurate identification and mapping of different land cover types, enabling researchers to analyze changes in land use patterns over time and across urban and rural areas. The analysis of results was done using different methods and techniques to compute the percentage and change detection in the study area. The analysis is followed by accuracy assessment of the recent image. Following equations were used for the accuracy assessment;

$$\boldsymbol{Overall\ Accuracy}$$

$$= \frac{Total\ number\ of\ correctly\ classified\ pixels\ (diagonal)}{Total\ number\ of\ reference\ pixels} \times 100$$

$$\boldsymbol{Users\ Accuracy}$$

$$= \frac{Number\ of\ correctly\ classified\ pixel\ in\ each\ category}{Total\ number\ of\ classified\ pixel\ in\ that\ category\ (the\ row\ total)} \times 100$$

$$\boldsymbol{Producer\ Accuracy}$$

$$= \frac{Number\ of\ correctly\ classified\ pixel\ in\ each\ category}{Total\ number\ of\ reference\ pixel\ in\ that\ category\ (the\ column\ total)} \times 100$$

$$\boldsymbol{Kappa\ Coefficient\ (K)}$$

$$= \frac{(Total\ Sample \times Total\ corrected\ Sample) - \sum(column\ total\ \times Row\ total)}{Total\ Sample^2 - \sum(column\ total\ \times Row\ total)}$$

For the accuracy testing, 1,000 randomly dispersed sample points were utilized, which were obtained by stratified sampling of various LULC classes of the inner and outer fringe regions. For each of the two zones, 500 sample points were obtained, distributed equally to 100 sample points for each of the land use land cover classes.

4.3 RESULT AND DISCUSSION

For various land resource studies, regional planning and management, LULC mapping is very important. In case of land degradation status mapping and monitoring, the LULC study is proved to be very helpful. In this study, LULC mapping was carried out to achieve the ultimate objective of this research. The LULC map was generated using supervised classification approach using satellite imageries, and five broad land categories (Fallow land, vegetation, water bodies, cropland and built up) were identified.

This study examines the dynamic changes in land use and land cover in Hisar district over a 20-year period, from 2003 to 2023. The data provides insights into the transformations between different land cover classes, highlighting how various types of land use have shifted and the extent of these changes. The classes interpreted were subsequently verified in the field by conducting an extensive field survey. Area statistics for different LULC categories was generated and are given in Tables 4.2 and 4.3 for inner fringe and Tables 4.6 and 4.7 for outer fringe respectively. In present study, the fringe divides into inner and outer fringe according to previous discussed statistics. The prime results of the analysis include the LULC maps and post-processing-based area calculation of the individual classes. This study analyzes the LULC changes in Hisar district over three key years: 2003, 2013, and 2023. The data highlights significant transformations in all five primary categories.

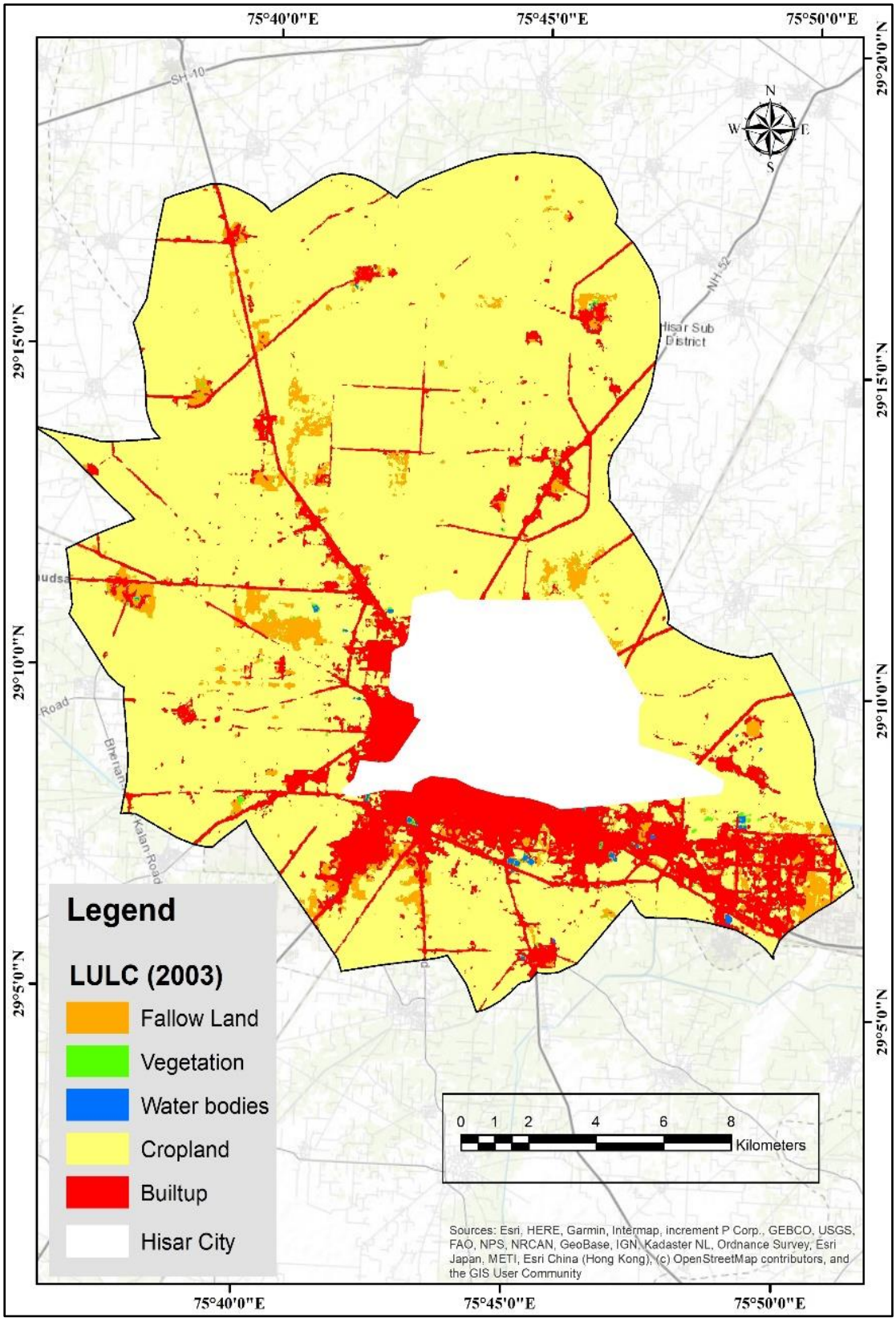
4.3.1. Land use and land cover scenario in inner fringe areas

An intriguing scenario is discerned from the LULC map of urban fringe in 2003. The map shows that cropland holds the largest land in inner fringe during 2003 (Map 4.1). The data provided in Table 4.2 shows the Land Use Land Cover (LULC) pattern in the study area in the year 2003 in an area of 334.20 sq. km. The largest LULC class is cropland, which takes up 270.96 sq. km and represents 81.08% of the entire area. This shows the agricultural nature of the area, indicating intensive cultivation as the main land use. Built-up area occupies 49.31 sq. km, which is 14.76% of the total area. This proportionate percentage of built-up area is quite high and indicates a moderate level of urbanization, involving residential, commercial, and infrastructural activities in urban and peri-urban areas. Fallow land represents 8.36 sq. km (2.50%) of the land,

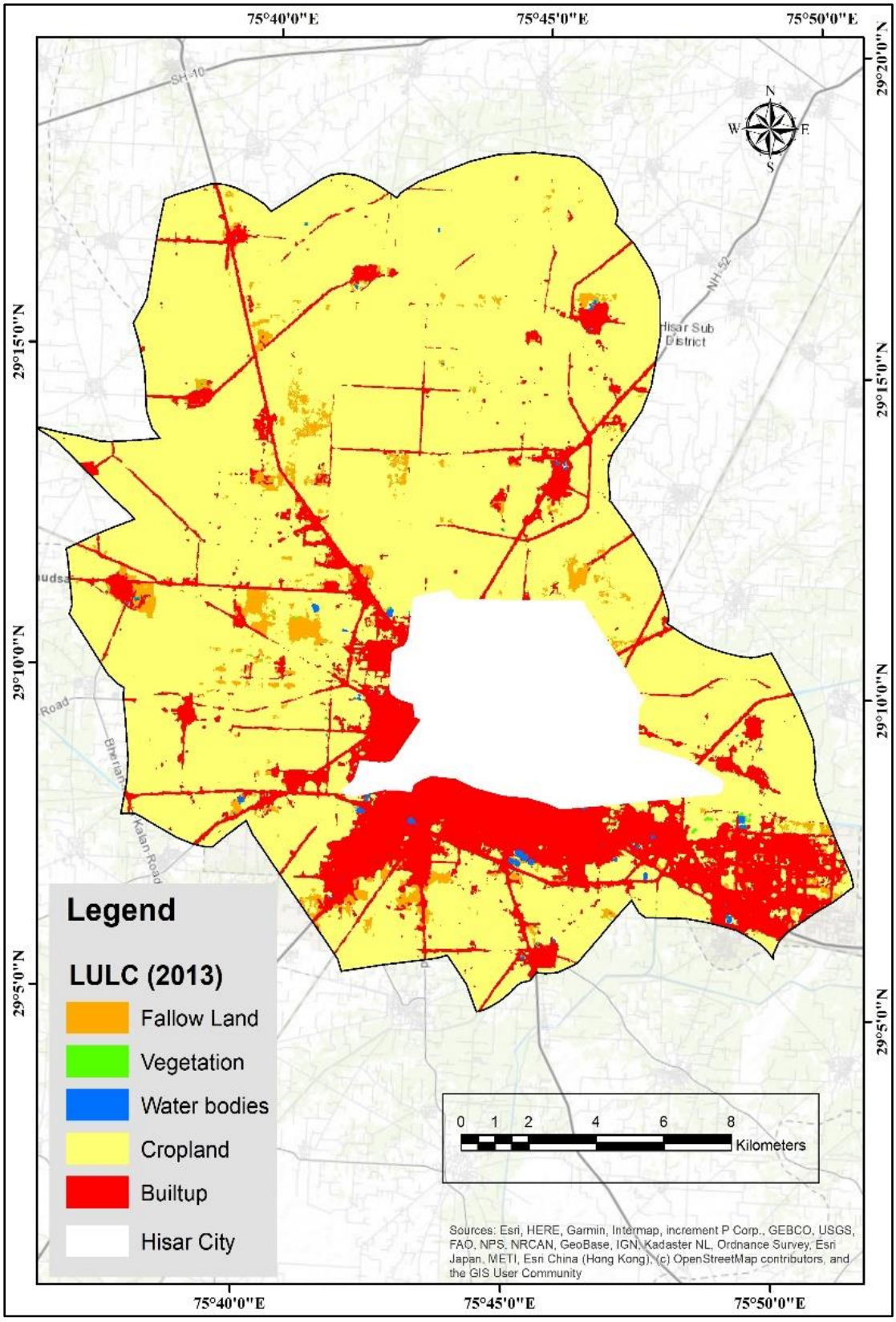
showing areas of agricultural land that remained uncultivated over the reference period, perhaps as a result of practices aimed at restoring soil fertility, irrigation limitations, or seasonal cropping strategies. Vegetation cover, such as patches of forest, groves, and plantations, takes up 5.08 sq. km, representing 1.52%, showing restricted natural or semi-natural vegetation cover in the area, which could have far-reaching effects on biodiversity conservation and ecological resilience.

Water bodies form the smallest class, representing 0.48 sq. km (0.14%), reflecting the lack of surface water resources like ponds, tanks, and small reservoirs available in the region in 2003. Therefore, the statistics show a scenario with predominance of agricultural land use, followed by built-up land as the second dominant category, and very little representation of vegetation cover and water bodies.

The Map 4.2 provide the Land Use Land Cover (LULC) pattern for the year 2013 in the study area, which totals 334.20 sq. km. According to the Table 4.2, cropland is the largest land use category, covering 264.09 sq. km, which is 79.02% of the total area. Nevertheless, since 2003, cropland area has reduced slightly, suggesting potential conversion of agricultural cover to other land uses, specifically urban development. The built-up area grew considerably to 59.69 sq. km, representing 17.86% of the total area. This is a significant increase in urban and peri-urban land use during the decade, an indication of the urbanization and infrastructural development processes in the region. Fallow land fell to 6.17 sq. km (1.85%), which indicates increased agricultural use or probable conversion of fallow lands to permanent crops or urban uses. Vegetation cover also fell to 3.44 sq. km (1.03%), reflecting ongoing pressure on natural vegetation resulting from urban growth and agricultural intensification. Notably, water bodies rose to 0.80 sq. km, accounting for 0.24% of the aggregate area, which could be due to the formation of new water storage facilities or expansion of existing water bodies for agriculture purposes, water supply for drinking, or aquaculture purposes. Overall, decadal variation between the period 2003 and 2013 shows a distinct pattern of urban sprawl at the expense of arable land and vegetation cover regions, marking the peri-urbanisation and land use change process resulting from demographic expansion, economic diversification, and infrastructural advancement within the area.



Map 4.1: Land use land cover of inner fringe of Hisar for year 2003



Map 4.2: Land use land cover of inner fringe of Hisar for year 2013

The Map 4.3 provides the Land Use Land Cover (LULC) pattern in 2023 in the study area. According to the Table 4.2, the most common land use is cropland, which covers 252.70 sq. km, making up 75.61% of the total area. Yet, there is a sustained loss of cropland area since past years (270.96 sq. km in 2003 and 264.09 sq. km in 2013), reflecting sustained conversion of agricultural land to other purposes, including built-up development. The built up area has grown considerably to 71.47 sq. km, representing 21.39% of the total area.

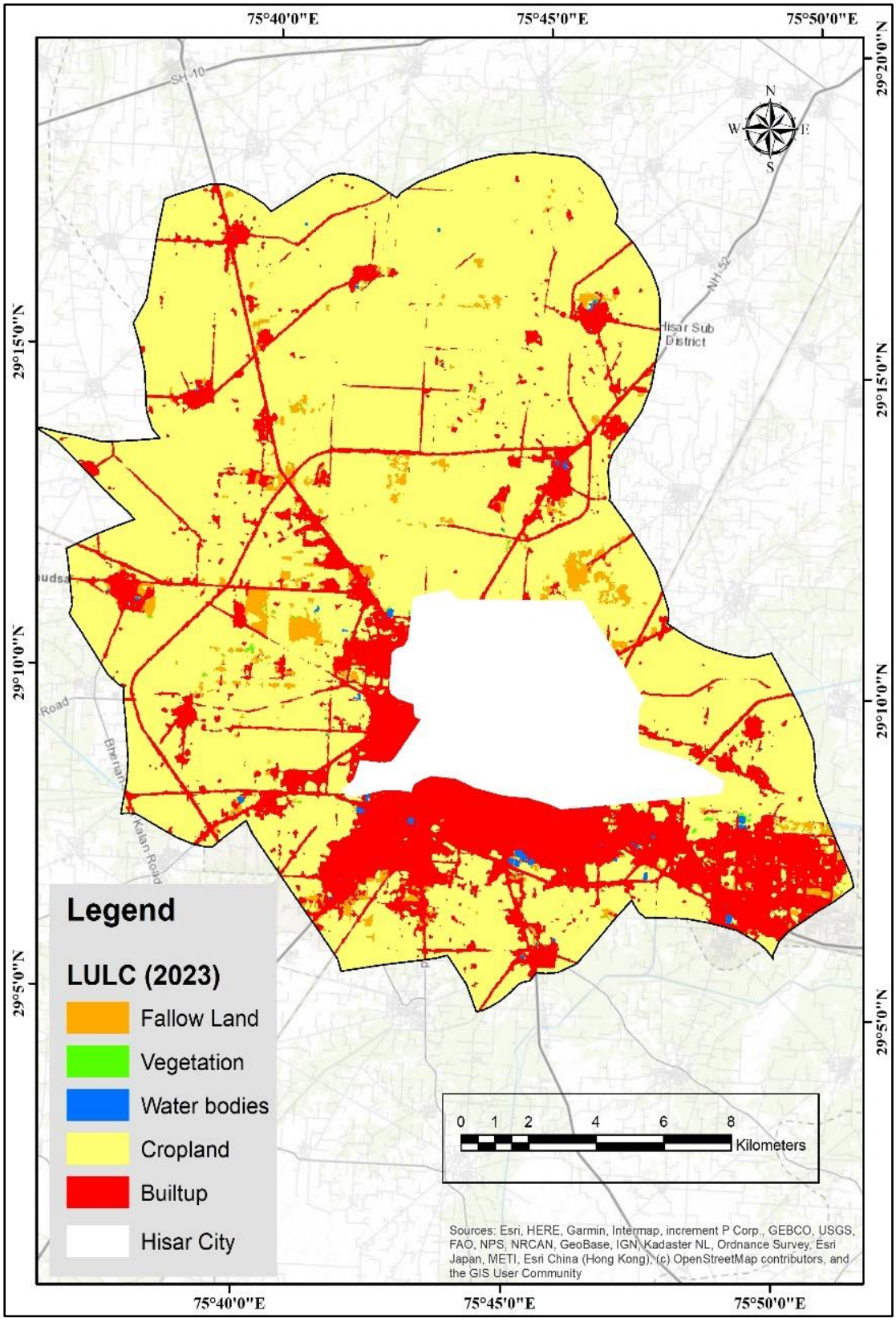
This indicates a consistent and large growth of urban and peri-urban land use in the last two decades, propelled by population increase, infrastructural development, and economic diversification. Fallow land also declined to 5.02 sq. km (1.50%), indicating better land use for agricultural purposes or ongoing conversion of fallow land to permanent cropland or urban uses. Vegetation cover actually increased slightly to 4.22 sq. km (1.26%) from 2013 (3.44 sq. km), possibly indicating afforestation efforts, plantation establishment, or community-led green space establishment in reaction to environmental management strategies.

Water bodies are fairly constant, with an area of 0.78 sq. km (0.23%), suggesting little changes in the extent of surface water over the period, perhaps with the retention of current water sources without major growth. In total, decadal and two-decade pattern from 2003 to 2023 indicates an evident trend of urban growth along with a continuous reduction in cropland cover, with minor variations in fallow land and vegetation cover. This change highlights the effects of urbanization processes on agricultural land use, ecological landscapes, and rural–urban land dynamics in the area of study.

Table 4.2: Land use/ Land cover under different category in inner fringe for the year of 2003, 2013, 2023

Sr. No.	LULC Classes	2003		2013		2023	
		Area (sq. km)	Area (%)	Area (sq. km)	Area (%)	Area (sq. km)	Area (%)
1	**Builtup**	49.31	14.76	59.69	17.86	71.47	21.39
2	**Cropland**	270.96	81.08	264.09	79.02	252.70	75.61
3	**Fallow land**	8.36	2.50	6.17	1.85	5.02	1.50
4	**Vegetation**	5.08	1.52	3.44	1.03	4.22	1.26
5	**Water bodies**	0.48	0.14	0.80	0.24	0.78	0.23
	Total	334.20	100.00	334.20	100.00	334.20	100.00

Compiled by the Author



Map 4.3: Land use land cover of inner fringe of Hisar for year 2023

4.3.2. Land use and land cover changes in inner fringe areas

The overall changing scenario was reported in Table 4.3 during 2003-2023. The Table 4.4 indicates land use and cover transformation between 2003 and 2023 within the study area. Urban built-up area widened by 22.16 sq. km, showing extensive urban growth within two decades. On the other hand, cultivated land reduced by 18.26 sq. km, meaning agricultural lands were converted to urban purposes. Fallow land reduced by 3.34 sq. km, indicating improved utilization of the land or its inclusion in built-up or permanent cultivation. Vegetation cover decreased by a marginal 0.86 sq. km, reflecting marginal loss of natural cover through urbanization or intensification of agriculture. Water bodies increased marginally by 0.30 sq. km, perhaps through the construction of new water reservoir facilities. Generally, the statistics depict a definitive change brought about by urbanization, with expansion in built-up area coming out of cropland, fallow land, and vegetation.

Table 4.3: Change in area (sq. km) of different land use/land cover classes of inner fringe for year 2003-2023

Sr. No.	LULC Classes	Area in 2003 (sq. km)	Area in 2023 (sq. km)	Absolute changes (sq.km)
1	**Builtup**	49.31	71.47	22.16
2	**Cropland**	270.96	252.70	-18.26
3	**Fallow land**	8.36	5.02	-3.34
4	**Vegetation**	5.08	4.22	-0.86
5	**Water bodies**	0.48	0.78	0.30

Compiled by the Author

The changes in land use in Hisar, Haryana, present clear-cut phases of urban-led transformation. According to the Table 4.4, from 2003 to 2013, built-up space expanded by enclosing 6.82 sq. km of cultivated land, 2.84 sq. km of fallow area, and 1 sq. km of vegetation cover, demonstrating early peri-urban growth along highways and the urban edge because of infrastructural development, industrial units, and educational centers. Between the time periods 2013–2023, this trend was heightened as built-up area acquired 9.88 sq. km of land from cropland, in addition to lesser

conversions from fallow land and vegetation, as indicators of speeding up urban sprawl due to population growth and economic diversification.

Table 4.4: Transformation of LULC in area (sq. km) of inner fringe for year 2003-2023

		2013				
2003		**Built up**	**Cropland**	**Fallow land**	**Vegetation**	**Water bodies**
	Built up	49.31	0	0	0	0
	Cropland	6.82	261.64	1.47	0.83	0.19
	Fallow land	2.84	0.98	4.15	0.38	0
	Vegetation	1	1.15	0.52	2.2	0.2
	Water bodies	0.05	0.01		0.01	0.41
		2023				
2013		**Built up**	**Cropland**	**Fallow land**	**Vegetation**	**Water bodies**
	Built up	59.69				
	Cropland	9.88	251.43	1.21	1.53	0.03
	Fallow land	1.77	0.49	3.71	0.2	0
	Vegetation	0.51	0.38	0.07	2.45	0.03
	Water bodies	0.04	0.03		0.02	0.71
		2023				
		Built up	**Cropland**	**Fallow land**	**Vegetation**	**Water bodies**
2003	**Built up**	49.31				
	Cropland	16.94	250.01	1.94	1.84	0.2
	Fallow land	4.07	1.24	2.64	0.4	0
	Vegetation	1.44	1.08	0.42	1.95	0.19
	Water bodies	0.07	0.02		0.01	0.38

Compiled by the Author

Throughout the whole period 2003–2023, the built-up area increased by 22.16 sq. km, mostly at the cost of cropland, which reduced by 18.26 sq. km, as indicators of prolonged pressure on agricultural land. Fallow land decreased by 3.34 sq. km, showing its conversion into cultivable land or urbanized areas, and vegetation cover

decreased minimally by 0.86 sq. km, as an indication of encroachment of natural patches for agricultural intensification and urban growth. Slight increase in water bodies (+0.30 sq. km) over these decades may be due to the development of water harvesting structures and irrigation ponds under state conservation programmes. These changes are caused by Hisar's urbanization as a regional center but, in turn, bring about issues like groundwater loss, increasing land surface temperature, and environmental degradation. In total, the pattern reflects a standard urban sprawl trend, with successive loss of croplands and expansion of built-up areas, with integrated sustainable urban planning required sustaining development while safeguarding the environment in this semi-arid area.

4.3.3. Accuracy assessment

The accuracy assessment of the classification of the inner fringe zone from the years 2003, 2013, and 2023 shows consistently high reliability of Land Use Land Cover (LULC) classification results using Google Earth data and satellite image as well as intensive field study as reference (Table 4.5). Producer's accuracy in 2003 varied from 90.63% for water bodies to 97.96% for vegetation, whereas user's accuracy ranged from 90% for built-up areas to 96.67% for multi-class, with overall accuracy of 94.58% and a Kappa value of 0.92, which indicates very good agreement and negligible classification error. Producer's accuracy in 2013 was also high, ranging from 92.25% (water bodies) to 96.66% (vegetation). User's accuracy also performed well, from 92.36% (built-up area) to 98.87% (water bodies). The overall accuracy again increased slightly to 95.68%, and the Kappa coefficient was 0.93, showing again excellent agreement. In 2023, classification again had high reliability, with producer's accuracy varying from 95.4% (fallow land) to 97.87% (water bodies) and user's accuracy varying from 95.23% (fallow land) to 98.52% (built-up area). The overall accuracy also increased to 96.58%, with Kappa coefficient equal to 0.94, again reiterating outstanding agreement between reference and classified data. Overall, the very high producer's and user's accuracy values, along with Kappa coefficients higher than 0.90, validate that the LULC classifications for all three years are extremely accurate, reliable, and appropriate for ensuing change detection analysis, spatial modeling, and policy-driven land use planning in the study region.

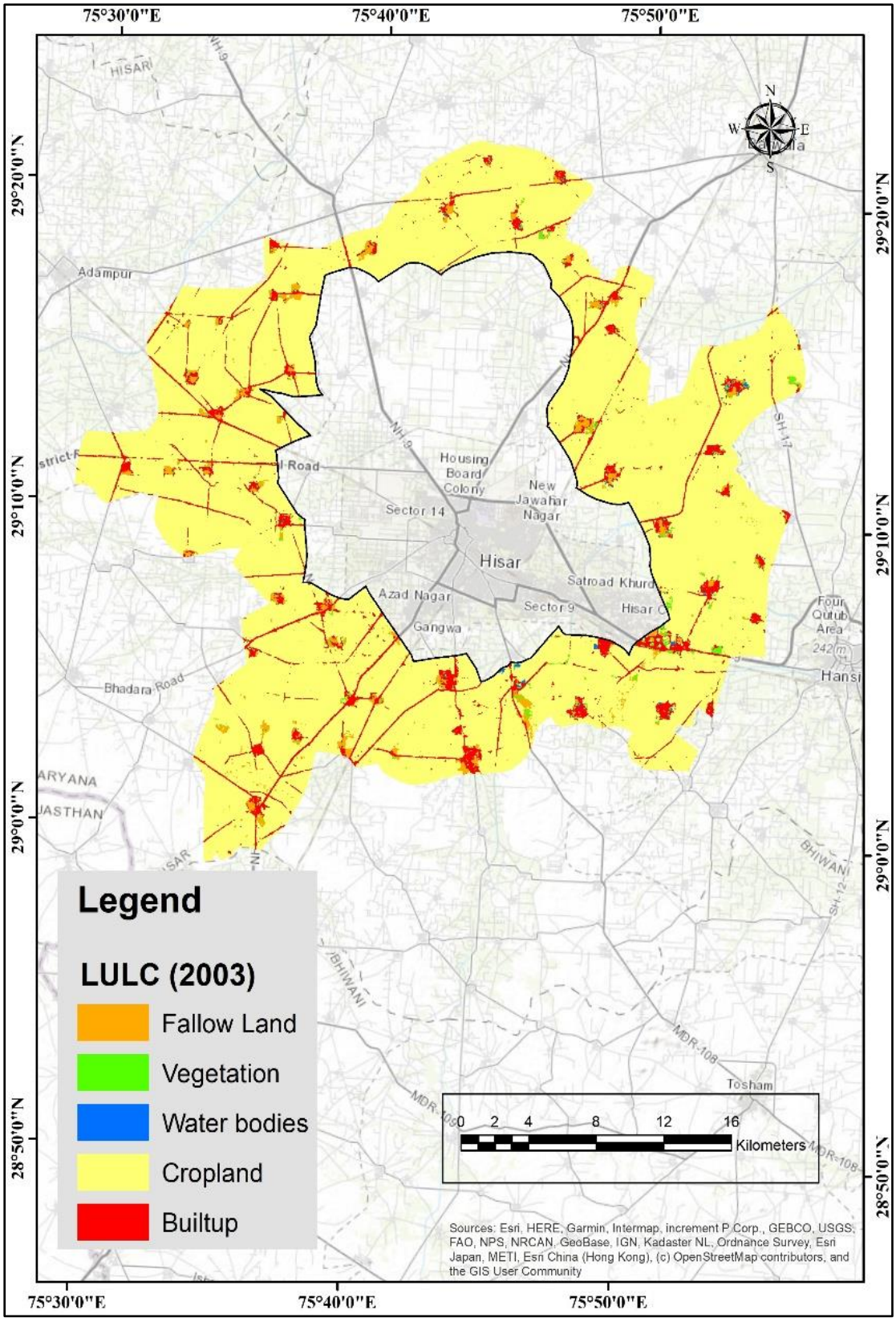
Table 4.5: Accuracy assessment of LULC in area (sq. km) of inner fringe for year 2003-2023

	LULC Classes	2003	2013	2023
Producer's Accuracy (%)	Cropland	94.55	96.6	95.55
	Built-up area	95.74	95.55	96.54
	Fallow Land	96.67	96.5	95.4
	Vegetation	97.96	96.66	95.55
	Water bodies	90.63	92.25	97.87
User's Accuracy (%)	Cropland	96.67	95.65	96.85
	Built-up area	90	92.36	98.52
	Fallow Land	96.67	95.54	95.23
	Vegetation	96	96.66	96.25
	Water bodies	96.67	98.87	96.54
	Overall Accuracy (%)	94.58	95.68	96.58
	Kappa Coefficient	0.92	0.93	0.94

Compiled by the Author

4.3.4. Land use and land cover scenario in outer fringe areas

Land use and land cover configuration over the outer fringe of Hisar in 2003 presented through Map 4.4. Land use land cover (LULC) for the year 2003 describes that cropland was the most dominant land use in the study area, covering 610.41 sq. km and contributing 90.83% of the total geographical area. Urban areas covered 42.76 sq. km or 6.36% of the total area, showing restricted urban growth during these years. Fallow land covered 13.39 sq. km (1.99%), and vegetation coverage was seen over 4.62 sq. km, and was only contributing 0.69% towards the total area. Water bodies occupied the least spatial coverage, with an area of 0.88 sq. km, which translates to about 0.13% of the area. As a whole, the LULC structure in 2003 illustrates a strong predominance of agricultural land use with least occurrence of built-up and natural vegetation classes.

