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# DYNAMICS OF LAND USE CHANGE OF URBAN FRINGE AND POSSIBLE INTERVENTION

**(A Case Study of Dhapakhel, Lalitpur)**

by
Bhagyashree Maharjan

**A THESIS**

**SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN URBAN PLANNING**

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**LALITPUR, NEPAL**

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This is to certify they have read, and recommended to the Institute of Engineering for the acceptance, a thesis report titled **"Dynamics of Land Use Change of Urban fringe and possible Intervention: A Case Study of Dhapakhel, Lalitpur"** submitted by **Mrs. Bhagyashree Maharjan (079/MsUrP/002)** in the partial fulfillment of the requirements for the degree of **Masters of Science in Urban Planning.**

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# ABSTRACT

Dhapakhel, located in known traditional district Lalitpur of Bagmati province of Nepal has developed mixed character of rural and urban, most suitably called as an urban fringe of Lalitpur Metropolitan City. This study is significant to understanding the drivers of growth can help predict future urbanization trends and can possibly fill data gaps related to urban-rural interactions. However, this particular area has not been studied yet and need to know the inherent factors of land-use change in this area and problem arises by the transformation. The main objective of the study is to gain conception on the dynamics of Urban fringe area in regional and national scenario and suggest for possible interventions taking Dhapakhel as example. Focus groups Discussion and key informant interviews were used for gathering primary data. Additionally, Sentinel-2 imagery from 2014 and 2024 was used for mapping land use and land cover in Dhapakhel using a Random Forest classifier and the Semi-automatic Classification Plugin in GIS software. This facilitated an interpretation of the land-use change and transformation scene. Land-use change, gradual population growth, migration, and substandard infrastructure are dynamic of urban fringe. Rapid urban expansion, spontaneous infrastructure development, and population growth have a substantial impact on water sources in the study areas, according to the analysis; the transformation from agriculture to built-up areas has consequence in storm water flow pattern change, and drainage management in low-lying areas has been a challenge in the case of Dhapakhel. Another fundamental issue brought on by land use change is congestion, which resulted by urban sprawl and incompetent transportation infrastructure. According to the findings, implementing integrated urban planning strategies that prioritize storm water management and sustainable drinking water through technical and financial solutions and road expansion is a quick fix for traffic problems while adhering to local national urban road standards. The analysis suggests on possible future implications on sustainable development management in Dhapakhel, Lalitpur.

**Keywords:** Land use**,** Urban fringe, Land use Classification**,** Intervention, GIS

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# ABBREVIATIONS

LMC Lalitpur Metropolitan City

GLD Guided Line Development

LULC Land-use/ Land cover

GEMS Graded English Medium School

KEC Kantipur Engineering College

ROI Region of Interest

NDVI Normalized Difference Vegetation Index

NDBI Normalized Difference Built-up Index

RF Random Forest

UTM Universal Transverse Mercator

CRS Coordinate Reference System

SCP Semi Classification Plugin

FAO Food and Agriculture Organization of the United Nations

OSM Open Street Map

CBD Central Business District

KII Key Informant Interview

FGD Focus Group Discussions

w/s Water Supply

QGIS Quantum Geographic Information System

KML Keyhole Markup Language

UGB Urban Growth Boundary

RWH Rain Water Harvesting

ROW Right of Way

FAR Floor Area Ratio

# CHAPTER ONE: **INTRODUCTION**

## 1.1 **Background**

The globe is rapidly becoming more urban, this urbanization entails the use of vast amounts of rural land and does not happen instantaneously. Unlikely, Urbanization in Nepal can be categorized into two distinct types. The first is a more organic form of urbanization, where people from rural areas migrate to towns, cities, and market centers in search of better job opportunities and improved living conditions. The second type results from administrative decisions, where the government declares certain areas as urban through political boundary announcements, often without corresponding levels of urban infrastructure or population density. Nepal is administratively divided into 7 provinces and 77 districts, comprising a total of 753 local level governments. This includes a total of 293 municipalities, comprising 6 metropolitan cities, 11 sub-metropolitan cities, and 276 municipal councils. In addition, there are 460 rural municipalities. However, the government's classification of certain settlements as urban areas has raised concerns. The designation process often lacks a elaborative assessment of key factors such as availability of urban infrastructure and services, population density, open space, and overall economic sustainability, which are essential for defining a settlement as urban. (Bhattarai et al., 2023) stated that In Nepal, numerous settlements that are officially designated as urban—often due to political motives—continue to function within a rural framework, effectively giving rise to what can be termed "ruralopolises." The demand for development land is a result of Nepal's expanding cities' incompetence to supply enough serviced land for public, commercial, and residential usage, which is limiting their economic potential. So far, three types of land development approaches have been implemented in Nepal: Site and Services, Guided Land Development (GLD), and Land Pooling.; Land Pooling is mostly used as land development techniques/tool. Hence, it has turned out to be the effective urban land development.

This research addresses the inadequate infrastructure in growing residential and commercial spaces due to dynamics of land-use change within demand of growing population and expansion in urban fringes. It helps identify sustainable solutions that balance economic growth, environmental protection, and social well-being. "Now in the urban area basic infrastructure needs to be established. Everyone wants affordable

housing, public hospital, school, college, university, drinking water, communication, drain and sanitation, wide road access. The responsibility of the government is to start urban infrastructure projects" (Koirala, 2018). The rapid expansion of urban populations, driven by the aspiration for better living conditions, has intensified the need for comprehensive urban infrastructure and services. This encompasses essential utilities and facilities as well as telecommunication systems, data centers, healthcare, education, transportation, and dedicated care centers for children and the elderly. Following the 1951 democratic movement, the country's present urbanization process began concurrently with the changes of social, economic, and infrastructure development. In support to this study by (Poudel & Paudel, 2023) have findings on that, by 2020, Nepal reported that about 60% of its total population; roughly 30 million people were living within officially designated urban areas. This marks a dramatic shift, especially considering that just 70 years ago, urbanization in the country was almost negligible. It's striking to see how rapidly this transformation has occurred, raising important questions about how such fast-paced urban growth is being managed. Urban infrastructure is fundamental for fostering in the growth and appeal of urban, sun-urb and urban fringe areas. It not only captivates individuals seeking better opportunities and scope but also creates a foundation for thriving start-ups, streamlined business operations and raising labor productivity. Also, urban infrastructure supports economic vitality and emphasize the overall quality of urban life. Additionally, urbanization is not merely driven by factors such as population growth and migration but also represents a transformative process that shapes societies. It drives social change and generates various economic and physical impacts, such as improved living standards, economic development, and shifts in land use and cityscapes, making it a critical element in modern development.

## 1.2 **Need**

Urban growth in Nepal is largely driven by rising unemployment in rural areas. The traditional sector of agriculture is unable to absorb the expanding workforce generated by the increasing population. Migration from rural to urban areas has bolstered the basic and non-basic sectors in economy of cities. Despite this, Nepal has experienced significant spatial growth in its urban areas. Numerous job opportunities were provided in the metropolitan centers by the several businesses that emerged. The need for research in urban fringe areas is rooted in the critical role these regions play in

urbanization processes and their unique challenges. Urban fringes are transitional zones experiencing rapid growth, often outpacing planning and governance capacities. This leads to unregulated development, informal settlements, and inadequate infrastructure, which affect the quality of life and economic productivity. These areas are also socio-economically diverse, often housing marginalized populations who face limited access to resources and services. Effective research is required to address governance gaps, balance development with environmental sustainability, and strengthen urban-rural linkages. Furthermore, with the growing pressures of resource scarce and climate change, urban fringes must be made resilient and adaptive to future challenges. This research will fill the knowledge gaps and provide evidence to analyze the causes and impacts of unplanned growth and develop frameworks for regularized and inclusive urban development.

### 1.3 **Importance**

The comprehensive strategy plan of Government (2017) describes a human-centered society that "balance economic advancement with the resolution of social problems; to ensure that all citizens can lead high-quality lives full of comfort and vitality." Also "The authors of the strategy described it as such because they understood how difficult it can be to balance economic development, resolution of social problems, and quality of life" (Hitachi-, 2020). "Although planners are constantly confronted with new and evolving situations, they often rely on information that functions more as a tool for quick and efficient learning than as a definitive guide; their ideas, hypotheses, conceptual frameworks, and analytical methods mainly help to interpret raw observational data and transform it into broader insights about the realities they face; the validity of these statements is limited to a set of specified conditions; but the problem on which planners work-whether the design for new town, a program for harnessing the water of a river or a policy for the blooming of scientific capabilities must be studied in the fullness of historical circumstances" (Healey & Hiller, 2008). The progression toward land development methods practiced so far has a diverse dimension to Nepal's development approach. Our knowledge has been derived from foreign philosophy and understanding with instances of west cities hence, one convenient attempt of abstraction of those ideas in our cities might not be well defined in our society, the matter is of adoptance and acceptance by environment and society with equity and justice in hand. This research helps identify patterns and drivers of

unregulated development, enabling policymakers to develop frameworks for planned and sustainable urbanization.

## 1.4 Problem Statement

- Urban expansion, population growth, and economic development are driving rapid urbanization, pushing city boundaries into fringe areas and causing significant land use changes
- The lack of coherent planning and governance exacerbates challenges such as urban sprawl, environmental degradation, and socioeconomic inequalities.
- The dynamics of land use change in the urban fringe are poorly understood, with limited data on the drivers, patterns, and impacts of these transformations.


**Figure 1: Urban Problems**

## 1.5 Research Objective

- To gain understanding of the urban dynamics of fringe area in regional and national scenario and suggest for possible interventions taking Dhapakhel as example.

## 1.6 Research Question

- What are the urban dynamics in general and that in urban fringes in particular context?
- What are the problems that arise out by Land-use change and transformation scene?
- What can be the possible interventions to address the above anomaly in general and that in the case study?

## 1.7 Research Gap

Limited studies provide comprehensive spatial and temporal analysis of how land use change occurs in the urban fringe, especially in rapidly urbanizing regions.

## 1.8 Scope and Limitation of Research

**Scope**:

- The study focuses on the growth of the urban forms, land-use patterns and level of infrastructure and services of the urban fringe area.
- The study covers some possible interventions for better management of the fringe area.

**Limitation:**

- The research area is limited to inner fringe of Lalitpur metropolitan city.
- This research does not consider effects of climate change.
- This research considers only physical aspects.

# CHAPTER TWO: **RESEARCH METHODOLOGY**

## 2.1 Conceptual Framework

The framework to be designed in accordance to the objectives set and variables to be addressed that needed to fulfill the objective. In sight, for this research constructivism research paradigm applies better for construct meaning, interpret phenomena, and contribute to the ongoing process of knowledge formation through their engagement with the world around them and focuses on the interplay between urban development drivers, infrastructure demand and provision, and policy and governance mechanisms.

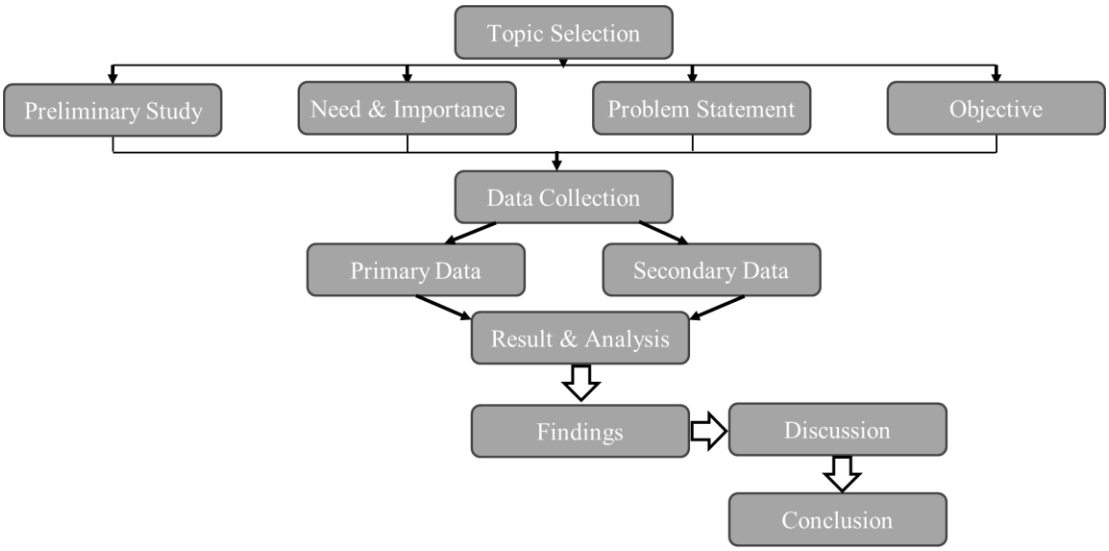



**Table 1: Framework Table**

| Component | Variable | Indicators |
|---|---|---|
| Development Dynamics of Urban Fringe | Land Use and Spatial Patterns | The conversion of agricultural land into urban uses has significantly contributed to rising housing density and rapid urban growth. |
| | Demographics | Population and socio-structure |
| | Environmental aspects | River degradation and Urban Waste management |
| | | |
| Infrastructure Planning | Transport Connectivity | Infrastructure linking urban cores to peri-urban and Equitable distribution and affordability of services |
| | Water supply | |
| | Waste management | |
| | | |

| | | |
|---|---|---|
| Intervention | Community Participation | Satisfaction of residences |
| | Local Government | Convenient access to basic services |
| | | |

## 2.2 Research Paradigms

| | |
|---|---|
| Positivist | Objective patterns of urbanization |
| Post-Positivist | Leans heavily on quantitative approaches, limiting exploration of subjective realities, can be complex and resource-intensive |
| Interpretivist | Socio-cultural impacts and perceptions |
| Constructivist | Co-created realities , Prioritizes community perspectives and empowerment |
| Pragmatic | Practical solutions integrating objective |

The **constructivist paradigm** offers a complementary understanding urban fringe development while guiding data collection and analysis throughout the research process. The constructivist paradigm is a powerful tool for understanding urban development dynamics and infrastructure planning in urban fringe areas because it highlights the diversity of perspectives, subjective experiences, and social interactions that shape these spaces. By emphasizing the co-construction of knowledge, the study can provide a more holistic, context-sensitive approach to infrastructure planning, ensuring that the solutions generated are inclusive, sustainable, and grounded in the lived realities of urban fringe communities.

## 2.3 Research Philosophy

In research, design philosophy encompasses the core principles and methodologies that influence how a study is planned, executed, and analyzed. It focuses on developing

knowledge or solutions that are intentional, user-focused, and aligned with the research goals. An ontology refers to a statement of fact of concepts, entities, relationships, and the underlying structure of knowledge within the domain of digital technologies and processes. Investigating the nature, source, and extent of knowledge—as well as how we know what we know and what it means to genuinely grasp something—is the focus of the philosophical field of epistemology.

*Urban fringes are dynamic spaces shaped by the interplay of social, economic, environmental, and political forces.*

> *Understanding urban fringes requires both quantitative insights (e.g., population growth rates, land use changes) and qualitative insights (e.g., perceptions of communities, governance challenges). Conducting interviews with the people residing there to explore problem facing by them and consideration of favorable policy to make life there easier in fringe area, this gives perception of local resident on existing land use policies and programs.*

The research aims to generate actionable knowledge that bridges theory and practice, contributing to the fields of urban studies, infrastructure planning, and governance.

## 2.4 Methodology

The methodology is grounded in early epistemological philosophy and is shaped by underlying ontological perspectives. This research demands systematic approach focusing on its design, implementation, challenges, and outcomes. From a social perspective, research focuses on how rearrangement and development impact quality of life, citizen engagement, and equitable access to resources. The environmental aspect emphasizes sustainability, examining strategies for reducing emissions, improving energy efficiency, and promoting green infrastructure. Finally, the governance perspective looks at policy-making, public-private partnerships, and transparency to ensure inclusive and adaptive urban development. By integrating these diverse fields, researchers can develop holistic solutions that address complex urban challenges and support the creation of sustainable, efficient, and livable cities. This needs **Mixed method approach with Case study** as a research tool. This research uses a mixed-method case study design that centers on constructivism. While the mixed methods

technique enhances the investigation by combining both qualitative and quantitative data, a case study approach allows for an in-depth analysis of the study area within transformation scene. The constructivist lens guides the interpretation of data in a way that prioritizes context, experience, and subjective realities by emphasizing the co-construction of meaning between participants and the researcher.

## 2.5 Methods

1. Data Collection Methods

   1.1 Primary Data Collection

   - Site Observation
   - Field Survey
   - Structured Questionnaire
   - KII (Key Informant Interview)
   - FGD (Focus Group Discussions)

   1.2 Secondary Data Collection

   - Policy Documents
   - Literature of other sides of world
   - Google Maps and Satellite Images
   - GIS and Spatial data

**Table 2 : Method Used for research**

| Research Method | Primary or Secondary | Qualitative or Quantitative | Use |
|---|---|---|---|
| Sample Survey | Primary | Quantitative | To comprehend the general perception of individuals |
| Observation | Primary | Either | To comprehend how something happens in its natural environment. |

| | | | |
|---|---|---|---|
| Key Informant and Users Interview | Primary | Quantitative | To obtain a deeper comprehension of the subject. |
| Focus Group Discussions (FGD) | Primary | Quantitative | To acquire a deeper comprehension of the subject |
| Literature Review | Secondary | Either | To assess trends within a research issue or to place research within an existing body of work. |

2. Data Analysis Method

This research requires analytical frameworks and tools to process and interpret collected data.

2.1 Quantitative Data Analysis Method

Statistical Analysis for summarizing survey results to identify trends, such as community satisfaction levels or change in land-use and also to analyze relationships between variables, such as the correlation between infrastructure improvements and value appreciation.

Spatial Analysis by using GIS tools to map land-use changes and their impact on accessibility, water networks, and sanitation systems.

2.2 Qualitative Data Analysis

Thematic Analysis for identifying key themes and patterns from interview transcripts, focus group discussions, and case study notes to understand perceptions and challenges. Content Analysis for reviewing policy documents, legal frameworks, and community feedback to identify gaps and areas for improvement.

3.3 Mixed Method

Comparative Analysis for challenges and planning approaches across different case study areas. Simultaneously collect both quantitative and qualitative data and compare the results to uncover areas of alignment or discrepancy.

# CHAPTER THREE: LITERATURE REVIEW

## 3.1 Introduction

Definitional inconsistencies across time and regions have made it challenging to study urbanization and urban expansion in Nepal. Despite this, Nepal still shows relatively low levels of urbanization compared to many other countries, when measured by indicators such as population size, income levels, and access to modern amenities. However, the pace of urbanization in Nepal is accelerating rapidly, reflecting a significant transformation in settlement patterns and land use. Although urbanization in Nepal does not have an extensive history it has diverse and gradually growing in compare to out of world. In Nepal, urbanization is a two-edged sword that presents major planning and sustainability issues in addition to substantial development prospects. Currently, the top objective is to prudently manage this growth, with an emphasis on creating more resilient, inclusive, and sustainable cities for the future. Nepal has seen an impressive increase in urbanization in recent years, with almost 60% of the country's population living in cities. But there is a clear discontinuity in the nation's urban system, exposing deficiencies in infrastructure, planning, and coordination across various metropolitan districts. Furthermore, in recent report after National Census 2078, Degree of Urbanization (DEGURBA) in Nepal has been published under Central Bureau of Statistics (2021) which classifies the urban into 3-categories:

I. **Urban Areas** are characterized by population density minimum 3 up to over 15 Population per Hector Area (ppHa) and population count over 5,000, with 4-point contiguity.
II. **Peri-Urban Areas** are characterized by population density between 3 - 15 ppHa and no minimum population threshold, with 8-point contiguity.
III. **Rural Clusters** are characterized by population density 3 ppHa or below and population no more than 5,000 with 8-point contiguity.