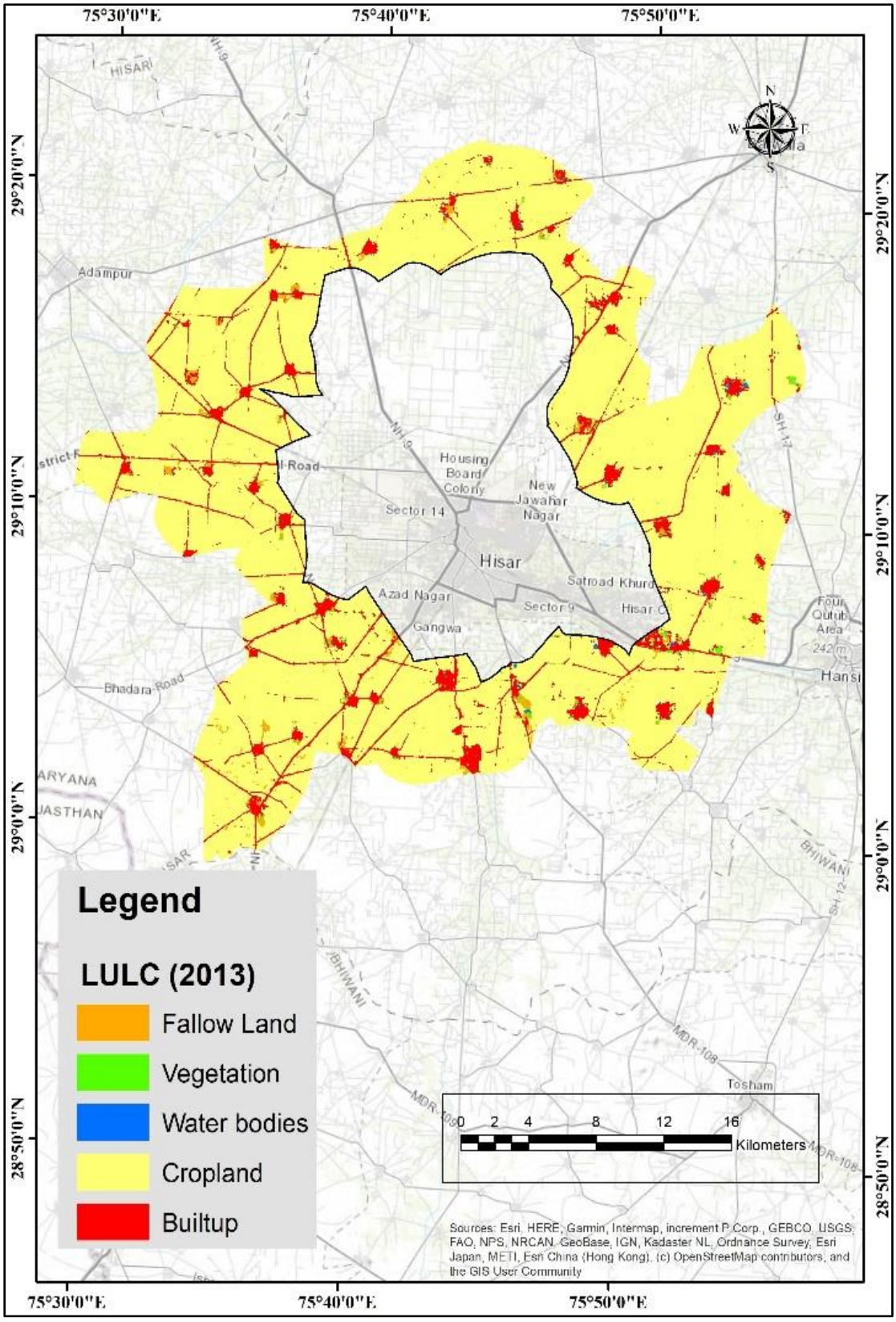


Map 4.4: Land use land cover of outer fringe of Hisar for year 2003

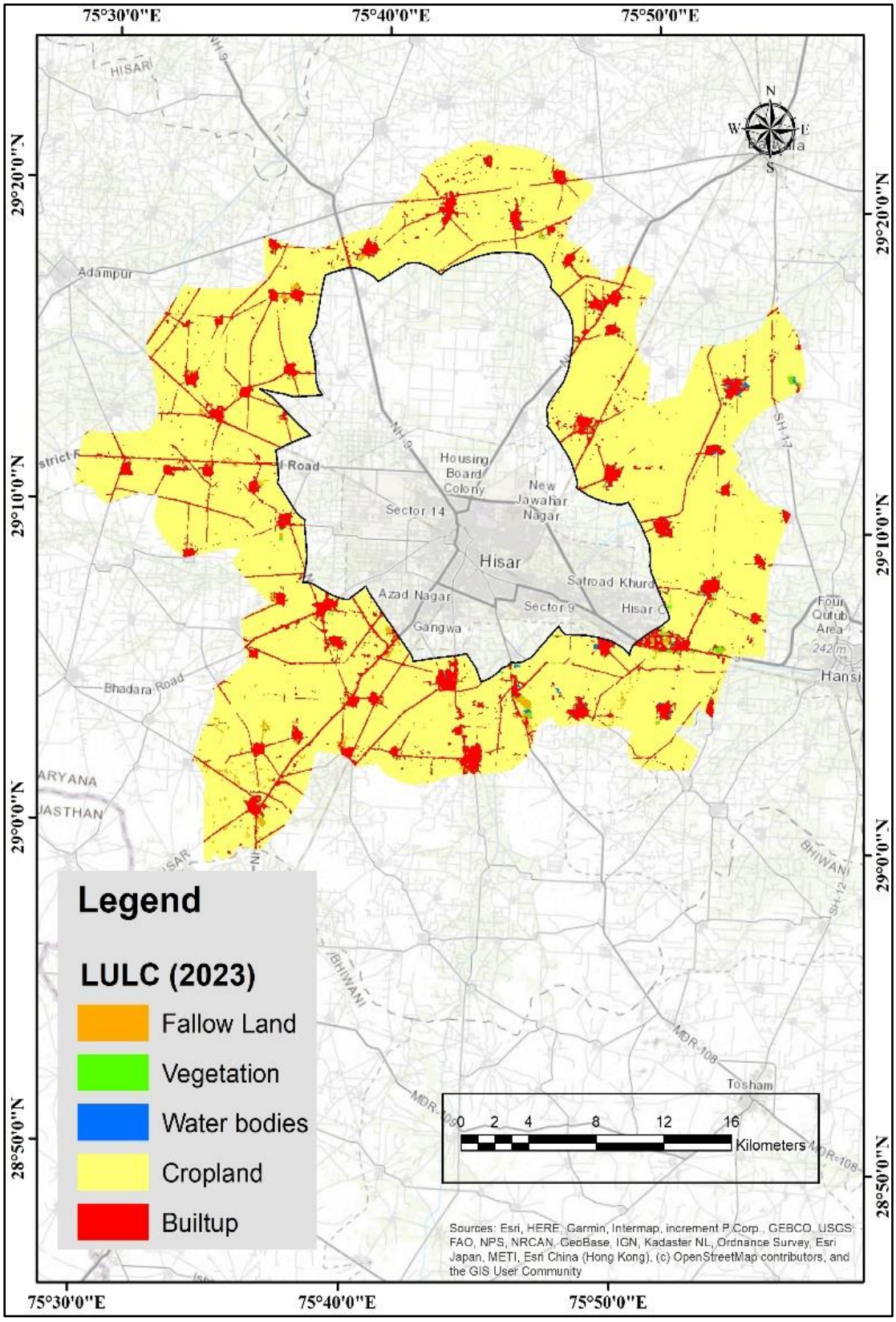
Land Use Land Cover (LULC) analysis for the year 2013 shows a dominance of cropland, which covers about 90.09% (605.43 sq. km) of the area (672.06 sq. km) (Map 4.5). This confirms that the study area is largely agricultural in character, portraying intensive cultivation activities.

Table 4.6 represents that the urban built-up area with a percentage of 8.15% (54.80 sq. km), showing moderate urbanization or settlement growth within the area. Fallow land occupies 1.13% (7.57 sq. km), which is temporarily abandoned agricultural lands that could be left for soil rejuvenation or as a result of seasonal cropping practice. Vegetation cover, natural vegetation patches, and plantations occupy merely 0.49% (3.26 sq. km), indicating very few forested or vegetated spaces, which would be of concern for ecological balance and sustainability of biodiversity in the area. Water bodies are very scarce, covering only 0.15% (1.00 sq. km), suggesting limited surface water resources, which may impact irrigation and water security.

The year 2023 land use land cover (LULC) data show that cropland is the most dominant land use category, having an area of around 593.16 sq. km, which accounts for 88.26% of the total area (Map 4.6). This reflects the farm-based dominance in the area, inferring a largely agricultural landscape. The area built up is 69.08 sq. km (10.28%), which is the measure of urbanization or infrastructural growth in the area of study. Fallow land is minimal, as only 5.88 sq. km (0.87%) is temporarily uncultivated land for agriculture. Vegetation cover takes up 2.82 sq. km, representing 0.42%, whereas water bodies are thinly distributed, occupying only 1.12 sq. km (0.17%). (Table 4.6) The minimal representation of vegetation and water bodies can be taken to mean lower natural vegetation and limited surface water catchments, which might have a bearing on biodiversity conservation and hydrological equilibrium within the area. Therefore, the landscape is extensively covered by cropland, followed by urban or built-up areas, with very small percentages of fallow land, vegetation, and water bodies.



Map 4.5: Land use land cover of outer fringe of Hisar for year 2013



Map 4.6: Land use land cover of outer fringe of Hisar for year 2023

Table 4.6: Land use/ Land cover under different category in outer fringe for the year of 2003, 2013, 2023

Sr. No.	LULC Classes	2003		2013		2023	
		Area (sq. km)	Area (%)	Area (sq. km)	Area (%)	Area (sq. km)	Area (%)
1	**Built up**	42.76	6.36	54.80	8.15	69.08	10.28
2	**Cropland**	610.41	90.83	605.43	90.09	593.16	88.26
3	**Fallow land**	13.39	1.99	7.57	1.13	5.88	0.87
4	**Vegetation**	4.62	0.69	3.26	0.49	2.82	0.42
5	**Water bodies**	0.88	0.13	1.00	0.15	1.12	0.17
	Total	672.06	100.00	672.06	100.00	672.06	100.00

Compiled by the Author

4.3.5. Land use and land cover changes in outer fringe areas

The analysis of land use land cover (LULC) changes in the outer fringe areas of Hisar, Haryana, between 2003 and 2023 reveals notable transformations driven by rapid urbanisation and infrastructural development. According the Table 4.7, the built-up area increased substantially from 42.76 sq. km in 2003 to 69.08 sq. km in 2023; recording an absolute rise of 26.32 sq. km. Figure 4.2 presents the nature of changes in LULC features from 2003 to 2023. This expansion is primarily attributed to improved transport connectivity, the establishment of industrial zones, and the proximity of Hisar to the National Capital Region (NCR), which collectively fostered peri-urban growth and intensified real estate development. Despite this, cropland remains the dominant land use, though it declined from 610.41 sq. km to 593.16 sq. km (a reduction of 17.25 sq. km), due to the conversion of agricultural lands into residential, commercial, and industrial uses alongside infrastructural projects such as roads and warehouses. Fallow land decreased by 7.51 sq. km, indicating a trend towards agricultural intensification driven by market demand or its conversion for urban purposes. Natural vegetation covers also reduced from 4.62 sq. km to 2.82 sq. km (a loss of 1.80 sq. km), reflecting encroachment and lack of conservation amidst expanding urban footprints. Interestingly, water bodies witnessed a marginal increase

of 0.25 sq. km, potentially due to the creation of artificial ponds or small reservoirs for irrigation and urban water needs. Overall, these changes highlight a clear shift from a predominantly agrarian landscape towards an urban-industrial fringe, driven by infrastructural expansion and economic growth, posing significant challenges for sustainable land management, agricultural retention, and ecological conservation in the region.

Table 4.7: Change in area (sq. km) of different land use/land cover classes of outer fringe for year 2003-2023

Sr. No.	LULC Classes	Area in 2003 (sq. km)	Area in 2023 (sq. km)	Absolute changes
1	**Builtup**	42.76	69.08	26.32
2	**Cropland**	610.41	593.16	-17.25
3	**Fallow land**	13.39	5.88	-7.51
4	**Vegetation**	4.62	2.82	-1.80
5	**Water bodies**	0.88	1.12	0.25

Compiled by the Author

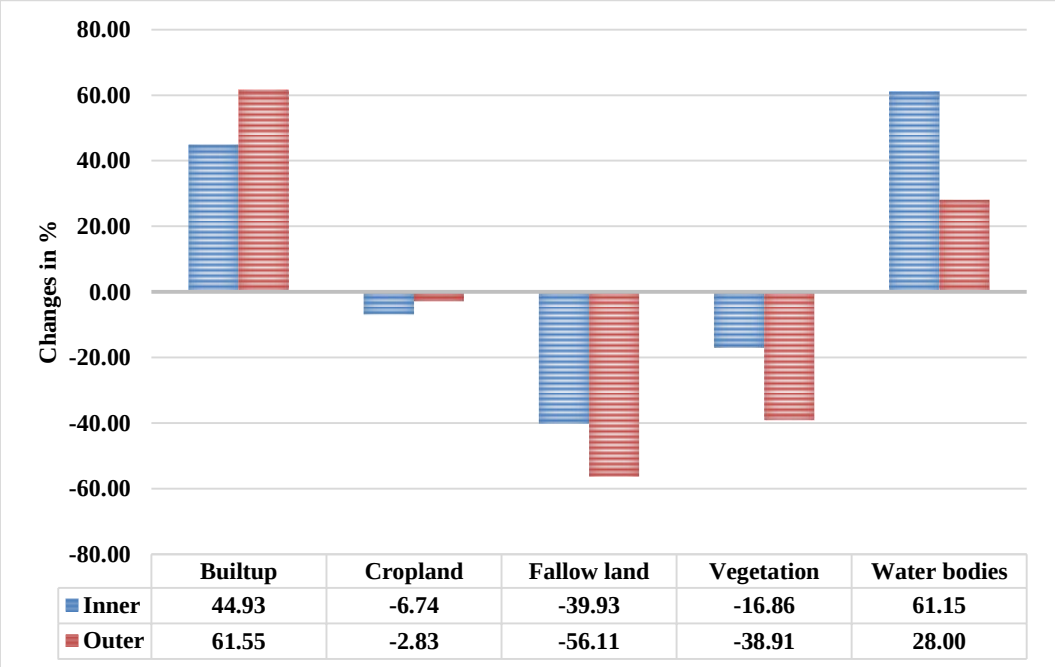


Fig. 4.2: Percentage change of land use and land cover classes in Hisar District 2003-2023

Land use land cover (LULC) transition assessment of the outer fringe of Hisar district between the two decades from 2003 to 2023 signifies dynamic spatial transformations induced by urbanization, agricultural intensification, and infrastructure development. The transformation matrix (Table 4.8) shows the scenario between 2003 and 2013, built-up land expanded from already existing built-up land along with the conversion of cropland of 6.35 sq. km and 5.36 sq. km of fallow land to built-up, reflecting the expansion of settlements and infrastructure in lieu of agricultural land. Cropland was converted to fallow land (0.81 sq. km) and vegetation (0.19 sq. km), reflecting minimal conversion reflecting relatively stable agricultural practice with small amounts of land abandonment. Vegetation and water bodies witnessed marginal transitions, with cropland transitioning to vegetation (0.19 sq. km) and limited cropland and vegetation transitioning to water bodies (0.04 sq. km and 0.32 sq. km respectively), likely because of farm pond development or seasonal water accumulation. Built-up areas continued expanding from 2013 to 2023, converting 11.46 sq. km of farmland and 2.54 sq. km of idle land into urban uses, signaling greater sprawl driven by nearness to the NCR, factories, and better road networks. Cropland once again saw negligible conversion to fallow land (1.2 sq. km), vegetation (0.32 sq. km), and water bodies (0.14 sq. km), and suggesting unabated prevalence of agriculture with minor diversions to other land use patterns. Fallow land was dominated by conversion to built-up land and cropland, indicating reclamation for productive or urban use. Vegetation showed small conversions to cropland (0.12 sq. km) and built-up land (0.69 sq. km), reflecting degradation by urban encroachment and agricultural expansion. Water bodies indicated slight increases by potential construction of artificial ponds for irrigation or water harvesting. (Table 4.8)

The 2003–2023 cumulative matrixes also reflect large transitions. During these two decades, urban areas expanded at the expense of 17.49 sq. km of cropland and 7.93 sq. km of fallow land, reaffirming the prevailing pattern of urbanization into farmlands. Cropland was converted to built-up (17.49 sq. km), fallow land (1.78 sq. km), vegetation (0.35 sq. km), and water bodies (0.14 sq. km) but also took 1.2 sq. km of fallow land, evidencing agricultural intensification in some areas. Fallow land reduced significantly as it was converted to built-up zones (7.93 sq. km) and agricultural land (1.2 sq. km), whereas vegetation declined due to conversion to

agricultural (0.72 sq. km) and built-up (1.32 sq. km). Water bodies increased marginally, presumably due to farm pond construction under water conservation programs. (Table 4.8)

Table 4.8: Transformation of LULC in area (sq. km) of outer fringe for year 2003-2023.

		2013				
2003		**Builtup**	**Cropland**	**Fallow land**	**Vegetation**	**Water bodies**
	Builtup	42.76				
	Cropland	6.35	602.97	0.81	0.19	0.04
	Fallow land	5.36	1.15	6.54	0.34	0
	Vegetation	0.67	0.77	0.19	2.67	0.32
	Water bodies	0.03	0.16	0	0.05	0.63
		2023				
2013		**Builtup**	**Cropland**	**Fallow land**	**Vegetation**	**Water bodies**
	Builtup	54.79				
	Cropland	11.46	592.25	1.2	0.32	0.14
	Fallow land	2.54	0.26	4.61	0.15	0
	Vegetation	0.69	0.12	0.04	2.29	0.11
	Water bodies	0.07	0.03	0	0.05	0.85
		2023				
2003		**Builtup**	**Cropland**	**Fallow land**	**Vegetation**	**Water bodies**
	Builtup	42.75				
	Cropland	17.49	590.56	1.78	0.35	0.14
	Fallow land	7.93	1.2	3.9	0.34	0
	Vegetation	1.32	0.72	0.17	2.08	0.34
	Water bodies	0.08	0.14		0.04	0.62

Compiled by the Author

These changes are scientifically attributed by a number of drivers: (i) pressure of urbanisation because of Hisar's locational advantage with respect to NCR resulting in peri-urbanization; (ii) development of industry and enhanced connectivity drawing

people and economic activity towards the peripheries; (iii) conversion of agricultural land for housing and infrastructure schemes; and (iv) marginal encroachments into water bodies prompted by water harvesting infrastructure with falling groundwater levels in the area. The general pattern illustrates a transition from an agrarian to an urban-industrial periphery landscape, which is of concern in terms of loss of productive farm land, fragmentation of ecosystems, and sustainability of future land use.

4.3.6. Accuracy Assessment:

The accuracy evaluation of the LULC classification of 2003, 2013, and 2023 shows uniformly high classification quality at all periods, reflecting maturity of the methodology and interpretation of data. (Table 4.9)

Table 4.9: Accuracy Assessment of LULC of outer fringe

	LULC Classes	**2003**	**2013**	**2023**
Producer's Accuracy	Cropland	93.16	93.14	96.65
	Built-up area	96.83	95.56	96.58
	Fallow Land	95.55	96.67	95.63
	Vegetation	98.99	96.96	98.99
	Water bodies	91.9	93.93	91.26
User's Accuracy	Cropland	97.66	94.59	98.66
	Built-up area	93.35	92.29	90
	Fallow Land	95.55	93.33	96.55
	Vegetation	96.66	97	96.65
	Water bodies	95.56	96	95.55
	Overall Accuracy (%)	93.52	95.05	95.66
	Kappa Coefficient	0.91	0.92	0.94

Compiled by the Author

The producer's accuracy of the producer for agricultural land continued to be high, rising from 93.16% in 2003 and 93.14% in 2013 to 96.65% in 2023, indicating enhanced classification performance for cropland over recent decades, potentially resulting from higher resolution imagery and improved classification algorithms.

Urban areas continued to record high producer's accuracy levels across the three decades, and they were between 95.56% and 96.83%, indicating consistent detection of urban features throughout. Producer's accuracy of the fallow land producer was consistent at 95-96%, and vegetation consistently had very high producer's accuracy ranging from 96.96% to 98.99%, demonstrating good vegetative cover identification. Producer's accuracy for water bodies was generally lower than other classes, ranging from 91.26% to 93.93%, potentially because of seasonal variation, small object size, or spectral similarity with shadow or wet soil in some cases. The user's accuracy for cropland increased significantly from 94.59% in 2013 to 98.66% in 2023, reflecting lower commission errors and greater class reliability for cropland over the past few years. Urban areas declined slightly in user's accuracy from 93.35% in 2003 to 90% in 2023, suggesting a marginal rise in misclassification of non-urban features as urban, possibly due to spectral confusion with fallow land or scattered vegetation. Fallow land and vegetation classes kept users' accuracy at over 93% throughout the years, whereas water bodies had high users' accuracy ranging from 95.55% to 96% and indicating high reliability even with small spatial coverage. Overall accuracy of classification in 2003 was 93.52%, whereas in 2023, it was 95.66%, and the Kappa coefficient was raised from 0.91 to 0.94, reflecting a high consistency of classified results with reference data and minimal classification mistakes over the years. Therefore, the classification outcomes show strong accuracy, coherence, and methodological reliability over the study period. The increase in overall accuracy and Kappa coefficient with time indicates an improvement in data quality, classification rules, and field validation approaches employed in the study. Nevertheless, a drop in built-up user's accuracy in 2023 implies the requirement for more training samples or spectral indices to differentiate built-up land use from identical land covers in subsequent classification processes.

4.4 CONCLUSION

This chapter shows that geospatial techniques, combined with multi-temporal Landsat imagery, provide a robust and reliable framework for monitoring land use and land cover (LULC) dynamics in the urban-rural fringe of Hisar district during the period 2003-2023. Using supervised maximum likelihood classification and rigorous accuracy assessment, the study successfully mapped the five main LULC categories

cropland, built-up area, fallow land, vegetation and water bodies for both inner and outer fringe regions, with consistently high overall accuracy (above 93%) and kappa coefficients greater than 0.90. These levels of accuracy ensure that the classified maps are suitable for detecting spatio-temporal changes. The findings clearly reveal a clear and systematic trend of urban expansion at the expense of agriculture and open land in both fringe regions. In the inner periphery, built-up area increased from 49.31 sq km (14.76%) in 2003 to 71.47 sq km (21.39%) in 2023, while cropland decreased from 270.96 sq km (81.08%) to 252.70 sq km (75.61%). A similar picture is evident in the outer periphery, where built-up area increased from 42.76 sq km (6.36%) to 69.08 sq km (10.28%) during the same period, and cropland decreased from 610.41 sq km (90.83%) to 593.16 sq km (88.26%). The transformation matrix also shows that most of the newly built-up area originated from cropland and to a lesser extent from fallow land and vegetation, highlighting the direct pressure of urbanization on the productive agricultural landscape.

At the same time, fallow land has consistently decreased in the interior and exterior, indicating an increase in cultivation intensity or conversion to permanent built-up use. Vegetation cover, although occupying a small fraction of the total area, has experienced marginal net loss in the exterior and slight fluctuations in the interior, reflecting local afforestation or plantation efforts under greater anthropogenic pressure. Water bodies remain spatially limited but show a small net increase, possibly related to the development of irrigation ponds and water-harvesting structures, indicating emerging efforts to address water stress in this semi-arid environment.

Therefore, the LULC dynamics of the urban-rural fringe of Hisar, reflect a classic peri-urbanization trajectory: increasing outward expansion of the built environment, fragmentation and reduction of cropland, and increasing encroachment on ecologically valuable open space. The spatially explicit evidence generated in this chapter forms an important empirical basis for further analysis of the impacts of urbanization and the design of sustainable land management and policy interventions in Hisar district.

CHAPTER 5

SOCIO-ECONOMIC AND DEMOGRAPHIC PROFILE OF THE RURAL-URBAN FRINGE

5.1 INTRODUCTION

With the increasing population, the urban area grows rapidly and intensifies the process of urban expansion. Through this process, the urban areas come closer to the surrounding rural areas and mutual interaction between both the areas starts increasing. The rural-urban interactions result in the transformation of land use, environment, and socio-economic attributes of the fringe area. The impact of increasing public facilities in the city is reflected in the nearby rural-urban fringe. The socio-economic transformations occurring within Hisar city are clearly reflected in the socio-economic characteristics of its surrounding fringe zone. With the declining of the core of the city, the population of the center part is moving to the outskirt of the city. Some other factors such as increasing land value, the friction of space, congestion, crowding, air, and noise pollution are crucial factors behind such migration. This in turn is increasing the population density in the surrounding area of the city. The fringe area is also expanding with this incoming population. Urban characteristic related to these population groups is increasing their influence on the socio-economic characteristic of the fringe population. The impact of the changing socio-economic pattern of the area around the city is also reflected in the socio-economic characteristics of the adjacent village. The economic activities in the village also get influenced by that of the urban secondary and tertiary economic activities. In his publication, **Golledge (1960)** characterizes the fringe area as a region marked by a dynamic pattern of land use, small-scale farming, and intense crop cultivation, a shifting population of low to medium density, semi-developed public amenities, speculative subdivisions and residential plots. This results in a constantly evolving and dynamic environment. :-

- ***Labor market demand*** – In view of the demand for specific labor within the city, the labor force of the surrounding villages tries to bring

exclusivity and newness accordingly. Thus the traditional occupational structure is changing according to the changing labor needs and the number of non-agricultural works is increasing rapidly.

- ***Family and society*** **–** Due to the impact of the urban social attributes, the number of individual families is continuously increasing in the fringe and the surrounding villages.
- ***Role of women*** **-** Participation of women in various economic activities has improved their position in the family and now they are emerging as making important decisions in the family.
- ***Fertility rate*** **-** With the advent of the rural environments to the urban environments, there was a change in the thinking of women, the size of rural families became much limited than before. The fertility rate has become significantly low.
- ***Education and training*** **–** With access to the urban educational facilities, individuals from the nearby rural area engage themselves for their intellectual development. This, in turn, increases the literacy rate especially the female literacy rate in the fringe area.
- ***Health and sanitation*** **–** The fringe area represents the outward expansion of the urban area, due to lack of necessary infrastructure facilities, the cleanliness system is not so well organized, and the effect of water and air pollution of the urban area is clearly visible on the people of this region. If we talk about health facilities, due to the close proximity of urban areas, it is definitely that people get good health facilities, but the gradual change from the rural environment to urban environment has many effects on the health of the individuals.
- ***Diversification of economic activities*** **-** Due to the diversity in the occupational structure within the urban area, there is a demand for employment. That is why the working population of the adjacent countryside is trying to adapt themselves according to the changing scenario of the labor market. They are moving away from agro-based activities due to their adjustment.

- ***Access to the new technology*** **-** Urban areas are centers of new technology and innovation, which are spreading it to the surrounding area and people from rural areas use this technology to fulfill various needs in their lives.
- ***Access to the public amenities*** **-** The expansion of various public facilities in the urban area gradually starts reaching the surrounding rural areas and people start getting benefits from them.

With the above discussed points, it is clear that the urban area has an impactful relationship with its surrounding countryside. Urban attributes have clearly reflected in the demographic and socio-economic characteristics of the surrounding rural areas. With the passage of time, as the urban area develops, it gives its various characteristics to the surrounding countryside. The main reason for this is that there is a highly intense relationship between the city region and the countryside. Neither the city nor the countryside can remain isolated without each other. While the city caters to the needs of the rural areas through various economic and administrative services, the rural areas meet the urban needs through various agricultural products. There is a give and take relationship between the two. No one can survive in isolation.

In India, different suburbs around urban areas often develop on arable land apart from rural areas. These suburbs are administratively part of the village, but the residents here consider themselves as a part of the urban area. Urban influence is clearly visible on socio-economic and other characteristics of these peoples. But all these people living do not get the benefit of any kind of urban facilities nor do they pay any kind of tax to the urban administration. But these areas around the city can be seen as representative of increasing urbanization. **Ramchandran (2001)** the people living in surrounding countryside often visit to the urban area for cater their need of education, health, shopping etc. The history of urbanization in India shows that growing cities have drastically changed the socioeconomic characteristics of the surrounding rural areas over time. The rapid development of large city centers in India is not only increasing its impact on the surrounding rural areas but also rapidly transforming them. **Clark (1982)** presently, a significant proportion of the populace resides in a rapidly expanding urban region or its

contiguous rural environs, wherein they are predominantly influenced by urban beliefs, standards, and way of life. The process of urbanization reflects the change in behavioral and social relationships that only occurs in the urban area but also in the countryside. It reflects the transformation from a traditional to a modern society **(Bhatta, B et al.)**. In the field of urban analysis, functional classification is an important factor for perceiving the domain and distinctive nature of the function of a particular town/city **(Guchhait, S. K. and Dasgupta, A. 2009).**

The intensive growth of population density creates pressure on the city center and the attraction of growing urban facilities in rural areas, people from both areas start settling between rural and urban areas. People of urban center, very close to the urban periphery, settle in open places. The population of rural areas starts settling in the outskirts very close to the city to get employment and other facilities in the urban area, thus the city not only provides various amenities to the people of the urban area but also to the population living just outside the urban boundary. Urban areas do not function in isolation but remain closely interconnected with the surrounding rural hinterland. Urban centers not only supply a wide range of services to neighboring rural areas but also depend on them to meet various urban demands. **(Mayerand Kohn, 1967)** proposed that the rural-urban fringe is a transitional zone that lies between urban and rural areas, exhibiting features of both urban and rural communities. This area can also be called a composite form of both these characteristics. There is some characteristic of rural-urban fringe such as Land value, urban habits, public utility service, literacy, sex ratio, household density, population growth, etc. influenced by nearby urban centers. These characteristic may vary from one urban center to another depending on the physical and cultural setting of the urban centers.

5.2 SAMPLING TYPES

Purposive sampling: This sampling method comes under the category of Non-Probability sampling. The sampling also is known as judgmental, selective, or subjective sampling. In this method of sampling, the judgment of the researcher plays a crucial part to select any sampling unit such as people, caste, organization or piece of data. This technique includes maximum variation sampling, homogeneous

sampling, typical case sampling, extreme case sampling, total population sampling, and expert sampling

Stratified sampling: This sampling technique is used for sample collection when the population is not homogeneous. This method divides the population into a smaller unit known as strata. These strata are formed based on similar attributes or characteristics. These strata are formed based on the experience and personal judgment of the researcher. For determining the strata, first of all, there should be a pilot survey for determining the appropriate and efficient stratified plan. The variability between different samples can be examined with this process. After the formation of these strata, the sample is collected from each stratum in proportion to the size of stratum when compared to the population. The selection of a sample from different strata can be done based on a random, systematic, or purposive sampling method. **Kothari, R.C., Garg, G. (2019)**

5.3 SAMPLING METHOD

In this research, purposive stratified sampling was utilized to incorporate representative units from both the primary and secondary fringes. Stratified sampling enables a better estimation by classifying the population into homogenous sub-groups (strata) and then sampling from each stratum **(Etikan & Bala, 2017)**. Having outlined the fringe areas, villages were proportionately selected, having about 10% of total villages of each type of fringe (3 out of 21 in primary fringe and 6 out of 60 in secondary fringe (Table. 5.1). Proportionate sampling within strata is a commonly used method since it maintains the true distribution of population attributes within strata and minimizes sampling error **(Singh & Masuku, 2014)**. Later, a household survey was done on 389 households using a comprehensive questionnaire in 2023. Around 3% of households were sampled from every sample village to provide reasonable representation without making the survey operationally burdensome. Purposive sampling in stratified villages is warranted since it enables the researcher to attend to pertinent units with desired characteristics **(Palinkas et al., 2015)**, particularly in fringe zones where the patterns of settlement and socio-economic differences are not uniform.

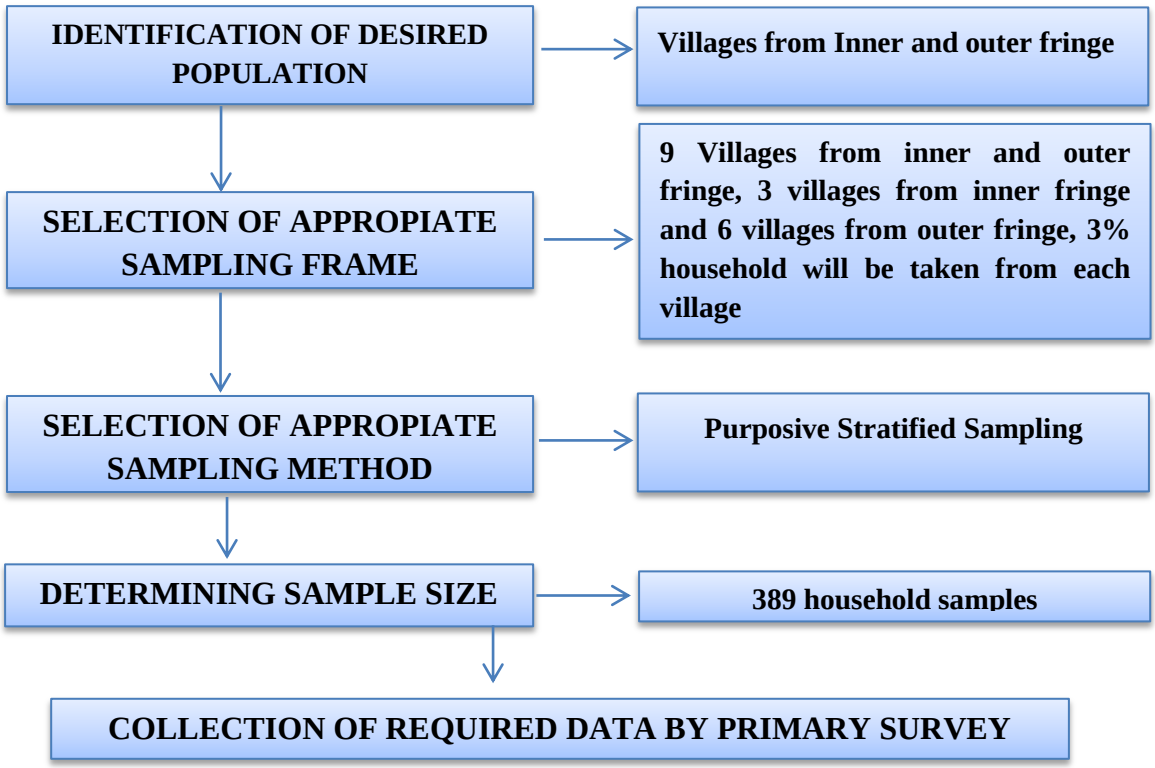
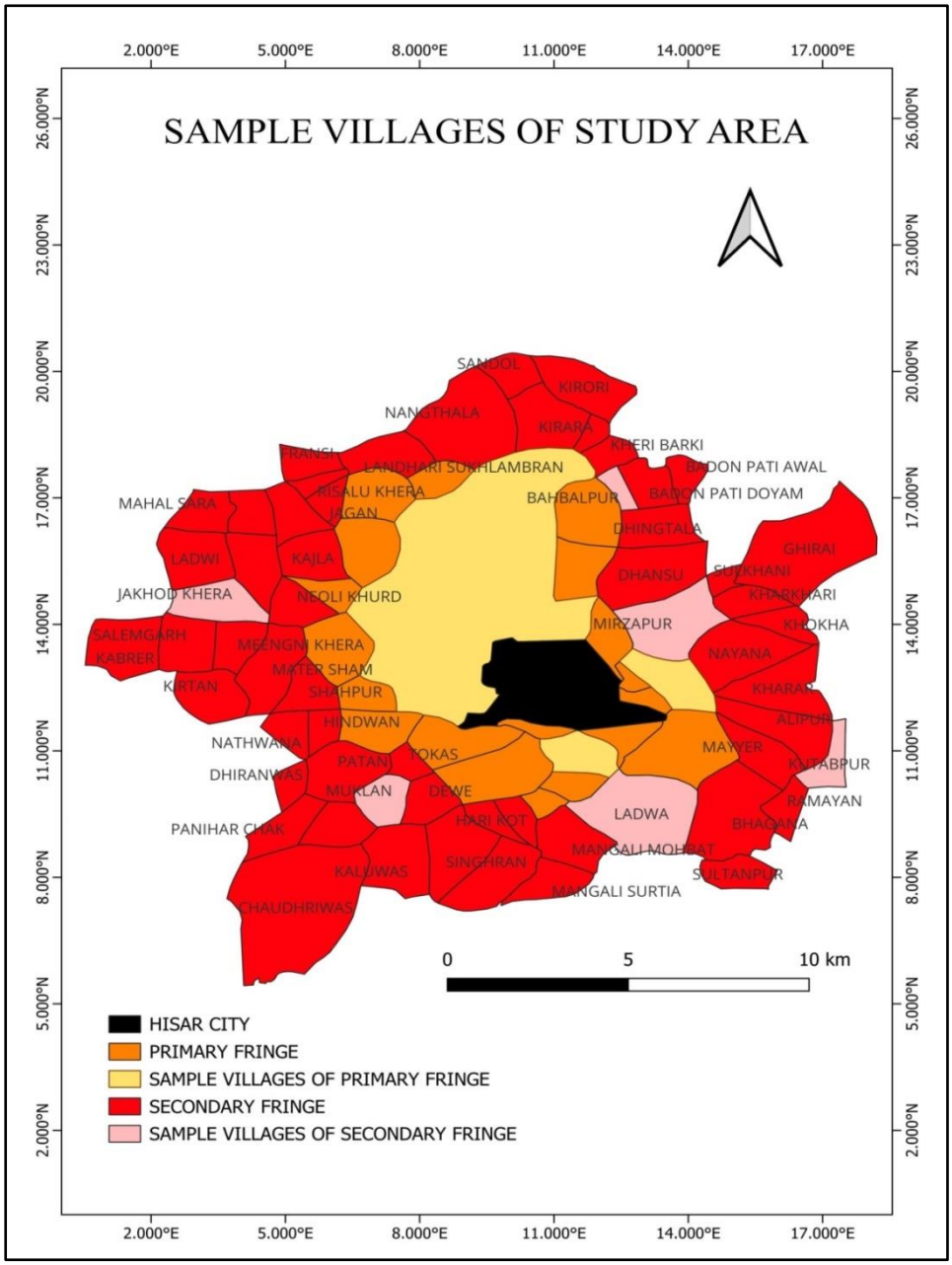


Fig. 5.1: Flow Chart of Sampling Method

5.4 LOCATION OF SAMPLE VILLAGES

In this study, the villages selected for the sample were selected from the center of the city within a distance of 5 to 20 km. These villages have been chosen with utmost care to represent the inner fringe as well as the outer fringe. Based on the study of the socio-economic characteristics of the village, the changes in the internal and external fringe during the last three decades can be accurately assessed. It also helps in accurately assessing future changes. While choosing the village, it has been kept in mind that all the villages are connected with the roads leading out of the city and the influence of the city is clearly visible on them. The villages from the primary fringe are Bir Hisar, Dabra and Raipur. The villages of the secondary fringe are Muklan, Jakhod Khera, Kutubpur, Ladwa, Mirzapur, and Bahbalpur, the villages from the primary fringe are Bir Hisar, Dabra, and Raipur, which lie within a 4 to 8 km. radius. Villages Bir Hisar, and Raipur, lie in the north and north-eastern parts of the city at a distance of 5, and 8 km, respectively. Village Dabra lies in the west-eastern part of the city at the distance of 8 km. The villages from secondary fringe are Muklan, Jakhod Khera, Kutubpur, Ladwa, Mirzapur, Bahbalpur, lies between 10 to 18 km km radius.

Village Muklan, lie in the south-western part of the city at the distance of 11km. Villages Jakhod Khera,, lies in the north-western part of the city at the distance of 17 km. Villages Kutubpur lies in the west and eastern part of the city at the distance 18 km. Villages Ladwa, lies in the south-eastern part of the city at the distance of 12 km. Bahbalpur and Mirzapur, lies in the north and north-eastern part of the city at the distance of 10, and 16 km. respectively.



Map 5.1: Sample Villages of the Study Area

Compiled by the Author

Table 5.1: Name of the Sample Villages from Rural Urban Fringe of Hisar City

Sr. No.	Primary Fringe	Distance from city center (Kms.)	No. of Households	No of sample taken @3%	Sr. No.	Secondary Fringe	Distance from city center (Kms.)	No of Households	No. of sample taken @3%
1	Bir Hisar	5	4629	139	1	Mirzapur	10	1466	44
2	Dabra	7	869	26	2	Muklan	11	558	17
3	Raipur	8	1234	46	3	Ladwa	12	1479	44
4					4	Bahbalpur	16	939	28
5					5	Jakhod Khera	17	704	21
6					6	Kutabpur	18	800	24

Compiled by the Author

5.5 OCCUPATIONAL STRUCTURE

The occupational structure helps in assessing the economic activities of any region. It indicates that the workers of the area are engaged in what kind of economic activities and what effect it has on the economic development of the area. The urban impact on the occupational structure can be seen clearly in the surrounding rural areas, under which most people engage in secondary or tertiary activities. Mutual interaction with urban centers causes a rapid change in the occupational structure of the surrounding rural areas. Over time, engagement in agriculture and the share of workers dependent on agricultural activities tend to decline; while participation in non-agricultural sectors and the number of workers employed in these activities progressively increase. This phenomenon is common in primary as well as secondary rural-urban fringe areas. Some of the common non-agricultural activities in these areas include dairy farming, household industry, and the production of fruits and vegetables. The semi-skilled workers of the fringe area engaged in some other activities e.g. masons, thela pullers, auto-rickshaw driving, cycle-rickshaw drivers, vendors, etc. In this way, the demand for labor is fulfilled in various activities within the urban area.

The fig 5.2 is showing that the numbers of total workers in the sample village of primary fringe are gradually decreasing during the last three decades. This is because of some reasons such as migration of labor force to the city, segregation of joint family system. With the dissolution of the joint family system, the number of earning members within a household often decreases to one or two, while the remaining relatives become financially dependent on them. This shift increases the intra-household dependency burden on a small proportion of working adults. On the other side, the Secondary fringe represents a sharp rise in the total workforce

The percentage of agricultural workers in 1991 in village Bir Hisar was 62.21% and decline to 48.42% in 2001 and 23.72% in the 2011 census. In the case of Dabra, the number of people engaged in agricultural work was 61.72% in the 1991 census, in 2001 and 2011 census, it kept decreasing continuously which was 50.70% and 47.10% respectively. The data on agricultural workers of Raipur village also show a sharp decline from 1991 census to 2001 census that is 80.45% in 1991 and 28.36% in 2001. (Table 5.2)

On the other hand, if we talk about the secondary fringe villages, the percentage of agricultural workers in Table 5.2 showing slow declining scenario during the last three decades and the percentage of the workforce in this sector is not very satisfactory. The percentage of agricultural workers of 1991 census, if we compare the situation of three secondary fringe villages follows as Muklan (87.17%), Mirzapur (81.20%) and Kutubpur (80.99%). In the 2011 census, the percentage of the agricultural shows a relative slow growth in these villages as Muklan (59.95%), Mirzapur (64.31%) and Kutubpur (59.76%).

From the data shown in Table 5.2, it is evident that there is not much change in the number of workers that are engaged in the sector of household and manufacturing industries. The number of workers in this sector, both in the external and internal fringe villages is very less. If we discuss about some stats of the workers engaged in this sector, in village Bir Hisar workers in Household and manufacturing industries was 3.62%, 1.53% and 1.07% in 1991, 2001 and 2011 respectively. In other villages such as Dabra and Raipur also recorded stability in this sector. There is no significant increase or decrease in the percentage of household and manufacturing sector workers in these villages during the last three decades. In the secondary fringe the situation is not very much different Muklan, Bahabalpur and Kutubpur in 1991 census the percentage of household and manufacturing sector workers are 1.23%, 2.33% and 6.02% respectively. But in 2011 census it reduced to 0.09%, 0.63% and 2.07% respectevily.

Talking about the number of persons engaged in other non-agricultural activities in the internal and external fringe sample villages, Table 5.2 data shows a positive trend of growth during the last three decades. The overall percentage of non-agricultural workers has increased in the primary fringe according to the data of sample villages. If we discussed the percentage of non-agricultural workers of 1991 census, the situation of primary fringe villages with the highest percentage follows as Dabra (38.28%), Bir Hisar (37.79%), and Raipur (19.54%). But in 2011 census the value increased to 37.05%, 43.83%, and 25.03% respectively. In the secondary fringe there is no significant increase in non-agricultural workers. In Muklan it was 12.84 in 1991, but in 2011 it was 21.07%. Similarily, in Kutubpur village, the proportion of non-agricultural workers was 19.02% in 1991 and increased slightly to 21.06% in 2011.

Table 5.2: Occupational structure in Sample Villages (1991-2011)

Fringe zone	Name of village	Total Workers			Agricutural & Allied Workers						Household and Manufacturing Industries						Other Workers					
		1991	2001	2011	1991	%	2001	%	2011	%	1991	%	2001	%	2011	%	1991	%	2001	%	2011	%
Primary Fringe zone	Bir Hisar 5	4697	8703	**8791**	2922	**62.21**	4217	**48.45**	2085	**23.72**	170	**3.62**	133	**1.53**	94	**1.07**	1605	**34.17**	3224	**37.04**	3759	**42.76**
	Dabra 7	1131	1988	**1709**	698	**61.72**	1008	**50.70**	805	**47.10**	181	**16.00**	140	**7.04**	25	**1.46**	252	**22.28**	379	**19.06**	616	**36.04**
	Raipur 10	1555	5928	**3312**	1251	**80.45**	1681	**28.36**	1600	**48.31**	87	**5.59**	41	**0.69**	54	**1.63**	217	**13.95**	3532	**59.58**	784	**23.67**
Secondary fringe zone	Muklan 11	896	1328	**1106**	781	**87.17**	986	**74.25**	663	**59.95**	11	**1.23**	28	**2.11**	1	**0.09**	104	**11.61**	276	**20.78**	232	**20.98**
	Jakhod Khera 17	950	1129	**1489**	591	**62.21**	584	**51.73**	904	**60.71**	201	**21.16**	88	**7.79**	16	**1.07**	158	**16.63**	214	**18.95**	239	**16.05**
	Kutabpur 18	831	1756	**1787**	673	**80.99**	723	**41.17**	1068	**59.76**	50	**6.02**	26	**1.48**	37	**2.07**	108	**13.00**	250	**14.24**	349	**19.53**
	Ladwa 12	2085	4065	**2790**	1210	**58.03**	2275	**55.97**	1675	**60.04**	531	**25.47**	53	**1.30**	35	**1.25**	344	**16.50**	1551	**38.15**	680	**24.37**
	Mirzapur 10	2090	2995	**3514**	1697	**81.20**	1806	**60.30**	2260	**64.31**	179	**8.56**	56	**1.87**	17	**0.48**	214	**10.24**	873	**29.15**	490	**13.94**
	Bahbalpur 16	774	1641	**1914**	609	**78.68**	1034	**63.01**	752	**39.29**	18	**2.33**	12	**0.73**	12	**0.63**	147	**18.99**	461	**28.09**	639	**33.39**

Source: Census of India

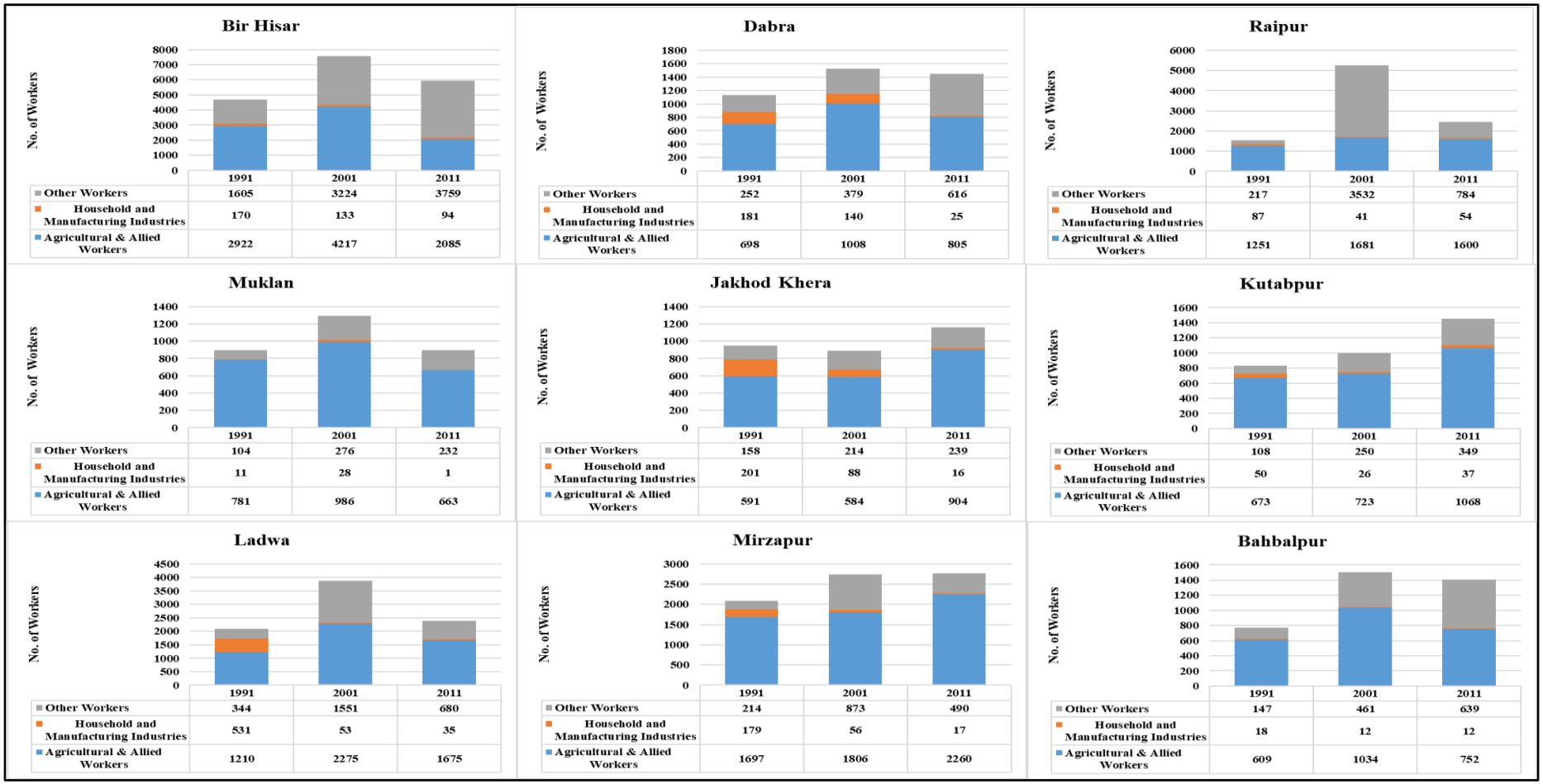


Fig. 5.2: Occupational structure in Sample Villages (1991-2011)

Source: Census of India

According to the 2011 Census, the proportion of non-agricultural workers increased markedly in the village of Bir Hisar, reaching 76.28 percent, while in Dabra and Raipur it stood at 52.90 percent and 51.59 percent, respectively. On the other hand, if we talk about the secondary fringe villages, the percentage of non-agricultural workers is not showing any significant growth during the last three decades and the percentage of the workforce in this sector is not very satisfactory. The lowest percentage of non-agricultural workers of 1991 census, the situation of secondary fringe villages follows as Muklan (12.83%), Mirzapur (18.80%) Kutubpur (19.01%), In the 2011 census, the percentage of the non-agricultural also shows a stable growth in these villages as as Muklan (40.05%), MIrzapur (35.69%) Kutubpur (40.24%) (Table 5.2)

After the above discussion, the conclusion can be drawn that the percentage of workforce engaged in non-agricultural activities in the villages of the primary fringe that adjoining the city has increased continuously during the last three decades. While the percentage of workforce engaged in non-agricultural activities in the village of the secondary fringe does not show any significant increase during the last three decades.

It shows how the pattern of the occupational structure is changing in the countryside adjoining the city and the population engaged in agricultural work is showing its mobility in other economic activities.

5.6 LITERACY

Literacy is an important parameter for the measurement of the socio-economic development of any society and higher achievement in literacy level always leads the society towards a higher standard of development and helps the society to coordinate with modernity. “The concept of literacy includes not only the fundamental abilities of reading and writing but also acquiring the requisite competencies for proficient and fruitful participation in the social environment” **(UNESCO 2011)**. In the rural areas around the city, there is a wave of change under the influence of urban attributes, it's leading these rural areas towards modernization, and gradually these villages are abandoning the traditional beliefs. With the help of education these rural areas trying to join the wave of development and looking towards their future full of aspirations. Based on the immense potential in the educational sector in the adjoining urban areas,

the youth of the rural areas are choosing their way of living according to their wish and choosing the occupation on the basis of competence. Instead of adapting their traditional economic activities, they are engaged to modify their future as per the present scenario. It shows that how urbanization can affect the surrounding fringe area and making an effective change in its socio-economic structure. Hisar city is also effectively transforming the rural countryside around it and its impact can be witnessed on the basis of a transitional process related to the social-economic characteristics of the fringe area during the last three decades. In particular, if we talk about literacy achievement, there is a positive trend in the surrounding fringe area during the last three decades. According to the data, it has been found that the sample villages of not only the primary fringe but also the outer fringe have shown positive growth in literacy rate during the last three decades i.e 1991, 2001, 2011 census. Table.5.3, represents a clear picture of the literacy achievement in the sample village can be drawn during the last three decades.

In 1991, census the literacy percentage in primary fringe villages Bir Hisar, Dabra and Raipur is 40.11%, 38.12 and 37.25 respectively. As per the 2011 Census, the literacy rates in the villages of Bir Hisar, Dabra, and Raipur were 61.22 percent, 62.78 percent, and 63.23 percent, respectively.

In 1991, census the highest literacy percentage in secondary fringe villages Jakhod Khera, Muklan and Mirzapur is 39.39%, 36.48 and 33.28% respectively. In 2011 Census data, the literacy rates in the villages of Jakhod Khera, Muklan and Mirzapur were 61.86 percent, 64.04 percent, and 58.03 percent, respectively.

This positive trend in the field of literacy directly associated with the influence of Hisar city. It is the educational infrastructure of the city that provides opportunities to the surrounding countryside to achieve higher literacy standards.

Higher female literacy is an important parameter for the measurement of modern society. Female literacy has a decisive role in the all-around progress of society. In female literacy also, there is a positive trend in the sample villages of the fringe area. In village Bir Hisar the female literacy was 30.27% in 1991, 48.45% in 2001 and 59.63% in 2011 census. Similarly in village Dabra the female literacy was 32.14% in 1991, 50.31% in 2001 and 58.72% in 2011. In village Raipur it was (29.23%) in 1991, (54.24%) in 2001, and (60.19%) in 2011.

Table 5.3: Literacy in Sample Villages (1991-2011)

Fringe zone	Name of village	Total no of Literates						Male and Female Literacy											
		1991	%	2001	%	2011	%	1991				2001				2011			
								Male	%	Female	%	Male	%	Female	%	Male	%	Female	%
Primary fringe zone	Bir Hisar	5273	**40.11**	10652	**52.31**	14340	**61.22**	3947	**65.77**	1326	**30.27**	6891	**75.10**	3761	**48.45**	11155	**79.37**	9200	**59.63**
	Dabra	1425	**38.12**	2306	**55.75**	2776	**62.78**	986	**60.45**	439	**32.14**	1490	**76.33**	816	**50.31**	2066	**81.56**	1858	**58.72**
	Raipur	2328	**37.25**	5683	**60.97**	5050	**63.23**	1645	**65.72**	683	**29.23**	3969	**84.59**	1714	**54.24**	3660	**83.85**	3291	**60.19**
Secondary fringe zone	Muklan	803	**36.48**	1486	**54.94**	1909	**64.04**	605	**61.11**	198	**23.38**	987	**79.60**	499	**45.78**	1370	**83.80**	1251	**60.83**
	Jakhod Khera	1168	**39.49**	1724	**50.17**	2256	**61.86**	890	**66.67**	278	**25.74**	1141	**74.28**	583	**42.99**	1679	**82.91**	1521	**56.80**
	Kutabpur	944	**33.13**	1879	**50.40**	2634	**60.48**	726	**60.20**	218	**21.29**	1237	**75.38**	642	**44.43**	1936	**81.71**	1784	**58.97**
	Ladwa	2204	**32.85**	3693	**45.04**	4681	**62.57**	1637	**54.42**	567	**23.43**	2451	**66.64**	1242	**39.63**	3507	**82.12**	3073	**58.61**
	Mirzapur	2019	**33.28**	3342	**48.82**	4618	**58.03**	1491	**56.71**	528	**24.52**	2167	**70.11**	1175	**44.17**	3641	**77.42**	3256	**55.25**
	Bahbalpur	876	**27.48**	2026	**51.10**	3295	**63.86**	678	**47.58**	198	**17.02**	1310	**76.97**	716	**46.64**	2349	**84.46**	2161	**60.67**

Source: Census of India

If we discuss about secondary fringe than in village Muklan it was 23.28% in 1991, 45.78% in 2001, and 60.83% in 2011, in village Kutubpur it was 21.29% in 1991, 44.43% in 2001 and 58.97% in 2011, in village Bahabalpu it was 17.02% in 1991, 46.64% in 2001 and 60.67% in 2011. It is evident from the above discussion that during the last three decades, there has been an increase in literacy in both internal and external fringe areas; it was 63.15% in the primary fringe and 61% in the secondary fringe.

5.7 POPULATION DENSITY

Population density is an important attribute of the fringe area which represents how the density of the fringe changes rapidly due to the proximity of the urban area. But if we discuss the density of the villages away from the urban influence, it shows a normal increase. There are multiple determinants that contribute to rising population density in rural settlements located in close proximity to urban centers, including good educational opportunities, transportation, water availability, employment opportunities, medical facilities, and other infrastructural facilities that encourage population growth. It is evident in the rural-urban fringe of Hisar that as we move from this area to a purely rural area, the population density keeps decreasing. A study of the villages selected for the sample shows that there has been a rapid change in the population density during the last three decades and the expansion of Hisar city has a positive relationship to the growing density of the surrounding villages in the countryside. That is why a sharp increase in the population density of the villages of the fringe areas can be noticed.

Based on the study in the following Table 5.4, we can say that not only in the primary fringe but in the secondary fringe, there has been a sharp increase in the population density during the last three decades i.e from 1991-2011. First of all, if we discuss the population density of sample villages under the primary fringe, in village Bir Hisar the population density increase from 93 persons/sq.k.m. in 1991 to 143 persons/sq.k.m. in 2001 and 165 persons/sq.k.m. in 2011. In village Dabra it was increase from 415 persons/sq.k.m. in 1991 to 460 persons/sq.k.m. in 2001 and 491 persons/sq.k.m. in 2011. In village Raipur it was increase from 694 persons/sq.k.m. in 1991 to 755 persons/sq.k.m. in 2001 and 664 persons/sq.k.m. in 2011. Similar changes are witnessed in the secondary fringe. In village Muklan it was increase from

314 persons/sq.k.m. in 1991 to 386 persons/sq.k.m. in 2001 and 426 persons/sq.k.m. in 2011. In village Mirzapur it was increase from 337 persons/sq.k.m. in 1991 to 380 persons/sq.k.m. in 2001 and 442 persons/sq.k.m. in 2011. In the village of Jakhod Khera, population density increased from 269 persons per square kilometre in 1991 to 312 persons per square kilometre in 2001, and further to 332 persons per square kilometre in 2011.

Table 5.4: Population Density in Sample Villages (1991-2011)

Fringe zone	Name of village	Area in Sq. Km.	Total Population			Population Density		
			1991	2001	2011	1991	2001	2011
Primary fringe zone	Bir Hisar	**142**	13146	20362	23425	**93**	**143**	**165**
	Dabra	**9**	3738	4136	4422	**415**	**460**	**491**
	Raipur	**9**	6250	9321	7987	**694**	**755**	**887**
Secondary fringe zone	Muklan	**7**	2201	2705	2981	**314**	**386**	**426**
	Jakhod Khera	**11**	2958	3436	3647	**269**	**312**	**332**
	Kutabpur	**6**	2849	3728	4355	**475**	**621**	**726**
	Ladwa	**27**	6710	8199	7481	**249**	**304**	**277**
	Mirzapur	**18**	6066	6846	7958	**337**	**380**	**442**
	Bahbalpur	**3**	3188	3965	5160	**1063**	**1322**	**1720**

Source: Census of India

5.8 PUBLIC AMENITIES

The growth of Hisar city has had a definite impact on the availability of public facilities in neighboring villages. Of these, pucca roads are an important infrastructural advance. During recent decades, various programs like the Pradhan Mantri Gram Sadak Yojana and other rural development programs have made it possible to construct pucca roads, which improved connectivity from periphery villages to the city. The improved connectivity has made villages part of the development stream with better access to urban services. Fundamental public facilities such as drinking water, communications, sanitation, and health facilities are more abundant in villages of the primary fringe area, within a radius of 5 km around the city. Analyzing the census data of 1991, 2001, and 2011 (Table. 5.5), suggests that Bir Hisar, Dabra, and Raipur villages have had steady access to dependable sources of drinking water in the form of tap water, wells, hand pumps, and tube wells. Conversely, secondary fringe villages such as Muklan, Mirzapur, Bahbalpur, and

Jakhod Khera had limited drinking water facilities at first but have experienced increased tap water and tube well availability over time up to 2011.

Communication infrastructure, such as post offices and telephones, has been present for long in the main fringe villages due to their proximity to urban areas. Yet, most secondary fringe villages remained without such infrastructure until the recent decades. As of 2011, even the villages of Muklan, Jakhod Khera, Kutabpur, and Bahbalpur had started to enjoy phone and PCO services, testifying to the overall betterment in rural communication facilities. Health facilities, an indicator of human development, have also been upgraded in the fringe areas. In 1991, villages like Bir Hisar (primary fringe) and Raipur (secondary fringe) did not have the basic medical facilities and relied upon adjacent settlements. Yet, by 2011, there was a well-developed health infrastructure that consisted of 1 Community Health Center, 1 Primary Health Center, 2 Primary Health Sub Centers, 2 Maternity and Child Welfare Centers, 2 Dispensaries, and 2 Veterinary Hospitals in these villages. On a broader perspective, transportation, drinking water, communication, and health facility development in edge villages highlights the contribution of urban growth and focused rural development schemes to improvements in the availability of public amenity and infrastructure integration in the peri-urban region.

Public facilities like drinking water sources, post offices, and health institutions all have a vital role to play in determining socio-economic development on both community and regional levels. Access to safe drinking water is a basic amenity that greatly influences health, education, and economic productivity. Studies prove that communities with stable water infrastructure have fewer cases of waterborne diseases, which decreases healthcare loads and increases rates of workforce participation. In developing countries such as Pakistan, the implementation of water supply projects in rural areas has been proven to directly improve quality of life measures and indirectly promote economic activities through releasing time that was otherwise devoted to water gathering, especially for children and women **(Hussain et al., 2022)**. Healthcare facilities are essential social infrastructure that affects human capital development as well as economic resilience. Empirical data from China proves that cities with strong medical facilities have enhanced economic recovery strengths in the wake of external shocks, given that healthy people have continued productivity and less social assistance need (Du et al., 2024).

Table 5.5: Public Amenities in Sample Villages (1991-2011)

Name of village	Source of Drinking Water			Post Office			Medical Institute		
	1991	2001	2011	1991	2001	2011	1991	2001	2011
Bir Hisar	T,W TW HP	T HP W SS-T	T,W TW HP	PO	PO (<5) PH (80)	PH, PCO CSC	--(5)	H 5 <5 MCW >5 PHC 5-10	D
Dabra	T,W TW HP	T HP W SS-T	T,W TW HP	PO PHONE	PO PH (28)	PO,PH, PCO	PHS, D, RP (2)	DA PHS RMP 2 H 5-10 MCW 5-10 PHC 5-10	PHS D VH MCW
Raipur	T,W TW HP	T HP W SS-T	T,W TW HP	PO	PO PH (9)	PH, PCO	--(5)	H 5-10 MCW 5-10 PHC 5-10	MCW VH
Muklan	T,W	TW SS-T	T,W TW HP	PO	PO PH (80)	PO PHONE	PHS D	PHS H (10) MCW (10) PHC (10)	PHS D VH MCW
Jakhod Khera	T,W HP	T HP SS-T	T,W TW HP	PO	PO PH (7)	SPO, PHONE, PCO	PHS, D, RP	DA PHS RMP 2 H 5-10+ MCW 10+ PHC 5-10	D, PHS VH

Kutabpur	T,HP	T HP TW W SS-T	T,W TW HP	PO	PO PH <5	SPO, PHONE, PCO	PHS	PHS CHW H <5 MCW <5 PHC <	PHS
Ladwa	T,W TW HP	T HP W SS-T	T,W TW HP	PO PHONE	PO PH 20	PO,PH, PCO	PHC PHS (3)	PHC PHS RMP 2 H 10+ MCW 10+	PHC PHS MCW VH
Mirzapur	T,W	TW SS-T	T,W TW HP	PO PHONE	PO PH 10	SPO, PHONE, PCO	PHS RP(3)	PHC RMP 4 H 5-10 MCW 5-10 PHS 10+	PHS MCW
Bahbalpur	T,W	TW SS-T	T,W, TW	PO	PO PH 16	PO,PH, PCO CSC	PHS	PHC RMP 2 H 10+ MCW 10+ PHS 5-10	PHS VH

Source: Census of India

Post offices and allied communication facilities offer economic transactions, information sharing, and social connection - especially in the rural regions. Research identifies the ways through which postal networks facilitate market outreach for local producers, financial access in the form of postal banking facilities, and access to government services **(Hussain et al., 2022)**. The coexistence of all these public facilities generates synergic impacts on socio-economic development. Societies with mature infrastructure of services exhibit increased resistance to economic shocks, increased social mobility, and enhanced human capital accumulation **(Hou et al., 2025; Wu, 2006)**.

5.9 CURRENT SOCIO-ECONOMIC STATUS OF THE RURAL URBAN FRINGE OF THE HISAR CITY, 2023

As mentioned above, the survey of the rural urban fringe was done on the basis of sample methods and techniques. During this survey, the data of selected villages of primary and secondary fringe on a socio-economic basis was collected through a comprehensive survey. During the survey, data on various parameters such as occupation, demography, public amenities, living standard, economic background, and social status has been collected with the help of a questionnaire.

5.9.1 Demographic Attributes

5.9.1.1 Age and Sex classification data of selected families

The demographic structure provides important information about the various characteristics of the population of an area. It provides knowledge of various demographic components and demographic aspects. The Table 5.6 related to occupational characteristics shows that the primary data represents 389 households from 3 villages of the primary fringe and 6 villages of the secondary fringe. The basis for selecting these households is 3 percent of the sample fringe villages. The total number of villages in the primary fringe is 21 and in the secondary fringe are 60. First of all 10 percent villages from these primary and secondary fringe villages were selected. Than 3 percent household of total households were selected. The highest number of household samples was drawn from the primary fringe village Bir Hisar i.e 139, the second-highest was from village Raipur 46 and the third highest was 26 households drawn from village Dabra. In the below table of surveyed data, there is

data related to the average age of the family members and the average age at the marriage. The highest average age of the family members was in the village Kutubpur i.e 46.28; the second-highest average age of the family members was in the village Jakhod Khera i.e 45.59 the third-highest average age of the family members was in the village Bahabalpur i.e 43.29 (fig. 5.3). In terms of joint family, the data shows that the number is very low in all villages that show the declining trend in terms of this phenomenon. The villages of the primary fringe show less value in terms of joint family. The highest joint families are found in the village Mirzapur of the secondary fringe. The second-highest join the family was found in the village Ladwa of the secondary fringe and the third-highest joint family was found in the village Bahabalpur. The highest number of joint families was found in the secondary fringe. The traditional values of the rural areas have an impact on the social structure of the family. On the other hand, less joint family in the primary fringe depicts that segregation plays an important role and can be an impact of the urban social structure. The opposite of the joint family system is the nuclear family system. The nuclear family system seems to very popular in the both fringe zones. But in the primary fringe nuclear family numbers are very high in term of numbers (fig. 5.4).