The results of 3-Category classification are presented in which Between 2011 and 2021, the urban population grew dramatically, rising from 22.31% to 27.07%. Similarly, the percentage of people living in peri-urban areas has grown from 39.19 to 39.75%. In addition, throughout the past ten years, the percentage of people living in rural areas has dropped from 38.5% to 33.19%. The majority of people continue to live in peri-

urban settings that are regarded as ‘urban’, while in character are urbanizing. Even now, one-third of the population still lives in rural areas, the ongoing migration from rural to peri-urban and urban centers highlights the growing pressure on cities to accommodate this influx and manage the resulting demand for housing, services, and infrastructure. This shows there is gradual urbanization occurring which might turn into sprawl that can go beyond boundary of planning remaining city unaesthetic and congested. Land rearrangement can be applied in urban, peri-urban, and rural settings, making it versatile for different developmental needs.

### 3.2 Urbanization and Urban Fringe Development

“The urbanization’s stage is correlated with a fundamental development (industrial revolution) and has led to the concentration of companies and residents in fast growing cities; Over time, the increasing pollution, land prices and nuisance of the industrial city progressively led a sub-urbanization stage in which residents steadily moved to suburbs (the city’s hard ring) while keeping most of the jobs in the central city; this spatial change has been underlined by another set of fundamental developments”(Pieter Van Dijk et al., 2013).

Urban growth in Nepal is largely driven by rising unemployment in rural areas. The traditional agricultural sector is unable to absorb the expanding workforce generated by the increasing population. Migration from rural to urban areas has bolstered the cities' basic and non-basic economies. Despite this, Nepal has experienced significant spatial growth in its urban areas. The inefficient spatial growth of metropolitan regions is often attributed to a number of distortions, including underpriced suburban infrastructure, unpriced traffic congestion, and uninternalized open-space externalities. In the core city, these distortions also lead to an ineffective deficit in housing maintenance and reinvestment. The various businesses that have been established have created a number of job opportunities in the urban centers. According to a 2012 estimate by Nepal National (Rastra) Bank, “the Kathmandu Valley alone generated 31% of the country's GDP and supported 630,000 jobs across multiple industries, making it a desirable travel destination for many rural residents”. As more people moved in and municipal revenues increased, the road network in urban areas, those especially within the Kathmandu Valley, expanded quickly (Bhattarai & Conway, 2021). It is important to distinguish between population growth driven by migration and that resulting from natural increase within cities. In cases of natural population growth, factors such as relative hardship,

ethnic tensions, and responses to modernization tend to play a more prominent role, even though the underlying issue of population pressure is relevant in both scenarios. Question that aroused by(Buhaug & Urdal, 2013) is such as “Are security implications of urban population growth qualitatively different in cities with large labor-induced immigration compared to cities that have absorbed large masses of people fleeing an unsustainable countryside, or cities with high natural reproduction rates?”. This query help in identifying the conditions that make urban population growth more likely to result in heightened societal upheaval and insecurity is a critical and logical next step.

“The landscape on the metropolitan fringe is characterized by a diversity of land uses, which are often thought to vary in relation to their functional linkages to urban and to rural sectors; Metropolitan fringe areas are widely considered to be “transitional” in nature-suggesting a patterned sequence of uses that become progressively more agrarian in orientation as one recedes from the urban center” (Browder et al., 1995) also continues that, the patterns of development on the metropolitan fringes of Bangkok, Jakarta, and Santiago show significant differences. While the term "peri-urban" has been widely used to describe populations living on the edges of metropolitan areas in Africa, it may not serve as a universally valid framework for identifying and planning development programs in other cultural or regional contexts. Unique land market conditions have emerged in the urban periphery, driven by locational conflicts over property acquisition and competing pressures from large landowners, private developers, and informal settlers or squatters.

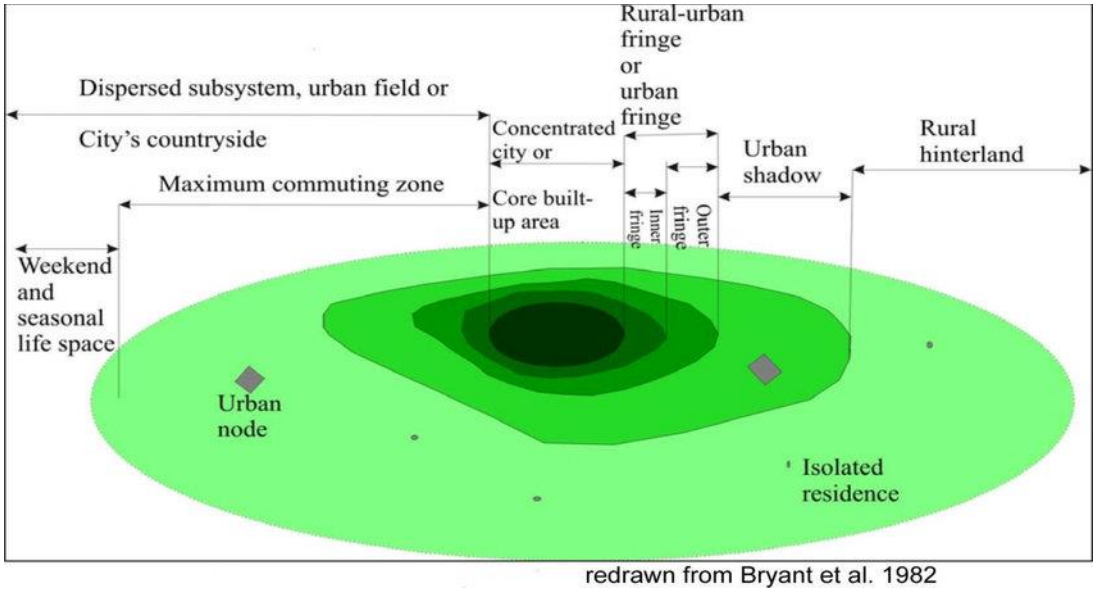
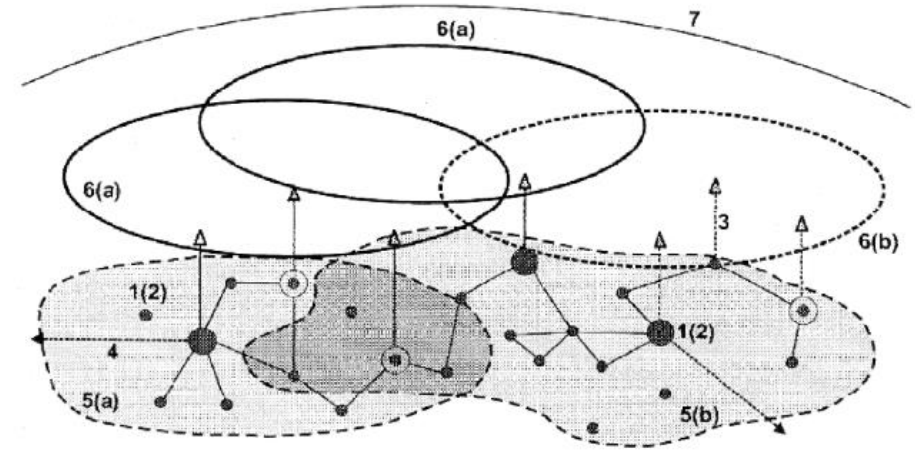



**Figure 2: Rural-urban fringe scheme**

Urban fringes, often referred to as peri-urban areas, represent transitional zones where urban and rural characteristics converge. These regions have been extensively studied due to their critical role in urbanization processes, infrastructure development, and socio-environmental challenges. Peri-urban areas which serve as critical nodes for economic exchanges between urban and rural regions, particularly in the context of labor and agricultural markets. It is characterized by a blend of urban and rural features, often including residential developments, industrial parks, commercial areas, and agricultural land.

### 3.3 Dynamics of Development

Development Dynamics refers to the study and understanding of the complex processes that drive the growth, transformation, and functioning of urban areas. From Pieter Van Dijk though article in 2013 (ch-4, pg. 49), writer tries to explains how cities grow and change as people, businesses, and governments make decisions based on their needs and preferences. As per Van den Berg's theory (1987), Residents look for better homes, neighborhoods, and lifestyles. Companies choose locations that support their business goals, like access to workers and customers. Governments adjust policies (e.g., housing, transport, and infrastructure) to fulfill the growing needs of people and businesses. These decisions are influenced by societal evolution like new technologies or values. Over time, the actions of one group affect the choices of others, creating a cycle of change in urban areas. “Unplanned concentrated growth or heightened developmental operations in a place has significant effects on natural resources (disappearance of open spaces - parks and water bodies), traffic congestion, increased pollution levels, and even changes in the local climate”(Ramachandra et al., 2012).




**Key:**
(1) Actors
(2) Interests and objectives
(3) Actions
(4) Networks
(5a) Informal organisation
(5b) Formal organisation
(6a) Observed orientations
(6b) Latent orientations
(7) Context

**Figure 3: Dynamics of Localities (Source: Bryant et. Al 2010,Ch-23)**

This above framework provide help to analyze how local government, institutions and citizen together can resolve issues to their mutual satisfaction with maintaining conflicts and rigidity.

### 3.4 Urban Infrastructure

By (Sharma Deepak & Parkin James, 1999) defined infrastructure that include facilities and processes in the following areas, Public Utilities, Public service and other transport sectors. Also confront on providing infrastructure is still the most effective indicator of global development, and planners only get involved in building infrastructure after crucial planning decisions have been made. Urban infrastructure forms the backbone of functional cities, encompassing transportation networks, water supply, sanitation, energy systems, waste management, and digital connectivity. To successfully lead planning teams, planners need both technical expertise and political acumen. Urban planning goes beyond technical aspects, it's closely tied to political, economic, and social dynamics. Therefore, planners must be skilled in navigating both technical and political spheres. Urban infrastructure refers to the essential systems, facilities, and services that enable cities to function effectively, support their growth, and promote long-term efficiency. It includes transportation facilities, basic utilities (such as water,

electricity, and telecommunications), waste management systems, housing, social services (like education and healthcare), and environmental structures. These elements are essential for enabling economic activity, ensuring public well-being, and maintaining the overall livability of cities.

Western regions, including Europe and North America, urbanized early and have established infrastructure networks. Their current priorities involve updating aging systems, advancing sustainability, and addressing urban sprawl through more decentralized and inclusive planning methods. In contrast, Eastern regions such as South and Southeast Asia are experiencing fast-paced urban growth. These areas grapple with issues like underdeveloped infrastructure, informal housing, and environmental strain. Planning in the East is generally more centralized, although many cities are expanding public transit and exploring smart city innovations. In summary, while Western regions are focused on modernization, Eastern regions are striving to keep pace, each facing unique planning strategies and obstacles. Further “The North-west and South-east regions should use their comparative advantages for attracting and developing new industries with their regional resources, thus opening an opportunity to gradually improve their urban infrastructure; Consequently, they can narrow the development gap with the other regions and improve the lives of their inhabitants”(Heshmati & Rashidghalam, 2020). “The Youth Development Index (YDI) is a composite index composed of 18 factors that jointly assess multidimensional progress in youth development. Nepal has 40.35% of 16–40 age cohorts, and it ranks at 77th position in Global Youth Development Index (YDI) and 63rd/140 in the Human Development Index (HDI)”. Also, the population size and growth rate has been increasing over the time, it has rapidly increased since 1961 globally.

“In the 2021 census of Nepal, the overall population is 29.1 million, up 10.1 million from the 26.4 million recorded in the 2011 census, with an average annual growth rate of 0.93 percent (2021), which is lower than the 1.35 percent growth rate reported in 2011; Tarai accounts for 53.6% of the total population, with a 1.56 percent average annual growth rate. By province, Madhesh province accounts for more than 20% of the country's population (20.99%) and has an average yearly growth rate of 1.20% and it could be owing to the inclusion of Tarai in this region; the highest population growth rate is observed in Bhaktapur district (3.32%), while the lowest is in Ramechhap (-1.65%)” (Mishra & Sijapati, 2023) .

To accumulate need and demand of the dynamics of population to cities the city must expand, hence the territory of urban area was expanded by accommodating urban fringe areas in many expeditiously urbanizing spaces such as in Kathmandu Valley. Being land limited with growing demand of plots government promptly accessed various plans of land development tools such as Guided line development and land pooling to accumulate and manage urban land but few were planned and many occurred abruptly. Land was developed initially later the infrastructure has been planned, this unsynchronized process of infrastructure planning in expanding urban areas can be seen in most of hastily grown spaces.

### 3.5 Urban Sprawl: Form of Fringe Development

"As the price of sprawl have become more apparent, the term urban sprawl has gone from urban planning construct to public policy concern. But what exactly is urban sprawl? In the early 1990s, sprawl was defined qualitatively for purposes of growth management in Florida" (Ewing 1997). The definition ultimately adopted by the State encompassed the following urban forms:

- Leapfrog or dispersed development
- Linear commercial strip development
- Extensive low-density urban expansion
- Widespread single-use zoning and land use

"Cities began to see the value in their old urban fabrics with the urge to redevelop back in and create much better-quality public transport, walking and cycling in their cities. The public responses to planning insisted that planners now had to do something about place-making in special places, and had to try and control urban sprawl" (Newman, 2016). Demand causes the development and also ignite the rapid planning resulting sprawl, thus planning is essential, but time frame values the most. Center/Core of Kathmandu Valley has no further vacant land to be planned and is in call of conservation and then the peripheral area are rapidly growing as unplanned and unmanaged commercial and residential hubs, which is in urge for better placed city that is alarming in living standard of people, safe, healthy and sound livelihood. "Land take does not always correspond with urban sprawl, as it can occur outside of urban or peri-urban areas (e.g., extraction sites), and new growth in cities that causes land take is not necessarily sprawled; It can be developed in high density, mixed use, and compact

urban form.; Yet excessive land take is a direct consequence of low-density development, which means the main channel to tackle land take is to minimize urban sprawl" (Colsaet et al., 2018). "The urban fringe presents highly valuable resources such as land, space, and landscape for the wealthy and powerful class, and for the low class, the urban fringe area is only a garbage dump that pollutes production and low-cost shelters away from various social resources available in city centres" (Sui & Lu, 2021). Sui and Lu have analyzed the urban fringe in various aspect and proposed of 7 different expansion–contraction dynamics model for study of urban fringe under 3 major constrains: Population, Socio-economy and Spatial environment. Out of 7 following model have significance in urban expansion relative to research.

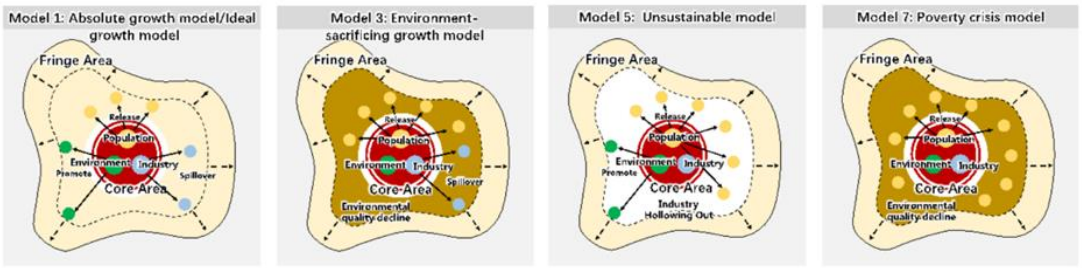



**Figure 4 : Urban Growth and Fringes (Sui & Lu, 2021)**

Urban fringes are dynamic zones where diverse and often competing interests converge including wholesalers and distributors, farmers, foresters, communities with recreational interests, public or private utilities, and expectant landowners.

### 3.6 Factors Influencing Growth in Urban Fringe

Urban fringes are often characterized by rapid and unregulated expansion driven by population growth, industrialization, and economic opportunities. Also, urban sprawl as a significant issue in peri-urban areas, leading to inefficient land use, increased commuting times, and fragmented landscapes. Thereby, the conversion of agricultural land to residential, industrial, and commercial purposes is a dominant trend. This have adverse effect on the small scale farmer living there, some development works pay compensation for land but some may not that undergoes on mutual understanding and accord. "Successful compensation models from other countries, like South Africa, could be adapted for Ethiopia. These models consider factors such as current property use, acquisition history, market value, state investments or subsidies, and the purpose of expropriation."(Haregeweyn et al., 2012a). A wide range of demographic, economic, infrastructure, and policy-related issues impact growth in urban peripheral regions.

While lower property costs and greater connectivity make periphery areas appealing for housing, business, and investment, rapid population growth and rural-to-urban migration force expansion outside of city cores. This growth is further supported by zoning changes, government regulations, and the construction of roads and utilities. Demand is also raised by shifting lifestyle preferences, such as the desire for suburban living and the ability to work remotely. The state of the environment and the availability of land are other important factors in influencing the rate and course of urban fringe growth. Accurately identifying suitable sites for specific land uses is a key element of sustainable land use planning. “Factors such as steep terrain, cultural or religious significance, and government-designated reserved areas can render certain sites unsuitable for particular types of development” (Nengroo et al., 2017a).

**Population:** The world’s population is increasingly urbanizing, driven in part by higher rates of rural-to-urban migration. However, future population growth remains uncertain, not only because of unpredictable trends in fertility, mortality, and migration, but also due to a variety of other factors that could influence these patterns.

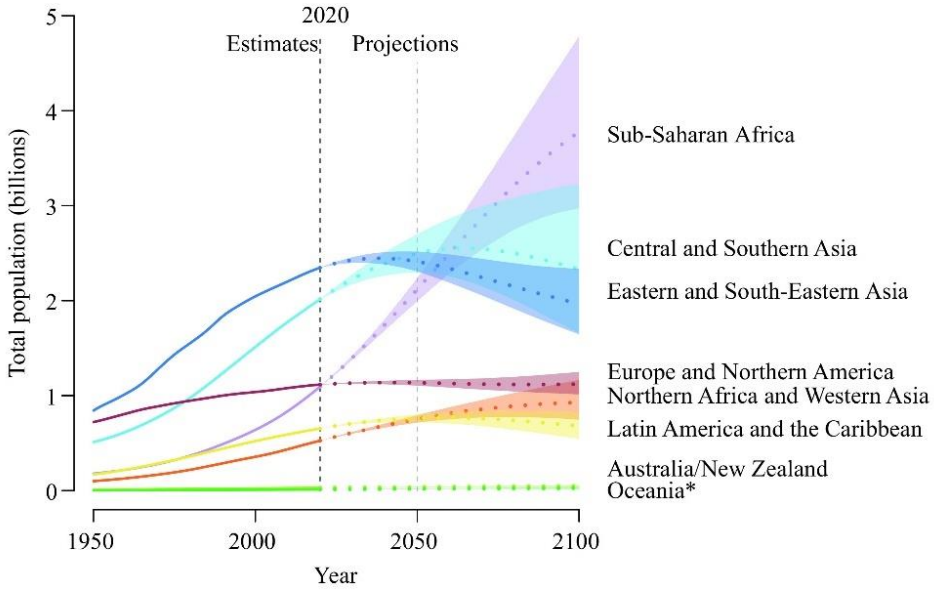



**Figure 5 : Global Population Growth and Prediction (Source: (Gu et al., 2021)**

Increase in population increase in demand and thus supply is also increased respectively, this is main factor for growth as population spread out along fringe area

causing phenomenal effect in urban system. An city need to be readily design to accumulated the projected population and meet their demands.