Table 5.6: Age and Sex classification data of selected families in Sample Villages

Fringe zone	Name of village	Number of Households	Number of family members	Average age of the family	Average age at the Marriage	Type of family	
						Joint	Nuclear
Primary fringe zone	Bir Hisar	139	642	35.33	24.55	9	130
	Dabra	26	110	38.27	29.34	2	24
	Raipur	46	223	36.21	32.40	5	41
Secondary fringe zone	Muklan	17	77	36.45	23.67	10	7
	Jakhod Khera	21	83	45.59	25.44	15	6
	Kutabpur	24	81	46.28	33.98	17	7
	Ladwa	44	169	34.71	22.35	30	14
	Mirzapur	44	182	30.88	19.61	32	12
	Bahbalpur	28	104	43.29	19.49	18	11
	Total	**389**	**1671**	**37.003**	**25.45**	**71**	**329**

Source: Primary Data

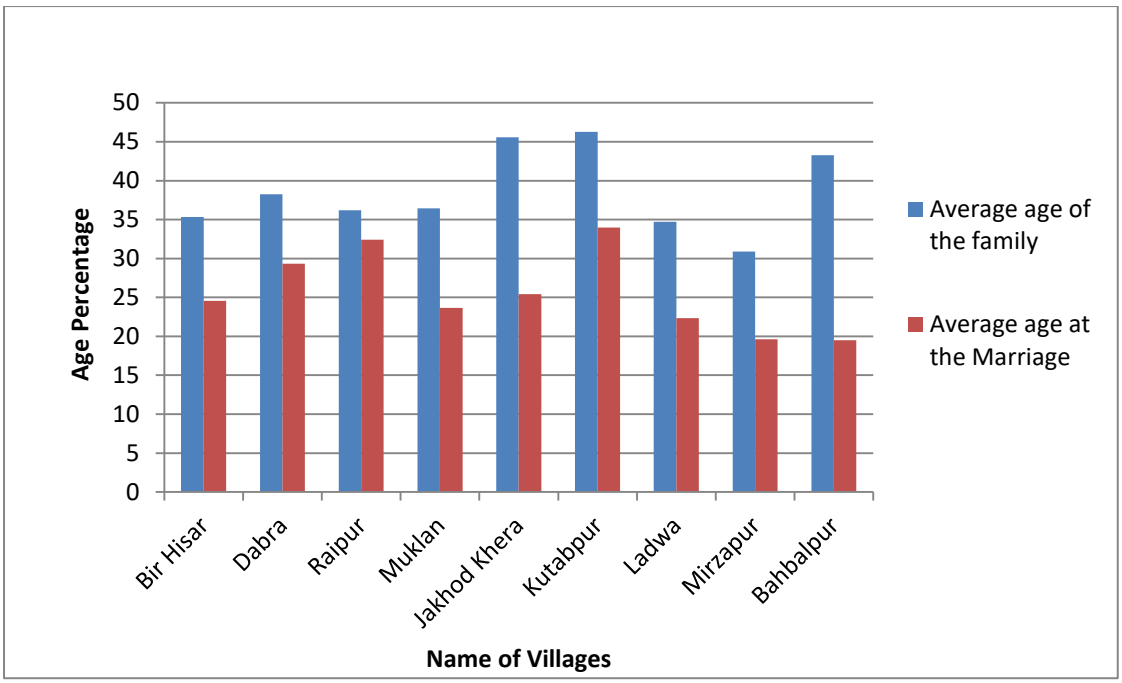


Fig. 5.3: Age structure of the sample villages based on Primary survey, 2023

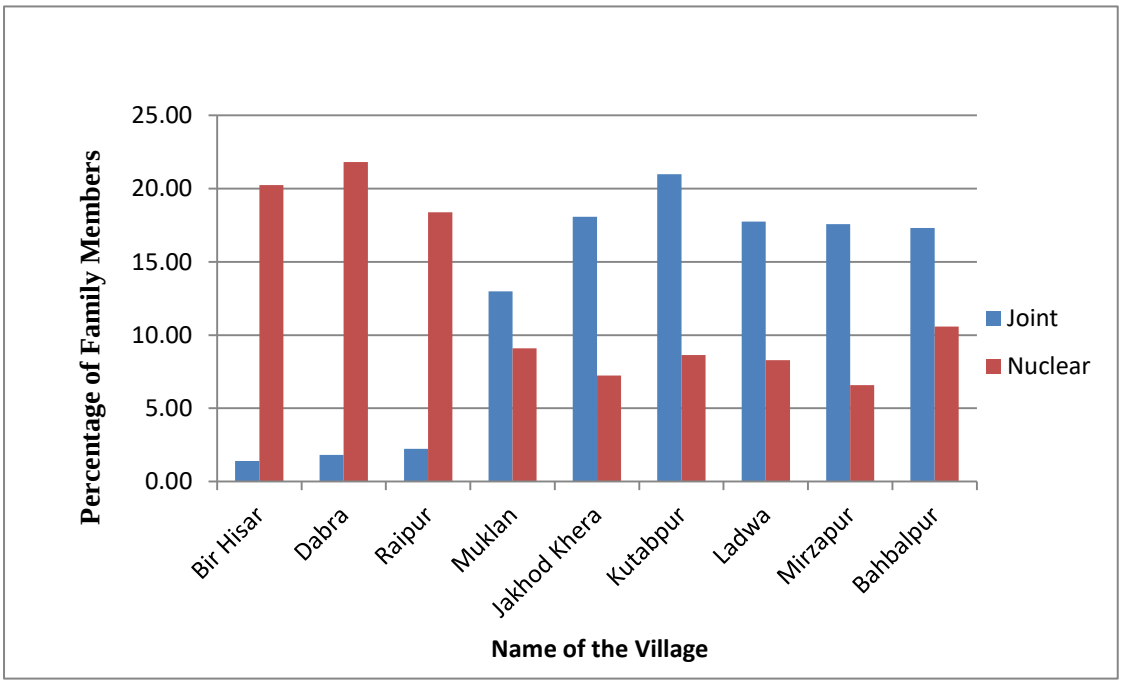


Fig. 5.4: Family structure of the sample villages based on Primary survey, 2023

The nearness of the city region showed its impact on the family system. The process of industrialization led to the process of the modernization and presently this les to the nuclear family system. **Parsons (1954, 1956)** proposed that modern society

influenced by industrial development has triggered the creation of isolated nuclear family. In the primary fringe area, Village Bir Hisar exhibited the highest prevalence of nuclear families, totaling 130 households. Raipur village followed as the second-highest with 41 nuclear families, while Dabra ranked third with 24 such units.

5.9.2 Sex Ratio

Sex ratio plays an important role in defining the socio-economic structure of any region; it shows the position of women in the society and what is their role. In the traditional Indian society, there is a special kind of discrimination against women; the desire for a boy in the family has always been the main reason for the negative attitude towards girls. In view of the dowry system in the Indian society and the various difficulties faced by the girls in the social conditions, the families always adopt a tight-lipped attitude towards the girls.

The area of this study Hisar is a major district of Haryana. Haryana State has always been in special concern in terms of sex ratio; the main reason for this is that the sex ratio in Haryana is very low. The attitude towards women in the traditional rural environment of Haryana is negative and boys have always been given more preference in the context of girls. In the villages taken for data collection in the primary and secondary fringes, very interesting facts have emerged in the context of sex ratio based on the surveyed data (Table 5.7).

If we talk about the sex ratio, then in the primary fringe the sex ratio is less, the same as we enter outside the city inside the secondary fringe, there is a continues increase in the sex ratio. A brief description of this is given below.

The highest sex ratio of the primary fringe was in the village Raipur i.e 873, the second- highest sex ratio of the primary fringe was in the village Dabra i.e 833 the third- highest sex ratio of the primary fringe was in the village Bir Hisar i.e 831. The data shows that the primary fringe villages represent a low-profile sex ratio.

The highest sex ratio of the secondary fringe was in the village Mirzapur i.e 936; the second- highest sex ratio of the secondary fringe was in the village Kutubpur i.e 928 the third- highest sex ratio of the secondary fringe was in the village Bahbalpur i.e 925. The lowest sex ratio of the secondary fringe was in the village Muklan i.e 878; the second- lowest sex ratio of the secondary fringe was in the village Jakhod Khera

i.e. 886. The third- lowest sex ratio of the secondary fringe was in the village Ladwa i.e. 920 (fig. 5.5 and 5.6).

Table 5.7: Sex Ratio data in Sample Villages

Fringe zone	Name of village	Number of Households	Number of family members	Male	Female	Sex Ratio
Primary Fringe zone	Bir Hisar	139	642	292	351	832
	Dabra	26	110	50	60	833
	Raipur	46	223	104	119	874
Secondary fringe zone	Muklan	17	77	36	41	878
	Jakhod Khera	21	83	39	44	886
	Kutabpur	24	81	39	42	929
	Ladwa	44	169	81	88	920
	Mirzapur	44	182	88	94	936
	Bahbalpur	28	104	50	54	926
	Total	**389**	**1671**			

Source: Primary Survey, 2023

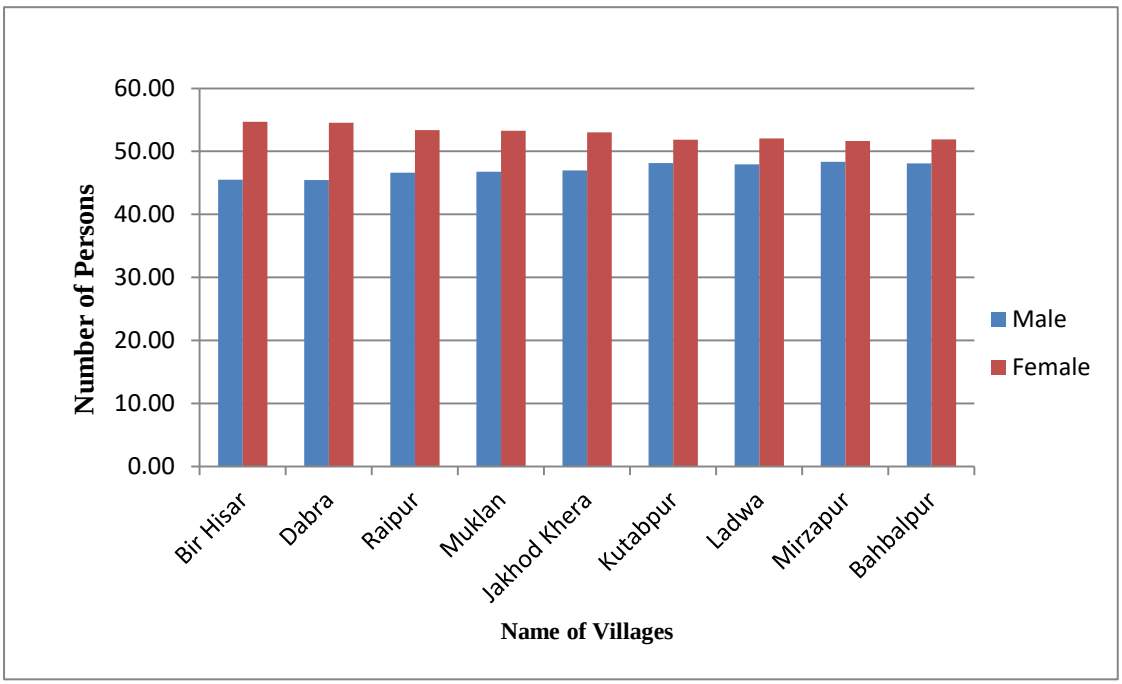


Fig. 5.5: Male-Female population of the sample villages based on Primary survey, 2023

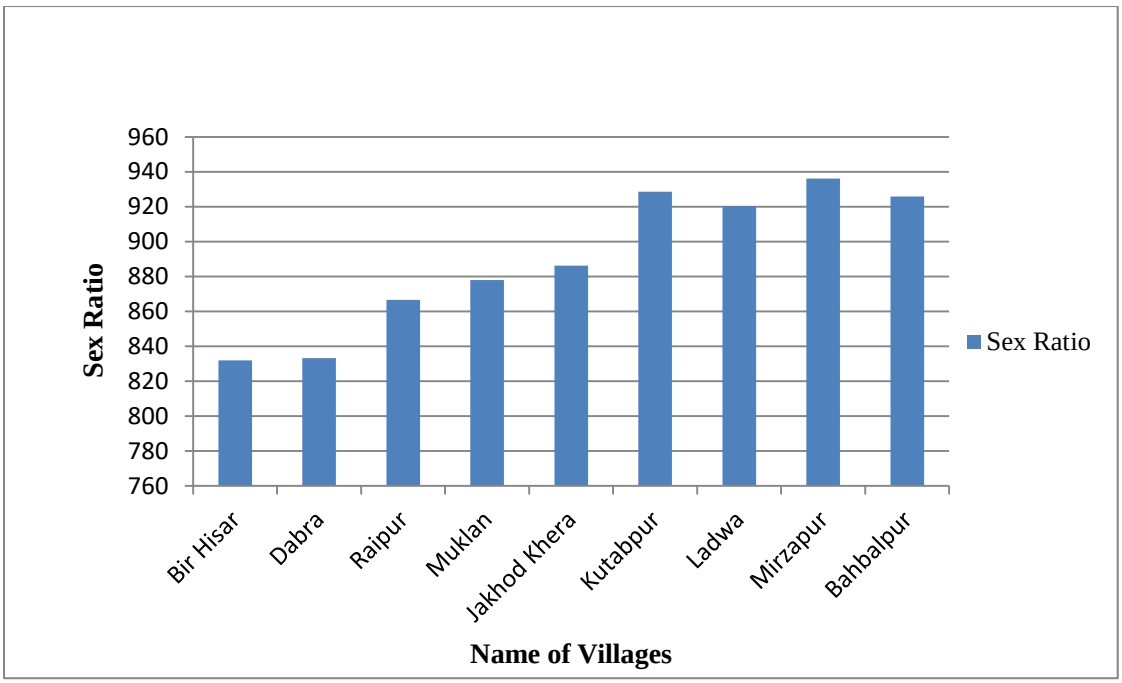


Fig. 5.6: Sex ratio of the sample villages based on Primary survey, 2023

5.9.3 Occupational structure

The occupational structure of an area defines the workforce by occupation and is used to measure the structure of the economy through the redistribution of the working force over a period of time. The occupational structure plays a crucial role in the development of the economy. The occupation structure reflects the distribution or division of its population according to different occupations. The occupation of any region can be broadly divided into three types (1) Agriculture, animal husbandry, forestry, fisheries, etc. are collectively known as 'Primary Activities'. They are primary because their products are essentials for human survival. They are related to nature and carried out with help of nature. (2) Manufacturing industries both large and small scale are known as 'Secondary Activities' (3) Transport, Communication, Banking and Finance, and Services are 'Tertiary Activities' which help the primary and secondary activities in a region.

The occupational structure of the primary and secondary fringe can be discussed on the following attributes of the table shown below. The occupational structure is discussed on three titles as (1) Type of occupation (2) Nature of the employment (3) Monthly income. In terms of the nature of the employment, there are two types i.e. (1)

Main (2) Subsidiary. After the primary survey, it comes out that the ratio of the main occupation is more in the primary fringe. The subsidiary or secondary work is less in the primary fringe.

The categories wise distribution of occupation shown in Table 5.8. The highest main occupation population of the primary fringe was in the village Bir Hisar i.e 62.47%, the second- highest main occupation population of the primary fringe was in the village Raipur i.e 61.25%, the third- highest main occupation population of the primary fringe was in the village Dabra i.e 60.24%. (fig 5.7).

The highest main occupation population of the secondary fringe was in the village Muklan i.e 55.10%, the second- highest main occupation population of the secondary fringe was in the village Kutubpur i.e 51.16%, the third- highest main occupation population of the secondary fringe was in the village Mirzapur i.e 49.02%. The lowest main occupation population of the primary fringe was in the village jakhod Khera i.e. 45.10%. 9The highest subsidiary occupation population of the primary fringe was in the village Dabra i.e 10.84, the second- highest subsidiary occupation population of the primary fringe was in the village Bir Hisar i.e 12.58%. The third- highest subsidiary occupation population of the primary fringe was in the village Raipur i.e 13.75%. (fig 5.7)

The highest subsidiary occupation population of the secondary fringe was in the village Bahbalpur i.e 32.76%; The second- highest subsidiary occupation population of the secondary fringe was in the village Ladwa i.e 32.04%, The third- highest subsidiary occupation population of the secondary fringe was in the village Mirzapur i.e 30.39%. The lowest subsidiary occupation population of the secondary fringe was in the village Muklan i.e.20.41%; the second- lowest subsidiary occupation population of the secondary fringe was in the village Kutubpur i.e. 25.58%. The third-lowest subsidiary occupation population of the secondary fringe was in the village Jakhod Khera i.e. 27.45%. (fig 5.7)

The highest regular employment population of the primary fringe was in the village Raipur i.e 20%, the second- highest regular employment population of the primary fringe was in the village Dabra i.e 18.07%. The third- highest regular employment population of the primary fringe was in the village Bir Hisar i.e 17.70%.

Table 5.8: Nature of Employment in Sample Villages

Fringe zone	Name of village	Total family members	Total workers	Occupation				Nature of Employment				Average Monthly Income Per Household (in Rupees)
				Main		Subsidiary		Regular		Self		
				Persons	%	Persons	%	Persons	%	Persons	%	
Primary fringe zone	Bir Hisar	642	469	293	62.47	59	12.58	83	17.70	34	7.25	42356
	Dabra	110	83	50	60.24	9	10.84	15	18.07	9	10.84	45899
	Raipur	223	160	98	61.25	22	13.75	32	20.00	8	5.00	43721
Secondary fringe zone	Muklan	77	49	27	55.10	10	20.41	5	10.20	7	14.29	32159
	Jakhod Khera	83	51	23	45.10	14	27.45	5	9.80	9	17.65	31496
	Kutabpur	81	43	22	51.16	11	25.58	3	6.98	7	16.28	30895
	Ladwa	169	103	49	47.57	33	32.04	5	4.85	16	15.53	31974
	Mirzapur	182	102	50	49.02	31	30.39	5	4.90	16	15.69	32594
	Bahbalpur	104	58	27	46.55	19	32.76	2	3.45	10	17.24	29113
	Total	1671										

Source: Primar Survey, 2023

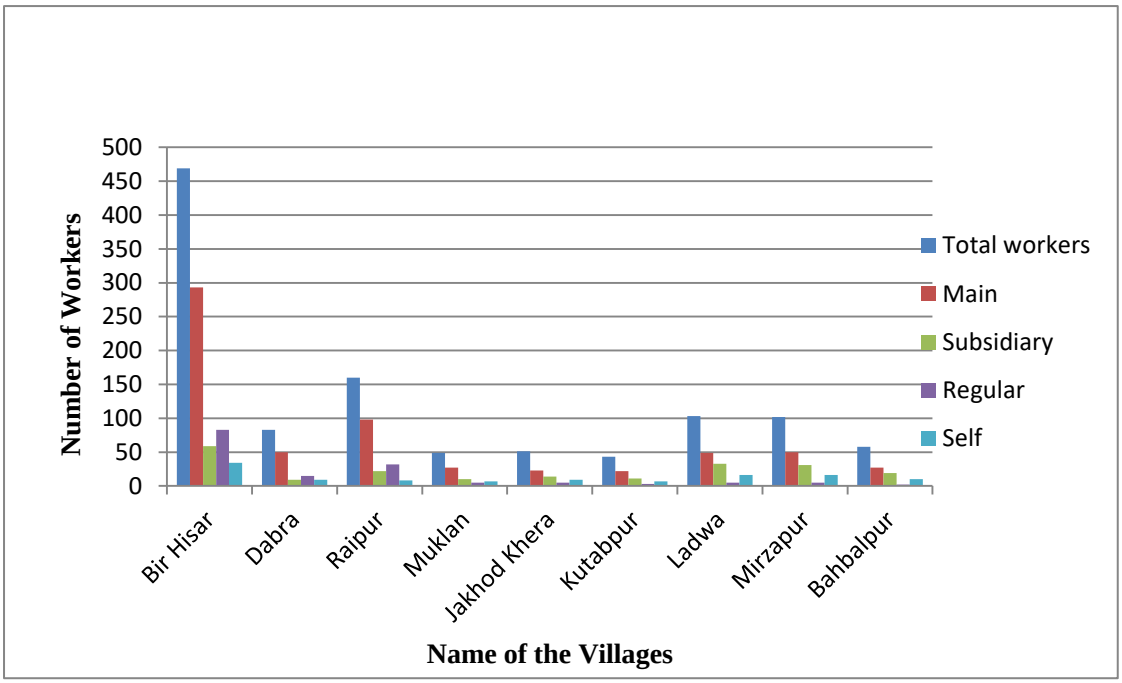


Fig. 5.7: Nature of employment of the sample villages based on Primary survey, 2023

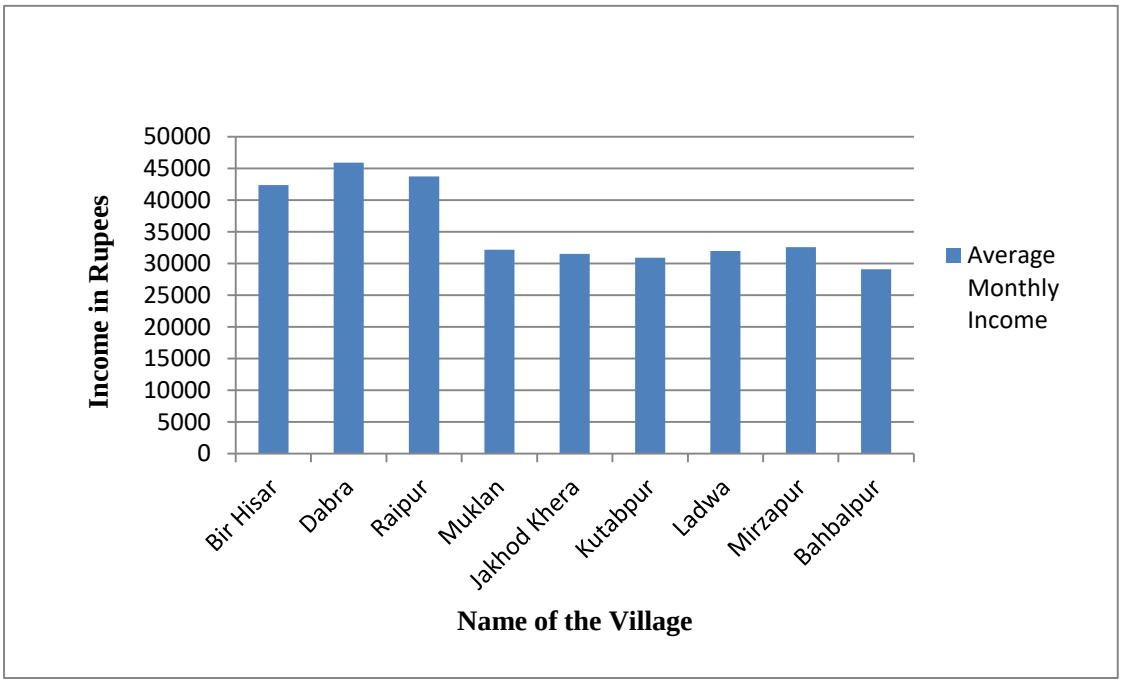


Fig. 5.8: Average household income of the sample villages

Based on Primary survey, 2023

The highest regular employment population of the secondary fringe was in the village Muklan i.e 10.20%, the second- highest regular employment population of the secondary fringe was in the village Jakhod Khera i.e 9.80%. The third- highest regular employment population of the secondary fringe was in the village Kutubpur i.e 6.98%. The lowest regular employment population of the secondary fringe was in the village Bahabalpur i.e.3.45%; the second- lowest regular employment population of the secondary fringe was in the village Ladwa i.e. 4.85%. The third- lowest regular employment population of the secondary fringe was in the village Mirzapur i.e. 4.90%. (fig 5.7)

The highest self-employment population of the primary fringe was in the village Dabra i.e 10.84%, the second- highest self-employment population of the primary fringe was in the village Bir Hisar i.e 7.25%. The third- highest self-employment population of the primary fringe was in the village Raipur i.e 5%.

The highest self-employment population of the secondary fringe was in the village Jakhod Khera i.e 17.65%, the second- highest self-employment population of the secondary fringe was in the village Bahbalpur i.e 17.24%. The third- highest self-employment population of the secondary fringe was in the village Kutubpur i.e 16.28%. The lowest self-employment population of the secondary fringe was in the village Muklan i.e.14.29%; the second- lowest self-employment population of the secondary fringe was in the village Ladwa i.e. 15.53%. The third- lowest self-employment population of the secondary fringe was in the village Mirzapur i.e. 15.69%. (fig 5.7)

The highest monthly income of Household of the primary fringe was in the village Dabra i.e 45899, the second- highest monthly income of the primary fringe was in the village Bir Hisar i.e 42356; the third- highest monthly income of the primary fringe was in the village Raipur i.e 43721.

The highest monthly income of population of the secondary fringe was in the village Mirzapur i.e 32594, the second- highest monthly income of population of the secondary fringe was in the village Muklan i.e 32159 (fig. 5.8). The third- highest monthly income of population of the secondary fringe was in the village Ladwa i.e.31974. The lowest monthly income of population of the secondary fringe was in the village Bahabalpur i.e 29113; the second- lowest monthly income of population of

the secondary fringe was in the village Kutubpur i.e.30895. The third- lowest monthly income of population of the secondary fringe was in the village Jakhod Khera i.e. 31496. (fig 5.8)

5.9.4 Types of Occupation

The occupational structure of any sector refers to the workforce engaged in various economic sectors. It defines the economic structure of an area. It shows the percentage of the population involved in different types of economic activity. It helps to analyze and interpenetrate the process of economic growth of an area. It helps in the development of the local economy with diversification of occupation. In this study the occupational types are divided broadly into three categories as follows: (1) Agricultural and allied workers (2) Manufacturing and industrial workers (3) Others.

In the present study, data has been collected from the above mentioned categories in the primary and second fringe villages. While compiling the data during the survey, it has emerged that the involvement of people in the agricultural and allied activities is very less in the primary fringe and the number of people engaged is seen more in other activities. Similarly, in manufacturing and industrial activities, there are less people involved in the secondary fringe. Similarly, under the secondary fringe, the number of workers involved in agriculture and allied activities is high and the number of workers engaged in manufacturing and industrial activities as well as other works is very less. Table 5.9 shows the data related to occupation structure.

The highest agricultural and allied workers of the primary fringe were in the village Dabra i.e 37.35%, the second- highest agricultural and allied workers of the primary fringe were in the village Raipur i.e 36.88%, the third- highest agricultural and allied workers of the primary fringe were in the village Bir Hisar i.e 28.14% (fig. 5.9). The highest agricultural and allied workers of the secondary fringe were in the village Bahbalpur i.e 62.07%, the second- highest agricultural and allied workers of the secondary fringe were in the village Ladwa i.e 59.22%. The third- highest agricultural and allied workers of the secondary fringe were in the village Mirzapur i.e.57.84%. The lowest agricultural and allied workers of the secondary fringe were in the village Muklan i.e 46.94%; the second- lowest agricultural and allied workers of the secondary fringe were in the village Jakhod Khera i.e.50.98%. The third- lowest agricultural and allied workers of the secondary fringe were in the village Kutubpur i.e.53.49%. (fig. 5.9)

Table 5.9: Types of Occupation in Sample Villages

Fringe zone	Name of village	Number of Households	Total family members	Total workers	Agricultural and Allied workers		Household and Industrial workers		Others	
					Persons	%	Persons	%	Persons	%
Primary fringe zone	Bir Hisar	139	642	469	132	28.14	14	2.99	323	68.87
	Dabra	26	110	83	31	37.35	3	3.61	49	59.04
	Raipur	46	223	160	59	36.88	4	2.50	97	60.63
Secondary fringe zone	Muklan	17	77	49	23	46.94	1	2.04	25	51.02
	Jakhod Khera	21	83	51	26	50.98	1	1.96	24	47.06
	Kutabpur	24	81	43	23	53.49	1	2.33	19	44.19
	Ladwa	44	169	103	61	59.22	4	3.88	38	36.89
	Mirzapur	44	182	102	59	57.84	3	2.94	40	39.22
	Bahbalpur	28	104	58	36	62.07	1	1.72	21	36.21
	Total	**389**	**1671**							

Source: Primary Survey, 2023

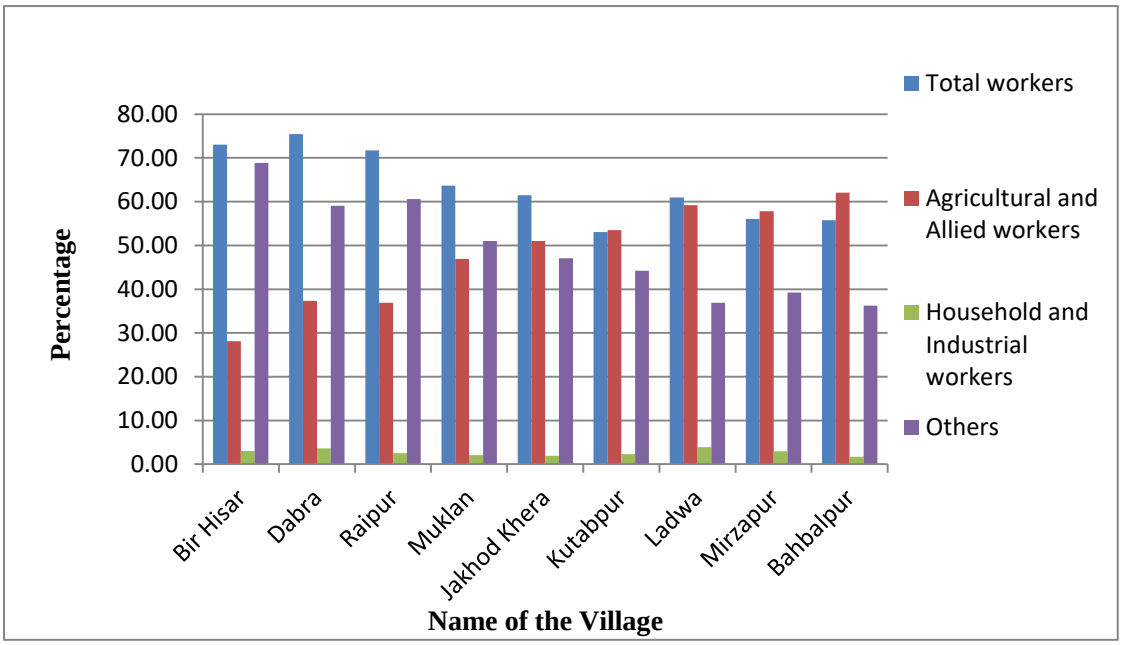


Fig. 5.9: Occupational structure of the sample villages based on Primary survey, 2023

The highest manufacturing and industrial workers of the primary fringe were in the village Dabra i.e 3.61%, the second- highest manufacturing and industrial workers of the primary fringe were in the village Bir Hisar i.e. 2.99%, the third- highest manufacturing and industrial workers of the primary fringe were in the village Raipur i.e 2.50%.

The highest manufacturing and industrial workers of the secondary fringe were in the village Ladwa i.e 3.88%, the second- highest manufacturing and industrial workers of the secondary fringe were in the village Mirzapur i.e 2.94 %. The third- highest manufacturing and industrial workers of the secondary fringe were in the village Kutubpur i.e.2.33%. The lowest manufacturing and industrial workers of the secondary fringe were in the village Bahbalpur i.e 1.72%; the second- lowest manufacturing and industrial workers of the secondary fringe were in the village Jakhod Khera i.e.1.96%. The third- lowest manufacturing and industrial workers of the secondary fringe were in the village Muklan i.e.2.04%. (fig. 5.9)

The highest others workers of the primary fringe were in the village Bir Hisar i.e 68.87%, the second- highest others workers of the primary fringe were in the village Raipur i.e 60.63%, the third- highest others workers of the primary fringe were in the village Dabra i.e.59.04%.

The highest others workers of the secondary fringe were in the village Muklan i.e 51.02%, the second- highest others workers of the secondary fringe were in the village Jakhod Khera i.e 47.06%. The third- highest others workers of the secondary fringe were in the village Kutubpur i.e.44.19%. The lowest others workers of the secondary fringe were in the village Bahbalpur i.e 36.21%; the second- lowest others workers of the secondary fringe were in the village Ladwa i.e 36.89%. The third-lowest others workers of the secondary fringe were in the village Mirzapur i.e. 39.22%. (fig. 5.9)

5.9.5 Literacy

Education is an important tool that helps in the development of manpower. It is a continuous process that promotes the capacity and capability of manpower and working population. It promotes the human development of any nation and significantly affects the quality of human resource.

The quality of human development determines the development plans and future direction of any country. Development has been directly related to educational achievement. Education brings out the hidden talents of human beings and enhances the quality of human development. Thus, education serves as the key to modernization and social development. Literacy can be seen as a milestone in solving various problems.

Without education man remains socially blind, economically handicapped and politically crippled throughout his life. **A.K.Hota *"Education is the second birth. Man may not get salvation without education"***

The literacy achievement of the primary and secondary fringe can be discussed on the basis of the following table. The literacy of the fringe discussed on four titles as illiterate, primary, middle and higher education achievement. The primary fringe has better education achievement than secondary fringe.

Nature of the education levels of the respondents shown in Table 5.10. The highest illiterate persons of the primary fringe were in the village Dabra i.e 9.09%, the second- highest illiterate persons of the primary fringe were in the village Raipur i.e 8.52%, the third- highest illiterate persons of the primary fringe were in the village Bir Hisar i.e 7.01%.

The highest illiterate persons of the secondary fringe were in the village Bahabalpur i.e 33.65%, the second- highest illiterate persons of the secondary fringe were in the village Mirzapur i.e 27.47%, the third- highest illiterate persons of the secondary fringe were in the village Kutubpur i.e 27.16%. The lowest illiterate persons of the secondary fringe were in the village Muklan i.e 14.29%; the second- lowest illiterate persons of the secondary fringe were in the village Jakhod Khera i.e 19.28%. The third- lowest illiterate persons of the secondary fringe were in the village Ladwa i.e. 25.44%. (fig. 5.10)

The highest primary level educated persons of the primary fringe were in the village Raipur i.e 33.63%, the second- highest primary level educated persons of the primary fringe were in the village Bir Hisar i.e 33.49%, the third- highest primary level educated persons of the primary fringe were in the village Dabra i.e 35.45%.

The highest primary level educated persons of the secondary fringe were in the village Muklan i.e 40.26%, the second- highest primary level educated persons of the secondary fringe were in the village Jakhod Khera i.e 39.76%, the third- highest primary level educated persons of the secondary fringe were in the village Ladwa i.e 34.91. The lowest primary level educated persons of the secondary fringe were in the village Bahbalpur i.e.25.96%; the second- lowest primary level educated persons of the secondary fringe were in the village Mirzapur i.e.29.67%. The third- lowest primary level educated persons of the secondary fringe were in the village Kutubpur i.e.33.33%. (fig. 5.10)

The highest middle level educated persons of the primary fringe were in the village Dabra i.e 24.55%, the second- highest middle level educated persons of the primary fringe were in the village Raipur i.e 22.87%, the third- highest middle level educated persons of the primary fringe were in the village Bir Hisar i.e 21.34%.

The highest middle level educated persons of the secondary fringe were in the village Mirzapur i.e 31.87%, the second- highest middle level educated persons of the secondary fringe were in the village Jakhod Khera i.e 28.92%, the third- highest middle level educated persons of the secondary fringe were in the village Bahbalpur i.e 28.85%. (fig. 5.10)

Table 5.10: Educational Status of Sample Villages

Fringe zone	Name of village	Number of Households	Number of family members	Level of Education							
				Illiterate		Primary		Middle		Higher	
				Persons	%	Persons	%	Persons	%	Persons	%
Primary fringe zone	Bir Hisar	**139**	**642**	45	7.01	215	33.49	137	21.34	245	38.16
	Dabra	**26**	**110**	10	9.09	39	35.45	27	24.55	45	40.90
	Raipur	**46**	**223**	19	8.52	75	33.63	51	22.87	67	30.04
Secondary fringe zone	Muklan	**17**	**77**	11	14.29	31	40.26	22	28.57	13	16.88
	Jakhod Khera	**21**	**83**	16	19.28	33	39.76	24	28.92	10	12.05
	Kutabpur	**24**	**81**	22	27.16	27	33.33	23	28.40	9	11.11
	Ladwa	**44**	**169**	43	25.44	59	34.91	48	28.42	19	11.24
	Mirzapur	**44**	**182**	50	27.47	54	29.67	58	31.87	20	10.99
	Bahbalpur	**28**	**104**	35	33.65	27	25.96	30	28.85	12	11.54
	Total	**389**	**1671**								

Source: Primary Survey, 2023

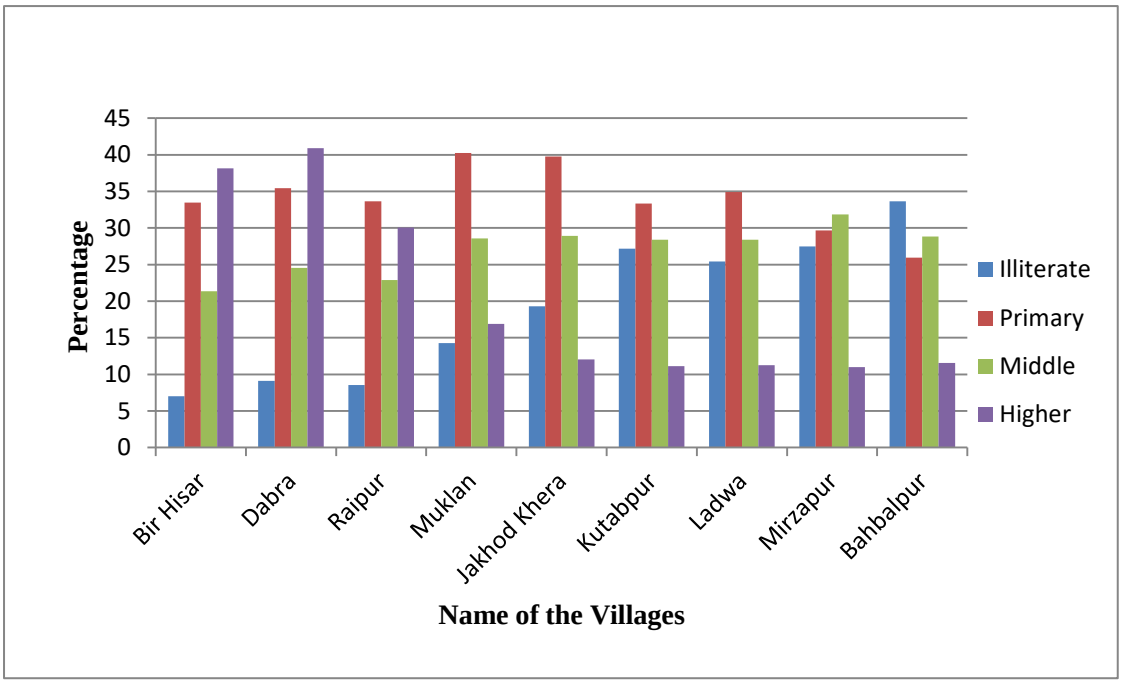


Fig. 5.10: Educational status of the sample villages based on Primary survey, 2023

The lowest middle level educated persons of the secondary fringe were in the village Ladwa i.e.28.42%; the second- lowest middle level educated persons of the secondary fringe were in the village Kutubpur i.e. 28.40%. The third- lowest middle level educated persons of the secondary fringe were in the village Muklan i.e. 28.57%.

The highest higher level educated persons of the primary fringe were in the village Dabra i.e 40.90%, the second- highest higher level educated persons of the primary fringe were in the village Bir Hisar i.e 38.16%, the third- highest higher level educated persons of the primary fringe were in the village Raipur i.e 30.04%. (fig. 5.10)

The highest higher level educated persons of the secondary fringe were in the village Muklan i.e 16.88%, the second- highest higher level educated persons of the secondary fringe were in the village Jakhod Khera i.e 12.05%, the third- highest higher level educated persons of the secondary fringe were in the village Bahbalpur i.e 11.54%. The lowest higher level educated persons of the secondary fringe were in the village Mirzapur i.e.10.99%; the second- lowest higher level educated persons of the secondary fringe were in the village Kutubpur i.e.11.11%, the third- lowest higher

level educated persons of the secondary fringe were in the village Ladwa i.e. 11.24%. (fig. 5.10)

5.9.6 Land holdings

The landholding is an important characteristic that explains the economic structure of a society. The landholdings of the fringe area exhibit the occupational means of fringe peoples. It describes the agricultural inclination of a certain society. In the present work, data has been collected with the help of a questionnaire from the primary and secondary fringe to find out their landholding status. The types of categories of land holdings study are taken as leased in / mortgage, leased out / mortgage, operational holding, irrigational and non-irrigational. Based on the above-discussed categories sample villages from both fringes were evaluated and a brief description is given in the Table 5.11.

The highest leased in / mortgage holdings of the primary fringe were in the village Raipur i.e 18.13%, the second- highest leased in / mortgage holdings of the primary fringe were in the village Bir Hisar i.e 18.03%, the third- highest leased in / mortgage holdings of the primary fringe were in the village Dabra i.e 17.58%.

The highest leased in / mortgage holdings of the secondary fringe were in the village Bahbalpur i.e 55.85%, the second- highest leased in / mortgage holdings of the secondary fringe were in the village Mirzapur i.e 52.64%; the third- highest leased in / mortgage holdings of the secondary fringe were in the village Kutubpur i.e 43.75%. The lowest leased in / mortgage holdings of the secondary fringe were in the village Muklan i.e.28.86%; the second- lowest leased in / mortgage holdings of the secondary fringe were in the village Jakhod Khera i.e. 31.56%. The third-lowest leased in / mortgage holdings of the secondary fringe was in the village Ladwa i.e. 42.30%. (fig 5.11).

The highest leased out / mortgage holdings of the primary fringe were in the village Raipur i.e 76.13%, the second- highest leased out / mortgage holdings of the primary fringe was in the village Dabra i.e 75.76% the third- highest leased out / mortgage holdings of the primary fringe were in the village Bir Hisar i.e 74.95%.

The highest leased out / mortgage holdings of the secondary fringe were in the village Kutubpur i.e 62.11%, the second- highest leased out / mortgage holdings of

the secondary fringe was in the village Muklan i.e 61.07%; the third- highest leased out / mortgage holdings of the secondary fringe were in the village Ladwa i.e 60.53%. The lowest leased out / mortgage holdings of the secondary fringe were in the village Jakhod Khera i.e. 56.89%; the second- lowest leased out / mortgage holdings of the secondary fringe were in the village Bahbalpur i.e. 57.19%. The third- lowest leased out / mortgage holdings of the secondary fringe were in the village Mirzapur i.e. 59.30%. (fig 5.11).

The highest operational holdings of the primary fringe were in the village Bir Hisar i.e 6.96%, the second- highest operational holdings of the primary fringe were in the village Dabra i.e 6.67% the third- highest operational holdings of the primary fringe were in the village Raipur i.e 5.74%.

The highest operational holdings of the secondary fringe were in the village Kutubpur i.e 14.84%, the second- highest operational holdings of the secondary fringe were in the village Ladwa i.e 14.15%; the third- highest operational holdings of the secondary fringe were in the village Jakhod Khera i.e 11.56%. The lowest operational holdings of the secondary fringe were in the village Muklan i.e.17.05%; the second- lowest operational holdings of the secondary fringe were in the village Jakhod Khera i.e. 25.53%. The third- lowest operational holdings of the secondary fringe were in the village Bahbalpur i.e. 30.28%. (fig 5.11).

The highest irrigational holdings of the primary fringe were in the village Dabra i.e 85.45%, the second- highest irrigational holdings of the primary fringe were in the village Bir Hisar i.e 85.12%; the third- highest irrigational holdings of the primary fringe were in the village Raipur i.e 82.48%.

The highest irrigational holdings of the secondary fringe were in the village Muklan i.e 77.18%, the second- highest irrigational holdings of the secondary fringe were in the village Kutubpur i.e 72.27%; the third- highest irrigational holdings of the secondary fringe were in the village Jakhod Khera i.e 69.33%. The lowest irrigational holdings of the secondary fringe were in the village Bahbalpur i.e.64.55%; the second- lowest irrigational holdings of the secondary fringe were in the village Mirzapur i.e. 68.30%. The third- lowest irrigational holdings of the secondary fringe were in the village Ladwa i.e. 69.03%. (fig 5.11).

Table 5.11: Characteristics of Land Holding in Sample Villages

Fringe zone	Name of village	Number of Households	Land owned										
			Total acre	Leased in/Mortgage		Leased out/Mortgage		Operational holding		Irrigated		Unirrigated	
				Acre land	%	Acre land	%	Acre land	%	Acre land	%	Acre land	%
Primary fringe zone	Bir Hisar	**139**	934	169	18.09	700	74.95	65	6.96	795	85.12	139	14.88
	Dabra	**26**	165	29	17.58	125	75.76	11	6.67	141	85.45	23	13.94
	Raipur	**46**	331	60	18.13	252	76.13	19	5.74	273	82.48	58	17.52
Secondary fringe zone	Muklan	**17**	149	43	28.86	91	61.07	15	10.07	115	77.18	34	22.82
	Jakhod Khera	**21**	225	71	31.56	128	56.89	26	11.56	156	69.33	69	30.67
	Kutabpur	**24**	309	112	43.75	159	62.11	38	14.84	185	72.27	124	48.44
	Ladwa	**44**	744	269	42.30	385	60.53	90	14.15	439	69.03	305	47.96
	Mirzapur	**44**	627	269	52.64	303	59.30	55	10.76	349	68.30	278	54.40
	Bahbalpur	**28**	371	167	55.85	171	57.19	33	11.04	193	64.55	178	59.53
	Total	**389**	3855										

Source: Primary Survey, 2023

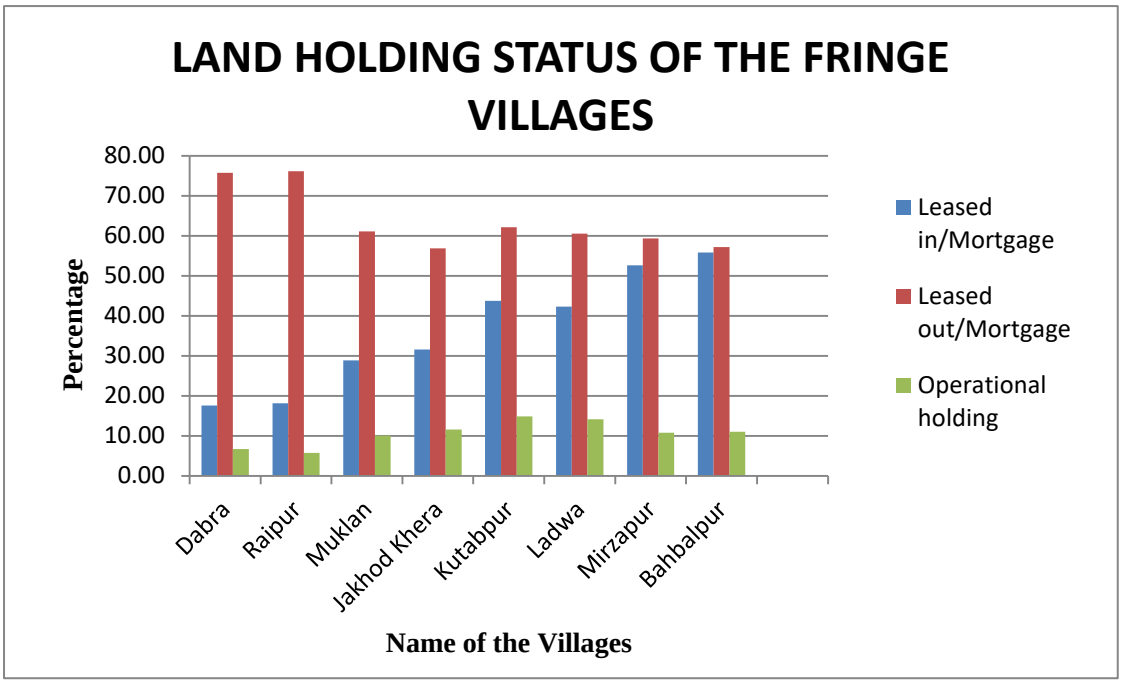


Fig. 5.11: Land holding status of the sample villages based on Primary survey, 2023

The highest unirrigational holdings of the primary fringe were in the village Raipur i.e 17.52%, the second- highest unirrigational holdings of the primary fringe were in the village Bir Hisar i.e 14.88%; the third- highest unirrigational holdings of the primary fringe were in the village Dabra i.e 13.94%.

The highest unirrigational holdings of the secondary fringe were in the village Bahbalpur i.e 59.53%, the second- highest unirrigational holdings of the secondary fringe were in the village Mirzapuri.e 54.40%; the third- highest unirrigational holdings of the secondary fringe were in the village Ladwa i.e Kutubpur 48.44%. The lowest unirrigational holdings of the secondary fringe were in the village Muklan i.e. 22.82%; the second- lowest unirrigational holdings of the secondary fringe were in the village Jakhod Khera i.e. 30.67%. The third- lowest unirrigational holdings of the secondary fringe were in the village Ladwa i.e. 47.96%. (fig 5.11).

5.9.7 Conclusion

In this chapter, the occupational and demographic structure of the fringe area of Hisar city has been analyzed on the basis of the 1991, 2001, and 2011 census. 9 samples

villages have been selected for proper representation of internal and external fringe of Hisar city. While selecting sample villages, proper care was taken to accurately represent almost every part of the internal and external fringe. It was ensured that each sample village should be at a certain distance and located on the road connected to the city. After selecting the sample villages, data was collected from the desired population with the help of a detailed questionnaire so that the demographic and occupational structure of the respective village could be lucidly presented. In this chapter, the occupational and demographic structure of the rural urban fringe was discussed.

If we discuss about the average percentage of agricultural workers in 1991 in village Bir Hisar was 62.21% and decline to 48.42% in 2001 and 23.72% in the 2011 census. In the case of Dabra, the number of people engaged in agricultural work was 61.72% in the 1991 census, in 2001 and 2011 census, it kept decreasing continuously which was 50.70% and 47.10% respectively. The data on agricultural workers of Raipur village also show a sharp decline from 1991 census to 2001 census that is 80.45% in 1991 and 28.36% in 2001. On the other hand, if we talk about the secondary fringe villages, there is no significant increase in the percentage of agricultural workers during the last three decades.

According to the 1991 census, within the primary fringe villages, the highest proportions of non-agricultural workers were observed in Dabra (38.28%), Bir Hisar (37.79%), and Raipur (19.54%). In the 2011 census, the respective percentages for these villages changed to 37.05%, 43.83%, and 25.03%. In the secondary fringe, the proportion of non-agricultural workers shows only a modest increase. In Muklan, this share was 12.84% in 1991 and rose to 21.07% by 2011. Similarly, in Kutubpur village, the proportion of non-agricultural workers increased from 19.02% in 1991 to 21.06% in 2011.

According to the 1991 census, the literacy rates in Bir Hisar, Dabra, and Raipur were 40.11%, 38.12%, and 37.25%, respectively. By the 2011 census, these figures had risen to 61.22%, 62.78%, and 63.23% for the same villages, respectively. In the 1991 census, the highest literacy levels among the secondary fringe villages of Jakhod Khera, Muklan, and Mirzapur were 39.39%, 36.48%, and 33.28%, respectively. By the 2011

census, the corresponding literacy rates in these villages had increased to 61.86%, 64.04%, and 58.03%, respectively. This positive trend in the field of literacy directly associated with the influence of Hisar city. It is the educational infrastructure of the city that provides opportunities to the surrounding countryside to achieve higher literacy standards.

Higher female literacy is an important parameter for the measurement of modern society. Female literacy has a decisive role in the all-around progress of society. In female literacy also, there is a positive trend in the sample villages of the fringe area. In village Bir Hisar the female literacy was 30.27% in 1991, 48.45% in 2001 and 59.63% in 2011 census. Similarly in village Dabra the female literacy was 32.14% in 1991, 50.31% in 2001 and 58.72% in 2011. In village Raipur it was (29.23%) in 1991, (54.24%) in 2001, and (60.19%) in 2011, in village Muklan it was 23.28% in 1991, 45.78% in 2001, and 60.83% in 2011, in village Kutubpur it was 21.29% in 1991, 44.43% in 2001 and 58.97% in 2011, in village Bahabalpu it was 17.02% in 1991, 46.64% in 2001 and 60.67% in 2011. It is evident from the above discussion that during the last three decades, there has been an increase in literacy in both internal and external fringe areas; it was 63.15% in the primary fringe and 61% in the secondary fringe.

First of all, if we discuss the population density of sample villages under the primary fringe, in village Bir Hisar the population density increase from 93 persons/sq.k.m. in 1991 to 143 persons/sq.k.m. in 2001 to 165 persons/sq.k.m. in 2011. In village Dabra it was increase from 415 persons/sq.k.m. in 1991 to 460 persons/sq.k.m. in 2001 to 491 persons/sq.k.m. in 2011. In village Raipur it was increase from 694 persons/sq.k.m. in 1991 to 755 persons/sq.k.m. in 2001 to 664 persons/sq.k.m. in 2011. Similar changes are witnessed in the secondary fringe. In village Muklan it was increase from 314 persons/sq.k.m. in 1991 to 386 persons/sq.k.m. in 2001 to 426 persons/sq.k.m. in 2011. In village Mirzapur it was increase from 337 persons/sq.k.m. in 1991 to 380 persons/sq.k.m. in 2001 to 442 persons/sq.k.m. in 2011. In village Jakhod Khera it was increase from 269 persons/sq.k.m. in 1991 to 312 persons/sq.k.m. in 2001 to 332 persons/sq.k.m. in 2011.

The analysis shows that villages of primary fringe such as Bir Hisar, Dabra and Raipur enjoy better public amenities for the last three decades. These villages lie

within a 5 to 8 km radius of the city. Those villages that are connected to the city by pucca village road enjoy good public amenities. Based on the analysis of the data, it is found that till 1991, there are problems in terms of drinking water facility in the village of secondary fringe and villagers are restricted to ponds and wells only. On the other hand, if we talk about the primary fringe, then from 1991 till now there has always been availability of water and those people have been getting better facilities of water.

The availability of communication facilities has also been in better condition in the primary fringe, whereas in the secondary fringe these facilities were not available.

Even on the basis of health facilities, the primary fringe villages have always been providing the best health facilities due to their proximity to the urban area, while the secondary fringe villages are dependent on the health facilities available at the village level due to the distance from the urban area.

On the basis of sample survey conducted in the primary and secondary fringe, some interesting facts have come out as follows. First of all let's talk about the age and sex wise data of both the fringes. The average age of the family is less in primary fringe, while in the secondary fringe the average of family member is very high.

Similarly, data is collected related to the joint and nucleated family. This reveals that in the primary fringe the nucleated family is more, whereas in the secondary fringe the data shows that the number of joint families is more.

If we talk about the sex ratio, then in the primary fringe the sex ratio is less, the same as we enter outside the city inside the secondary fringe, there is a continues increase in the sex ratio. A brief description of this is given below.

The highest sex ratio of the primary fringe was in the village Raipur i.e 873. The lowest sex ratio of the primary fringe was in the village Bir Hisar i.e 831. The data shows that the primary fringe villages represent a low-profile sex ratio.

The highest sex ratio of the secondary fringe was in the village Mirzapur i.e 936. The lowest sex ratio of the secondary fringe was in the village Ladwa i.e. 920. The analysis reflects high level of sex ratio in the secondary fringe.

The primary data also collected on the occupational structure of both the fringes. The occupational structure is discussed on three titles as (1) Type of occupation (2) Nature of the employment (3) Monthly income. In terms of the nature of the employment, there are two types i.e. (1) Main (2) Subsidiary. After the primary survey, it comes out that the ratio of the main occupation is more in the primary fringe. The subsidiary or secondary work is less in the primary fringe.

In this study the occupational types are divided broadly into three categories as follows: (1) Agricultural and allied workers (2) Manufacturing and industrial workers (3) Others

The data has been collected from the above mentioned categories in the primary and second fringe villages. While compiling the data during the survey, it has emerged that the involvement of people in the agricultural and allied activities is very less in the primary fringe and the number of people engaged is seen more in other activities. Similarly, in manufacturing and industrial activities, there are less of people involved in the secondary fringe. Similarly, under the secondary prince, the number of workers involved in agriculture and allied activities is high and the number of workers engaged in manufacturing and industrial activities as well as other works is very less.

The primary data also collected from literacy perspective. The literacy of the primary and secondary fringe discussed on four titles as illiterate, primary, middle and higher education achievement. The primary fringe has better education achievement than secondary fringe. The highest illiterate persons of the primary fringe were in the village Dabra i.e 9.09%. The highest illiterate persons of the secondary fringe were in the village Bahabalpur i.e 33.65%, The highest primary level educated persons of the primary fringe were in the village Raipur i.e 33.63%. The highest primary level educated persons of the secondary fringe were in the village Muklan i.e 40.26%, The lowest primary level educated persons of the secondary fringe were in the village Bahbalpur i.e.25.96%. The highest middle level educated persons of the primary fringe were in the village Dabra i.e 24.55%. The highest middle level educated persons of the secondary fringe were in the village Mirzapur i.e 31.87%. The lowest middle level educated persons of the secondary fringe were in the village Ladwa i.e.28.42%. The highest higher level educated persons of the primary fringe were in

the village Dabra i.e 40.90%. The highest higher level educated persons of the secondary fringe were in the village Muklan i.e 16.88%. The lowest higher level educated persons of the secondary fringe were in the village Mirzapur i.e.10.99%.

In the present work, data has been collected with the help of a questionnaire from the primary and secondary fringe to find out their landholding status. The types of categories of land holdings study are taken as leased in / mortgage, leased out / mortgage, operational holding, irrigational and non-irrigational.

The highest leased in / mortgage holdings of the primary fringe were in the village Raipur i.e 18.13%. The highest leased in / mortgage holdings of the secondary fringe were in the village Bahbalpur i.e 55.85%. The highest leased out / mortgage holdings of the primary fringe were in the village Raipur i.e 76.13%. The highest leased out / mortgage holdings of the secondary fringe were in the village Kutubpur i.e 62.11%. The lowest leased out / mortgage holdings of the secondary fringe were in the village Jakhod Khera i.e. 56.89%. The highest operational holdings of the primary fringe were in the village Bir Hisar i.e 6.96%. The highest operational holdings of the secondary fringe were in the village Kutubpur i.e 14.84%. The highest irrigational holdings of the primary fringe were in the village Dabra i.e 85.45%. The highest irrigational holdings of the secondary fringe were in the village Muklan i.e 77.18%. The lowest irrigational holdings of the secondary fringe were in the village Bahbalpur i.e.64.55%. The highest unirrigational holdings of the primary fringe were in the village Raipur i.e 17.52%. The highest unirrigational holdings of the secondary fringe were in the village Bahbalpur i.e 59.53%.

Therefore, the increases in the non-agricultural workers, rise in literacy rate with higher educational level mainly improve the socio-economic condition of inner fringe areas as compared to the outer fringe area at present.

CHAPTER 6

CHARACTERISTICS OF THE RURAL - URBAN FRINGE

The rural-urban fringe is a transitional belt in between purely rural and purely urban areas. It represents an intermixed land use pattern with both rural and urban characteristics. There is a strong interrelation between the urban centers and its surrounding periphery. They complement each other in terms of exchanging goods and services. This area signifies the changing land use pattern with the growing urban influence. It depicts the transition of purely agricultural land into urban land use. The land use in this area can be described as dormitory settlements, the housing of middle-income commuters, small farm size, vacant land etc. Some other characteristics are changing land value, urban attributes, less traveling time, scarcity of public amenities, daily commuting, and high population growth, the intensity of non-farm activities, growing population density, and unplanned built-up area. The analysis of these characteristics represents the changing scenario in the fringe area.

The rural-urban fringe can be described as a peripheral zone that encircles the urban center. It is characterized as a transitional zone with a diverse range of land uses and is closely linked to the adjacent urban area in terms of daily transportation, provision of services, and exchange of goods. The land use depicts a changing pattern with the growing city region. The city region influence can be witnessed in terms of land–use configuration, occupation structure, and morphological characteristics.

The fringe zone originates from the influence of pull and push factors that works actively in the city region. Various socio-economic and cultural factors of urbanization are very crucial in shaping the rural urban fringe structure. The land acquisition for the urban use in the fringe area instigates the transformation process. It enhances the socio-economic and cultural shift from the rural to the urban phase. It refers to a kind of haphazard development in the outskirts of the municipal limit, has been defined as ***"urban fringe", "no man's land", "peri urban land", "heterogeneous region", "urban district" and "metropolitan zone"***. Actually, the

rural-urban fringe is a zone of transition that can be traced in terms of functional attributes; structure, demographical pattern, and social life lie between the urban and rural areas.

Rodehaver (1947) proposed that the presence of a fringe area indicates a distinctive characteristic, namely, the provision of accessibility for new residents who originate from both urban and rural locations.

Dewey (1948) finds out that the fringe zone is the intermixing of two types of the working-class population that is agricultural and non-agricultural workers.

Pryor (1969) figures out that lack of public amenities, undeveloped public transport facility and high ratio of residential houses are the main attributes of the fringe area.

6.1 CHARACTERISTICS OF RURAL URBAN FRINGE

The outskirts of the city, which shows the remarkable transformation in terms of physical, economic, cultural and morphological aspects and represents a transition zone with mixed land use of both rural and urban features, are termed as a rural-urban fringe. The rural-urban fringe is a contiguous region with a city that reflects urban nature and patterns in terms of physical and morphological attributes. If we talk about the definition of rural-urban fringe, from time to time many scholars have represented many definitions related to it and from their study, it is clear that the fringe area is neither completely urban nor completely rural. It is a reflection of rural characteristics, rather this area exhibits mixed characteristics and characteristics of both these areas.

In his research on the periphery of the United States, **Wehrwein (1942)** delineates various characteristics of this locality, including slaughter facilities, junkyards, large-scale oil storage facilities, and public infrastructure such as sewage treatment plants and burial grounds.

Walter Firey (1946) in his study underline the following characteristics of the fringe area:

1) The encroachment of productive land.
2) The randomly scattered plots of lands, factories, and residential areas.

3) For better public amenities high taxes system should be there but factories and shops do not have adequate abilities.

4) The emergence of modern buildings hiking the price of lands and in turn the agricultural activities are becoming less attractive.

5) The demographical aspects show changing scenarios as more youth and children dominate the population structure. It shows high dependency on the urban area for daily needs.

Golledge (1960) in his work of Sydney fringe point out seven characteristics:-

1) Changing pattern of land occupancy.
2) Small farm size.
3) Intensive agriculture.
4) Low or moderate density and high population mobility.
5) Residential occupation of land.
6) Lack of public amenities.
7) Speculative building type.

Thus it is clear that the above-mentioned characteristics outline the conditions of the rural urban fringe and it attracts youth from rural areas to the fringe area on the basis of the speculative type of houses and incomplete public facilities. **Golledge** has identified certain supplementary characteristics, including reduced farm dimensions and heightened crop yield, which are likely associated with urban consumption.

R.E. Pahl (1956) in his study summarizes four characteristics of fringe zone, that also proposed by **Golledge** in his earlier work.

(i) ***Segregation:*** It is a phenomenon that is very prevalent in the fringe. The ability to buy new house on own basis is the main reason for this. Thus the population segregated on the basis of 'classes'. It becomes status symbol in residential context, popular to live in.

(ii) ***Selective Immigration:*** The rural-urban fringe has been observed as attracting a social group of ***"mobile middle-class commuters"*** who choose to reside in the

periphery while being employed in the urban center. So they commute every day from fringe to city center. They are different from other permanent resident social groups in many aspects. They show a tendency to return urban area on regular basis**.** ***Kurtz and Smith*** in their research conducted in Lansing, Michigan indicate that individuals who have migrated to urban fringe areas exhibit a tendency to frequent visits to their previous living place.

(iii) ***Commuting:*** Another important characteristic is commuting; people work in the city region and commute every day to back home in the fringe area.

(iv) ***The Collapse of Geographical and Social Hierarchies:*** In his work **Pahl** provided the most unique and interesting conclusions about fringe. He advances the concept of distinctive fringe. The fringe settlements modify their service expertise according to the movement of the urban population towards the different parts of the city for the fulfillment of certain services. They do not require to carry a wide range of goods and services proportionate to the people they serve but might specialize in specific areas.

(v) **Pryor (1968)** in his work suggested that some different set of characteristics such as land use transition, social and demographic attributes.

i. Build up urban and sub urban areas.

ii. The rural hinterland.

These two zones have some distinct defined characteristics as follows:

i. Absence of non-farm dwellings.

ii. Unplanned growth and unorganized zoning or planning regulations,

iii. Expansion beyond the political boundary of the central city.

iv. A sharp Increase in population density, but lower than that of city region and above of surrounding rural area.

v. Inadequate public amenities.

Giggs (1979) his work related for Nottingham proposed that there is basic difference between north and west side of the city which were developed and industrialized in

the 19th century; on the other side south and east part considered as fringe area. A cluster examination was conducted on a dataset consisting of 78 parishes and 15 variables. The variables included such as growing population, age composition, housing features, socioeconomic situation, job prospects, mode of transportation, and dependencies.

1. Modern Mining Settlement,
2. Large residential suburbs,
3. Small residential suburbs,
4. Small village – unmodified villages

He comes to the conclusion that ***'the major residential tracts of the suburbs-old privates housing council estates and miners'***. Most of the estates are isolated in nature and some of these private estates are located near villages. Land with well planned development was given to commercial, educational and institutional uses.

Carter (1975) suggested that the rural-urban fringe represents different dimensions of characteristics related to old rural settlements to contemporary residential developments. There is variety of commercial properties such as shopping centers and industrial areas located at convenient distances from city.

Dr. Sudesh Nangia (1976) had a study related to the Delhi Metropolitan fringe area and underline following characteristics:

1. The fringe zone includes the huts, slum and illegal occupations. These settlements are unplanned and unorganized.
2. The land-use is mixed in nature.
3. Decreasing agricultural practices and land –use.
4. Inadequate public amenities.
5. Scattered type of settlements and lack of budget to provide amenities.
6. Represent mixed form of rural and urban way of life.

M.M.P. Sinha (1980) in his work related to the Patna Metropolitan states that rural-urban fringes provide a platform that connects the rural and urban areas.

Many scholars in India as well as International level publish their works related to the rural urban fringe and figure out that the mixed land use of both rural and urban characteristics is the soul of fringe area. The evolution of western and Indian cities may be different, but the fundamental process of urban growth and land use transformation remains the same. The development model of Indian cities established after independence resembles the development model of cities in western countries in which the informal sector plays a significant part. The main feature of the Fringe area of the pre-independence Indian cities was the cantonment zone and the airstrips, which was gradually replaced by other features after post- independence such as brick kiln, godowns, big factories, graveyard, sewage plants, garbage stores and periodic markets etc. Another significant attribute of the fringe area is establishing various informal sector units such as ‘gimti’, 'chat corners’ grocery, and retail shops. If we discuss about the residential pattern of the fringe area, most of the residents of rural areas live here, who is unable to afford the high expenses of real estate in the city region, but wants to reside near in urban areas. Over time, the limited availability of land and the rapid growth of transportation in the urban area has also developed the interest of the urban population towards the fringe areas.

According to scholars, agricultural activities are considered as rural activity in western countries, but in India, such activities are considered as the internal limit of the rural-urban fringe regions.

Thus, if the agricultural activities occur within the municipal boundary, then the beginning of the fringe is considered to be from the inner part of the city. This phenomenon can be witnessed in many Indian cities (e.g. Greater Mumbai), whose limits have been deliberately defined as to include some agricultural land. Revenue village, in India, contiguous with the city municipal boundary with urban land use, deemed to be included in the city boundary. A revenue village with mixed land use regarded as a component of rural-urban fringe. Thus, the different attributes of the rural-urban fringe in India can be summarized as follows:

1. Presence of factories within the village or at the boundary of the village.
2. Presence of brick kiln, timber yard, warehouse, air ports, bus and truck mechanic shops.