**Transportation:** Improved transportation cause comfort on commute large distance in short time and here implies per Bid rent theory. This creates CBD and enhance in creating multi nuclei forming satellite city and that emerges on land use change of Urban fringes.

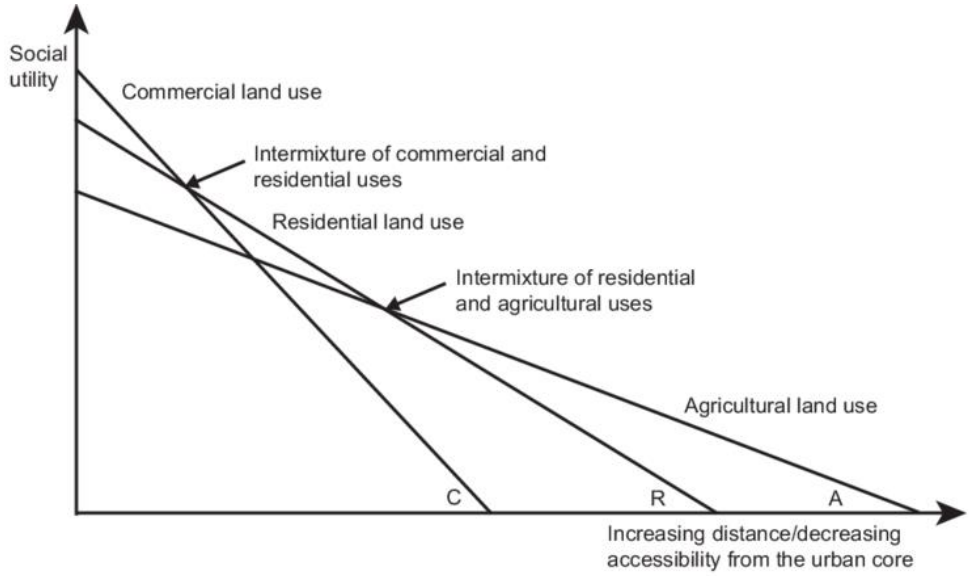



**Figure 6: Bid rent model of landuse (Source: Barlowe 1978.)**

**Land:** Land is the only constrain whose value never goes down. Land value also plays major role in dynamics of land use change in urban fringe area.

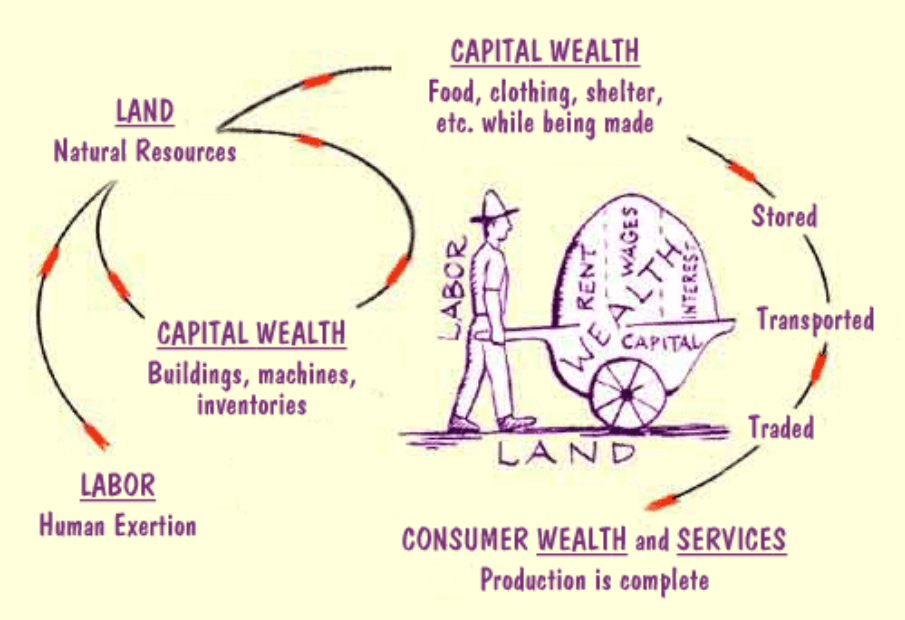


**Figure 7: Land and Economy (Source: https://www.henrygeorge.org)**

"The urban-rural fringe is a constantly evolving area where urban expansion constrains the availability of landscape services. Economic valuation of these services is suggested as a method to quantify the effects of urbanization and provide planners with insights into the potential losses resulting from land-use changes" (Zhou et al., 2020).

### 3.7 Land Use Change and its impact

Land is the basis of city planning or simply planning. Population growth is prime cause of urban growth/expansion. Growing population results on consumption of more land by the people and spread towards the fringe areas. Urban land use must be seen as dynamic pattern rather than a static entity. In Srinagar city, India dynamics of land use change occur in demanding of new city. On the other hand, the needs of the center metropolitan region have also led to considerable land alterations in Srinagar City. "The main characteristic of urban sprawl in cities is the ongoing transformation of undeveloped, natural territory into urbanized areas"(Nengroo et al., 2017b). In Bangladesh, urban household dynamics and population expansion, distance to cities and major roadways, and precipitation dynamics have been the main drivers of the conversion of agricultural land to standing water bodies in the southwest region (Xu et al., 2020). "The growth in forest area in Bhutan from 1990 to 2010 was much higher than the loss of forest, mainly due to the annual plantation activities throughout the country. Agriculture is expanding very slowly due to the limited population growth. Grass and other land use classes depend highly on season and climatic conditions" (Gilani et al., 2015). "According to land cover data for the urban-rural fringe south of Bogotá, natural vegetation generally declined while farmland's spatial extent increased with significant variability among the various phenological states of the land cover classes, indicating that human-made or human-influenced structures and patterns gained spatial significance" (Anselm et al., 2018). Study by (Heilig, 1997) have provided with five anthropogenic driving forces of land-use change in China include population growth, urbanization, industrialization, changes in lifestyles and consumption patterns, and shifts in political and economic structures. The aim is to highlight the wide array of factors, beyond bio geophysical conditions, that will shape future land-use patterns in China. Similarly, in North-West Asia the study of two

countries by (Yuan et al., 2022) brough into “The recurring changes in land cover between grasslands and croplands reflect the effects of the Soviet Union’s extensive reclamation efforts in Kazakhstan during the 20th century, as well as the Atar-3 agricultural redevelopment in Mongolia”.

In scenario of Nepal, it urged on rapid urbanization that contributing unpredictable change in land use and land cover.

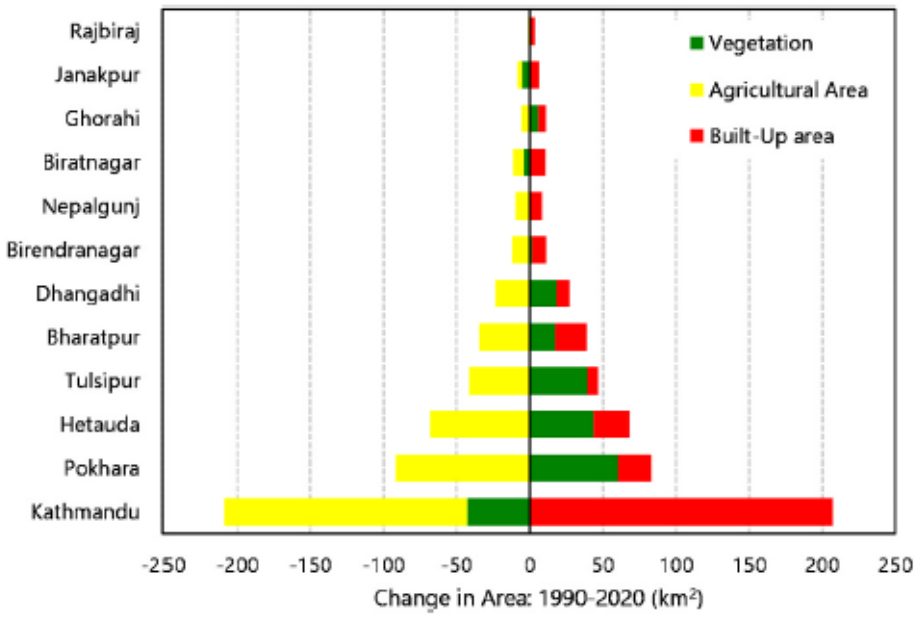



**Figure 8: “Overall changes in vegetation, agricultural and built-up areas in 2020 with respect to 1990 in major cities of Nepal” (Devkota et al., 2023a).**

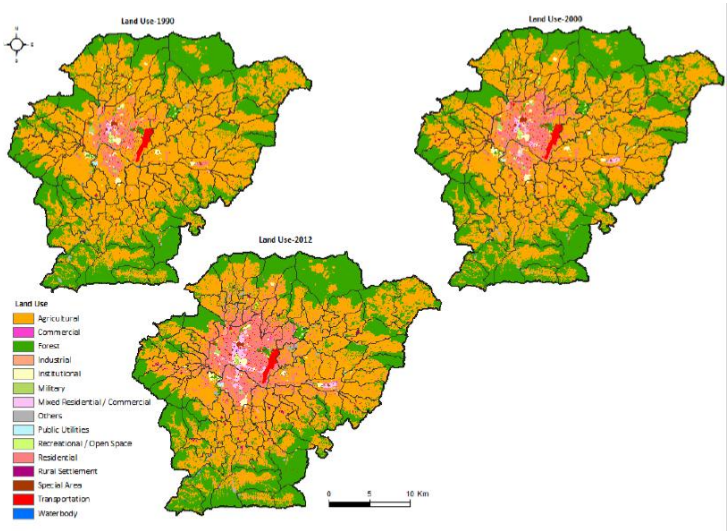



**Figure 9: Land Use of Kathmandu Valley,1990,2000 and 2012(Duwal, n.d.)**

### 3.8 Urban Growth Management

The growth of the city is unavoidable as it is natural process. The city is dynamic so the growth cannot be avoided as it is obligatory aspect of change. As the city begin to expand it expand into the fringe hence, it starts to show changes, change in its urban fabric and forms. Both the management of growth and fringe is prior. If the growth could be managed properly then urban fringe can be managed, and land is prime factor to be managed. Growth management is procedure for assessing management and present developments of result which provides a means of forecasting and accommodating needs of development. As global populations rise, cities experience increased migration, leading to higher demands for housing, transportation, and essential services. This rapid urbanization often results in overcrowding, strained infrastructure, and environmental stress. At the same time, climate change and other environmental challenges pose significant risks, with rising temperatures, extreme weather, and resource depletion necessitating sustainable solutions like green buildings and renewable energy. Uncontrolled sprawl may end up in a number of issues, including traffic jams, environmental damage, inadequate infrastructure, and the loss of farmland, when metropolitan areas expand in response to growing populations, greater migration, and growing economies. The purpose of advance planning is to deal with and mitigate these issues through efficient urban growth management.

### 3.9 Problems of Unplanned Urban Growth

Unplanned urban growth, or urban sprawl, is a global phenomenon that has significant social, economic, and environmental consequences. Uncontrolled urban sprawl often leads to the degradation of natural ecosystems, including forests, wetlands, and farmland. Studies by (Seto et al., 2012) indicates that habitat fragmentation and deforestation play a major role in both the decline of biodiversity and the increase in carbon emissions. Additionally, unplanned cities contribute to urban heat islands and poor air quality due to increased vehicular emissions and industrial activities (Grimm et al., 2008). Poor water management systems exacerbate flooding and water pollution, further straining urban environments. Rapid, unplanned growth overwhelms existing infrastructure. Research shows that inadequate transportation systems lead to severe traffic congestion, longer commutes, and reduced productivity. Public services such as healthcare, education, and emergency response systems become overburdened, particularly in developing countries(UN-Habitat, 2020). Utility systems, including

water supply and sewage, often fail to meet the demands of growing populations, leading to health risks and inefficiencies. Unplanned urban growth exacerbates social inequalities. Literature highlights the proliferation of informal settlements and slums due to a lack of affordable housing. These areas often lack basic services, perpetuating cycles of poverty and poor health. Additionally, marginalized communities are disproportionately affected by environmental hazards and inadequate infrastructure. The economic costs of unplanned urban growth are significant. Studies emphasize the high costs of retrofitting infrastructure in unplanned areas, which is often more expensive than planned development (Brueckner & Helsley, 2011). Unstable property markets and reduced agricultural productivity due to urban encroachment further strain local economies (Han et al., 2020). Unplanned growth often results in the destruction of culturally and historically significant sites. Literature underscores the loss of community identity and heritage as cities expand without regard for local traditions and historical landmarks. Urban sprawl encroaches on fertile farmland, this has threatening food security. Research shows that the conversion of agricultural land to urban uses reduces local food production and increases reliance on imported goods (D'Amour et al., 2017). Addressing these issues requires integrated urban planning, sustainable policies, and community engagement.

### 3.10 Land Use Planning

Land use planning is a critical process for sustainable development, ensuring the optimal utilization of land resources while balancing economic, social, and environmental concerns. Scholars and policymakers have extensively studied land use planning to address challenges such as urbanization, environmental degradation, and resource management. Several theories help in shaping land use planning, including the Concentric Zone Model by Burgess (1925), which explains urban land use that were based on expansion from a central business district. Alonso (1964) introduced the Bid-Rent Theory, suggesting that land value and use depend on accessibility and economic activity. More recent studies, such as those by Neuman (2005), advocate for smart growth strategies to reduce urban sprawl and improve land efficiency. It also plays a crucial role in disaster risk reduction by identifying safe zones for construction and protecting ecologically sensitive areas. By integrating economic, social, and environmental factors, land use planning ensures that land is utilized optimally to meet

present and future needs while maintaining a balance between development and conservation.

### 3.11 Land Policies in Nepal

**Table 3: Key Land use Policies of Nepal**

| | |
|---|---|
| **National Land Act,2019** | provide base for equitable distribution of benefits obtained from land and its resources |
| **Land Act, 2021** | Ceiling and floor of land plots, Acquisition and co mpensation provision. |
| **KVDA Act, 2045** | Land development through Site and services, GL D and Land pooling tools |
| **Town development Act, 2045** | Thia<br>provide necessary services and facilities to the resi dents of the town by reconstructing, expanding an d developing existing towns |
| **National Urban Policy, 2081** | The policy aims to improve urban infrastructure, land use, and economic hubs while promoting climate adaptation and better governance for livable, well-planned cities. |
| **Local Government Operati on Act, 2074** | This covers the local government's roles, responsibilities, and authority in disaster risk reduction and management. |
| **Building Bylaws 2071 and Guidelines 2072** | Provided with zoning and laws that provide institutions and organizations with a thorough understanding of Nepal's building permission |

| | |
|---|---|
| | system and safer construction methods including provisions for planning. |
| **Land (Survey and Measurement) Act, 2019** | This is intended to foster harmonious relationships among citizens by organizing land measurements and classification. |
| **Land Acquisition Act, 2034** | The government of Nepal has the authority to acquire land for public welfare. Land acquisition can be carried out for any institution that has covered all associated costs, provided a detailed technical report, and submitted an estimated timeline. |

### 3.12 Land Interventions

Land Interventions are typically designed to promote socially desirable outcomes, such as affordable housing, environmental protection, or efficient land allocation. They often interact with complex urban real estate markets in unpredictable ways. Because these markets involve multiple stakeholders, dynamic demand-supply relationships, and regulatory constraints, interventions can lead to unintended negative effects. For example, policies like rent control, aimed at making housing more affordable, can sometimes discourage new housing development, exacerbating shortages and escalation of rents in the long run. Similarly, zoning restrictions intended to maintain neighborhood character or prevent congestion can inadvertently lead to urban sprawl, increased commuting times, and reduced housing affordability. Infrastructure projects, while meant to improve accessibility and economic development, can sometimes displace vulnerable communities, or increase property values in ways that contribute to gentrification and inequality. “Changes in land-use patterns in the case of the unrestricted development scenario, which shows a disorderly increase of low-density urbanization; shows that constraining urban expansion to buildable areas with urbanization projects keep urban compactness and save over 4200 hectares of land acquired from grassland and agriculture compared to unconstrained development.

Despite populations is expected to continue growing in the FUAs at low rates, scenarios based on strict land-use planning constitutes a relevant output for planners to prevent non-sustainable trends and urbanization do not overpass populations demands." (Domingo et al., 2021). Given the complexity of urban real estate markets, land use policies often lead to unintended consequences that policymakers may not have anticipated.

### 3.12.1 Zoning

Zoning is a fundamental tool in land use planning that regulates how land can be used within specific geographic areas to ensure orderly development and sustainable growth. It plays a crucial role in urban planning which aids by designating land for residential, commercial, industrial, agricultural, and recreational purposes. Since the early twentieth century, zoning has served as an important regulating device. In New York City, zoning is a set of land use regulations intended to direct urban development and influence the built environment. The Department of Buildings (DOB) enforces it, and the NYC Department of City Planning (DCP) is in charge of overseeing it. What can be erected where, how large structures can be, and what activities can take place in particular regions are all determined by zoning. Compared to other nations, US cities have a disproportionately high prevalence of low-density residential zoning, which restricts the housing alternatives available to individuals unable to purchase larger homes. "These zoning regulations, which raise housing costs and promote segregation patterns, have racist and classist roots" (Lens, 2022). "The gross floor area that can be built per parcel, as defined in the zoning plan, supports the allocation of varying degrees of urban densities" (Domingo et al., 2021). From lecture note of Kriti Kusum Joshi "Minimum lot size zoning defines minimum lot area for residential development to decrease population density (for e.g., 0-2-2-0 ropani or 855.625 sqft. in Nepal) and Maximum lot size zoning defines maximum lot area for residential development to increase population density. In Karachi, in mid-1970s, a ceiling of 9000 sq. feet was placed on new plot sizes".

### 3.12.2 Height Restriction

Height restrictions are a common government intervention in urban land use, intended to control building heights for reasons such as preserving historical skylines, reducing congestion, maintaining aesthetic appeal, Safety and preventing excessive population density. But also, study claimed that building height constraints cause urban sprawl and

increased emissions from commuting (Borck, 2016). While well-intended, these regulations often generate unintended economic and social consequences that can outweigh their intended benefits.