3. Presence of different kinds of shops on both sides of the road leading from village to the city.
4. Growth of the different unplanned residential areas, developed by the people who came from the villages or from the city itself.
5. Emergence of different colleges, hospitals, and dispensaries, etc.
6. Establishment of water works, sewage plants, crimination or burial ground and slaughter house.
7. Development of stadium and playground.
8. Growth of different residential flats by builders and corporate houses.

Thus the rural-urban fringe represents the mixed characteristics of rural and urban areas.

6.2 CHARACTERISTICS OF THE RURAL URBAN FRINGE OF THE HISAR CITY

The effect of urbanization on the various attributes of the fringe zone of Hisar city can be observed clearly during the last three decades. Along with the development of Hisar city, many changes were seen in the socio-economic, demographic and morphological aspects of the surrounding rural areas. As a pull effect of urbanization, the people of rural areas started moving towards the city for many reasons, but due to the high costs of land in the metropolitan regions, they started settling in their surroundings. Commuting played an important part in mobility and also in bringing the urban impact to these areas. The increasing modern means of transport not only facilitated commuting but also enabled the transformation of many characteristics of the surroundings. Some of these characteristics directly associated from the social framework and economic basis of the fringe area. Gradually, the land use in the rural areas along with the city started changing and it was changing from agricultural to non-agricultural land use. Unlike purely rural flavor, certain types of land use began to emerge between rural and urban areas such as brick kiln, godowns, big factories, graveyard, sewage plants, garbage stores and periodic markets etc. In a way, it can be defined as the early phase of the rural urban fringe. With the growth of the city towards its surroundings, the rural-urban fringe also expanded and it emerged as an

important transitional zone between the countryside and the city region. It represents a mixed setup to the characteristics of both areas. The accessibility to the city demonstrates an inverse correlation with the attributes of the rural-urban fringe. With the increasing distance characteristics show a change in their nature. In this chapter, these characteristics will be analyzed on the basis of some following indicators:

1. Population Density
2. Sex Ratio
3. Ratio of Non-Agricultural workers
4. Literacy

Further, the current research explores the influence of the city on the surrounding regions on the parameters discussed above. It particularly discusses the impact of the City Centre in terms of distance on the surroundings, differentiating between the inner fringe and the outer fringe regions. This discussion is placed within the city region framework, acknowledging that the area of influence of a city is defined by the range of services provided from the city to its hinterland and its hinterland to the city, and this in turn determines the nature of the rural–urban fringe. Firstly, the mean and standard deviation of all indicators were analyzed and after attaining the values, these were tabulated. The scores of these indicators were divided into five categories and examined for further conclusion.

Table 6.1: Range of values of different indicators

Categories	Range of Values
Very High	Above Mean + 3 S.D.
High	Mean + 2 S.D. to Mean +3 S.D.
Medium	Mean + 1 S.D. to Mean +2 S.D.
Low	Mean to Mean +1 S.D.
Very Low	Below Mean

Compiled by the author

Thus from the above Table 6.1, it is clear that the five categories have been created to study the values of different indicators. The villages that fall within the range of above mean + 3 S.D are classified as being in a very high category, Similarly, villages

that fall within the range of mean + 2 S.D. to mean +3 S.D are classified as being of a high category.. The indicators that fall within the range of mean + 1 S.D. to mean +2 S.D. are classified as medium, while those falling within the range of mean to mean +1 S.D. are classified as low. Villages categorized as very low values fall below the mean range. Table 6.2 is showing the values of different characteristics by 2 km distance zones.

Table 6.2: Rural-Urban Fringe – Population Density, Occupational Structure, Sex Ratio, and Literacy by 2 km. distance zones

Distance Zones	Zones 1	Zones 2	Zones 3	Zones 4	Zones 5	Zones 6	Zones 7
Population Density (Persons per sq. Km.)							
1991	937	371	257	259	213	248	237
2001	2350	625	371	360	264	336	282
2011	2179	773	532	446	278	314	361
Sex Ratio							
1991	807	847	818	844	865	853	859
2001	844	762	847	866	867	854	880
2011	868	705	782	786	908	873	836
Literacy							
1991	46	38	36	33	36	35	36
2001	60.4	57	52	50	48	52	51
2011	65.5	62.58	62.57	62.22	60.35	61.59	61.77
Percentage of Non-Agricultural Workers							
1991	48	35	19	29	12	20	19
2001	78	62	54	52	49	48	40
2011	89	78	49	51	37	45	46

Source: Census of India

6.2.1 Demographic Characteristics

To study the different components of rural-urban fringe of Hisar city, the demographic characteristics of the fringe play an important role. The description and

analysis of various demographic aspects help in understanding different dimensions of the rural-urban fringe of the city. Different demographic indicators such as density, literacy, sex ratio, and the ratio of non-agricultural workers depict the present and past changing patterns of these characteristics in the fringe zone.

6.2.1.1 Literacy

Literacy is a significant indicator to determine the socio-economic progress of a society. Literacy represents the direction of progress of society and the future prospect of this aspect. If we discuss about the literacy status of the rural-urban fringe of the Hisar city, there is a more educated population in the primary fringe than that of the secondary fringe.

Table 6.3: Rural-Urban Fringe Literacy - 2011

Sr. No.	Fringe Zone	Distance from the city center	Total population (2011)	Population literate (2011)	Literacy Rate(2011)
1	Inner Fringe	4-6	81227	53213	65.50
2		6-8	33226	20796	62.58
3		8-10	30848	19304	62.57
4		10-12	62064	38621	62.22
5	Secondary fringe	12-14	34792	21000	61.70
6		14-16	41474	25545	61.59
7		16-18	48346	29866	61.77

Source: Census of India

The Table6.3 depicts the distribution of total population, literacy population, and literacy rates for different distances from the city center within the fringe areas of the city under consideration in 2011. The inner fringe zone, extending from 4 to 12 km, accommodates a population ranging from 30,848 persons in the 8–10 km band to 81,227 persons in the 4–6 km belt, which records the highest concentration within this zone. Literacy levels in this inner periphery region show a declining pattern with greater distance: the peak literacy level of 65.50% is observed in the 4–6 km zone, which steadily drops to 62.22% in the 10–12 km zone.

In the second fringe zone, from 12–18 km from the city center, a comparatively uniform literacy rate is found that oscillates between 61.59% and 61.77%, the lowest rate in the 14–16 km zone and the highest in the 16–18 km zone. The population in this zone is also kept moderate, ranging from 34,792 to 48,346. Therefore, the evidence indicates that the rate of literacy decreases with an increase in distance from the city center, as an indicator of spatial distribution of educational attainment in fringe areas (fig 6.1). The inner fringe exhibits a steeper decline compared to the secondary fringe, where literacy is more influenced by proximity to the city core. This trend concurs with urban-rural literacy differentials where access to urban infrastructure as well as educational facilities has a significant impact on literacy levels.

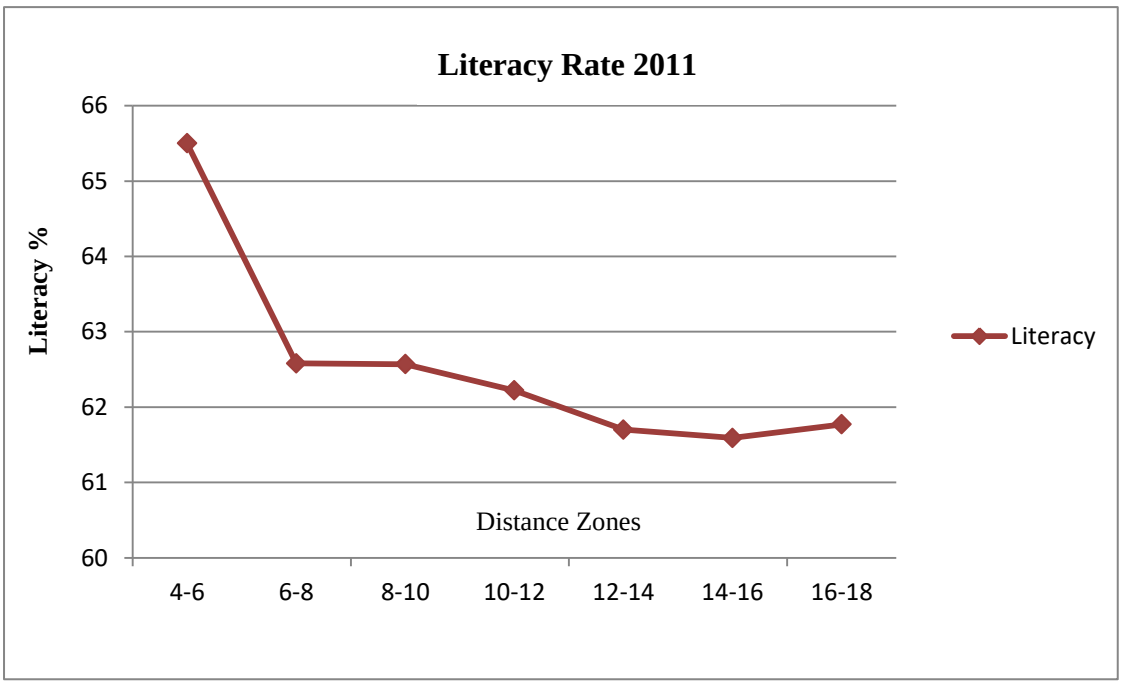


Fig. 6.1: Trend of Literacy from City Centre, 2011

Compiled by the author

6.2.1.2 Sex Ratio

Sex ratio is an important characteristic that represents the male female natural population balance in the society. It analysis population sex composition and underline the imbalance in term of male-female ratio. The Table 6.4 represents the sex ratio of male and female populations and respective sex ratios in fringe zones at different distances from the city center in 2011. In the inner fringe zone (4–12 km),

the sex ratio improves gradually with distance. Particularly, the sex ratio is 870 women per 1000 men in the 4–6 km zone, diminishing somewhat to 860 in the 6–8 km zone, growing to 878 and 902 in the 8–10 km and 10–12 km zone, respectively. This shows relatively more gender balance with growing distance in the inner fringe.

Table 6.4: Rural-Urban Fringe Sex Ratio - 2011

Sr. No.	Fringe Zone	Distance from the city center	Total Male population (2011)	Population Female Population (2011)	Sex Ratio (2011)
1	Inner Fringe	4-6	43441	37786	870
2		6-8	17862	15364	860
3		8-10	16246	14260	878
4		10-12	33817	30489	902
5	Secondary fringe	12-14	20493	18640	910
6		14-16	22191	20194	910
7		16-18	26188	23945	914

Source: Census of India

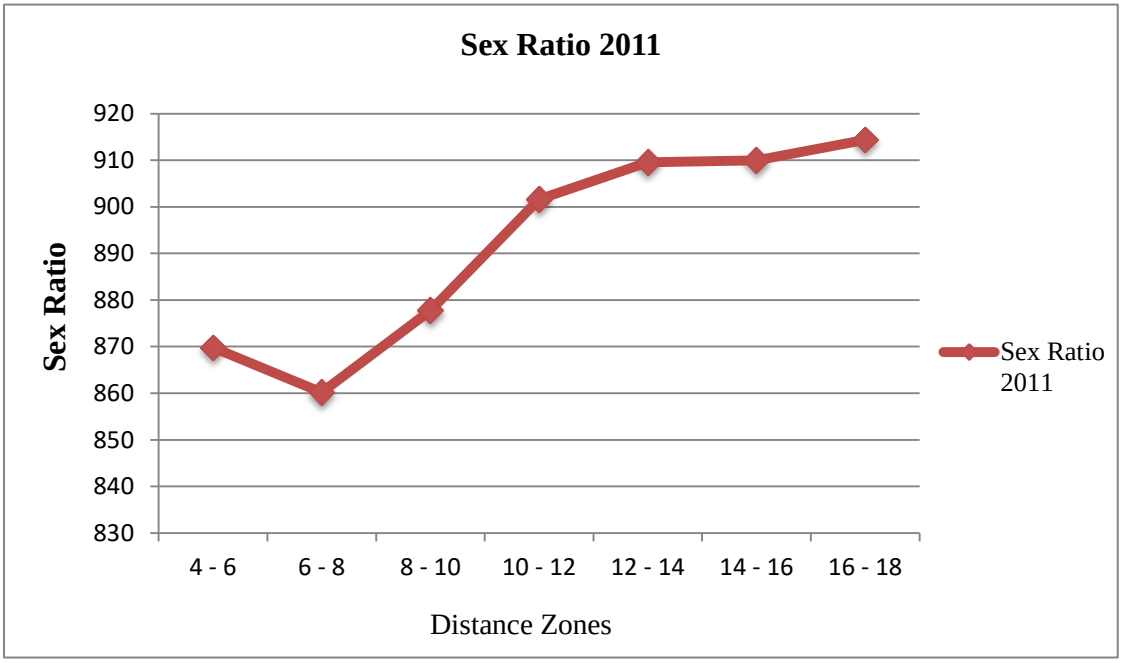


Fig 6.2: Trend of Sex ratio from City Centre, 2011

Compiled by the author

In the secondary fringe (12–18 km), the sex ratio increases even further to 910 in the 12–14 km as well as the 14–16 km zone, and marginally to 914 in the 16–18 km zone. Therefore, outer belts have a relatively better gender balance compared to the inner fringe areas. Therefore, the study shows a positive relationship between distance from the city center and sex ratio, that outer fringe and rural-proximate regions have a higher female-to-male ratio than inner fringe regions (fig 6.2). This might be due to patterns of migration where males outnumber females in the regions closer to the city as a result of work-induced migration, and the peripheral regions have a more balanced or female-skewed population.

6.2.1.3 Density of Population

Population density is an essential factor in determining the rural-urban fringe of the city. In term of Hisar city, a high concentration of population surrounds the adjoining city region. The Table6.5 provides the spatial distribution of total population, area, and population density over fringe zones at rising distances from the city center in 2011. Within inner fringe zones (4–12 km), the highest population density occurs in the 4–6 km zone with 2,179 persons per sq. km, reflecting high population concentration because of higher urban influence and land use intensification. The density drops steeply to 773 persons per sq. km in the 6–8 km zone and further to 532 and 446 individuals per sq. km in the 8–10 km and 10–12 km zones, respectively, even though the population is relatively high in the 10–12 km zone. The declining trend indicates smooth transition of land use from urban to inner fringe with increasing residential, agricultural, and mixed land uses at greater distance.

In the secondary fringe areas (12–18 km), the population decreases, reaching 278 persons per sq. km in the 12–14 km area, 314 in the 14–16 km area, and increasing slightly to 361 in the 16–18 km area. Although overall densities are still low in these outer zones relative to the inner fringe, the minimal rise in the outermost zone (16–18 km) could be a sign of incipient peri-urban settlement concentration as an effect of urban sprawl and processes of fringe development. Therefore, the figure 6.3 indicate that density declines with growing distance from the city center, tracing a typical urban–rural gradient with the highest densities being restricted to the proximal areas within the inner fringe and then spreading out gradually to the secondary fringe. This

trend indicates the effects of urban influence, proximity to employment and services, and resulting land use intensity around the urban nucleus.

Table 6.5: Rural-Urban Fringe Population Density - 2011

Sr. No.	Fringe Zone	Distance from the city center	Total population (2011)	Total Area Sq. Km.(2011)	Density (2011)
1	Inner Fringe	4-6	81227	168.5	2179
2		6-8	33226	43	773
3		8-10	30848	58	532
4		10-12	62064	139	446
5	Secondary fringe	12-14	34792	125	278
6		14-16	41474	132	314
7		16-18	48346	134	361

Source: Census of India

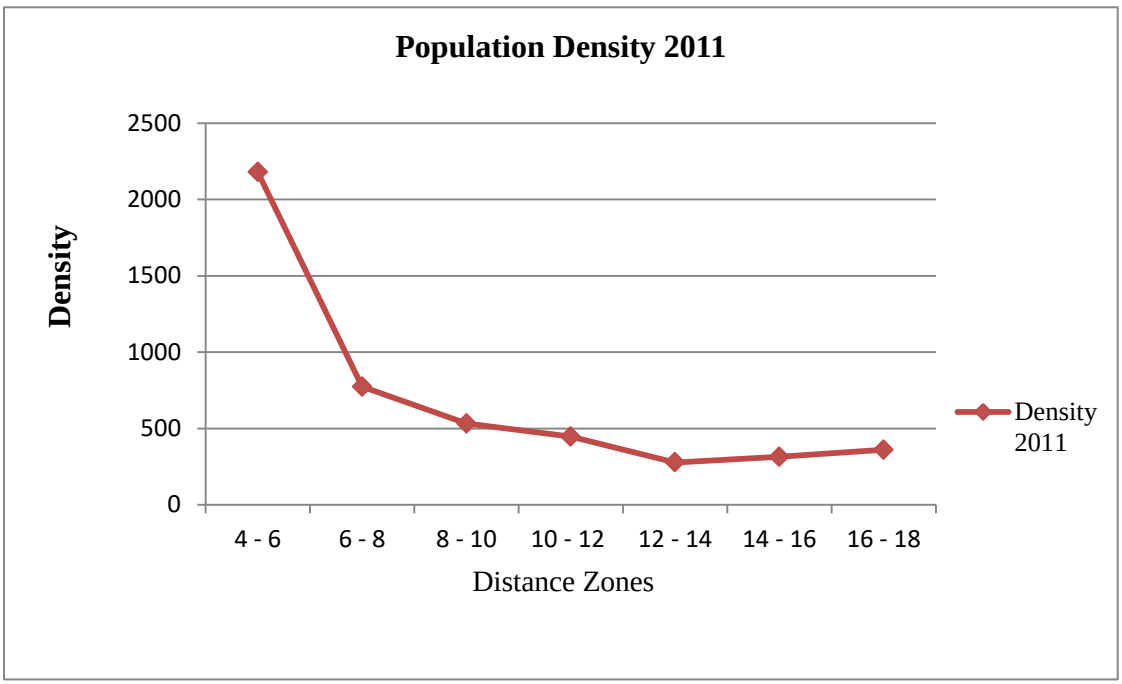


Fig 6.3: Trend of Population density from City Centre, 2011

Compiled by the author

6.2.1.4 Non-Agricultural Workers

The occupational composition of a region is reflected by the proportion of individuals engaged in non-agricultural professions. As it is evident, the urban areas have been dominantly engaged in secondary or tertiary economic activities. However, as the distance from the city center increases, to the peripheral countryside, farming is the significant economic activity that emerged. Mostly the population is involved in agricultural and allied activities. Table 6.6 shows total population distribution and the percentage of non-agricultural workers over fringe zones at rising distances from the city center in 2011. In the inner fringe zones (4–12 km), a sharp declining trend in the percentage of non-agricultural workers can be seen. The 4–6 km zone has the largest percentage at 89%, indicating a predominant urban occupational pattern with a presence of industrial, service, and other non-farm activities. The percentage drops to 78% in the 6–8 km zone and drops even more drastically to 49% and 51% in the 8–10 km and 10–12 km zone, which points to a shift towards mixed economic activities as distance increases.

Table 6.6: Rural-Urban Fringe Non-Agricultural workers - 2011

Sr. No.	Fringe Zone	Distance from the city center	Total population (2011)	Percentage of Non-agricultural workers (2011)
1	Inner Fringe	4-6	81227	89
2		6-8	33226	78
3		8-10	30848	49
4		10-12	62064	51
5	Secondary fringe	12-14	34792	37
6		14-16	41474	45
7		16-18	48346	46

Source: Census of India

For secondary fringe areas (12–18 km), non-agricultural workers are still few in number, at 37% in the 12–14 km area, rising slightly to 45% in the 14–16 km and 46% in the 16–18 km zones. The figures (fig. 6.4) point to the domination or reliance on agriculture in these outer areas, although limited rises in the outer areas might

represent the beginnings of occupational diversification. Therefore, the evidence illustrates a strong inverse gradient between distance from the city center and percentage of non-agricultural employment, in line with urban–rural occupational gradients. Inner zones have the urban economic profile with high non-agricultural employment, while outer zones maintain largely agricultural or mixed economic profiles, testifying to urban influence falling off with distance.

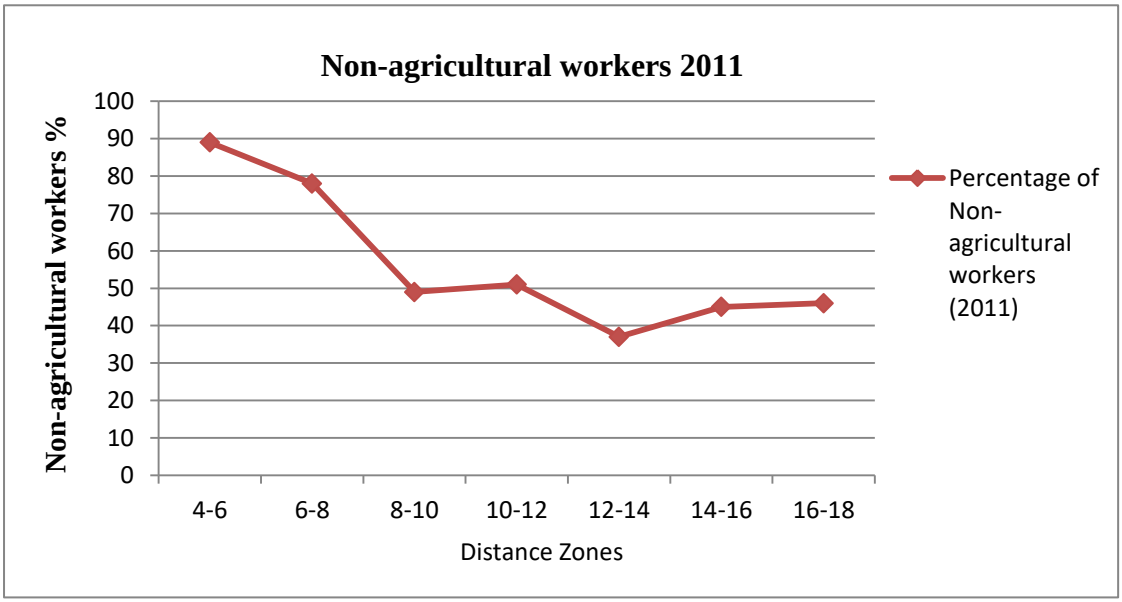


Fig 6.4: Trend of Non-agricultural workers from City Centre, 2011

Compiled by the author

6.3 CORRELATIONAL ANALYSIS

Correlation analysis shows the degree of association between two variables. It shows the relationship between two variables whether it is negative or positive. This relationship is described through a quotient of coefficient and hence, called coefficient of correlation. Thus this correlational analysis focuses on two variables coefficient of correlation. That shows the degree of relationship, whether positive inclination or negative. It is a pure number, limited by the values ranging from -1.00 to +1.00 that reflects the extent of relationship and expresses the relationship between two set of variables. The letter "r'' is usually used to represent the coefficient of correlation. In correlation analysis, logical relationship is considered when one variable affects the other variable. In this analysis there is one independent variable and the other is dependent on it. Sometimes both the variables are independent of each other and both

have no relation with each other. Under the study, if an increase in one variable result in an increase in the value of the other variable, then there is a positive relationship between the two, but if there is no increase in the other variable, that is, it does not make any difference, then it is negative. As the extent of correlation decrease the value of "r'' approaches zero.

6.3.1 Methods of correlation:

1) Pearson's Product Moment Method
2) Spearman's Rank Difference Method

In present study the analysis of the two variables has been done on the basis of Spearman's Rank Difference Method. Here rank correlation (r) is given by

$$r = 1 - \frac{6 \sum D^2}{N\,(N^2 - 1)}$$

Where, r = Rank correlation

$\sum D^2$ = Sum of Squared Difference

N = Number of Individuals

In the present study, the relationship between various variables like literacy rate, density, sex ratio, and non-agriculture worker, and various distance zones i.e. 4-18 km. from the city center has been investigated.

Table 6.7: Correlation of Distance Zones (4-18) with Literacy Rate

Sr. no	Variable	Correlational value
1	**Literacy**	**-8.57***

			V1	V2
Spearman's rho	V1	Correlation Coefficient	1.000	-.857*
		Sig. (2-tailed)	.	.014
		N	7	7
	V2	Correlation Coefficient	-.857*	1.000
		Sig. (2-tailed)	.014	.
		N	7	7

*. Correlation is significant at the 0.05 level (2-tailed).

The analysis of the mentioned Table 6.7 indicates that there is a negative correlation between literacy rate and distance zone with a correlation coefficient of r = -857*. The statistical correlation has achieved significance at the 0.05 level with a two-tailed test. It is clear from the analysis that the literacy rate decreases with increasing distance. Thus an increase in one variable results in a decrease in the other variable. The analysis reveals that literacy rate is closely related to distance. Where the literacy rate is higher in the nearby areas of the city, with increasing distance from the city centre, the literacy rate begins to decline. Similarly, rural areas have a substantially lower percentage of literacy than urban areas. The following pattern that has been observed, in which the literacy rate is higher in villages close to the city and lower the farther away from the central city, can be explained by several interlinked factors based on urban–rural gradients. Urban regions, including the nearby fringe areas, typically have higher educational facilities, including a higher density of schools, colleges, coaching centers, and adult literacy programs. Access to such institutions is greatly increased in urban areas because of highly developed transportation networks and connectivity, allowing frequent visits and follow-up of education. In addition, urban and inner fringe regions generally enjoy great socio-economic conditions, such as higher occupational diversification, and higher sensitization to the value of education, all of which are favorable to literacy outcomes. Being in close proximity to work opportunities in non-agricultural sectors also indirectly stimulates educational achievement since labour markets in urban areas increasingly require literate and skilled labour. As compared to this, rural regions, especially those situated more away from the city, experience systemic issues like scarcity of schools, particularly at secondary and higher levels, shortage of qualified teaching personnel, and structural deficiencies. Further, socio-cultural realities like traditional occupational reliance on agriculture and gender-based educational inequalities also limit literacy expansion in these areas. Therefore, the falling literacy rate with greater distance from the city mirrors the spatial disparity in learning opportunities, infrastructure facilities, and socio-economic growth, strengthening the rural–urban divide typical of developing areas.

Table 6.8: Correlation of Distance Zones (4-18) with Sex Ratio

Sr. no	Variable	Correlational value
1	**Sex Ratio**	.964**

			V1	V2
Spearman's rho	V1	Correlation Coefficient	1.000	.964**
		Sig. (2-tailed)	.	<.001
		N	7	7
	V2	Correlation Coefficient	.964**	1.000
		Sig. (2-tailed)	<.001	.
		N	7	7

**. Correlation is significant at the 0.01 level (2-tailed).

The analysis of the mentioned Table6.8 indicates that there is a positive correlation between sex ratio and distance zone with a correlation coefficient of r = 9.64**. The statistical correlation has achieved significance at the 0.05 level with a two-tailed test. The analysis indicates a positive correlation between distance from city center and sex ratio, whereby the sex ratio tends to increase as distance increases. Consequently, a rise in one variable leads to a corresponding increase in the other variable. The analysis reveals that sex ratio is closely related to distance. In the areas near the city, there is a decrease in sex ratio, however, the sex ratio increases with increasing distance from the city center can be accounted for by migration patterns and occupational patterns related to urbanization. Inner fringe areas surrounding the city usually witness an excess of male-dominated migration, mainly of working-age males looking for job opportunities in urban-agglomerated industrial, construction, transport, and service sectors. This male-preferred migration creates a sex ratio imbalance, reducing the female share compared to males in regions closer to the city. Conversely, at greater distances from the city proper to rural and secondary urban fringe areas, the sex ratio becomes healthier, nearing or even surpassing local averages. This reflects that rural regions have lower rates of out-migration of females and tend to have more even or female-skewed demographic compositions as a result of the out-migration of males to work in cities. Furthermore, the rural agrarian

societies also have a more settled resident population with family-based livelihoods that is balanced in terms of sex ratio.

Hence, the spatial disparity in sex ratio is largely explained by urban-biased male migration with resulting male-dominant populations in urban and inner fringe areas, whereas the villages of outer fringe mirror more natural or even sex ratios with limited migration mechanisms.

Table 6.9: Correlation of Distance Zones (4-18) with Population Density

Sr. no	Variable	Correlational value
1	**Population Density**	**-8.57***

			V1	V2
Spearman's rho	V1	Correlation Coefficient	1.000	-.857*
		Sig. (2-tailed)	.	.014
		N	7	7
	V2	Correlation Coefficient	-.857*	1.000
		Sig. (2-tailed)	.014	.
		N	7	7

*. Correlation is significant at the 0.05 level (2-tailed).

The analysis of the mentioned Table6.9 indicates that there is a negative correlation between population density and distance zone with a correlation coefficient of r = -857*. The statistical correlation has achieved significance at the 0.05 level with a two-tailed test. It is clear from the analysis that the population density decreases with increasing distance. Thus an increase in one variable results in a decrease in the other variable. The findings of the analysis indicate a significant correlation between population density and distance. The spatial distribution of population density exhibits a positive correlation with proximity to urban centers, with a corresponding negative correlation observed as the distance from the city center increases can be explained by the very basics of urban land use, accessibility, and economic agglomeration. Urban areas act as centers of economic, administrative, educational, and service functions, drawing big populations because of the agglomeration of employment opportunities,

schools, hospitals, and infrastructural facilities. Large accessibility in city centers and the immediate inner fringe areas promotes high-density residential occupation, commercial activities, and land-use mixing, resulting in high population densities.

With increased distance from the city center, the level of urban influence decreases, and therefore land values and demand for high-density settlements reduce. Periphery and rural areas are dominated by scattered settlements with concentrated agricultural land uses and less economic diversification, restricting population concentration. Additionally, infrastructural improvement and public service delivery decrease with distance, hence further limiting peripheral areas' ability to support high population densities.

This trend is in accordance with traditional urban theories like the Concentric Zone Model and Urban Land Rent Theory, which state that population density and intensity of land use decrease away from the city center because of diminishing accessibility and economic attractiveness.

Table 6.10: Correlation of Distance Zones (4-18) with Non-Agricultural Workers

Sr. no	Variable	Correlational value
1	**Non-Agricultural Workers**	-.821*

			V1	V2
Spearman's rho	V1	Correlation Coefficient	1.000	-.821*
		Sig. (2-tailed)	.	.023
		N	7	7
	V2	Correlation Coefficient	-.821*	1.000
		Sig. (2-tailed)	.023	.
		N	7	7

*. Correlation is significant at the 0.05 level (2-tailed).

It is clear from the analysis of the above Table6.10 that there is a negative correlation between non-agricultural workers and distance zone i.e. r = -821*. This correlation is significant at the 0.05 level (2-tailed). It is clear from the analysis that the ratio of non-agricultural workers decreases with increasing distance. The preponderance of

non-agricultural laborers in inner fringe regions, with a declining share in outer fringe regions, is understandable in light of economic activity spatial structure and urban influence gradients. Inner fringe regions, near the city center, are enmeshed in the urban system of economy and have high functional and occupational diversification. These places usually provide space for industrial estates, wholesale markets, transport hubs, warehousing, and other urban service sectors because of their locational advantage on the urban–rural interface, which is accessible to the city and hinterlands. As a result of this, manufacturing, construction, trade, transport, and services employment opportunities converge in these areas, and they have a high percentage of non-agricultural employees. Conversely, outer fringe zones, being further from the city, are still largely rural with agriculture as the major economic activity. Urban influence in such areas is minimal, leading to fewer industrial and service sector units, limiting occupational changes away from agriculture. Furthermore, infrastructural constraints, reduced connectivity, and smaller market sizes slow the process of economic diversification in outer fringe areas.

Therefore, the spatial occupational pattern observed illustrates the urban–rural occupational gradient, with the city proximity promoting non-agricultural work through economic agglomeration and infrastructural spillover, while outlying regions still rely mainly on agriculture.

6.4 POLICY IMPLICATIONS

6.4.1. Targeted Educational Infrastructure and Improvement in Literacy

The strong negative correlation between the distance to the urban center and the level of literacy proves the existence of a pronounced spatial imbalance in the access to educational facilities along the rural-urban border. This effect is a manifestation of the localization of the educational infrastructure and service delivery in the inner fringe and the relative under-investment in the outer zones. In order to correct this imbalance, the policy interventions must focus on the development and upgrading of educational institutions such as primary and secondary schools, tertiary institutions and vocational training centres in the outer fringe. Moreover, the access barriers would be significantly reduced by improving transport connectivity between the peripheral villages and urban educational hubs. It is also important that specific

literacy and ongoing education programmes are put in place to target the marginalized rural groups especially women and the youth and thus close the urban-rural literacy gap and enhance more inclusive education growth throughout the fringe.

6.4.2. Gender-centric Planning and Migration Management

The empirical data which show that there is a positive relationship between sex ratio and spatial proximity to urban centers supports a trend of male-dominated outward migration to the inner fringe areas, hence creating a strong gender imbalance in peri-urban regions near the city. This is a similar process to the concentration of male labour in urban and peri-urban labour markets- especially in the sectors of industry, construction and service economies that are mostly located in the inner fringe. To resolve this gender disparity in population, it is important to introduce gender-inclusive urban employment policies aimed at expanding economic opportunities of women in the city center and in the surrounding areas. Moreover, targeted investment in female-specific professional training programs, as well as the improvement of safety infrastructure, can trigger the growth of female representation in the urban labor market and lead to more equal migration. Moreover, the supportive social infrastructure, including childcare centers, health-care services, and community support systems in both inner and outer fringe areas can strengthen the family settlement patterns, reduce gender inequalities and promote more equitable socio-economic development across the fringe area.