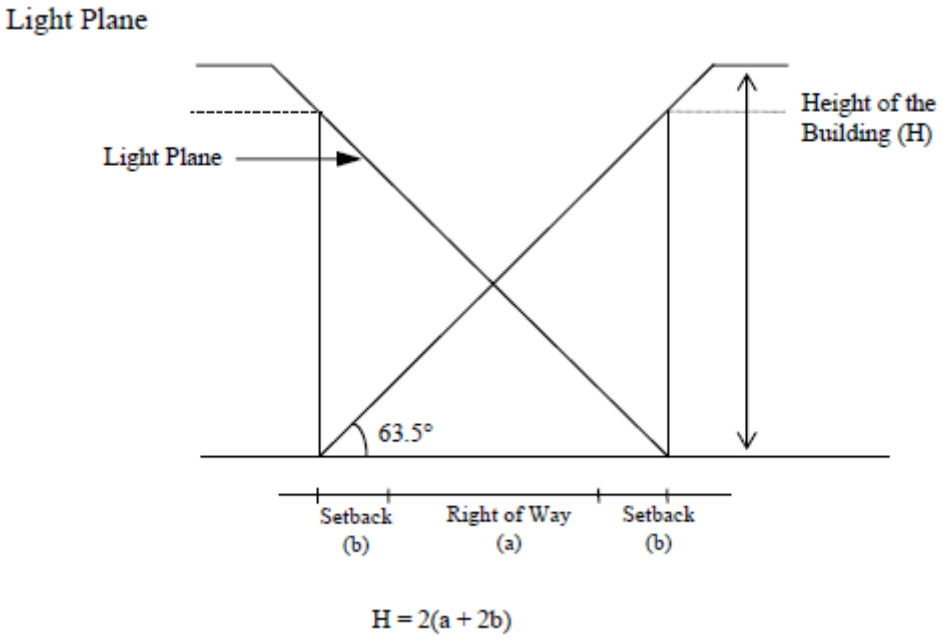



**Figure 10: Height of building and light plane (Building Bylaws, 2071)**

### 3.12.3 Floor Area Ratio

**Floor Area Ratio (FAR)** is one of the regulatory tools in planning field which determines the allowable building floor area relative to the size of the land parcel. Given by the formula (*Source*:(Building Bylaws, 2064),

**"भुई क्षेत्रको अनुपात" (Floor Area Ratio, (FAR) )** भन्नाले भवनका सम्पूर्ण तल्लाहरुको क्षेत्रफल (Built up area) लाई प्लट (Plot) को सम्पूर्ण क्षेत्रफलले भाग गरेर आएको भाग फल संझनु पर्छ।

$$\text{एफ.ए.आर. (FAR)} = \frac{\text{भवनको सम्पूर्ण तलाको कूल क्षेत्रफल}}{\text{भवन बन्ने जग्गाको सम्पुर्ण क्षेत्रफल}}$$

"FAR limits can potentially decrease total emissions. While on the one hand, FAR limits lead to urban sprawl and thereby increase commuting in a city, on the other hand, increased competition for inner city land raises housing prices and may reduce the total demand for housing" (Borck, 2016).

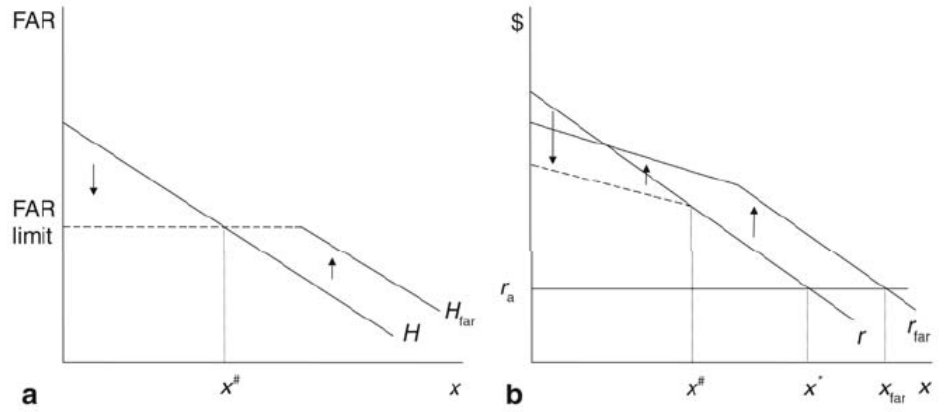



**Figure 11: "Floor area ratio limit (a) Effect on building height, (b) Effect on land rent"(Brueckner, 2009)**

### 3.12.4 Urban Growth Boundary

The primary objective of UGBs is to manage urban sprawl, preserve farmland and natural resources, and promote sustainable, high-density development within designated urban areas. While UGBs have proven effective in some cases, they also present challenges related to housing affordability, land prices, and economic development. Portland, Oregon, and the United Kingdom are two more well-studied UGBs. One of the most well-known uses of UGBs is in the Republic of Korea, where greenbelt zones limit urban sprawl. However, if not managed carefully, they can lead to rising housing costs, land speculation, and unintended suburban expansion.

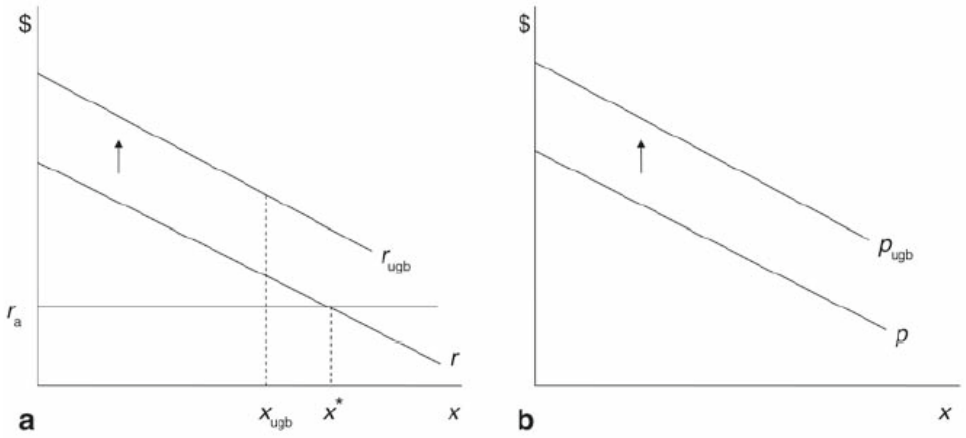



**Figure 12: "Urban growth boundary (a) Effect on land rent, (b) Effect on housing price"(Brueckner, 2009)**

### 3.12.5 Vacant Land Management

Vacant land refers to undeveloped or underutilized parcels of land in urban, suburban, or rural areas. Investors may purchase land and hold it unused, expecting property values to increase before developing or selling it. This situation can lead to artificial

scarcity and rising in land prices. In some areas, land remains vacant due to a lack of essential infrastructure, such as roads, sewage systems, or water supply, making development economically unfeasible. Taxing vacant land can be approached from a variety of angles. The first, and possibly the least controversial, is how this can increase revenue possibilities (Kim et al., 2020). In additional he also stated that incentive frameworks can increase public investment in unoccupied property. Tax on unused or underdeveloped land with the goal of promoting development and lowering land hoarding. It promotes the supply of land, discourages speculation, and generates in revenues for the government. “A deeper appreciation of the public value of urban unoccupied land is critical for any endeavor to explore alternative techniques to optimize the way these places are used for both short-term and long-term uses to support urban regeneration and renewal” (Kim, 2016).

# CHAPTER FOUR: CASE STUDY OF INTERNATIONAL CONTEXT

## 4.1 India

The study by (Nengroo et al., 2017a) on Srinagar, the summer capital of Jammu and Kashmir which used satellite image from 1971 to 2009 to study on the transformation of the Srinagar city whose result interpreted that "Continuous movement of land from non-developed natural categories to developed land use is the common problem of urban sprawl, but Srinagar City is also characterized by severe land alterations in response to the demands of the major city".

Similar study on Bhopal city with reference from article (Dhote K K et al., 2013); In order to create a reproducible intervention tool, the study conducted in Bhopal, a city chosen by JNNURM, looked at urban regeneration options through expert-led conversations and analysis. Key findings show that slums need to be reorganized to fit city patterns, government housing can maximize existing open spaces, and inner-city districts need to be decongested. Slums require renovation because of incompatible land uses, government housing adheres to formal designs, and mixed land use is valued in inner cities. In order to achieve effective and context-sensitive urban redevelopment, interventions should concentrate on the local level and integrate social and cultural elements with physical infrastructure.

## 4.2 Bahir Dar City of Ethiopia

Bahir Dar city was found intensively studied in Ethiopia, some relevant studies were taken in account for the research. By (Wubie et al., 2020); the study evaluated LULC changes using spectral and object-based imagine classification, exposing inconsistent horizontal built-up area development brought on by unsuccessful traditional land treatments. While sociological data verified that present land regulations and behaviors are important but constrained drivers of these developments, spatial data (1993–2020) demonstrated that urban sprawl varied among peri-urban zones.

Another study of (Haregeweyn et al., 2012b); the study examined at how land use/land cover (LULC) and small-scale farmers in peri-urban areas were affected by urban expansion in Bahir Dar, Ethiopia. In addition to analyzing LULC changes triggered by sprawl and densification (1957–1994), it sought to determine the pace and extent of

urban growth (1957–2009) and the impact of expansion on the livelihoods of local farmers.

### 4.3 Bhutan

From the study of (Tempa, n.d.) on Gelephu, situated in the Himalayan region using a Random Forest classifier in QGIS, the study examined changes in land use and land cover (LULC) in interval of 2016 to 2023. OpenStreetMap data and Sentinel-2 imagery were used for validation. The findings revealed a 75.11% decrease in healthy vegetation and a 5.65% increase in urbanization and a 15.05% urban growth. Future concerns for sustainable urban development are highlighted by this study, which is the first to map the area's LULC and NDVI.

From the study of (Gilani et al., 2015) on Overall Bhutan; this study used object-based image analysis of Landsat data to examine changes in Bhutan's land cover between 1990 and 2010. Ten categories of land cover were identified using a defined classification system; the 2010 map had an accuracy rate of 83%. According to the results, afforestation was primarily responsible for the 1,174 km² increase in forest cover over the course of two decades, with Bumthang District seeing the most benefits. Currently, 51% of Bhutan is under conservation, while 75% of the country is covered by forests and scrublands. The significant increase in forest cover during the study period was largely driven by ongoing afforestation initiatives. The study also highlights the potential for future replication, given the expected availability of new satellite data for continued monitoring and analysis.

# CHAPTER FIVE: **CASE STUDY AREA**

Accumulation of all services and facilities in the Kathmandu Valley, functionality and governance been still centralized although, been nearly decade of deceleration as decentralized government, this valley has pressure, pressure of supply and demand. All this has led to chaotic and unplanned urban growth in the valley, which has taken a serious toll on the environment. It has also worsened urban poverty and left a growing number of people vulnerable to multiple risks, like natural disasters and poor living conditions. To tackle these challenges and strike a better balance between growth and sustainability, the government has stepped in. It has introduced a new urban development strategy focused on building cities that are not just expanding, but also safer and more resilient. The plan includes fresh programs aimed at supporting the growth of emerging towns, city centers, and the fast-changing edges of the valley. To study its implications, for this research I have chosen Dhapakhel as Case Study area.

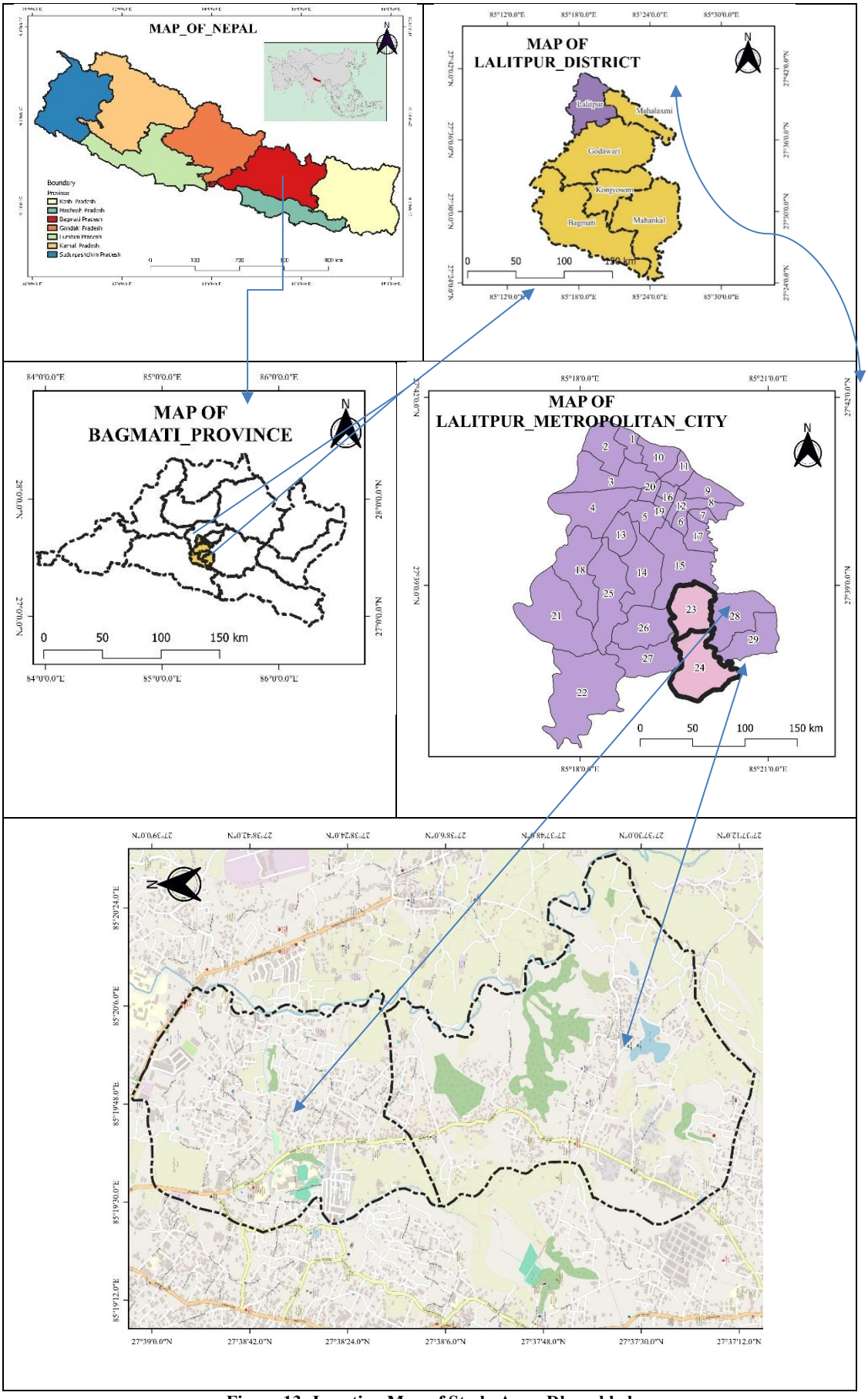



**Figure 13: Location Map of Study Area, Dhapakhel**

### 5.1 Introduction

Dhapakhel lies in South west region of Lalitpur Metropolitan City including two different wards; 23 and 24. Previously it was Dhapakhel village Development committee, wards 1 and 2 are merged to form LMC ward-23 and wards 3,4,5,6,7,8 and 9 were merged to form LMC ward-24. On boundaries at North LMC ward-15, East LMC ward-28 & 29, West LMC ward-26 &27 and South Godawari Municipality with total area of 3.671 Sq Km. Lagankhel is nearest market space from Dhapakhel which is 4km way. Geographically it lies in 27.64 N latitude and 85.33 E longitude with lowest elevation of 1259 m and highest elevation of 1381 m. Elevation difference in this area has both props and cons on the land-use and infrastructure planning. Kodku-Karmanasa is the major river of this area with other two small rivers, Mahadev Khola and Gangatee Khola. These rivers act as the administrative boundary of Dhapakhel. Nagdaha and Akhidaha are only eclosed waterbodies found in this area. Dhapakhel was zoned as residential area by LMC but this place possess potential in farming and have lots of open spaces with beautiful water bodies in south-east part although the northern part are fully occupied by the built-ups. The land use of Dhapakhel in map below defines the area as residential area with significant cultivation area in low lands. This study area has experience of all sort of development such as Agriculture and research center at gateway, Transformation of Industrial area into residential, Real State housing programs, Government's Land development program, gradual expansion of old settlement, conversion of land-use. I find this area a studable case for how pattern of urbanization and infrastructure planning accommodate on the livability of society.


2014

**Figure 14: Spatial Change captured in 2014 (Source: Google Satellite Image)**


2024

**Figure 15: Spatial Change captured in 2024 (Source: Google Satellite Image)**

## 5.2 Population

Ward wise population distribution

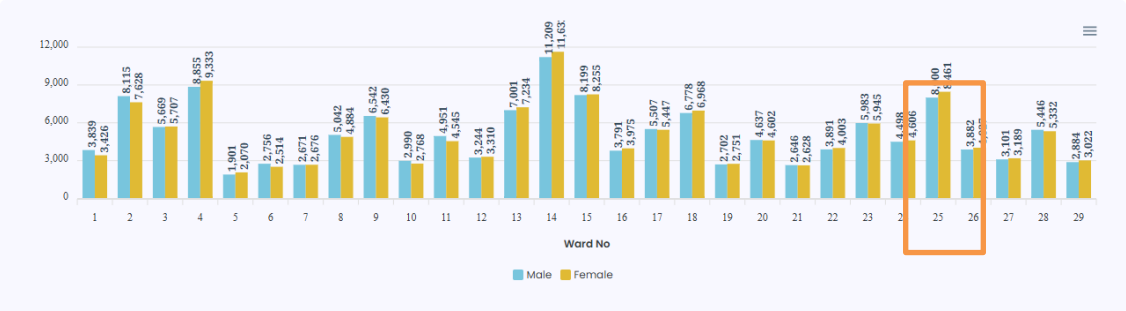



**Figure 16: Ward wise Population distribution, Census 2021 (Source: National Population and Housing Census 2021)**

**Table 4: Population and Population Density(Source: National Population and Housing Census 2021)**

| Ward | Area (Sq Km) | Population | | | Number of households | Average household size | Population Density (per Sq Km) | Sex ratio |
|---|---|---|---|---|---|---|---|---|
| | | Total | Male | Female | | | | |
| 23 | 1.4696 | 11928 | 5983 | 5945 | 3205 | 3.72 | 8116 | 100.64 |
| 24 | 2.2022 | 9104 | 4498 | 4606 | 2252 | 4.04 | 4134 | 97.66 |


**Figure 17: Population distribution of Dhapakhel (Source: National Population and Housing Census 2021)**

**Table 5: Data of Absentee Population(Source: National Population and Housing Census 2021)**

| Ward | Usually Absent within county Population | | | Usually Absent Abroad Population | | |
|---|---|---|---|---|---|---|
| | Total | Male | Female | Total | Male | Female |
| 23 | 224 | 121 | 103 | 935 | 579 | 356 |
| 24 | 117 | 78 | 39 | 676 | 447 | 229 |

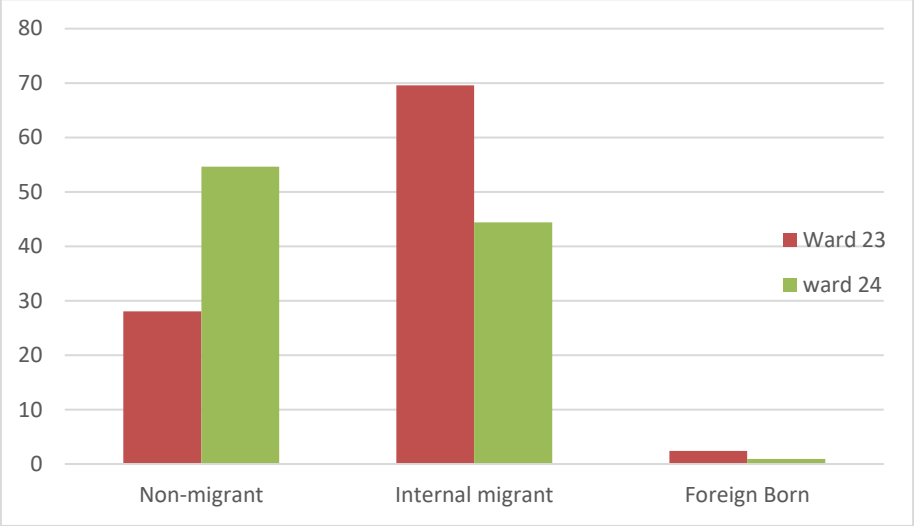



**Figure 18: Status of Life-time Migration (Source: National Population and Housing Census 2021)**

### 5.3 Social Structure

This area is common residence area for all caste, ethnicity and religion with majority of Newar and Chhetri community. Majority of Hindu is seen but other religions are also heartly welcomed here with significant Temples and Churches. This area celebrate jatra on Holi festival which was originally derived from Hatisidhhi Jatra.

### 5.4 Settlement Pattern

In this study area there is varying slope land. In traditional old time high land were use for settlement and low land for cultivation, which is still visible in this area but the new plots and plans have distorted such pattern emerging of haphazard settlements. Some observational change been detected in the study area and interpreted as in figures below.

**Figure 19: Diminishing Traditional Pattern of Residents**

**Figure 20: Farmland transforming to Residential Plots**

**Figure 21: Loss of older Settings**

**Figure 22: Row Housings**

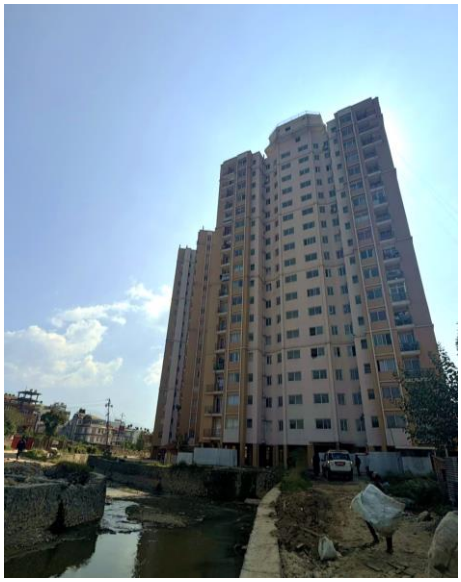


**Table 6: High Rise Residentials**

### 5.5 Institutions and Services

In this study area there are 4 government school and 10 Private Schools among them for change in the urban pattern GEMS School, IJ Pioneer School and KEC College have greater impact. Sumeru Hospital in only hospital and for minor health care government run 2 Health post in this area. For street dog care there is an institute called *Sneha Kaakha*. Apart from this there are significant *Upabhokta Samiti* for infrastructure development, *Samuha* for women uplifting and other local *Guthis* and *Mandali*.

# CHAPTER SIX: **OBSERVATION AND DATA COLLECTION**

## 6.1 Observations

The study area was first performed desk study with available map and satellite images. Later physical field visit conducted to observe all necessary aspect and decide the need of other source and methods on data collection. This area is have mixed change, northern part has completely engulfed by the urban expansion possessing it like inner fringe whereas the southern part of this area has blended characteristics of peri-urban. In as a whole Dhapakhel is urban fringe that is undergoing in process of urban expansion, where green areas are gradually converting into houses without any planning of basic services.

### 6.1.1 Urban expansion and Road Network

This area is gradually developing as residential area as there is seen expansion of urban and migration from rural. On increase of demand, land plotting seen to be carried out extensively without consideration for planning basic service; this led to unregulated road networks degraded quality and no thought for walkability. Worst condition of road and non-regulated public transport system have added congestion in this area.

**Figure 23: Condition of Road**

### 6.1.2 Natural Drain

Khodku-Karmanasa is the major river that flows along south to north boundary line of Dhapakhel, which serves most of agriculture area here. Either bank of river has potential in agriculture but transportation lacks here, but on going downstream of river corridor development work started. On start of corridor development all agriculture land transforming to industrial and commercial contributing pollution to the river.

**Figure 24: River Encroachment**

Mahadev Khola is small non-perennial river that flow down from Balkumari Forest area but no concern been taken for this river as very few people acknowledge it as river because it appears as conduit in some area due encroachment. This can have adverse effect on environment and people.

### 6.1.3 Existing Agriculture

Low lying area are still busy in agriculture due to availability of water for irrigation. Seasonal crops and cash crops area prevalent in this area, in souther-eastern part floriculture have significance in this area.

**Figure 25: Agriculture practices**

### 6.1.4 Pollution

Degrading Green areas, depleting forest, uncontrolled development and river pollution have adverse effect on living standard of this study area. Fast pacing to developing the fringe area without consideration of environmental factor has made urban fringes more vulnerable.

## 6.2 Primary Data Collection

This approach focuses on understanding how current land use in the urban fringe—and the policies and interventions that shape it that are actually working on the ground. To get a clear picture, information was gathered through focus group discussions (FGDs), interviews, and questionnaires, all aimed at capturing how land use decisions are made and how they're affecting the area. The results of the questionnaire and the analysis of

the spatial data were supplemented by a FGD and an interview. FGD was held with selected residence with guidance of local representatives, 1 group discussion in each group was conducted with consent of photo and recording. A summary of the conversation given to the participants later served to validate the response. Interviews were conducted with the aim of observing the opinions, experiences, and suggestions of land-related institutions and land zoning on the fringes of cities and land use interventions. In order to gather primary data on the impact and efficacy of the current urban fringe land use change and intervention process, both open-ended and closed-ended questionnaires were created.

**Table 7: Response of Focus Group Discussion and Interviews**

| | | | |
|---|---|---|---|
| 1 | Interviews with Concerned Individuals | Interview of five persons from each ward. Including Public elective representatives, Old Knowledgeable and surveyor. | This summarized as they showed concern about the basic services and some key points on implementation of building by laws and land fragmentation system. |
| 2 | Focus Discussion with Residents | Two groups of six residents were consulted about the issues affecting the wards' quality of life. | The male respondents brought up the issues of poor services, narrow roadways, and development gaps. The female respondents expressed concerns about garbage disposal, street lighting, and bias in local training and participation. |
| 3 | Sample Survey | Targeted to 50 samples for fulfilling gap on knowhow from group discussion. | Updated to gather more information on interventions and its Effectiveness for Governing Land Use Dynamics. |

### 6.3 Spatial/Secondary Data

Research used satellite imaging data to evaluate LULC and NDVI and carry out change detection analysis for Dhapakhel. Satellite product availability was investigated and Level A Sentinel-2 satellite multispectral data images from the years 2014and 2024 was obtained from the USGS Earth Resources Observation and Science (EROS) Centre website (https://ers.cr.usgs.gov/). In order to reduce cloud interference, the satellite photos were chosen with a cloud coverage range of 0-5% in the study time frame onto the study area, with a focus on the drier months. Based on the fundamental observations and developments in both urban and rural areas, the dates were purposefully chosen with the intensity of growth and expansion. The table-8, below lists the 13 spectral bands that the Sentinel-2 offers, which have spatial resolution products of 10 m, 20 m, and 60 m.

**Table 8: Sentinel-2 spectral bands (Source: https://custom-scripts.sentinel-hub.com/)**

| Sentinel-2 Bands | Central Wavelength (µm) | Resolution (m) |
|---|---|---|
| Band 1 - Coastal aerosol | 0.443 | 60 |
| Band 2 - Blue | 0.490 | 10 |
| Band 3 - Green | 0.560 | 10 |
| Band 4 - Red | 0.665 | 10 |
| Band 5 - Vegetation Red Edge | 0.705 | 20 |
| Band 6 - Vegetation Red Edge | 0.740 | 20 |
| Band 7 - Vegetation Red Edge | 0.783 | 20 |
| Band 8 - NIR | 0.842 | 10 |
| Band 8A - Vegetation Red Edge | 0.865 | 20 |
| Band 9 - Water vapour | 0.945 | 60 |
| Band 10 - SWIR - Cirrus | 1.375 | 60 |
| Band 11 - SWIR | 1.610 | 20 |
| Band 12 - SWIR | 2.190 | 20 |

### 6.4 Data Projection and Processing

The coordinate reference system (CRS) of the study region is defined in this project utilizing Geographic Information System (GIS) technology, precisely using

EPSG:4326; WGS 84 / UTM Zone 45N. This CRS is part of the Universal Transverse Mercator (UTM) system, which segments the Earth's surface into 60 longitudinal zones, each spanning 6 degrees. UTM Zone 45N covers the area between 84°E and 90°E in the northern hemisphere, extending from the equator up to 84°N, and includes parts of Bangladesh, Bhutan, China, India, Kazakhstan, Mongolia, Nepal, and the Russian Federation. The system is based on the WGS 84 ellipsoid, a globally recognized reference model commonly used for accurate positioning and mapping. This coordinate reference system, specific to the designated UTM zone, offers a precise and localized foundation for various GIS operations, including mapping, spatial analysis, and data integration. In flow chart below, shows the methodological implementation of LULC.

Normalized Difference Vegetation Index (NDVI) and Land Use Land Cover (LULC) data were acquired, pre-processed, and post-processed for the study, which included statistical analysis and change detection. For these analysis, two different sets of Sentinel-2A satellite imagery were used. The Semi-Automatic Classification Plugin (SCP) in QGIS was used to process each dataset. The first step was converting the calibrated digital number (DN) values from the Sentinel-2 bands into reflectance. These reflectance values were then used to generate color composites essential for image classification. “The generated composites aided in identifying Regions of Interest (ROI), which were used to create training datasets for the Random Forest (RF) classification algorithm, Specifically, composites such as band combinations 4-3-2 (true color), 5-6-2 (healthy vegetation), 5-4-3 (infrared vegetation), and 7-6-4 (false color for urban analysis) were examined and utilized during the classification process” (Tempa, n.d.) .

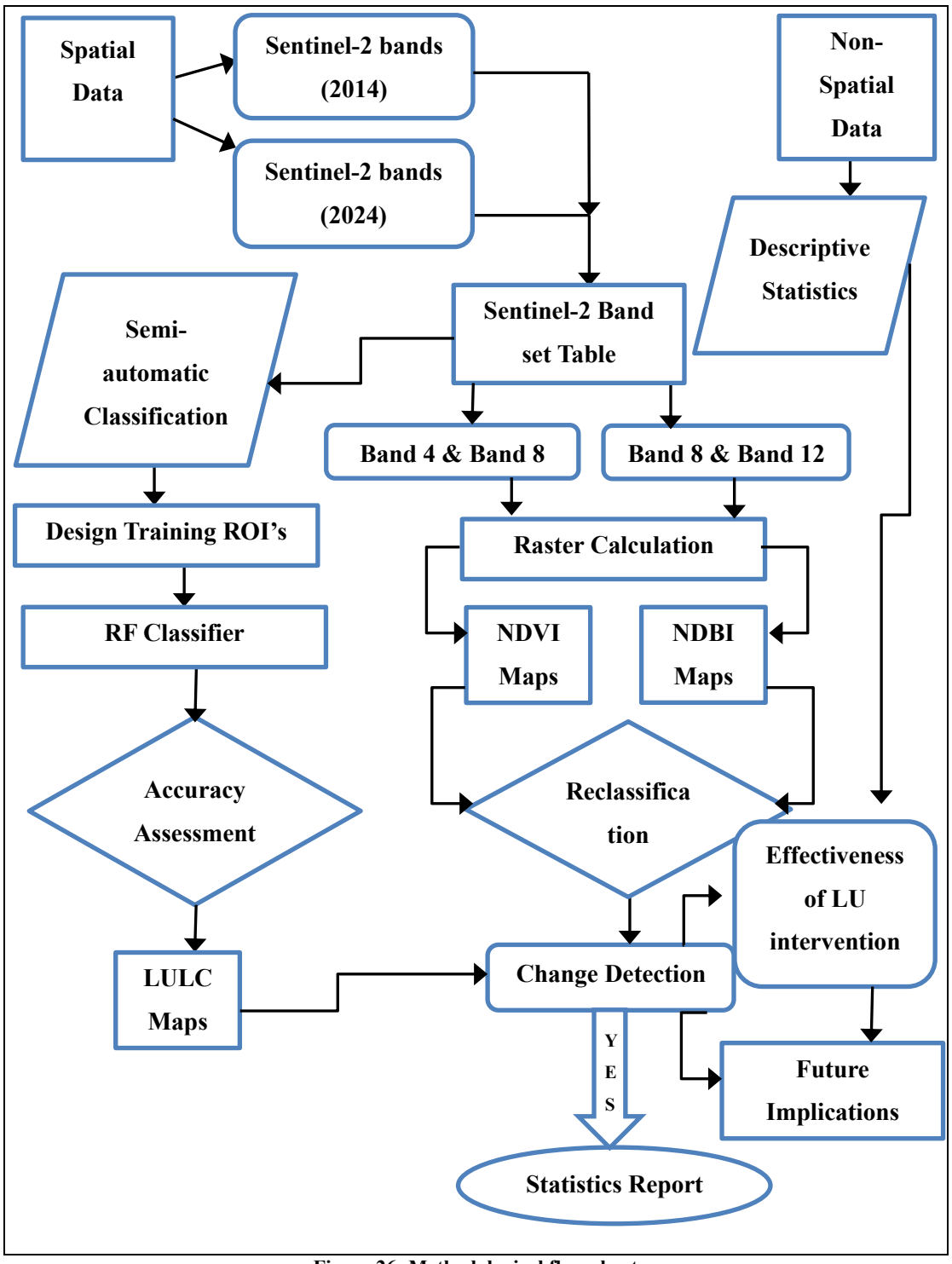



**Figure 26: Methodological flow chart**

**Random Forest classifier** (Tempa, n.d.) "Efficient classifier selection is required for successful image classification to classify the spectral signature features. RF classifier, a machine learning algorithm, is widely applied as it offers efficient and high performance resulting in high accuracy of the classification model (Piao et al., 2021). In machine learning, the typical workflow involves dividing the dataset into two parts: the training set and the testing set. The distinct training set is used to train the machine

learning model, while these testing set are used to evaluate its performance and generalization ability on unseen data that executes an ensemble learning method based on a decision tree, combined with massive ensemble regression and classification trees (Talukdar et al., 2020).”

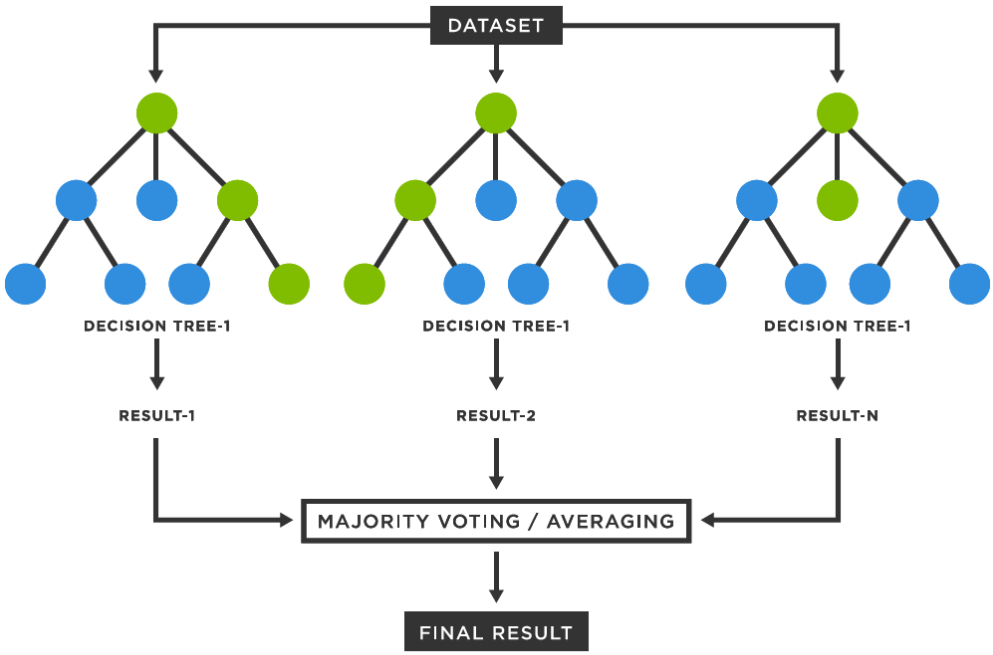



**Figure 27: Classification tasks for the ROI classes using RF(Tempa, n.d.) .**

**LULC classification,** as seen in the above tree diagram, the main focus of LULC classification in the framework of the GIS-based SCP is the categorization of ROI classes using the Random Forest (RF) algorithm. The Semi-Automatic Classification Plugin (SCP) in QGIS is specifically designed for image classification and land cover mapping. It employs a semi-automated approach, enabling users to guide and refine the classification process interactively. This iterative workflow continues until the desired classification accuracy is achieved, with particular emphasis on optimizing the training dataset and enhancing the performance of the classification model.

| Land Use/Land Cover Classes | Description |
|---|---|
| Built-ups | Areas that have an artificial cover/uses resulting from human activities such as constructions of all kind, urban fabric, industrial, commercial, residential, transportation units and other construction sites |
| Farmlands | Areas that are used for crop cultivation and other heterogeneous agricultural/farming areas |
| Vegetation | Areas that have a vegetative cover consisting of woody, trees, shrub or herbaceous, sparse forest and vegetation association |
| Open and green areas | All open spaces with little or sparse vegetation, including artificially vegetated green areas |
| Wetlands | Waterlogged ecosystem/areas either permanently or seasonally |
| water bodies | Areas that are covered by lakes, ponds, and rivers |

**Table 9: Type and description of land use/land cover classes (Source: FAO)**

**NDVI and NDBI:** For this classify of vegetation and built-up particular band were selected which later raster calculations were performed using specific algorithm.