6.4.3. Sustainable Urban Expansion

The trend of the high population density in the inner fringe regions, which fades away to the outer fringe, is a clear indication of a process of urban sprawl that is taking place in the lack of proper planning and regulation. This spontaneous growth has serious consequences of sustainable urban development. In order to overcome this hurdle, there is a need to ensure that clear limits are put on urban development and that there is proper zoning that controls and limits the development in the future. The focus on compact and mixed-use development in the fringe areas could be used to maximize land use and reduce the development of informal and haphazard settlements. Moreover, it will be necessary to enhance the basic infrastructure (transport networks, housing facilities, sanitation systems, and waste management

services) in the inner and middle fringe belts to serve the increasing populations in a more efficient and sustainable way. These would not only improve the quality of life in these transitional areas but also provide a more balanced and controlled urban development in the area surrounding the Hisar city.

6.4.4. Diversification of Rural Economy and Employment Generation

The high relative fall in the non-agricultural employment density with radial distance to the urban core is ostensibly an indicator of lack of diversification in the economy in the peripheral fringe zones. These trends, therefore, emphasis on the alternative opportunity to reduce the over dependency on agriculture for balanced regional development. The promotion of rural industrialization by developing small- and medium-sized enterprises, agro-based industrial projects and warehouses has the potential to boost the local economy and create jobs near rural settlements. The zoning of economic zones and logistics hubs along major transport routes would enhance connectivity among the peripheral fringe regions and metropolitan markets, hence facilitating easier assimilation into the economic environment of the city. At the same time, specific skill-development programmes that are adjusted to the non-agricultural industries may allow rural young people to widen their job opportunities beyond the agricultural activities. The enhancement of basic infrastructure, including transport systems, housing, sanitation, and waste-management systems, especially in the inner and middle fringe areas, will support the sustainable population growth and create a favorable environment in which diversified economic activities and the improvement of the quality of life can be achieved.

6.4.5. Integrated Transport and Connectivity Improvement

Commuting is one of the main factors in the dynamics of spatial and economic development in the rural-urban fringe of Hisar. A large proportion of the population located in these fringe areas leaves every day to the urban centre in search of work, education and access to services. This empirical trend underscores the need to have holistic transport interventions. The policy tools must focus on the development of affordable and reliable transport systems that are efficient in linking the fringe villages to the city center thus reducing the use of personal modes of transportation. It is also of the essence that multimodal mobility solutions should be encouraged, and

the last-mile connectivity reinforced to reduce congestion, improve the efficiency of travel, and increase the overall accessibility. To make sure that the growing urban influence is supported by well-structured and sustainable growth corridors, it is necessary to combine transport planning with land-use strategies, which will not only help to support the growing urban influence but also contribute to the balanced development of the region.

6.4.6. Inclusive Urban Governance

The rural-urban fringe is faced with major challenges that are brought about by poor public facilities and poor governance systems, hence hindering balanced regional development. To overcome these issues, the policy tools should focus on the expansion of the basic municipal services such as water supply, waste management, sanitation, education, and healthcare into the peripheral fringe areas, outside the administrative area of the city. These actions are expected to reduce the differences in the access of basic services between urban and fringe residents. Moreover, the establishment of metropolitan or regional planning authorities is essential in ensuring a coordinated and integrated development, thus enabling better land-use planning, provision of infrastructure and delivery of services. It is also significant to encourage participatory governance systems where the fringe residents are actively involved in decision-making processes. This type of inclusive planning does not only increase the sensitivity of development projects to local demands but also the ownership of the community and long term sustainability of urban growth.

6.4.7. Environmental and Agriculture Land Protection

The intensive conversion of agricultural land in the rural-urban fringe can cause significant ecological pressure and destabilize the traditional livelihoods. This change, brought about by urban growth and the rising land prices, poses a threat to the ecological balance and social-economic stability of the fringe communities. The protection of high-value agricultural land by the establishment of effective land-use zoning and the establishment of agricultural buffer zones should be considered as a priority of policy interventions to limit the unplanned transformation of fertile land into built-up areas.

At the same time, the development of peri-urban agriculture needs to be promoted as a potential and sustainable means of livelihood and an essential part of the local food supply system, thus guaranteeing economic sustainability and food security. Moreover, the incorporation of green infrastructure and environmental conservation measures in the planning of the fringe areas can contribute to the maintenance of the ecological functions, improvement of the environmental quality and more sustainable and balanced rural-urban transitions.

6.5 CONCLUSION

This chapter examines the variation of different demographic and occupational variables in the fringe zones on the basis of different distances zones from the city center. The demographic and occupational variables selected under the study are follows as literacy, sex ratio, population density and ratio of non-agricultural workers. The selected variables are divided into different distance zones and it is studied what effect these variables have with increasing distance.

For the analysis, the mean and standard deviation for each variable were determined, and five groups were created: very high, high, medium, low, and very low. The Hisar city periphery zone is separated into seven distinct zones for further analysis of literacy, sex ratio, population density, and non-agricultural workers, ranging from 4-6,6-8,8-10,10-12,12-14,14-16, and 16-18 kilometers from the city center. After this zoning procedure, each variable was studied zone by zone.

To examine the various attributes of the rural urban fringe of Hisar city, it essential to examine certain variables such as literacy rates, sex ratios, population density, and the proportion of non-agricultural laborers. The study indicates that there is an obvious trend in literacy rates across the zones under consideration. Specifically, the zones adjacent to urban areas indicate higher literacy rates, whereas the literacy rates decrease progressively as one move away from the urban areas towards the rural areas. The data from the 2011 census indicates that the average literacy rate in the primary fringe villages is 63.15%, whereas, in the rural or secondary fringe, it is 61.92%. In contrast, the 1991 census reported a literacy rate of 38.96% in the primary fringe and 35.99% in the rural or secondary fringe. The literacy rate has evidently increased by nearly twice. Then if we talk about zone wise comparison, it is clear that there is a variation from zone one to zone

seventh. Whereas in the zone 1 the literacy rate is 65.05% and in the seventh zones it was 61.77%. Thus as we go outside from inner fringe to outer fringe the literacy keep decreasing.

It is clear from the correlation analysis that there is a negative correlation between literacy rate and distance zone with a correlation coefficient of r = -857*. The statistical correlation has achieved significance at the 0.05 level with a two-tailed test. It is clear from the analysis that the literacy rate decreases with increasing distance. According to the analysis, 28 villages fall within the range of very high to high category, 89 villages fall within the range of high to medium category, and 50 villages fall within the range of medium to low category.

It is clear from the analysis that there is a positive correlation between sex ratio and distance zone with a correlation coefficient of r = 9.64**. The statistical correlation has achieved significance at the 0.05 level with a two-tailed test. The analysis indicates a positive correlation between distance and sex ratio, whereby the sex ratio tends to increase as distance increases. Consequently, a rise in one variable leads to a corresponding increase in the other variable. The analysis reveals that sex ratio is closely related to distance. In the areas near the city, there is a decrease in sex ratio, however, the sex ratio increases with increasing distance from the city center. According to the analysis, 16 villages fall within the range of very high to high category, while 52 villages fall within the range of high to medium category, and 53 villages fall within the range of medium to low category.

There is a negative correlation between population density and distance zone with a correlation coefficient of r = -857*. The statistical correlation has achieved significance at the 0.05 level with a two-tailed test. It is clear from the analysis that the population density decreases with increasing distance. Thus an increase in one variable results in a decrease in the other variable. The findings of the analysis indicate a significant correlation between population density and distance. The spatial distribution of population density exhibits a positive correlation with proximity to urban centers, with a corresponding negative correlation observed as the distance from the city center increases. The population density within the 4-6 km radius is recorded at 2179 individuals per square kilometer, which subsequently declines to 361

persons per square kilometer as the range extends to the 16-18 km zone. The reason for this is related to the absence of essential amenities, such as transportation, education, employment, and healthcare services, outside the urban central zone.

The analysis reveals a significant decline in the non-agricultural workforce as one moves away from the primary fringe in the direction of the countryside, this decline is very high in the primary fringe. It is 89% in the 4-6 km zone, and 51% in the 12-14 km zone and 46% in the 16-18 km zone. Thus there is a sharp decline from zone first to last zone. The data indicates that there exist 42 villages that can be classified as having a very high to high status, while 44 villages can be categorized as medium and 29 villages can be classified as low to very low. In rural areas, the number of non-agriculture workers is seen less due to the more agricultural work and more people were involved in the same as we move nearer to the city, due to the occupational diversity, the number of non-agriculture workers is seen more. There is a negative correlation between non-agricultural workers and distance zone i.e. r = -821*. This correlation is significant at the 0.05 level (2-tailed). It is clear from the analysis that the ratio of non-agricultural workers decreases with increasing distance.

CHAPTER 7

PROBLEMS AND FUTURE PROSPECTS

7.1 INTRODUCTION

Like the cities of western countries, Indian cities are also facing the problem of a rapidly growing population. Population growth is a major problem of the 21st century and it also affects the growing urbanization in different ways. Village to urban migration in a developing country like India is an important fact of the 21st century. The migration of people from villages to cities in large numbers creates various problems in urban areas. Gradually, due to the lack of capacity to hold such a large population in urban areas, the city starts expanding outwards and this expansion is an unplanned and uncontrolled type of development. Fringe area shows a similar development, a transition zone between the both urban and rural area, embodying the characteristics of both.

In this type of development without planning and foresight, various types of problems emerge which present challenges for the present and future. The problems emerging in the fringe area are not only seen in Indian cities but also in the cities of western countries and from time to time various scholars have pointed their attention towards these problems. In various Indian major metropolises cities such as Delhi, Mumbai, Kolkata and Chennai, such problems are seen that due to lack of suitable facilities within the urban area, the increasing population gradually starts settling in the outskirts. The increasing population in the outskirts of the city, ie the fringe, increases the burden on public facilities and due to lack of suitable facilities; the population has to go through various problems. Thus it may be stated that this development has been brought about unconsciously without realizing the seriousness of consequent problems and without exercising any planning efforts. It is clear from the above discussion that various types of problems are observed in the fringe area which may be related to public amenities, economy, infrastructure and land use etc. It is clear from the description related to the above problems of rural urban fringe that it is necessary to discuss this topic in detail which is as follows.

7.2 PROBLEMS OF THE FRINGE AREA

Most of the problems associated with the Rural Urban Fringe reflect the shortcomings of the administrative system, which is unable to coordinate with the rapidly changing structure of the fringe area.

7.2.1 Land use problem

Related to the land use problem **Jeen Gottman and J.R. Vence** stated that, ***"The issue of land use resulting from rapid urbanization persists over time."*** they say that in this context it is necessary to include rural urban fringe in the urban planning and control its growth and expansion. The situation of Hisar city is also no different from this. During the last few decades, rapidly increasing population is becoming difficult to absorb in the city, due to which the flow of this population is going towards the agricultural land of the surrounding rural area. Arable land's encroachment by the unauthorized colonies has increase and rural urban fringe is expanding. Rural Urban Fringe is being used not only to settle the population but also for dumping station, sewerage waste water disposal and setting up of the factories. According to **Dickinson**, a significant amount of fertile land is being sold for the purpose of constructing residential and industrial buildings, while a considerable portion of agricultural land remains abandoned and unused. The looming presence of construction companies poses a threat to the land, rendering it unproductive. Due to the proximity of the urban area, it is becoming the center of various other activities on the cultivable land and various institutions are also being established, due to which the cultivable land of the farmers is coming under non-agricultural works. Many other such activities can be seen in the rural urban fringe of Hisar city which is a big deal in the development of a planned city.

Hisar urbanization was directly related to the socio-economic development, offering new social and economic opportunities for habitant. Urban centers tend to be related to greater socio-economic development, which pulls in people from rural communities looking for improved employment and living standards. This phenomenon badly affected the agricultural activities and irrigation system **(Kumar et al., 2019)**. Also had a bad effect on the cropping pattern. Road expansion and other infrastructural growth, coupled with enhanced access to the capital area, have

hastened urbanization in the region at the cost of agricultural fields. Climatic aberrations like erratic patterns of rainfall, abnormal temperature variations, and enhanced attack from pests now strongly impact crop yield negatively. The localized environmental issues coupled with business interests have immensely influenced agricultural sustainability. As a result, land for farming is at risk, and the patterns of crops are changing along with a threat to food security. Moreover, because of falling agricultural profitability and the temptation of high land prices, vast tracts of farmland go uncultivated. Such barren farmland is being increasingly sought by developers for the development of new residential colonies and other non-farm pursuits **(Sangwan, 2013)**. **Wehrewein** has also narrated that much of the land in the rural – urban fringe is getting frozen by speculative individuals, parties and firms. In Hisar city, such activities are predominantly concentrated along the Hisar–Rajgarh, Hisar–Sahrwan, Hisar–Tosham and Hisar–Delhi road corridors. Sengupta considers the increase of population pressure for the conversion of farmland into non-farm land.

Thus, due to the rapid urbanization and the explosion of urban population, the availability of cheap agricultural land near the highway coming out in different directions of Hisar city has attracted people not only for residential purposes but also for various other non-agricultural activities.

7.2.2 Administrative Problems

The lack of complete administrative arrangements is also seen in the fringe area. The fringe area comprises most of the villages or dhanis, which are administered on the day of the Gram Panchayat, headed by the Sarpanch. In this way, under the development of the area, there is a tussle going on between the village panchayat and the urban administration, due to which the proper development of this area is not done. Due to not coming under the urban municipality or Municipal Corporation, the fringe area is deprived of various urban facilities and it does not have the right to get those facilities. However, some villages which are very close to the urban area and come under the primary prince, get the best urban facilities as most of these villages have come under the municipal corporation or municipality. Gangwa and Satrod villages of the primary range of Hisar city are now census towns and comes under the municipal cooperation and enjoys many public amenities such as of the town itself

7.2.3 Infrastructural Problems

There are many infrastructural problems pertains in the rural urban fringe of the Hisar city such as poor transportation, housing, lack of shopping, banking, medical and other public amenities. In this way, various types of infrastructural problems can be seen in the fringe area and it is difficult to solve them because the fringe area is situated between both the rural and urban administrations. The condition of the roads under the area is very bad, if we talk about the highway, then the situation is quite good, but the road leading from the highway to the village is broken or is it an unmetalled road or kutcha, or brick paved road. And it becomes very difficult to walk on these roads during the rainy season.

If we talk about drinking water, then the villages of the primary fringe get good drinking water facility, some of these villages are included under the municipal limit of the city; due to this good drinking water facility is available. But some villages which come under the secondary fringe depend on other means for drinking water like wells, tanks and pond etc.

The rural urban fringe of Hisar city also lacks other public facilities like electricity supply, telephone, internet, disposal system, health care and educational institutes etc. Like the city, the lack of other entertainment facilities is also seen in the fringe area, where there is no arrangement of park, cinema, restaurant and playgrounds.

The shortage of shops of essential commodities is also seen here and to meet their shortage, the residents here have to go towards the city continuously. The condition of the education system is also not good and senior secondary school is only in few villages and for higher education and vocational education the students have to go towards the city.

Even on the basis of health facilities, the infrastructure in the fringe area is not good, although health centers have been established in some villages, but in case of emergency, all the facilities are not available there and the people of the village have to go towards the city and get their treatment. Although many private clinics have been established in rural areas, the treatment is so expensive that it is beyond the reach of common man.

In terms of public facilities, there is also a lot of difference in the fringe zones, if we talk about the village adjoining the city of the primary fringe, then they are perfect in almost every facility, in the same way if we talk about the village adjoining the rural areas of the secondary fringe, there is a lack of public facilities and they have to look mainly towards the city to cater their demands.

Such kind of infrastructural disparities and underdevelopment due to the administrative and local government issues. This kind of issues also raised due to the administrative status. Fringe regions usually fall between rural (Gram Panchayat) and urban (Municipal Corporation/Municipality) governments. This creates ambiguity about which organization is planning, infrastructure, and delivering services. When rural and urban governments both stake or disown claims, priority development projects like roads, water supply, and garbage disposal are stalled or disregarded (Jain, 2018).

7.2.4 Housing Problems

Due to the lack of ability to handle the rapidly growing population in Hisar city, the population has started settling rapidly towards the outskirts, this has led to the development of a special type of transition zone between rural and urban areas, where different types of unplanned colonies have emerged, one advantage of this is that common man can establish his dream house there but it is very difficult for poor person to establish a house because the land rates have become very high there. Due to this, many types of problems related to housing have emerged there.

7.2.5 Rural Slums

During the field survey, it was found that there are many people whose living conditions are very bad and they live there by making Jhuggi on both sides of the road. Most of the peoples are from lower class such as thela wals, masons, domestic servants, brick kiln laborers and sweepers etc. These people do not have a home of their own and most prefer to settle in the nearest area to their place of work. Thus there are many pockets of these Jhuggis near the work places and the conditions are very unhygienic. They suffer from many problems such as illiteracy, lack of public amenities, diseases and social evils etc. In study area these pockets were found around Hisar-Delhi road, Hisar-Sirsa road, Hisar-Tosham Road and Hisar-Rajgarh Road.

7.2.6 Traffic congestion

Transport is an indicator of urban expansion and development of urban fringes, because the fringe extends around the city like a ribbon around transport routes. The increasing population and functional development of the city as a result of increasing liberalization in the 21st century requires the development of roads. The development of roads plays an important role in the economic development of any city and only roads are helpful in connecting all the parts of the city. The following problems are seen in the rural urban fringe of Hisar city with respect to the development of traffic system.

1. Due to the availability of limited resources, development of roads is not possible in the proportion in which the city is developing. The roads are still in bad shape and are not able to walk through in the rainy season.
2. The expansion of urban transportation networks has resulted in a decrease in their overall accessibility and development despite their increased length and transport capacity, due to the application of ad-hoc planning in maintenance, in the absence of the application of modern technology, the unavailability of the transport route is proved because of the congestion on the routes. The increase in blockage is the fuel of that time, the multiplicity of accidents and the problem of sludge waterlogging in the roads is getting worse.
3. The population of the town is experiencing rapid growth, and there is a corresponding increase in the number of daily commuters from the rural-urban fringe. However, the means of transportation available at the city entrance have failed to maintain pace in terms of the both quantity and quality of public vehicles. Consequently, there has been a rise in the number of private vehicles such as taxis and tempos on the roads. The prevalence of crowds, pollution, and accidents is showing a rising trend.
4. Built in the rural urban range of Hisar city, the narrow bridges, the railway crossing, the thin road, the encroachment of the roads by commercial activities, the traffic mix created by the movement of fast moving vehicles and animals. Accidents have increased, which has been accelerated due to lack of

facilities for repair shops, first aid centers, telephone booths, clean toilets, restaurants, rest houses along the roads.

These traffic related problems are mostly seen in the primary range rather than the secondary fringe as the primary fringe is closer to the urban area.

7.2.7 Economic Deprivation

The city is basically the product of the regional economy because the rural urban fringe of Hisar does not have a self-sufficient economy in general. Sudden urban growth has led to agricultural land loss and fragmentation, resulting in unviable farm plots and forcing farmers into subsistence farming or low-wage casual employment **(Muchelo et al., 2024)**. The problem of employment is still on, with lowering agricultural viability due to water shortages and soil erosion resulting in underemployment and seasonal out-migration, while off-farm work remains casual, low-paying, and irregular, with low female employment participation further limiting household earnings. Socio-economic deprivation and marginalization exacerbate poverty, since government resources are disproportionately held, and the marginalized Scheduled Castes experience discrimination and restricted access to credit, education, and work. Moreover, population changes characterized by out-migration of young people and in-migration from other areas raise competition for limited resources and labor, overstretching local infrastructure. As a whole, these elements perpetuate poverty and underdevelopment in the fringe regions of Hisar in spite of their closeness to urban development **(Shome, 2023)**. People living in the villages of Hisar's fringe is dependent on the informal economy of the inner city, in which temporary, traditional market type, irregular wages, lack of assured income, illiteracy, lack of technical training, lack of skilled labor and administrative neglect are found. Characteristics are found due to poverty created by deprivation on economic area. This is the main economic problem of this belt. Most of the people living in the fringe sector work as domestic servants, laborers, rickshaw pullers, handcart drivers, cycle reformers, barbers, washer men, masons, raised and bai etc. Thus most of the people in the fringe are looking for Poverty of Money, Poverty of Power and Poverty of Infrastructure and these people are mostly people living near the urban area in the primary fringe

7.2.8 Socio Economic Crimes

In the rural urban fringe of Hisar city, various types of socio-economic crimes are becoming increasingly sheltered in them, due to the residents being mostly poor people; there is a possibility of developing criminal tendency in them. The fringe area is mostly governed by Panchayati Raj institutions, which often have relatively limited formal regulatory and enforcement mechanisms. Consequently, the absence of a robust administrative and policing framework may facilitate the rapid diffusion of criminal tendencies in these peripheral zones. In the nearby fringe area below Hisar city, there is a slum in many places, where the condition is very pathetic due to lack of urban facilities. Ultimately, apart from the slum dwellers from the slum living in this belt, the ethnic group is still young. Many types of crimes like obscenity theft, dacoity, solicitation, drug recruitment, prostitution kidnapping rape, dowry murder, female feticide, child labor, corruption, bribery, political criminalization, casteism, ambiguity, black money and sexual exploitation, etc., are posing a serious threat to happiness and peace. In which women, children, poor and senior citizens are the most vulnerable groups, the crime propensity ratio is higher in the primary fringe village than in the secondary fringe village. Primary fringe regions close to the city center have greater population density and fast urbanization, causing fierce competition for scarce resources, employment, and services, thus causing greater unemployment and underemployment, which are central triggers for socio-economic offences. Great levels of landlessness and small landholdings in these areas constrain livelihood prospects, driving the inhabitants towards low-income, informal, or illicit economic pursuits. Social inequality further contributes to vulnerability since marginalized communities, such as those in slums, are excluded and experience limited access to legal economic opportunities. Further, poor infrastructure and access to life's basic necessities like education, health, and sanitation create social frustration and a tendency to often turn to crime as a survival strategy. The trauma of urban-rural transition in such regions derails traditional social controls and communal cohesion, making it easier to commit theft and fraud. Conversely, secondary fringe regions are less urbanized with tighter community ties and conventional control, feeling less urban pressure and, therefore, fewer cases of socio-economic offenses **(Larii & Cojocaru, 2023)**.

7.2.9 Environment Pollution

Environmental problems are also observed during a field survey in the rural-urban fringe of Hisar city such as solid waste, water, slums, excess use of fossil fuels, heavy industries, brick kiln slaughterhouse, and other types of air pollution. In the rural–urban fringe, not only are various forms of environmental pollution—such as air, noise, water and soil pollution—intensified, but different dimensions of socio-cultural, economic, religious and political disorganization or "pollution" are also manifested. These intertwined environmental and societal stresses contribute to a degradation of overall quality of life and exacerbate conflicts and vulnerabilities in fringe communities. These various forms of pollution are most intensely concentrated in the primary fringe, where the expanding city exerts its immediate environmental and socio-economic impacts on adjacent settlements.

7.2.10 Lack of Perception And Awareness

One of the problems in the rural-urban fringe of Hisar city is the lack of awareness, due to which the population of this area is not able to keep pace with the steps towards the modernity of the population of the urban area. The big problem is the lack of education. As we move from the fringe areas adjoining the city to the rural areas, that is, towards the second fringe, the lack of education is clearly visible, due to which the modern era in these areas is very far away. There is a lack of many modern amenities and information and even today they are leading the life of traditional rural lifestyle. Thus, due to lack of awareness, unplanned land use, traffic blockage in rural fringe, under-developed civic infrastructure, facilities, economic discourse, socio-economic crime, low effective good governance and environmental pollution prevailed in fringe area and this problem is mainly in rural areas of the secondary fringe.

The rural urban fringe of Hisar city is rapidly getting urbanized and rapid population growth is also happening in this area. The rural urban fringe of Hisar city is divided in two parts i.e. primary fringe and secondary fringe. Most of the facilities under the fringe zone like transportation, education, water supply, health facilities and other useful facilities are obtained from the urban area. It is close to the urban area, where various facilities are available in the fringe zone, as well as various problems in the

fringe zone. Government intervention is necessary to solve these problems so that the planned development of the area can take place and the standard of living of the people here can be raised. From time to time, such efforts have been made by the government so that urban expansion can be planned and direction can be given to its expansion with proper planning.

Under this planning, the government is paying attention to the spatial planning, urban infrastructure and well-planned administration, so that the available agricultural and non-agricultural land can be used properly, providing basic public facilities to the people living here and improving the administration to provide the best administrative system to the people.

Moreover, there exists a certain degree of correlation between the progress of urbanization and the expansion of the peripheral regions. The growth of the periphery not only has an impact on the advancement of the city but also contributes to its overall improvement.

The fringe area is in between the city and the countryside. Since neither the city nor the rural administrative system is focused on the problems of the fringe area, it is very important to set up a separate organization to solve the problems of the fringe area. Similarly, it is very important to have both control and monitoring on the development of fringe because present day fringe is the city of tomorrow. Therefore, there is a need to take some drastic steps for the planning of the fringe so that it can be an example of developed. Some of the planning and development suggestions for the fringe area are following

7.3 FUTURE PLANNING AND DEVELOPMENT SUGGESTIONS

7.3.1 Land-use Planning

To solve the major problems of the fringe, it is necessary that the land use should be done according to the rules and planning. It is often seen that there is no rule or legal process of land use in the free area and the allocation of land under different land uses keeps happening, due to which unplanned land use is emerging in this area. Therefore government should provide proper land for different development purpose, such as residential colonies, playing grounds, parks, waste management, industrial zones, etc.

Due to unplanned land use, there is a rapid loss of cultivable land in the fringe area, therefore planning should be done in such a way that the cultivable land is not tampered with and attention should be paid to the inappropriate agricultural land for development works. Agricultural waste land has been suggested for building tanks and dumping station. **The Hisar Metropolitan Development Authority (HMDA) Act, 2024** declares a statutory body to regulate integrated and coordinated planning for the Hisar metropolitan area. HMDA is required to formulate and execute plans for infrastructure, urban facilities, mobility management, and sustainable environmental management. It aims to redefine urban governance through coordination with local authorities to rationalize land use, urban growth, and public service delivery. Augmenting this, the Town and Country Planning Department has announced various controlled areas around Hisar to manage land use and direct development through master plans like the **Development Plan Controlled Area 2021 AD**. In addition, the Department of Urban Local Bodies and **Haryana Shehri Vikas Pradhikaran (HSVP)** administer policies for legalizing illegal subdivisions, encouraging affordable housing, and purchasing and developing land for planned urban development **(Haryana Government, 2024)**.

7.3.2 Location of Brick Kilns

The process of rapid urbanization intensifies the construction work, due to which it is very important to increase the production of the materials used in it, which is specially included bricks and other materials. That is why the establishment of brick kilns in the fringe zone is very common. It is happening fast but it is very dangerous for the cultivable land because they are mining the soil for production from the cultivable land and use it to make bricks. This is rapidly decaying the useful agricultural land. Secondly, the pollution caused by brick kilns is also very harmful for the surrounding area, so the establishment of these brick kilns should be done within a certain radius, they should be established mainly on inappropriate agricultural land for the use of raw materials. There should also be some rules and regulations, as well as to reduce pollution, the height of their chimney should be more than 60 feet. **The Haryana State Pollution Control Board (HSPCB)** maintains strict environmental norms for brick kilns, mandating the imposition of Consent to Operate (CTO) and periodic

inspections to ascertain adherence to emission standards and operational protocol. Following the 2022 **Union Environment Ministry** notification and **HSPCB** regulations, all new brick kilns should use zig-zag or other cleaner technology approved by the government. The operation of approved fuels, e.g., PNG or certain types of coal, is required, and kilns are required to have control measures in place for fugitive dust emissions. Operating permits usually restrict kiln operations to four months a year, starting in March, to minimize air pollution during peak winter seasons. Non-compliance leads to closure orders and the levy of environmental compensation penalties **(HSPCB, 2022)**. There should proper housing facilities for their workers and their families.

7.3.3 Residential Planning

Rapid population growth in Hisar city, coupled with intensifying congestion, pollution and related urban stresses in the central areas, has prompted residents to increasingly relocate to the surrounding fringe zones. In view of this, there is a rapid growth of residential areas in the fringe area in the coming time. But to handle such a large population, a special type of planning is needed in the fringe. So the government should come up with a proper policy for the development of residential areas in the area so that the development of residential areas in the area will be given proper direction. **HSVP** (earlier known as HUDA) is the main agency that develops and allots residential plots in new sectors of Hisar. Plots are allotted through public advertisements and a transparent draw process. The allottees are given exhaustive terms and conditions, i.e., a payment schedule and a condition to complete the construction within two years from the date of possession. Town and Country Planning Department is responsible for preparing and implementing development plans for Hisar, like ***"Development Plan Controlled Area 2021 AD"*** and ***"Draft Development Plan 2025."*** These plans identify land use zones (residential, commercial, institutional, etc.), control urban sprawl, and ensure the provision of infrastructure in new developed and fringe areas **(Town and Country Planning Department, Haryana, 2010)**. The District Administration and other state departments coordinate to execute master plans, infrastructure schemes, and urban facilities so that residential development keeps pace with the overall urban development strategy **(District Hisar, Government of Haryana, 2018)**.

7.3.4 Agricultural Planning

To meet the needs of the growing population of the urban area, it is also very important to make the production of fruits and vegetables in the fringe area. The farmers here should pay attention to this because instead of traditional farming, keeping in mind the present need has to be grown these products Vegetables and fruits not only be easily transported to the nearby market , but more income can also be obtained. Seasonal vegetables like carrot, cauliflower, brinjal, bitter guard, lady fringer, green chilli, raddish etc and fruits like orange, mango, guava etc. not only can give farmers extra income but also cater the demand of the city and fringe area. To mitigate groundwater depletion, especially in areas such as Hisar, mass scale promotion of on-farm water management technologies like **Underground Pipeline (UGPL)** systems is being undertaken and financial support to farmers is being given to avoid wastage of water and improve irrigation efficiency **(Chief Minister's Office Haryana, 2025)**. With this in mind, the government plans to take one lakh acres in natural farming during 2025–26 to ensure crop diversification and soil health improvement. Through the ***"Mera Pani Meri Virasat"*** initiative, farmers are encouraged to move away from water-guzzling paddy farming towards other crops like maize, cotton, pulses, oilseeds, vegetables, fruits, and agroforestry, with an incentive of ₹7,000 per acre. There is also an incentive for fallowing land to enhance the soil health, and thousands of hectares of Hisar get registered for diversification every year **(Finance & Planning Department, Government of Haryana, 2025)**. Particular focus is given to cotton growing, such as integrated pest management, micronutrient application, soil health testing, production of hybrid seeds, and extensive training and awareness programs for the farmers. Agri-Business and Information Centers are also being set up at district headquarters, like Hisar, to bring market information, training, and operational facilitation to farmers. The creation of new fruit and vegetable markets in the district level seeks to intensify post-harvest management, storage facilities, and direct consumer marketing by farmers, ultimately increasing farmers' incomes and minimizing post-harvest losses **(Haryana State Agricultural Marketing Board, 2016)**.

7.3.5 Industrial Planning

Urbanization and modernization are two intertwined processes; both cannot be separated from each other. Increasing urbanization promotes industrialization, due to which various problems emerge rapidly in the urban area such as water pollution, air pollution, noise pollution etc. In view of the problems, modern planning takes care that industrial areas should always be away from residential areas so that the problems caused by them can be reduced, as well as industries should be established on inappropriate cultivable land so that land degradation can be stopped. In Hisar city also it is necessary that industries should be given separate space and there is a need to do separate planning for them so that they can be established far from residential areas and especially in a particular place in the fringe area. It is often seen that industries are established outside the city only in the free area and for which no special type of planning is taken care of, due to which various problems arise even in the fringe area. Special care and planning is needed for the establishment of industries. **The Haryana Enterprises and Employment Policy, 2020** offers large-scale subsidies and incentives to draw new manufacturing establishments, including in Hisar. The policy aims to channel sizeable investment, promote innovation, and provide employment by encouraging manufacturing, high technology industries, and green industrial growth **(Nexdigm, 2023)**.

7.3.6 Proper Medical Facilities

Having health facilities is an important need of today's modern era. During the collection of data, it was found in the field survey that health facilities in most of the villages of the secondary fringe are not of proper standard. There should be dispensaries, health center and medical store in the fringe villages. There should be proper clinic accomplished with doctor and nurses for general and maternity purposes.

7.3.7 Educational Planning

During the field survey it was found that there is a shortage of high school and senior secondary school in most of the villages of the secondary fringe, whereas it is very important to have them in every village to increase the level of education, it is necessary that there is a high school within a radius of at least 3 km. There must be a

senior secondary school within a radius of 5 km, as well as for the increased promotion of higher education, there should be a provision of college and vocational education in the nearby areas so that not only the children of the secondary fringe villages to get good education, but children from other areas should also get opportunities for proper education.

7.3.8 Recreational Facilities

There is a lack of recreational facilities in the fringe area, especially in the secondary fringe. There should be proper facilities of parks, playground and cinemas in the fringe area. For this Gram panchayats and urban administration should work together.