"NDVI=(NIR-RED)/(NIR+RED) and NDBI=(SWIR-NIR)/(SWIR+NIR)"

The results from the raster calculations were reclassified to derive specific indexes. With a range of -1 to +1, the Normalized Difference Vegetation Index (NDVI) was one of the main indices utilized. NDVI helps estimate how rainfall affects vegetation over time and is also used to assess rangeland capacity, crop yields, and overall environmental quality.

Additionally, built-up areas have been studied using the Normalized Difference Built-up Index (NDBI). NDBI values also range from -1 to +1, where higher values signify built-up regions and lower values represent non-built-up land. The NDBI was categorized into two groups for this study: one is built-up and another is non-built-up. This binary classification is useful for mapping urban expansion, spotting areas for potential development, monitoring urban change over time, and distinguishing between urban and rural zones.

Visual representations of these indexes for the study area are presented in Chapter 6.

### 6.5 Validation

In this study using a quick validation procedure, the true color composite from a 2024 Sentinel-2 image was combined with Open Street Map (OSM) data in this Land Use and Land Cover (LULC) study. The validation process took into account, in part, the footprint of buildings in the built-up regions. In order to verify the LULC map's accuracy, two sets of building polygons were compared. The vast majority of building shapes that matched pixels on the LULC map of Dhapakhel were categorized as built-up due to the lower clarity of the 10 and 20 m pixel resolution. This method complies in the study area, as the area has not much varying and does not consist unique features of land covers.

# CHAPTER SEVEN: LAND USE CHANGE ANALYSIS AND DISCUSSION

## 7.1 Patterns and Spatial of Vegetation Areas

The study of patterns and spatial change of vegetation in Dhapakhel Vegetation index been classified to identify the different spatial patterns of distribution around the study area. Interpreting the patterns which helps in the urban planning and sustainable land use management. Sentinel-2 satellite images from 2014 and 2024 were used for the decade change study in order to determine the vegetation dynamics in Dhapakhel. One of the best indicators of the density and condition of the vegetation is the NDVI, which is obtained from remote sensing satellite imagery. The NDVI is computed using a raster calculator and the QGIS software as the ratio of bands 4 and 8. The primary obtained ranges were reclassified by table representing 0 to 6 indexes. The 0 is water bodies, 1 is barren land and 2-6 are distribution pattern of vegetation over the computed area. The obtained value is summarized in report in form of pixels, area and percentage occupied, finally the mapping was done that is presented below in figure and also in tabular form.

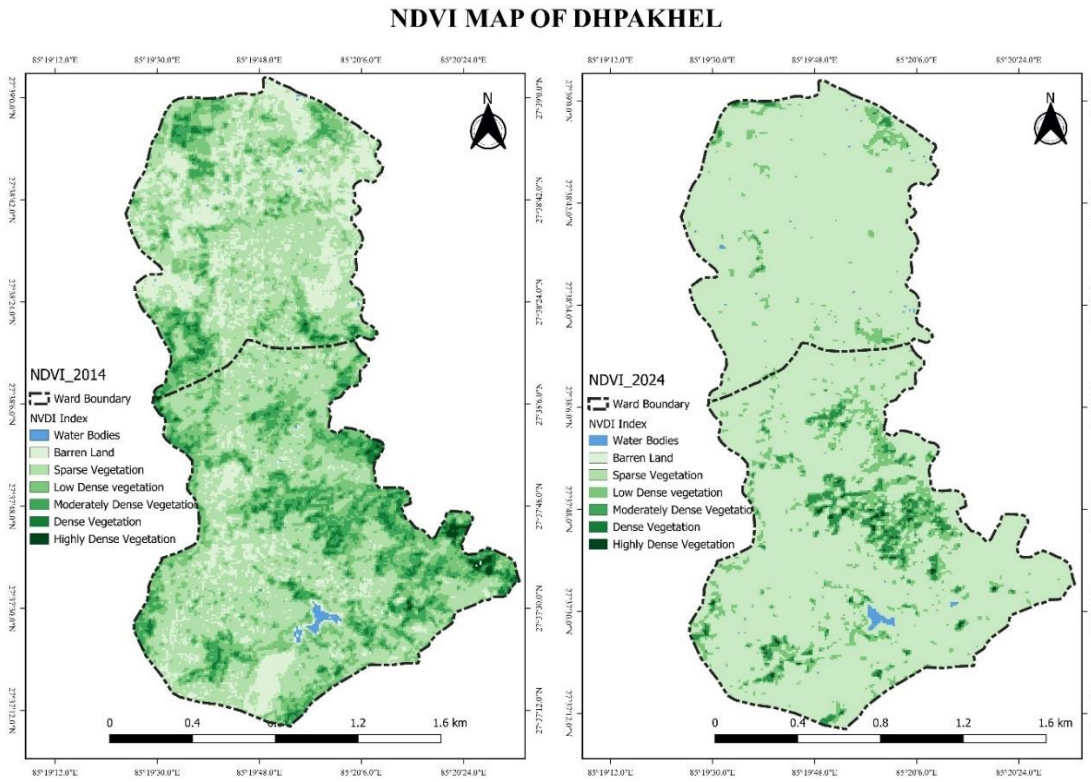



**Figure 28: Map showing Vegetation Areas**

This map shows the visual difference in the vegetation mapping of 2014 and 2024. The shades are more clear in 2014 but the change is clearly seen in the 2024 map, further the map was reported in data form which showed us that there is random change in the vegetation cover over the decade. From 2014 to 2024 barren land has increased by 2.559 Sq. km area resulting to change the space from 0.6327Sq km to 3.1922Sq km, which indicate the dynamic in change of land cover. As barren land has significant increase and also indicating the diminishing of vegetations as we can see in the table, this clearly says that the vegetation been transforming to the lands/ plots, which within short time might get converted to buildings and roads. Out of total area in 2024,86.96 % cover is been classified as land which indicate in loss of green spaces and there might consequences of it. Also factors like climate, soil type, topography, and human intervention shape these spatial distributions, influencing biodiversity, ecosystem stability, and land management practices.

**Table 10: Spatial Change in Vegetations of Dhapakhel**

| Vegetation Index | Vegetation of 2014 | | Vegetation of 2024 | | Spatial Change in Sq Km |
|---|---|---|---|---|---|
| | Area (Sq Km) | % covered | Area (Sq Km) | % covered | |
| Water Bodies | 0.0129 | 0.35 | 0.0112 | 0.31 | -0.0017 |
| Barren Land | 0.6327 | 17.24 | 3.1922 | 86.97 | 2.5595 |
| Sparse Vegetation | 1.7133 | 46.68 | 0 | 0 | -1.7133 |
| Low Dense Vegetation | 0.8031 | 21.88 | 0.3408 | 9.29 | -0.4623 |
| Moderately Dense Vegetation | 0.4007 | 10.92 | 0 | 0 | -0.4007 |
| Dense Vegetation | 0.0945 | 2.57 | 0.1163 | 3.17 | 0.0218 |
| Highly Dense Vegetation | 0.0128 | 0.35 | 0.0098 | 0.27 | -0.003 |
| Total | 3.6704 | 100 | 3.6704 | 100 | |

### 7.2 Patterns and Spatial expansion of Built-up Area

The spatial expansion and the built-up area's pattern of urban fringe in Dhapakhel is computed by the Sentinal-2 of 20m resolution imageries using the SCP and raster calculation in QGIS software. Likewise, NDVI, NDBI is also computed in similar way, this gives the expansion form of the built-up to know as the built-up areas can expand in different spatial patterns, including linear, radial, clustered, and leapfrog patterned development. For such interpretation the Sentinal-2 Band of 2014 and 2024 image was considered and processed to know on the areas weather there is built-up or not.

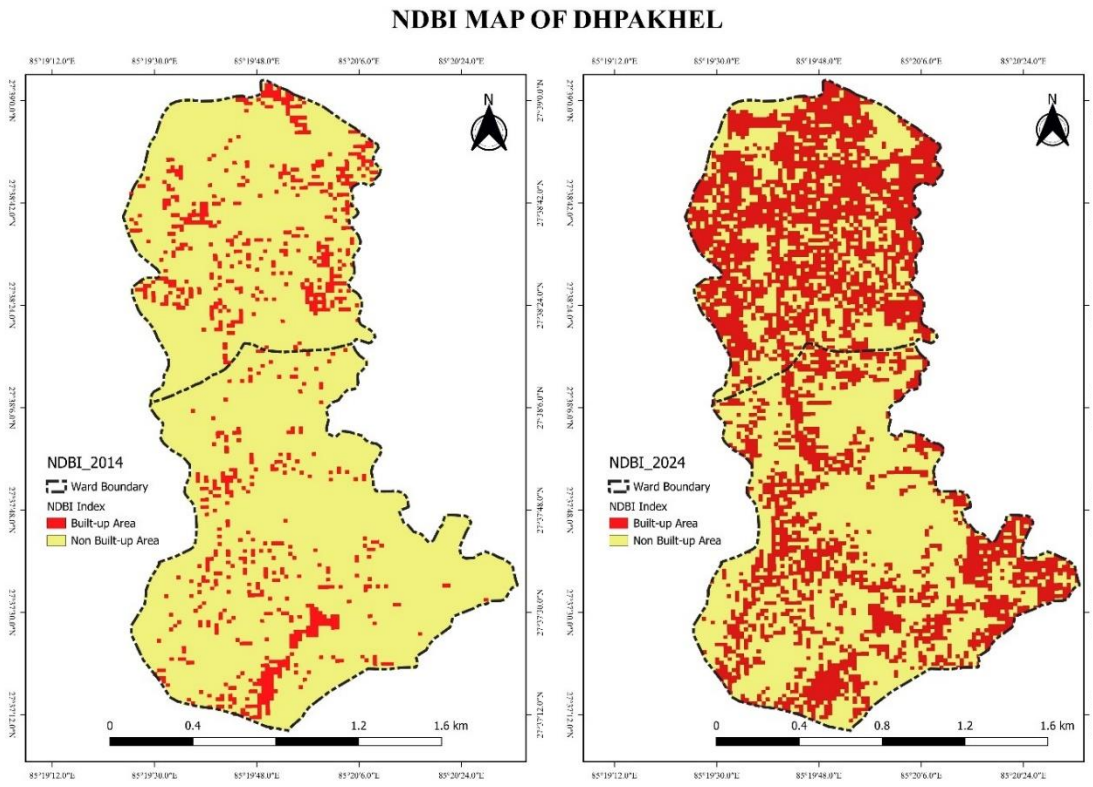



**Figure 29: Map showing Built-Up Areas**

As from the NDBI mapping this result on the sprawl of the built-up area, preliminary stage it was liner along the main road, then gradually the space was developed, north area seems to obtain saturation in near future where south area is partially built-up and partially non-built-up forms. From the tabular data change id built-up area in dhapakhel has changed from 0.37 Sq km in 2014 to 1.629 Sq km in 2024, which is nearly 77% change. This area indicates houses and roads which gives the picture of construction of road lead the people to build houses and vice versa, in the name of development in urban fringes the previously *Goreto bato* are expanded to 13ft and 20ft roads nevertheless of necessity and usage of that road, this is the result of multiple institution involvement in the fringe area. From map it is more vivid that the built-up are newly emerged on corridor area as the corridor are is mostly occupied by informal settlements. In east Kodkhu- Karmanasa flows along south to north and in west there is Mahadev Khola. Meanwhile, in ward 23 Karmanasa corridor work have made lot of progress so the area there is more in Red on map as in site we can find the industrial activities along the corridor. Unlike in ward 24 there is no corridor work yet observed so the space have agriculture in plain land and land arrangement works in steep lands

**Table 11: Spatial Change in Built-up area of Dhapakhel**

| Built-up Index | Built-up of 2014 | | Built-up of 2024 | |
|---|---|---|---|---|
| | Area (Sq Km) | % covered | Area (Sq Km) | %covered |
| Built-up Area | 0.3700 | 10.08 | 1.6290 | 44.38 |
| Non Built-up Area | 3.3004 | 89.92 | 2.0414 | 55.62 |
| Total | 3.6704 | 100 | 3.6704 | 100 |

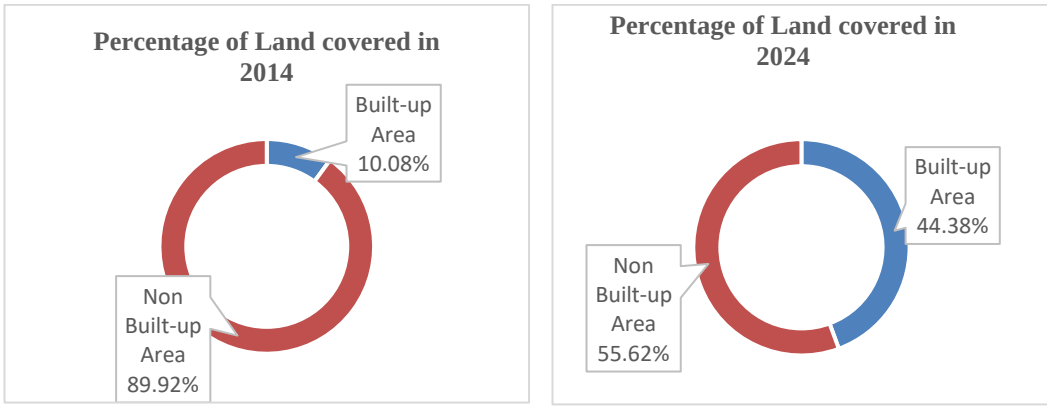



**Figure 30: Graphical Representing Change in Built-up area of Dhapakhel**

In addition, a rather inconsistent pattern of accumulated expansions was noted tackling in north being ring-road within close range and east development corridors and following the main road at center, especially irregularly increase away from the main road due to road expansion in main road (Satdobato to Thecho road), people prefer to stay way from noise. The Nagdaha area is preserved as natural resource as well as social belief lies within. The area except steeped land are hardly seen open and cultivable as people prefer renting/ selling spaces rather than investing efforts. The results show that the growth of built-up areas doesn't just drive the outward spread of urban spaces; it also shapes the way people interact with the land. This involves both formal planning processes and informal, often unplanned, growth. The patterns and spread of urban areas are closely tied to key factors like the presence of main roads and the area's natural topography, which influence where and how development happens. The expansion of built-up areas outside the metropolis, despite the presence of open spaces within, indicates inefficiencies in land use management and intervention processes. This uncoordinated growth results in fragmented, disputed, and unregulated land development, particularly in urban fringe areas. Such patterns contribute to disorderly urban expansion, leading to challenges in infrastructure provision, environmental

sustainability, and governance. Spatial analysis further illustrates these trends, showing how built-up areas grow in a manner that reflects weak planning controls and land management strategies. Thus the spatial expansion of built-up areas can consistently impact dynamics of land use.

### 7.3 The Spatial Dynamics of Urban Fringe Land

The dynamics of spatial features in the urban fringes has been studied and has been area of interest since urbanization. The study in LULC of Kathmandu valley is no difference in pattern and implications. From 1990 to 2019, forest and agricultural lands, followed by built-up areas, were the predominant land covers in the study area. A primary driver of changes in land use and land cover, which has resulted in the transformation to farm and forest lands, is the fast growth of urbanization. Additionally, there has been a significant decline in water bodies, highlighting the urgent need for adaptation and mitigation strategies (Wang et al., 2020). “Between 1990 and 2020, Biratnagar, Janakpur, Kathmandu, Nepalgunj, and Rajbiraj experienced an overall increase in built-up areas, primarily at the cost of vegetation and agricultural lands; In contrast, cities like Bharatpur, Birendranagar, Dhangadhi, Ghorahi, Hetauda, Pokhara, and Tulsipur saw a decline in agricultural areas, while built-up areas and vegetation expanded” (Devkota et al., 2023b). like was in other studies the LULC map obtained from Sentinel-2 from 2014 to 2024 have not unique change, this illustrates the dynamic of land feature of urban fringe. The analysis was computed for the last decade using Semi-classification tool of QGIS. As distinctly shown in Land use map of Dhapakhel, 2014 was dominated by green area where as 2024 is predominated by the red area.

From 2024 to 2024 (Fig 31), vegetation i.e. forest is decreased from 2.2196 Sq km to 0.856 Sq km resulting in increase of cropland from 0.7208 Sq km to 1.271Sq km and built-up from 0.73 Sq km to 1.5432 Sq km. in comparison the built-up areas have drastically increased from 2014 to 2024. Over the course of the last ten years, 1.363 square kilometers of land area have been transformed to either cropland or built-up area in both regular and irregular patterns.

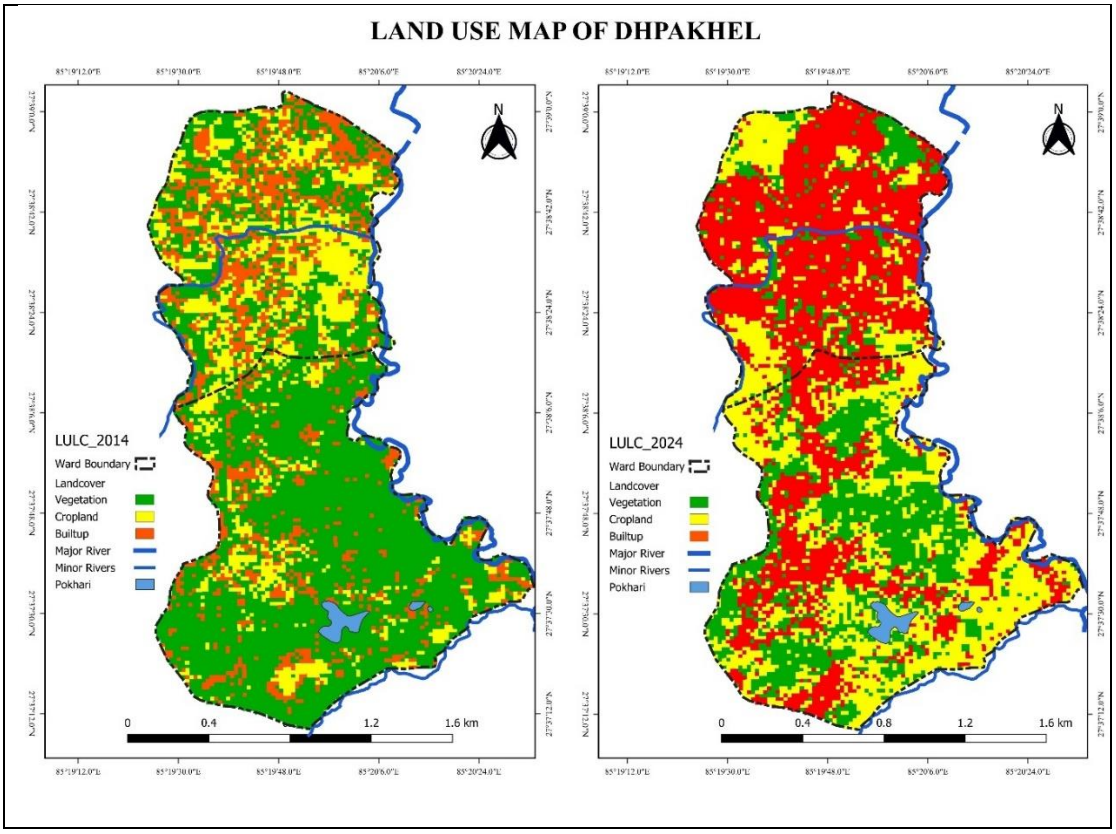



**Figure 31: Land use Map**

The south-west and south-east corners showed particularly regular patterns of built-up expansion. This implies that the expansion of built-up areas, frequently at the expense of alternative land uses, has been significantly influenced by current land intervention processes. With a relatively high rate of conversion in peri-urban areas, the land use analysis's findings demonstrate that informal land use interventions are a key driver of these changes. “The rapid and unplanned expansion of settlements in certain areas presents significant risks, particularly from flooding in low-lying, flood-prone zones and from seismic hazards in areas with soils prone to high liquefaction potential” (Alam et al., 2020). In studied interval of years, rapid urban expansion has led to substantial alterations in land use patterns, particularly within the study area. Within these transitional zones, the spatial dynamics of various land use patterns show significant diversity, showing a complex interaction between the forces of urban development and lingering rural features. “Before developing an urban core, the majority of the rural hinterland experienced a phase of being on the outskirts of cities” (Long et al., 2022). This study offered a method by combining the development of land size, pattern, and density. Determining the urban fringe can aid in precisely comprehending the urban growth pattern, which is crucial for integrated development planning.

**Table 12: LULC statistics for Dhapakhel**

| LULC | LULC of 2014 | | LULC of 2024 | | Spatial Change in Sq Km |
|---|---|---|---|---|---|
| | Area in Sq Km | Percentage covered | Area in Sq Km | Percentage covered | |
| Vegetation | 2.2196 | 60.47 | 0.8560 | 23.32 | -1.3636 |
| Cropland | 0.7208 | 19.64 | 1.2712 | 34.63 | **0.5504** |
| Built-up | 0.7300 | 19.89 | 1.5432 | 42.04 | **0.8132** |
| Total | 3.6704 | 100 | 3.6704 | 100 | |

### 7.4 Dynamics of land use change and Impact of land use change

Landcover is changing one type of land use to another or converting natural areas into built environments (such as agriculture or urban development). Population, transportation development and the land values have been the determining factor for these dynamics in urban fringe. The development often follows transportation corridors, with irregular growth influenced by legal and illegal settlements. Improved infrastructure, such as roads and public utilities, accelerates land value appreciation and attracts further investment. However, unplanned expansion can lead to environmental degradation, loss of green spaces, and socio-economic disparities. The interaction between formal urban planning and informal land occupation plays a critical role in shaping the spatial organization of these areas, making it essential for policymakers to implement sustainable strategies for managing urban fringe growth. Here is the result illustrated on the environmental changes noticed by residents due to land use changes in Dhapakhel.

**Table 13: Major Drivers of LULC change in Dhapakhel**

| | | |
|---|---|---|
| 1 | Population Growth | Increased demand for housing, infrastructure, and resources |
| 2 | Urbanization | Expansion of cities and urban infrastructure |
| 3 | Industrial Development | Shifting of old industries out of metropolis and developing area as residential. |
| 4 | Corridor Development | Economic activities concentrated along corridor hence linear growth occur |

| | | |
|---|---|---|
| 5 | Earthquake | Transforming of new houses along old and new settlements |
| 6 | Policy Implementation | Flexible policy and lagging implementation generate gap in development. |

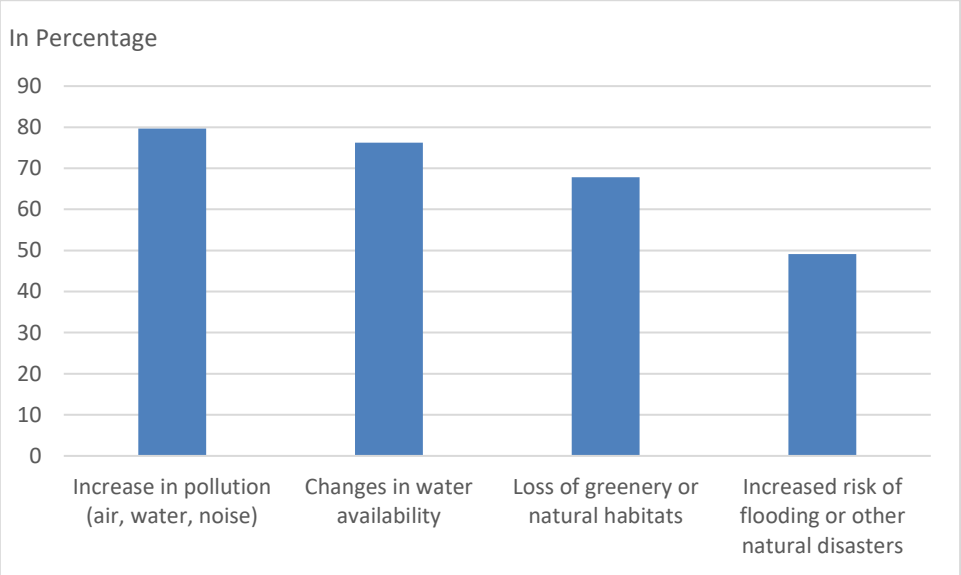



**Figure 32: Environmental changes noticed due to LULC change**

In urban fringe, as in the study area there are changes observed by the transformation scene, places have been developed as residential and road network have increased in mobility having said that the negative impact have dominance over positive expect so, this research have prior study on the problem arise by the land use change and to go through to identify possible solutions. From survey the impacts are been listed as shown in fig.33.

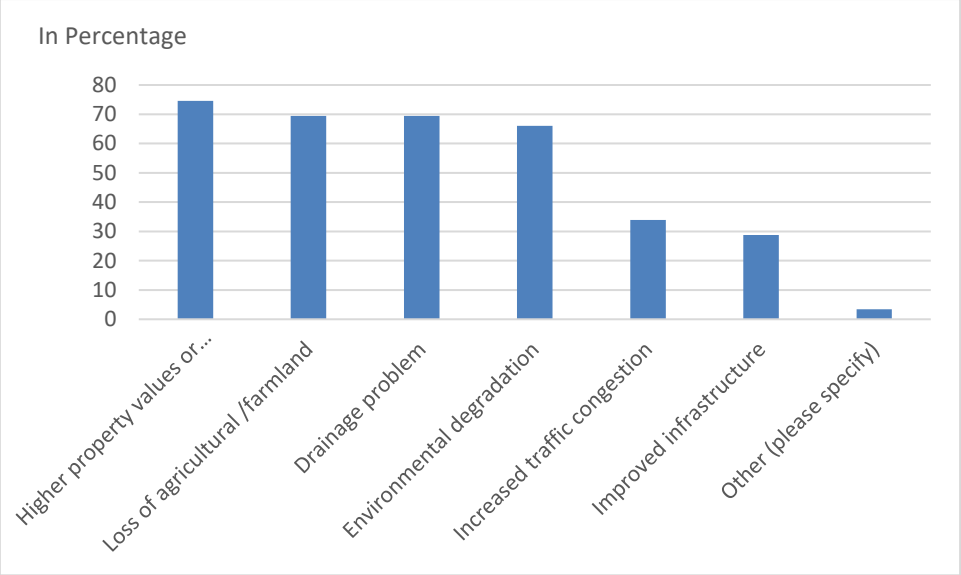



**Figure 33: Impacts of land use change**

**Table 14: Response of FGD and Interview on the dynamics of land-use change and the problem facing by them.**

| S.N. | Determinants | Result / Responses | Implications |
|---|---|---|---|
| 1 | Housing | Height of building has no such restriction. | Uneven skyline and feel of dominance. |
| | | FAR is considered during building permit by Local. | Pre developed plots follows minimum of 4 aanas |
| | | Engineered drawing is accepted. | |
| | | Road aligned houses are mixed-use, other are solely residence. | Linear development |
| | | Ward 23 have larger number of migrated residents in compare to ward 24. | Demand of Basic services |
| | | New area for residence was developed and plotted after removal of Brick Industry in ward 23. | Uneven as well as unsuitable slope of plots |

| | | | |
|---|---|---|---|
| | | Old settlement have larger plot with house and farms and Mostly new settlement have newly built houses with a not a single temple and social space | Change in social Structures |
| 2 | Road | Karmanasa Corridor and Road of Satdobato-Dhapakhel is 10-12m and other are min. of 10-12ft, narrow roads. | Traffic congestion, no alternative wide route in case of block of main road. |
| | | In old Settlement roads are expanded by contribution but new settlement were planned by developers with plot and roads. | |
| | | Does not follow any pattern, goes along plot shape. | Providing of enough width in bent and curves. |
| | | Except some roads in old settlement all road are either earthern or gravelled, difficulty to travel druing rainy days. Main roas connecting Satdobato to Dhapakhel first portion in ward 23 was paved few months before but another portion in ward 24 have bumpy roads. | Upliftment of road condition |
| | | Some roads such as Dhapaheight, udhyog marg, karmanasa marg and other are under upgrading level(concreting). | Feel like entering in tunnel, narrow section and both side walls. |
| 3 | Land Development | Minimum Plot size rule is accepted and implemented | |
| | | Government / public lands are either transformed into community building or recreational space. Some are inaccessible due to unsuitable topography | Priority must be given to open/ social spaces |
| | | Vacant lands are polluted with waste and often seems as dump yards. | Land either be used or be provided for open and play space |
| 4 | Water Supply | Old settlement have water supply from lele, that services weekly basis, | Identification of alternative source in vicinity |

| | | | |
|---|---|---|---|
| | | In new settlement, Pipe line been layered few years ago in all new settlement but no supply of water as all depend on either wells or buying tankers. | |
| | | Certain area is steep so gravity flow is mostly impossible from downs stream source and upstream source have not sufficent water as increase of populations. | |
| 5 | Drainage | Underground drainage was actively constructed 4/5 years ago along every roads. | Quantity/ Volume and usage check |
| | | Septic tank is most in every house hold, waste water from soak pit are only allowed to discharge in drain. | |
| | | Designed for storm water only but as decrease in open area resulted in heavy storm water glow. | Redesign is required to calculate new volume and predict future flow as well |
| 6 | Waste management | Sirjansip's staffs are doing their job right in collection on scheduled basis. | |
| | | not strict rule for segregation but it depent on individuals to segregate organic and non organic waste. | Allow segregation rule in-house/ individual |
| | | Old settlement still organic waste are decomposed by own, but in new areas land insufficiency so all waste are collected. | Use of modular organic waste decomposing vessel |
| | | Collection center is located beside Karmanasa river. | Monitoring body be deployed |
| 7 | Residential Satisfaction | Lesser sense of belongingness and social structure are dispersed in new settlement area in compare to old settlement. | Adult get busy in their work, children and elders need social space to play and interact. |

| | | | |
|---|---|---|---|
| | | Elder citizen are happy to reside in this locality, as they get much more facilities from local govt. | |
| 8 | Willingness to Improve Condition | The residents pay taxes and are prepared to contribute to infrastructure upgrades. | Encouragement of community involvement |
| | | Seeking for opportunity in community participation in any decision making. | |

### 7.5 "Land Intervention process and its Effectiveness for Governing Land Use Dynamics"

In order to determine if a clear and contextual land use policy (LUP) or legislative framework for land use allocation and intervention has been formed, empirical data on land use intervention processes were gathered through group discussions, questionnaire surveys, and interviews with household sample. This intervention entails setting aside land for particular purposes, such agriculture, commercial, industrial, or residential. The kind and number of developments permitted in certain locations are governed by zoning laws. Beginning by browsing the area's government's or local municipality's official website. These websites frequently offer information on zoning regulations, annual development plans, and bylaws in national level rather than in particular context of fringe area. So, engaging with community leaders, civil society organizations, and activists can help you understand how land interventions are perceived on the ground and their impact on local populations of the study area.

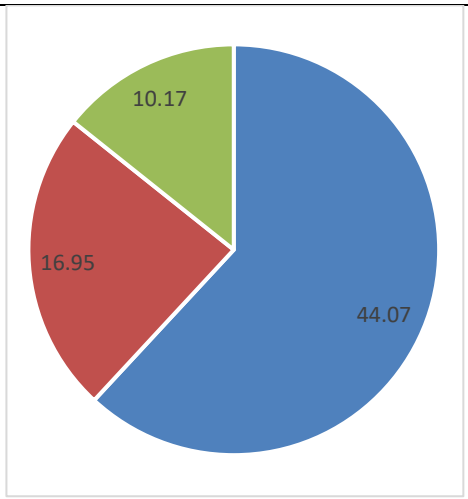
On interview both ward chairperson stated that the zoning regulation and land cover related decisions are made on suggestion of the ward representative and they registered Dhapakhel as residential area. Surveyor said that Ward-23 have not any land remain to be arranged, all are either plotted or construction been happened but ward-24 have most of agricultural land that still people depend on it. Ward-24 informant stated "I still clearly picture that houses were at high land and low land were for agriculture, but there seen shift of houses in cultivable land. Southern east part of this ward the space is renowned for floriculture and *daha* area for vegetable. First the land shifted in renting

for horticulture and Livestock farming, then they needed road for it, they made road for access some were in trace maps some they bought on mutual understanding after they left the land did not shift back to old form but turned into housing plots. The process and no intervention resulted on the road and plots as we see today. What could be done now after the rice been cooked, now it will decay."

Further, FGD and KII can summarized that the intervention on land rearrangement, road track opening, land transfer and acquisition, land rent and building bylaws are considered but these are been revised as per requirement and need of the specific area by local government. Rules and regulations are flexible here so these are overlooked until the minor issues does not create any problem. Even LMC Mayor stated on anniversary function of LMC that "Dhapakhel is the part of LMC, to say this I feel ashamed off, road is prime identity of any reason but it made Dhapakhel uninhabited". Bad condition of road and the water insufficiency are the major problem arose in discussion. On taking about this condition ward chairperson made DOR and KUKL responsible for it. On reality check the cause is not that, the cause is unplanned housing and unintegrated development. Other informant also supported on the issues that been raised and they also suggested for integrated method to be adopted in land use plan and enforcing intervention related to it. Further, the discussion concluded on issues and some set of their own knowhow to address the issue through intervention method with support of local government and public participation.

**Table 15: "Effectiveness of the existing LU framework for governing the rate and extents of land use dynamics"**

<table>
<tr><td rowspan="2">Responses</td><td colspan="2">"How do you Evaluate the effectiveness of the existing land use change or the Land Intervention Practice for governing the rate and extent of Land Use Dynamics in Urban fringe Areas?"</td><td rowspan="2"></td></tr>
<tr><td>Frequency</td><td>Percentage</td></tr>
</table>

| | | | |
|---|---|---|---|
| Moderately Effective | 26 | 44.07 |  |
| Ineffective | 10 | 16.95 | |
| Effective | 6 | 10.17 | |



To assess the impacts of current urban fringe land use dynamics and intervention processes, a sample was taken using six different indicators, with responses rated on a 5-point scale ranging from "strongly agree" to "strongly disagree". Statistically, the majority of sample respondents agreed that the certain changes has improved in their access to basic services. Similarly, this change and lack of proper intervention have greatly affected on the socio- structures of local communities in fringe. The respondent strongly agreed on the increasing energy and water stress in the study area. In the same way, local government representative also stands out on increasing demand of water and unable to provide adequate and clean water on regular basis as the residents are bound to buy water from out private sources. Likewise, urban fringe being interest of all authorities due to dynamic character of fringes local, federal and provincial institution invest in fringe area creating overburden development and fragmented responsibilities on operation and maintenances. Most of respondent agreed that existing land use intervention in urban fringe is creating fragmented institutional responsibilities. In addition to this gap in development was considered major loop hole of urban fringe development and proper binding law is required to integrate the development work, also many respondents agreed on the landuse change of urban fringe and ineffective intervention have consequence and resulted in gap in infrastructure development. In the same way informant also came up with the gap in development of whole nation as Nepal missing in the Industrial revolution era and creating pressure in fast urbanizing within targeted timeframe. It is conceivable to draw the conclusion that Dhapakhel's current urban fringe land intervention framework is insufficiently suitable

and complaint to monitor and regulate the spatial expansions of built-ups and undesired land use dynamics based on both spatial and non-spatial data analysis and debates thus far.

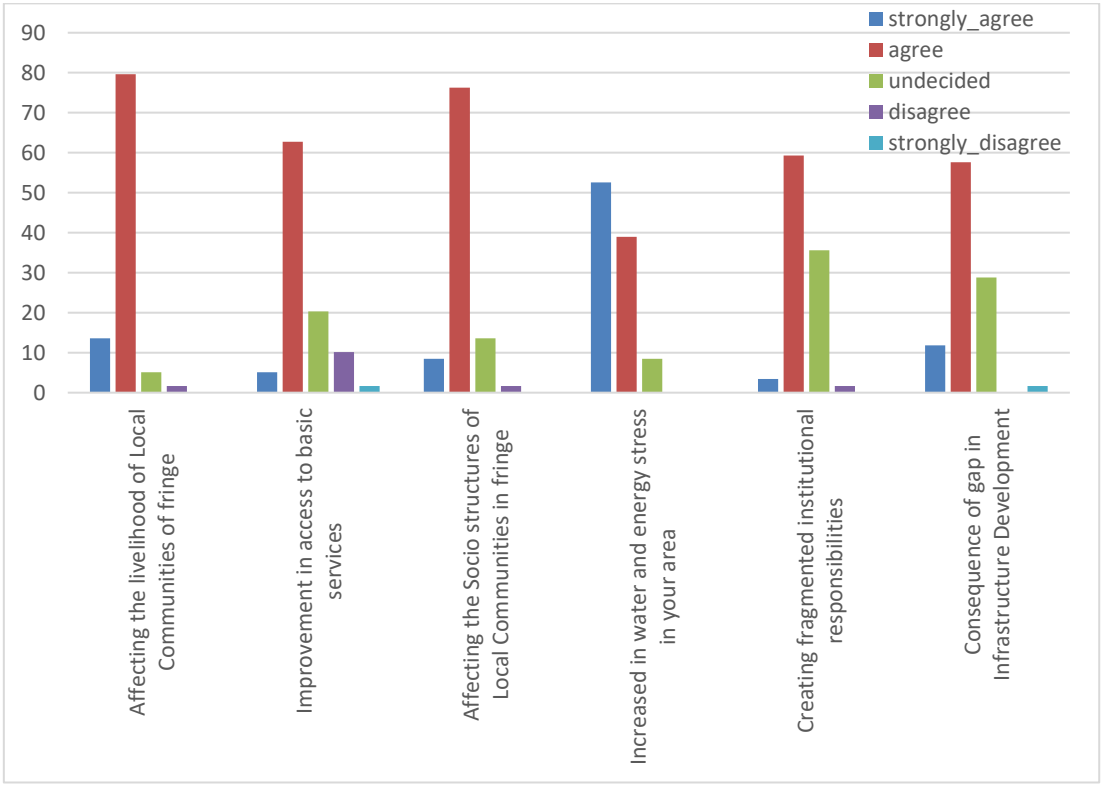



**Figure 34: Impacts of the existing Urban Fringe land use intervention process**

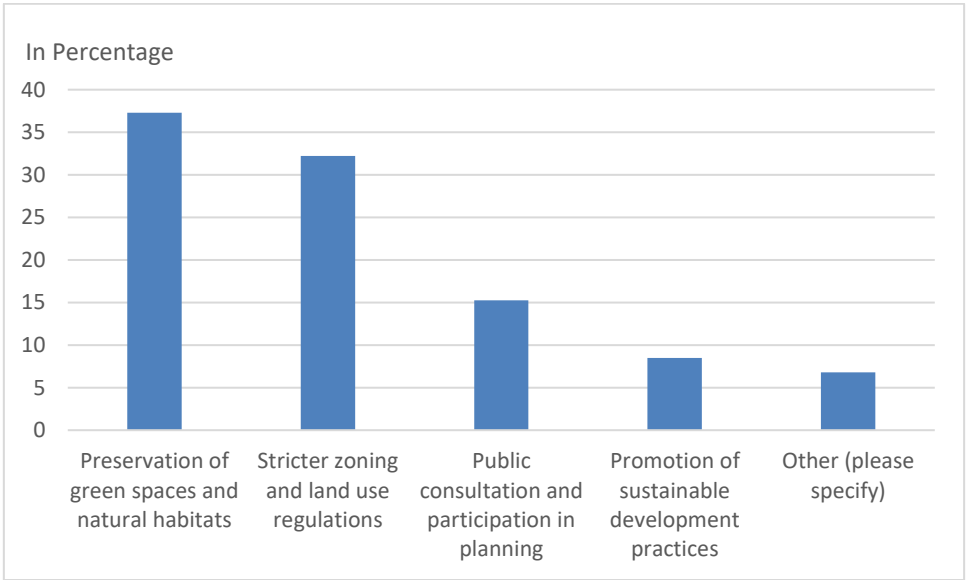



**Figure 35: Measures be taken to minimize negative impacts of land use changes**

The methodological approach is strengthened by this investigation, which gives it a stronger empirical foundation. Differences in severity and frequency throughout urban fringe areas during the past ten years are revealed by the spatial analysis, which amply illustrates the consequences of horizontal expansion along road networks and the changing patterns of land use. In addition, the non-spatial analysis provides insight into the techniques of land use intervention, which are found to be substantial contributors to the changes that have been seen. Regardless of location, this combined strategy can be used to other areas with comparable features and aid in the development of comprehensive land use management plans supported by efficient regulatory and monitoring systems.