CHAPTER 8

SUMMARY AND CONCLUSION

8.1. SUMMARY AND CONCLUSION

The process of urbanization is very similar to the process of modernization and socio-economic change. In today's time, increasing urbanization is doing many types of transformations. In the process of urbanization, increasing population and migration from surrounding rural areas play a crucial role. Cities has been attracting people to itself for various reasons since its inception, whether it is employment, good living or amenities, the city has always been the center of attraction of the people. The main feature of urbanization in Indian conditions is the accumulation of population from the surrounding rural areas to the urban areas.

People in the rural areas of India tend to migrate to the city due to the problems of illiteracy, unemployment, poverty. As a result of this, there has always been a significant movement of individuals from peripheral countryside to urban centers. Urban areas experience increased stress on their systems due to a significant number of individuals shifting to the city and the city would not have been able to handle such a large population, neither could all the amenities be provided to such a large population. The population gradually starts settling in the surrounding areas and a zone of mixed land use develops between the surrounding rural neighborhood and the city region, which includes the characteristics of both rural and urban systems, but this emerging transition zone exhibits many problems in coming future. The emergence of this transitional belt has brought about major modifications in the utilization of land, physical structure, and socio-economic structure. It is transforming the lifestyle of the rural population in the region.

This area is an area in which the city grows peripherally and radially and any development here is unplanned and uncontrolled. Due to urban overcrowding and high land prices, most of the middle-class people migrate from the city to the area and gradually the development of the area starts from the city to the rural area. The landscape of the region rapidly transforms into urban and semi-urban features. This

area is known as the Rural Urban Fringe which refers to the intermixing and overlapping of urban and rural features. ***"The phrase "Rural-Urban Fringe"*** is commonly employed to delineated areas that exhibit interplay of rural and urban land utilization".

Thus, the rural-urban fringe is a transitional area that comprises characteristics of both urban and rural environments. It is an area that shows mixed land use and characteristics and the integration of urban characteristics within the rural environment. It is a zone in which commercial, educational, recreational, public service and agricultural land is going through a transformation. The situation of Hisar city is also not different from other cities. Due to the rapidly increasing population and migration from rural areas, the surrounding area of Hisar city has rapidly expanded into various residential and non-residential processes and has a continuous growth in terms of rural urban fringe. In terms of rapid modifications occurring in the rural-urban fringe of the city of Hisar and the potential future prospects, it is essential to examine it extensively.

The current study has been divided into eight different chapters. Chapter first deals with the introduction of the study and lays down various aspects of the present study. This chapter represents the concept, meanings, and definitions of urban geography. This chapter also includes the origin and evolution of the urban fringe. It discusses the conceptual background and classification of the rural-urban fringe. It discusses concept of the fringe in India and its development around the world. In this chapter, a comprehensive analysis on the research problem, research objectives, research questions, methodology, data, and literature review has been involved. This chapter forms the base of the study.

The second chapter of the proposed study is 'Geographical Appraisal' of the study area i.e. the Hisar city. This chapter discuss about location, history, climate, rainfall, physiography, soil, drainage, economic resource, population and settlement, economy, occupational structure and trade and commerce. The city of Hisar is located in the western portion of the state of Haryana. It is one of the largest urban areas in Haryana. It shares a border with Rohtak in the east, Fatehabad in the west, Jind in the north, and district Bhiwani in the south. The Hisar city is the administrative headquarter of the

Hisar district. The study area extends between 29° 9’ North latitudes and 75° 45’ East longitudes.

Established in 1354 AD by Firoz Shah Tughlaq as a fortress ("Hisar-e-Firoza", or "Fort of Firoz", later abbreviated to "Hisar"), the district is located in west-central Haryana in the Yamuna sub-basin (Ganga basin), with a semi-arid subtropical climate (mean annual rainfall: 472 mm; summer maxima: 45-47°C, winter minima: 1-2°C). Its landscape, a part of the Ghaggar-Yamuna alluvial plain, consists of Quaternary alluvial and Aeolian deposits over a hard rocky foundation, with soil types being Heavy Loam, Light Sandy Soil, and Heavy Clay. Being devoid of natural drainage, irrigation is dependent to a large extent on the Bhakra and Western Yamuna Canals. The vegetation is mostly tropical moist deciduous forests (such as Neem, Kikar). Population was 1,743,931 (Sex Ratio: 871; Literacy: 73.2%) according to the 2011 census, depicting major growth since 1961 (Rural: +148%, Urban: +467%), with population density averaging 302 people/km² over 269 villages. Though agriculture is the major economic pursuit, aided by productive plains and tubewell/canal irrigation, there is industrialization with 46 large and 3,675 small units manufacturing agricultural machinery, textiles, engineering goods, and furniture. Workforce statistics (2011) indicate 30.46% Main Workers, 9.20% Marginal Workers, and 60.34% Non-workers; among the workers, 37.8% Cultivators and 20.9% Agricultural Labourers. Major transportation corridors are NH-9 and NH-52. Studies defining the rural-urban fringe (4-16 km radius) of Hisar city applied GIS-based analysis (ArcGIS 10.8) of Census 2011 data (Demographic: density, sex ratio, literacy, household density; Occupational: ratio of non-agricultural workers), locating primary and secondary fringes by applying standardized determinants overlaid as choropleth maps guided by physiography and road connectivity.

The urban-rural fringe in the city of Hisar follows a near circular trend due to a lack of natural features like rivers or hills, with the city encircled by plains that are relatively flat, hence easy for connectivity in every direction. Expansion is significantly higher in the north and northwest directions where there are big chunks of land acquired by the government for non-farming purposes, including government buildings and farms. This area is spread by National Highway 9, linking Hisar with

Fatehabad, Sirsa, and Punjab, increasing village-city interactions and urban assimilation. To the southwest, the fringe spreads linearly along National Highway 52, with villages having prominent urban influences. To the east, in the direction of the satellite town of Hansi, urban encroachment is extensive along Highway 9, with additional influence from the Hisar cantonment and prevalent non-agricultural activities. The northeast periphery also exhibits linear spread along National Highway 52 towards Chandigarh, with towns undergoing similar urban effects. Also, continuous development of Hisar Airport along this route is likely to intensify non-agricultural pursuits. From this analysis, the fringe consists of 21 villages in the primary fringe and 60 villages in the secondary fringe and a total of 81 villages with a population of 373805 living in 96900 hectares. The primary fringe has 151370 persons and 32600 hectares, and the secondary fringe has 222435 persons over 64300 hectares.

Chapter four analyzes land use and cover (LULC) dynamics of Hisar city between 2003 and 2023 with remote sensing and GIS methods. The results indicate built up area increase of inner fringe by (49.31 to 71.47 sq.km), which was coupled by the reduction in cropland (270 sq.km to 252.70 sq. km.), fallow land (8.36 sq.km to 5.02 sq. km.), and vegetation (5.08 sq.km to 4.22 sq.km). In contrast, artificial water bodies increased by (0.48 sq.km to 4.78 sq. km.), which indicates increasing urban water demand. The land use and land cover changes in the secondary fringe show a clear increase in built-up areas, which expanded from 42.76 sq. km to 69.08 sq. km. This increase mainly occurred due to the conversion of cropland, which declined from 610.41 sq. km to 593.16 sq. km. Fallow land also reduced considerably, decreasing from 13.39 sq. km to 5.88 sq. km, along with a reduction in vegetation cover from 4.62 sq. km to 2.82 sq. km. In contrast, water bodies slightly increased from 0.88 sq. km to 1.12 sq. km, indicating efforts to improve water supply in rural areas. In total, urbanization at a swift rate has altered the spatial scene, diminishing green and agricultural areas.

The Chapter five examines the occupation and population composition of the rural-urban fringe on the basis of 1991, 2001, and 2011 census data supplemented by primary surveys in 9 sample villages representing internal (primary) and external (secondary) fringe areas. Major occupational trends are the decline in farm laborers (e.g. Bir Hisar 62.21% in 1991 to 23.72% in 2011) and rising non-farm work in primary fringe villages (e.g. Dabra 22.28% in 1991 to 36.04% in 2011). Secondary

fringe villages, on the other hand, experienced little non-agricultural employment growth, lagging well below 20% in many instances. On the literacy front, the overall percentage increased from 37.18% in 1991 to 62.56% in 2011, with primary fringe villages recording consistently higher literacy rates compared to the secondary fringe. Female literacy too improved hugely on both fringe zones during this time.

Population density also raised significantly, with villages such as Raipur show a growth from 694 persons/sq.km. (1991) to 887 persons/sq.km. (2011) in the primary fringe, while secondary fringe villages like Ladwa and Jakhod Khera experienced moderate density growth. Public amenity analysis indicates improved accessibility in primary fringe villages based on their proximity to the city and coverage by pucca roads, while secondary fringe villages lacked access to drinking water, communication, and healthcare facilities, although some improvement was seen over time.

The research also identifies socio-cultural differences:

Primary fringe: More nucleated families, lower sex ratios, higher main occupation employment, and improved educational levels.

Secondary fringe: Joint families primarily, more sex ratios, and higher reliance on agricultural livelihood.

As far as landholding pattern is concerned, primary fringe villages had more leased-out holdings, whereas secondary fringe villages had larger operational holdings and unirrigated holdings.

Chapter six examines the diversity of literacy, sex ratio, density of population, and non-agricultural labour force in seven distance zones (4–6 km, 6–8 km, 8–10 km, 10–12 km, 12–14 km, 14–16 km, and 16–18 km) around Hisar city center. To analyze, mean and standard deviation were computed for every variable and classified under very high, high, medium, low, and very low classes. Literacy percentages had a negative relationship with distance ($r = -0.857^*$, $p < 0.05$), i.e., decreasing as distance rose. The literacy percentage was 65.05% in zone 1 (4–6 km), falling to 61.77% in zone 7 (16–18 km). Primary fringe villages in 2011 exhibited an average literacy of 63.15%, whereas secondary fringe villages had 61.92%, as against 38.96% and 35.99% in 1991, i.e., almost doubling. Sex ratio had a positive relationship with

distance ($r = 0.964^{**}$, $p < 0.05$), which increased with increasing distance from the city center. Villages close to the city recorded lower sex ratios, whereas far-off rural areas reported greater ratios.

Population density also had a negative relationship with distance ($r = -0.857^{*}$, $p < 0.05$). It declined from 2179 persons/sq.km. in zone 1 to 361 persons/sq.km. in zone 7 due to limited access to urban facilities like education, employment, and healthcare with rising distance. The ratio of non-agricultural labor displayed a steep reverse relationship with distance ($r = -0.821^{*}$, $p < 0.05$). 89% of labor in the 4–6 km range was occupied in non-agricultural pursuits. The number decreased to 51% in 12–14 km and 46% in 16–18 km ranges. The densities of non-agricultural employment are found to be the maximum in villages that are nearest to the city because of occupational diversification, whereas faraway villages are still agrarian in majority. The results show that being close to Hisar city has a positive effect on literacy, non-agricultural employment, and population density, while sex ratio increases with increasing distance. These spatial differences highlight the gradual process of rural-to-urban transition across fringe areas and emphasize the impact of urban proximity on socio-economic organization.

In the last chapter, various problems of the fringe area of Hisar city and the improvements that can be made in the future have been discussed. Due to the rapidly increasing population in Hisar city and the migration from rural areas, the pressure is increasing in the major city, due to which an area is developing in the radial from around the city. This area is accommodating this increasing population. But in this rapidly expanding fringe area, unplanned uncontrolled development is being seen which is giving rise to various problems. This last chapter not only discusses these problems but also proposes some future solutions to these problems. First of all following are the some problems of the fringe zone.

1. Unplanned and uncontrolled land use
2. Effect on production capacity of land as a result of mixed land use
3. Large part of agricultural land is used in non-agricultural use by the colonizers, entrepreneurs and speculators and they are constructing houses, buildings and roads etc.

4. Establishment of brick kilns on large scale cultivable land, due to which not only the agricultural land is being wasted but fertile soil is being mined in the name of using raw materials
5. The availability of inadequate administrative facilities in the fringe area is also a challenge; here the apathy of not only the village panchayat but the urban municipality is giving rise to various types of problems.
6. The rural urban fringe of Hisar city lacks various basic facilities like education, health, transport, housing parks, playground and recreational facilities etc.
7. Rural slum is another problem of the fringe area. Most of the peoples are from lower class such as thela wals, masons, domestic servants, brick kiln laborers and sweepers etc. These people do not have a home of their own and most prefer to settle in the nearest area to their place of work.

Most of the problems related to the fringe area of Hisar city are not resolved because it neither come under the panchayat of rural areas nor come under the urban municipality administration, due to this reason most of its problems remain unsolved. In view of all this, it is necessary that a separate authority should be established for the rural-urban fringe, which should try to find solutions to the various problems discussed above. Similarly, it is very important to have both control and monitoring on the development of fringe because present day fringe is the city of tomorrow.

1. Planning should be done in such a way that the cultivable land is not tampered with and attention should be paid to the inappropriate agricultural land for development works. Agricultural waste land has been suggested for building tanks and dumping station.
2. The brick kilns should be established mainly on inappropriate agricultural land for the use of raw materials. There should also be some rules and regulations, as well as to reduce pollution, the height of their chimney should be more than 60 feet. There should proper housing facilities for their workers and their families.
3. To handle large population, a special type of planning is needed in the fringe. So the government should come up with a proper policy for the rational distribution

of the residential zones in the fringe area so that the development will be given proper direction.

4. The farmers here should pay attention to grow commercial crops instead of traditional farming. Vegetables and fruits not only be easily transported to the nearby market, but more income can also be obtained.
5. The industrial areas should always be away from residential areas so that the problems caused by them can be reduced, as well as industries should be established on inappropriate cultivable land so that land degradation can be stopped.
6. There should be dispensaries, health center and medical store in the fringe villages. There should be proper clinic accomplished with doctor and nurses for general and maternity purposes.
7. It is necessary that there is a high school within a radius of at least 3 km. There must be a senior secondary school within a radius of 5 km, as well as for the increased promotion of higher education, there should be a provision of college and vocational education in the nearby areas.
8. There should be proper facilities of parks, playground and cinemas in the fringe area.

8.2. CONTRIBUTION OF FINDINGS TO INTERNATIONAL DISCUSSION ON RURAL-URBAN FRINGES

The current research adds to the international discussion of rural-urban fringes by offering empirical insights into the spatiotemporal processes, demographic changes, and occupational reordering at the fringe areas of a fast-growing city in India. Some of the key contributions are:

Validation of urban sprawl effects*:* The results support worldwide observations that city growth results in extensive land use and land cover modification, with agricultural land and natural grasslands being transformed into built-up land, consistent with patterns indicated in Asian, African, and Latin American cities.

Distance-decay trends in socio-economic indicators: The research substantiates that literacy levels, non-agricultural labour, and population density decrease with distance

from the urban center, whereas sex ratios rise. These gradients reflect urban-fringe studies worldwide, supporting theories of urban impact lessening with distance.

Occupational diversification around cities: The major change from farm to non-farm jobs in villages closer to Hisar city indicates global trends in economic diversification in peri-urban areas, and it is relevant in discussions regarding livelihood change under urban influence.

Disparities in public amenities: The results demonstrate differences in infrastructure and provision of public services between inner and outer fringe areas, reinforcing global calls for inclusive planning to counteract peri-urban injustices.

Empirical foundation for Global South urbanization research: This research enhances the scarce empirical studies of South Asian secondary cities, providing data-led commentary that can be applied to comparative rural-urban fringe analyses globally.

Policy implications: The patterns highlighted indicate the necessity of integrated rural-urban planning, sustainable land use policies, and equity in the distribution of services, in accordance with international agendas such as the New Urban Agenda (UN-Habitat) and SDG 11 (Sustainable Cities and Communities).

8.3 LIMITATIONS

The current study has some limitations. It was based mainly on census data (1991, 2001, 2011) and remote sensing data (2003, 2023), which might not be entirely representative of sudden annual change in land use or socio-economic frameworks taking place within the study duration. Because of the decadal character of census data, intermediate changes in demographic and occupational trends could not be explored, restricting the portrayal of slow transformations. Moreover, the spatial scale was confined to the fringe of Hisar city, and hence, the results cannot be extended to rural-urban fringes of metropolitan cities with dissimilar economic, ecological, and demographic contexts. The research considered only some of the socio-economic indicators like literacy, sex ratio, population density, and occupational structure, leaving important ones like income distribution, migration movements, and quality of life out, which are significant for comprehensive development of fringe dynamics. Lastly, the primary data collection using the cross-sectional method reflected only one moment in

time, failing to notice dynamic changes at the household level and livelihood transitions between years.

8.4 FUTURE RESEARCH DIRECTION

Future studies should embrace longitudinal analyses based on yearly or biennial observations utilizing high-resolution satellite data to quantify subtle land use changes and urban spread dynamics. Cross-city and cross-ecoregion comparative research is required to draw general insights into rural-urban fringe change in diverse settings. Incorporating patterns of migration, livelihood diversification, and income disparities would give a more comprehensive view of socio-economic restructuring in fringe areas. Incorporating environmental impact studies, including air, soil, and water quality monitoring, can guide sustainable management of the urban-rural fringe. Moreover, an assessment of the efficacy of policy programs such as PMGSY, Smart Cities Mission, and urban growth control regulations can provide an analysis of the impact of these on fringe development. Finally, participatory methodologies with civic inputs by means of participatory GIS and household surveys would enhance comprehension of lived realities, civic needs, and priorities in fringe regions.

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Appendix-1

LOVELY PROFESSIONAL UNIVERSITY, PHAGWARA, PUNJAB

DEPARTMENT OF GEOGRPAPHY

DYNAMICS OF RURAL URBAN FRINGE IN HARYANA (A CASE STUDY OF HISAR CITY)

Dear Respondent,

This questionnaire is part of a survey on socio-economic characteristics of fringe zone of Hisar city. Your help is greatly valued, and all responses will be used only for academic research. Please take a few minutes to complete it and support this study.

HOUSEHOLD SURVEY

District: …….

Name of the village/city: …….

Name of the head of household: …….

Caste: ..…….

Family type Joint…… Nuclear….. Extended If nuclear from when?

Do you have ration card …… If yes, (Yellow/Pink/Green) …….

BPL card holder (Yes/No)

DEMOGRAPHIC CHARACTERISTICS

Name of the members of household	Relationship with the head of family	Age	Marital status	Age at marriage	Level of education	Monthly Income	Occupation		Nature of employment	
							Main	Subsidiary	Regular	Self

HOUSEHOLD AMENITIES/ASSETS

Transport vehicles: Car/Scooter/Jeep/Bicycle/others Communication: Phone/Computer/Internet/Others Others Assets: T.V/Fridge/Washing Machine/Others

MEDICAL FACILITIES

Dispensaries

Primary Health Facility

Community Health Center

STATUS OF WOMEN

Whether female takes part making in the family decision? Yes/No

If yes: Family planning, Education, Marriage, Service, Health, Vote, Others Does women of your family work outside house? Yes/ No

If yes, nature of work: Services, Labour/others

If no, then reason, illiterate/less education/social or religious taboo/tradition.

Is any woman from your family elected in panchayat/local bodies?

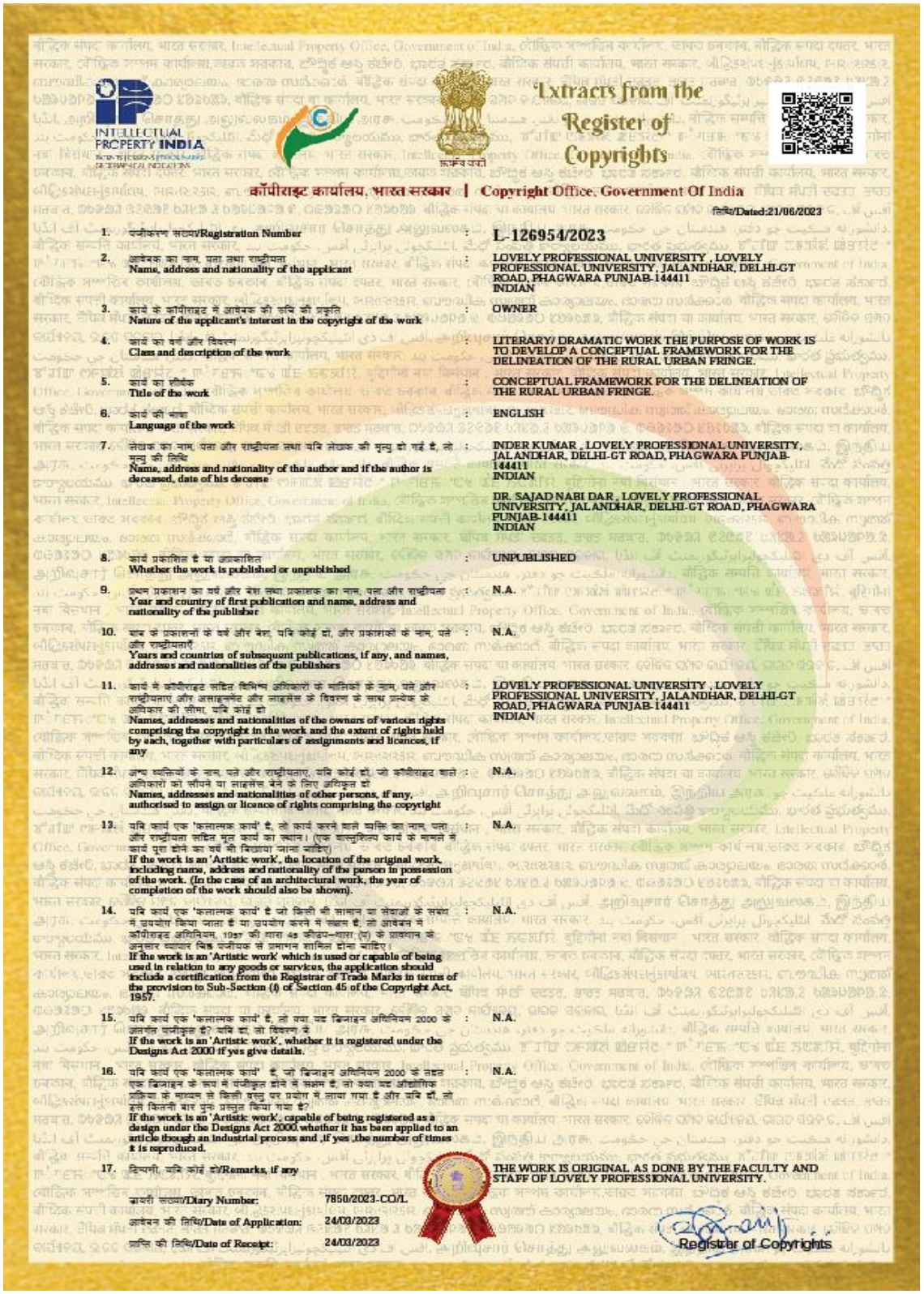
If, yes, then does she herself attend meeting etc. or represented by a male member of the family? Are women of kept under veil? Yes/ No

If yes, why? If no, why?

CHARACTERISTICS OF LAND HOLDING

Category	Total area (Acre)	Irrigated	Unirrigated
Land owned			
Leased in/mortgage			
Leased out/mortgage			
Operational holding			

Appendix-2



INTELLECTUAL PROPERTY INDIA

सत्यमेव जयते

Extracts from the Register of Copyrights

कॉपीराइट कार्यालय, भारत सरकार | Copyright Office, Government Of India

तिथि/Dated:21/06/2023

1.	पंजीकरण संख्या/Registration Number	:	L-126954/2023
2.	आवेदक का नाम, पता तथा राष्ट्रीयता Name, address and nationality of the applicant	:	LOVELY PROFESSIONAL UNIVERSITY , LOVELY PROFESSIONAL UNIVERSITY, JALANDHAR, DELHI-GT ROAD, PHAGWARA PUNJAB-144411 INDIAN
3.	कार्य के कॉपीराइट में आवेदक की रुचि की प्रकृति Nature of the applicant's interest in the copyright of the work	:	OWNER
4.	कार्य का वर्ग और विवरण Class and description of the work	:	LITERARY/ DRAMATIC WORK THE PURPOSE OF WORK IS TO DEVELOP A CONCEPTUAL FRAMEWORK FOR THE DELINEATION OF THE RURAL URBAN FRINGE.
5.	कार्य का शीर्षक Title of the work	:	CONCEPTUAL FRAMEWORK FOR THE DELINEATION OF THE RURAL URBAN FRINGE.
6.	कार्य की भाषा Language of the work	:	ENGLISH
7.	लेखक का नाम, पता और राष्ट्रीयता तथा यदि लेखक की मृत्यु हो गई है, तो मृत्यु की तिथि Name, address and nationality of the author and if the author is deceased, date of his decease	:	INDER KUMAR , LOVELY PROFESSIONAL UNIVERSITY, JALANDHAR, DELHI-GT ROAD, PHAGWARA PUNJAB-144411 INDIAN DR. SAJAD NABI DAR , LOVELY PROFESSIONAL UNIVERSITY, JALANDHAR, DELHI-GT ROAD, PHAGWARA PUNJAB-144411 INDIAN
8.	कार्य प्रकाशित है या अप्रकाशित Whether the work is published or unpublished	:	UNPUBLISHED
9.	प्रथम प्रकाशन का वर्ष और देश तथा प्रकाशक का नाम, पता और राष्ट्रीयता Year and country of first publication and name, address and nationality of the publisher	:	N.A.
10.	बाद के प्रकाशनों के वर्ष और देश, यदि कोई हो, और प्रकाशकों के नाम, पते और राष्ट्रीयताएँ Years and countries of subsequent publications, if any, and names, addresses and nationalities of the publishers	:	N.A.
11.	कार्य में कॉपीराइट सहित विभिन्न अधिकारों के मालिकों के नाम, पते और राष्ट्रीयताएं और असाइनमेंट और लाइसेंस के विवरण के साथ प्रत्येक के अधिकार की सीमा, यदि कोई हो Names, addresses and nationalities of the owners of various rights comprising the copyright in the work and the extent of rights held by each, together with particulars of assignments and licences, if any	:	LOVELY PROFESSIONAL UNIVERSITY , LOVELY PROFESSIONAL UNIVERSITY, JALANDHAR, DELHI-GT ROAD, PHAGWARA PUNJAB-144411 INDIAN
12.	अन्य व्यक्तियों के नाम, पते और राष्ट्रीयताएं, यदि कोई हो, जो कॉपीराइट वाले अधिकारों को सौंपने या लाइसेंस देने के लिए अधिकृत हो Names, addresses and nationalities of other persons, if any, authorised to assign or licence of rights comprising the copyright	:	N.A.
13.	यदि कार्य एक 'कलात्मक कार्य' है, तो कार्य करने वाले व्यक्ति का नाम, पता और राष्ट्रीयता सहित मूल कार्य का स्थान। (एक वास्तुशिल्प कार्य के मामले में कार्य पूरा होने का वर्ष भी बिताया जाना चाहिए) If the work is an 'Artistic work', the location of the original work, including name, address and nationality of the person in possession of the work. (In the case of an architectural work, the year of completion of the work should also be shown).	:	N.A.
14.	यदि कार्य एक 'कलात्मक कार्य' है जो किसी भी सामान या सेवाओं के संबंध में उपयोग किया जाता है या उपयोग करने में सक्षम है, तो आवेदन में कॉपीराइट अधिनियम, 1957 की धारा 45 जीटेप–धारा (i) के प्रावधान के अनुसार व्यापार चिह्न रजीयक से प्रमाणन शामिल होना चाहिए। If the work is an 'Artistic work' which is used or capable of being used in relation to any goods or services, the application should include a certification from the Registrar of Trade Marks in terms of the provision to Sub-Section (i) of Section 45 of the Copyright Act, 1957.	:	N.A.
15.	यदि कार्य एक 'कलात्मक कार्य' है, तो क्या यह डिजाइन अधिनियम 2000 के अंतर्गत पंजीकृत है? यदि हां, तो विवरण दें If the work is an 'Artistic work', whether it is registered under the Designs Act 2000 if yes give details.	:	N.A.
16.	यदि कार्य एक 'कलात्मक कार्य' है जो डिजाइन अधिनियम 2000 के तहत एक डिजाइन के रूप में पंजीकृत होने में सक्षम है, तो क्या यह औद्योगिक प्रक्रिया के माध्यम से किसी वस्तु पर प्रयोग में लाया गया है और यदि हाँ, तो इसे कितनी बार पुनः प्रस्तुत किया गया है? If the work is an 'Artistic work', capable of being registered as a design under the Designs Act 2000,whether it has been applied to an article though an industrial process and ,if yes ,the number of times it is reproduced.	:	N.A.
17.	टिप्पणी, यदि कोई हो/Remarks, if any	:	THE WORK IS ORIGINAL AS DONE BY THE FACULTY AND STAFF OF LOVELY PROFESSIONAL UNIVERSITY.

डायरी संख्या/Diary Number: 7850/2023-CO/L

आवेदन की तिथि/Date of Application: 24/03/2023

प्राप्ति की तिथि/Date of Receipt: 24/03/2023

Registrar of Copyrights

LIST OF PUBLICATIONS

Sr. No.	Journal/Conference/Book	Title of Paper	Date
1.	Advance Engineering Science	Using Landsat Satellite Data for Land-Use Land-Cover Change Detection in Hisar City.	15 Nov., 2022
2.	Bio Gecko	Literacy Differentials among Rural-Urban Population in Haryana, India: A District wise Study.	Jun, 2023
3.	Education Administration Theory and Practice	Unveiling Gender Disparities in Literacy: A case study of Haryana, India.	29 May, 2024
4.	South Eastern European Journal of Public Health	Research paper - Assessment of Land Use and Land Cover Dynamics in the Rural-Urban Fringe of Hisar City	05 Jan., 2025

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LIST OF CONFERENCES AND WORKSHOPS

Sr. No.	University/Organization Institute	Topic	Date
1.	Khwaja Mainuddin Chisti Language University	Emerging Trends in Social and Gender Geography" International Conference	15-16 Jan., 2021
2.	Govt. Auto. Girls P.G College of Excellence Sagar, M.P	One Week national Workshop on Research Methodology	1-7 Feb., 2021
3.	Lovely Professional University	Innovative Research Methods and Statistical Analysis	9 Feb., 2021
4.	Jamia Miliya Islamiya University, New Delhi	Climate Change and Pathways to self – reliant India : Opportunity and Challenges for Sustainable Development National Conference	15-16 March, 2021
5.	National Institute of Disaster Management	Webinar on Issues of Women & Children in Resurgence of Covid-19	11 May, 2021
6.	International Conference On Equality, Diversity, Inclusivity: Issues and Concerns. Lovely Professional University	Paper Presentation on the topic Literacy differentials among SC Population-NON SC Population in Haryana, India : A district-wise Study	25 Sep., 2021
7.	International Conference on Geography Shaping History: A Journey Through History. Lovely Professional University	Literacy differentials among Rural Urban Population Population in Haryana, India : A district-wise Study	24 June, 2022
8.	7th NAGI International Conference on "Clean Water, Good Health, and Sustainable Cities & Communities(CWGHSCC)" being or ganized by the Department of Geography, Lovely Professional Univ ersity,	Literacy differentials among Male and Female Population Population in Haryana, India : A district-wise Study	18-19 Oct., 2023

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Assessment of Land Use and Land Cover Dynamics in the Rural-Urban Fringe of Hisar City

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KEYWORDS

Urban-rural fringe, Land use land cover change, Geospatial technology, Hisar, Urbanization.

ABSTRACT

Rapid urbanization in Hisar city has significantly impacted the peri-urban areas, known as the urban-rural fringe (URF), where the boundaries between urban and rural landscapes are becoming increasingly indistinct. This study investigates land use/land cover (LULC) changes in Hisar's fringe areas, focusing on how the land has transformed over time. By utilizing geospatial technologies, we analyzed LULC changes through digital image processing and supervised machine learning classification applied to Landsat data from 2003, 2013, and 2023. The results reveal notable changes: barren land decreased by 28.2 sq km, while built-up areas expanded by 248.1 sq km in the inner fringe and 69.7 sq km in the outer fringe. Vegetation increased by 15.1 sq km in the inner fringe, but declined by 14.32 sq km in the outer fringe. Both water bodies and forested areas experienced substantial reductions, with losses of 15.5 sq km and 40 sq km in the inner fringe, and 39.12 sq km and 147.07 sq km in the outer fringe, respectively. These transformations indicate broader socio-economic and environmental shifts, emphasizing the need to understand the causes and consequences of urbanization for effective land management. The study highlights the importance of continuous monitoring of LULC changes to inform sustainable planning and development in the fringe area of Hisar city.

Introduction

The impact of urbanization on the rural-urban fringe (RUF) is significant and multifaceted, influencing both the environment and the socio-economic landscape. The rural-urban fringe, also known as the peri-urban area, is the transition zone between urban and rural environments, where urban development and rural landscapes coexist and often compete for space and resources. The expansion of urban areas often leads to the conversion of agricultural land, forests, and natural landscapes into built-up environments. This shift in land use can reduce the availability of fertile land for farming, impacting food production and local agriculture (Seto et al., 2012). Urban sprawl may lead to fragmented land use patterns, where agricultural land is interspersed with industrial, residential, and commercial developments, complicating land management and sustainability. Urbanization brings an increase in impervious surfaces like roads, buildings, and parking lots, which contribute to soil erosion, reduced water infiltration, and higher flood risks (Alemu et al., 2024). Deforestation, habitat destruction, and the decline of wetlands in peri-urban areas can lead to a loss of biodiversity and ecological balance (Alam et al., 2019). Pollution from urban areas, including air, water, and soil contamination, can spread into the rural-urban fringe, negatively affecting agriculture and public health.