# CHAPTER EIGHT: **FINDINGS AND DISCUSSION**

In case of LULC change of urban fringe, Dhapakhel, showed the transformation of land use change of vegetation has been observed more than other. The change in vegetation to cropland of 0.973 Sq km as shown 26.51%; cropland to built-up 0.813 Sq km as shown in 22.16%; and change in vegetation to built-up of 0.39 Sq km as shown in 10.63% in graph.

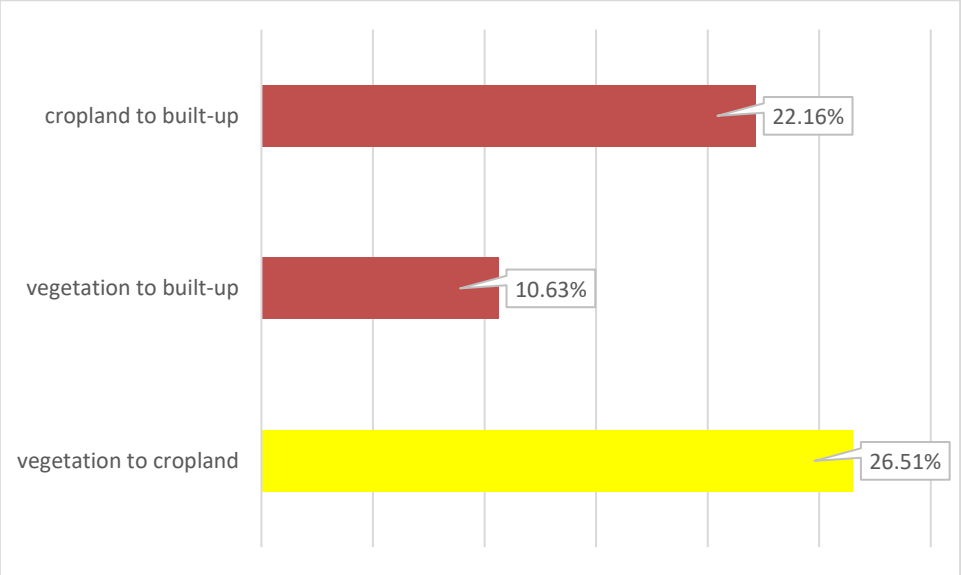



**Figure 36: Transformation of Land use in Dhapakhel**

Above figure clearly showed the land being transformed, and there's been change and if this continues without any plan and planning there might cause adverse effect in the population and the environment.

**Table 16: Key Findings of the study in Dhapakhel**

| **Land-use Change** | | **Problem observed due to change in Land-use** | **Intervention needed on** |
|---|---|---|---|
| Before (2014) | Present (2024) | | |
| Agriculture / Barren land | Residential | Demand of Housing and Infrastructures | **Water Supply System** |
| | Roads | Low Quality, Congestion and Pollution | **Drainage System** **Congestion** |
| | Public Spaces | Inadequate Open spaces | |

| | | | |
|---|---|---|---|
| | Commercial | Congestion and Pollution | |
| Industry / Built-up | Mix Residential | Uneven distribution | |
| | Commercial | Congestion and Pollution | |
| | Institutions | Congestion and rental demands | |

Based on the analysis and discussion in Table 14, key findings have been identified through interviews and on-site discussions and also to narrow the focus and prioritize sectors for intervention. Accordingly, Table 16 has been prepared to support further conclusions and recommendations.

### 8.1 Stress on Water Supply

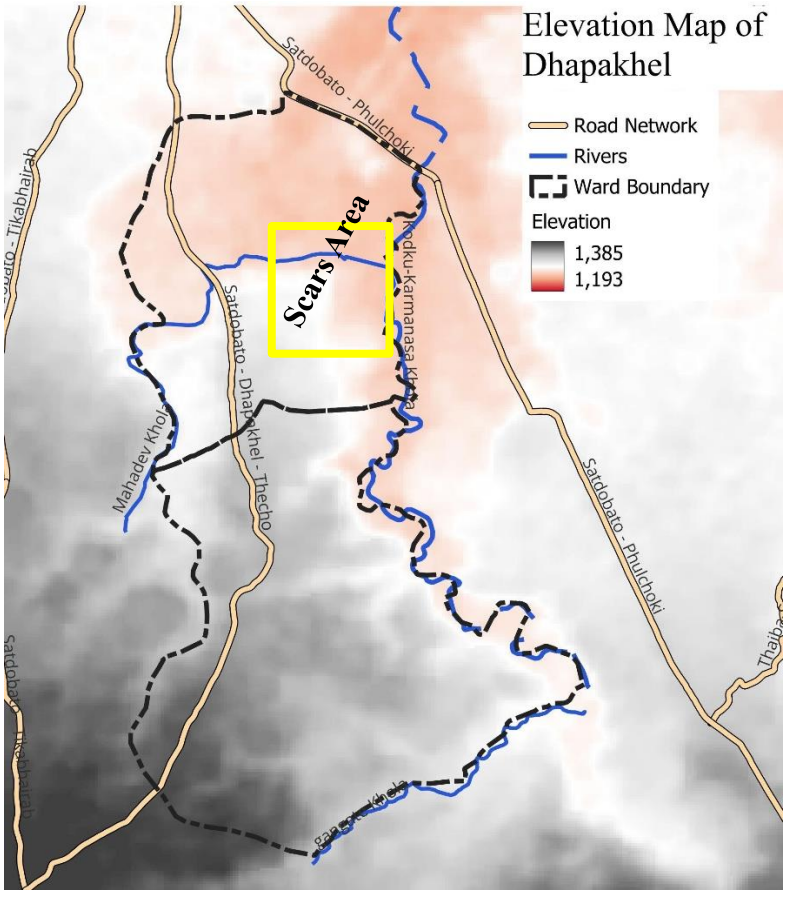



**Figure 37: Plan Showing Stress in Water Supply**

Rapid urban expansion, unplanned infrastructure development, and population growth in this study areas significantly impact water resources. Changes in land use, such as

the conversion of agricultural land into residential, commercial, and industrial zones, create stress on water supply systems, affecting both availability and quality.

Centralized system is in practice in this area, Lele (Source 1) is prime source for drinking water in this area, being only source in downstream of Lele, quantity is not sufficient to meet today's population of this area also in future there may arise conflicts between urban and rural communities over water resources. About 800 Household have not been provided with water supply although connection been made years ago so, the required 0.7MLD quantity can be distributed through Melamchi (Source 2). Slope has been major challenge here for these household as they are new resident in east side, being technically feasible nevertheless of the slope, being uneconomic this is still in consideration.

### 8.2 Drainage Management

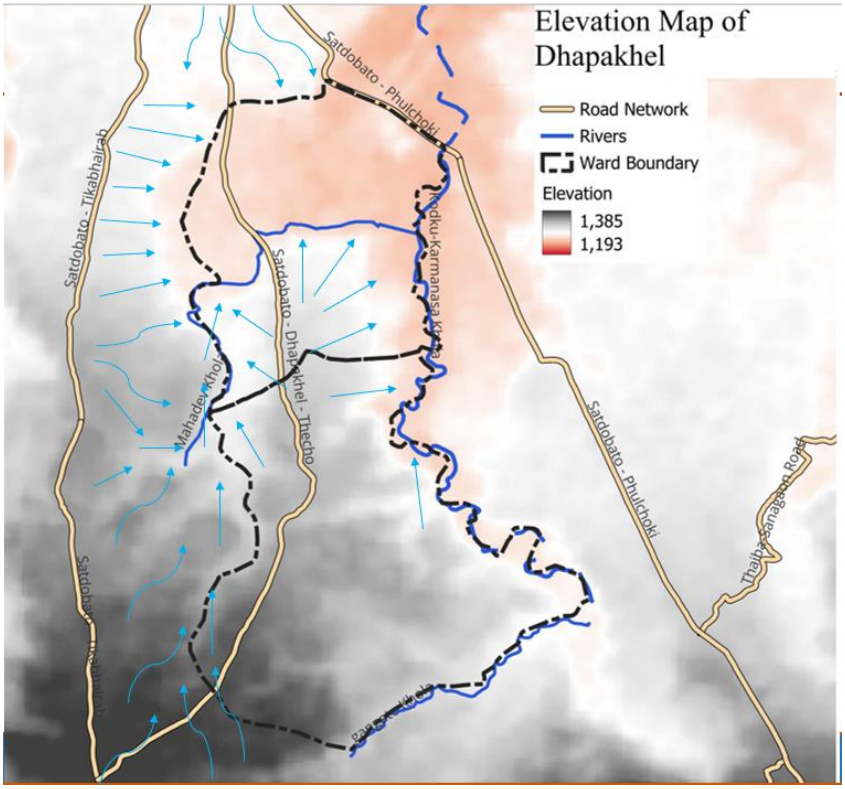



**Figure 38: Map showing Storm water Flow**

Drainage management has been a issue due to land use change in the urban fringe are a growing concern as cities expand, this is no very new in case of Dhapakhel. But its identical to other urban fringe area, as this area gets flooded during rain as area lies in low land and natural flow pattern has been disturbed by the built-up and infrastructure

construction also urbanization replaces permeable soil with impermeable surfaces like concrete, reducing natural infiltration and increasing runoff.

As shown in above fig. the red shaded area is low land and lighter to darker shade of grey represent increasing elevation, slope in this area is about 25 degrees in almost area so water from upstream flow downstream in lesser time as the flow direction is shown in the fig. above. Drainage concern is more on the red shaded area, because existing drainage systems been undersized and outdated, struggling to handle increased stormwater loads, as surface runoff rate is more than infiltration rate. On tentative calculation it is to said that 1.805 Sq km area as its major nearer catchment area (residential and agricultural) runoff volume is about 7.23 m3/s. Only natural drain in this area has not been maintained it's Right of Way (ROW), it has been treated as sewer. In case of heavy rain, it cannot handle the quantity itself and additional urban storm water need to be planned in managed way.

### 8.3 Congestion

Rapid and unregulated development have led to inefficient road networks in Dhapakhel and Mixed land use have increases traffic volume, these are creating congestion in this area. Road to Satdobato -Thecho is only 2-lane road in this area but this road is in phase of expansion but due to some underlying reason it has not upgraded, resulting in absence of footpath and bumpy road in addition the time regulation of public transport does not seem to follow because to travel 3km distance, public transport takes 35 minute, so here public transport being traffic itself. In addition, the narrow 3.5 to 4m roads are prominent in this area so if anyone need to alternative route to travel its stressing especially in ward 23 as the area is mostly occupied.

# CHAPTER NINE: **CONCLUSION AND RECOMMENDATION**

## 9.1 Conclusion

The study attempted to understand the dynamics of land-use change in urban fringe setting on particular context with acknowledging the problem aroused by the transformation. In other words, land use, transportation, and population are the main drivers of urban growth, especially in the periphery. The study found that there is a need for integrated urban planning strategies due to changes in land-use, the growth of built-up areas, changes in urban forms, deficient infrastructure, and changes in physical standards. The foundation of integrated urban planning is a comprehensive strategy that unifies numerous areas, including land use, transportation, housing, the natural environment, and economic development. It emphasizes livability and inclusivity, with the goal of creating communities that are equal, accessible, and tailored to meet the needs of its residents. Another essential element is integrated mobility, which emphasizes smooth transitions between walking, bicycling, and public transportation to lessen reliance on cars and improve connectedness. In order to guarantee that planning is open and representative of local opinions, community involvement is essential. Resilience is crucial because integrated urban planning foresees problems and adjusts accordingly to create cities that are not just operational but also prepared for the near future.

The findings of this study reveal that rapid land use change from past decade in urban fringe areas has placed significant stress on water supply, drainage management systems and rising congestions. The conversion of agricultural and natural land into urban infrastructure has increased water demand while simultaneously reducing groundwater recharge areas. Additionally, unplanned urban expansion has led to inadequate drainage systems, resulting in frequent flooding, waterlogging, and pollution of water bodies. The roads are constructed without any planning and consideration of urban standards, which have now derived congestion.

To address these challenges, it is crucial to implement integrated planning strategies that prioritize sustainable water management. This includes adopting nature-based solutions such as green infrastructure, rainwater harvesting, and upgrading drainage systems. Strengthening policy frameworks and enforcing land use regulations can also ensure that urban expansion and consider challenges.

Overall, the study underscores the urgent need for holistic interventions to balance urban growth with sustainable water resource management, ensuring resilience and environmental suitability in urban fringe areas.

### 9.2 Recommendation

On the basis of findings, it is concluded that unplanned and uncontrolled urban growth are the main cause for land use change, there is need to intervene existing practices which are not suitable to maintain sustainable development of urban fringes. If the current situation and patterns of uncontrolled land use change continue for the next decade, the urban infrastructure, especially water supply and drainage systems will come under severe stress. The ongoing transformation of open areas and wetlands, and farmland into urban developments is likely to diminish groundwater recharge zones, causing a significant drop in water availability. This situation may lead to persistent water scarcity, particularly during periods of high demand. At the same time, drainage systems often fail to keep pace with rapid urban expansion, resulting in insufficient capacity. This mismatch can cause frequent flooding, waterlogging, and health risks due to stagnant or contaminated water. Furthermore, prioritizing dense urban construction without proper transportation and infrastructure planning can worsen traffic congestion. In the long run, this may reduce urban efficiency, heighten pollution levels, and negatively impact residents' quality of life. If these trends continue without strategic policies, integrated planning, and infrastructure improvements, cities may become increasingly vulnerable to the pressures of climate change and growing populations. Here are some recommendation to incorporate the loss in near future,

#### 9.2.1Water Distribution Management

Water distribution through gravity has never been problem for lowland area but for high elevation there is been issue, but this can be resolved by construction of overhead tank then collection by pumping be done and the distribution be followed be gravity flow system. Overhead tank be constructed in such a space that it be feasible for both pumping and distributing system for those area. For economic recovery, water tariff be decided as per necessity.

Beside this, community system/ decentralization can also be practiced in the area for

sustainable water source which has been effective in Chandragiri Municipality and Tarkeshwor Municipality.

**9.2.2** Rainwater Harvesting

Dhapakhel has average minimum annual rainfall of 1233.014mm measured at Khumaltar station, this is enough for RWH, have potential and can be applicable in commercial and public buildings even in individual households. Beside this Water harvesting/ Rainwater harvesting can be made mandatory in this area as this provision been discussed in Basic guidance on building construction,2072, cl-14.20. Thus, this water be use in domestic purpose in this area as well as enhance groundwater recharge. Some examples:

| | |
|---|---|
| Rain Water Harvesting schemes in Rural Nepal | Within districts especially concerned with use of water for drinking purpose program under UNDP |
| India (specially in Chennai) City-wide Rainwater Harvesting Mandate (Implemented in 2003) | The government made it mandatory for all buildings to install rainwater harvesting (RWH) systems to recharge groundwater.<br>Impact: Helped Chennai replenish its water table and mitigate severe water shortages. |

9.2.3 Artificial Groundwater Recharge Zones

Protect and restore natural recharge areas such as wetlands, green spaces, and permeable zones to improve water availability, this can be carried out in up-steam area where there is still unused sufficient public land. This need community participation and government intervention on such activities when will provide a good measure on groundwater table recharge as well as it help on holding of storm water and prevent direct flow to low lands.

Some examples:

| | |
|---|---|
| Case of Kirtipur and Sunakothi | Scientifically: Recharge zones<br>Culturally: Festive and beliefs associate to ponds |

| | |
|---|---|
| Managed Aquifer Recharge (MAR) – Perth, Australia | Wells and infiltration basins for treated wastewater and stormwater to recharge aquifers |
| Rotterdam, Netherlands, Water Squares (Benthemplein) | A public space designed to store rainwater temporarily during heavy rainfall before it gradually drains into the ground.<br><br>Impact: Prevents urban flooding, enhances aesthetic appeal, and promotes community engagement. |

9.2.4 Upgrading Drainage Infrastructure

Implementing green roofs, permeable pavements, and rain gardens to enhance infiltration in household/plots and upgrading stormwater drains might give solution for this issue in Dhapakhel. But the storm water needs to be traced toward the major river to prevent recurring disaster. Local Government should initiate a plan to calculate quantity of storm water flow and to prepare storm water flow map with expert and knowledgeable, which then be implemented, if it is not possible to do so for single entity, state and federal government should also provide technical and financial effort. Also, the existing natural stream be made open with including right of way of river on both sides which help in effectiveness of artificial drain too.

| | |
|---|---|
| Mumbai, India Brihanmumbai Storm Water Disposal System | Upgrades to the old British-era drainage system with larger stormwater drains and pumping stations.<br><br>Impact: Helps reduce monsoon flooding, though ongoing improvements are still needed. |
| Tokyo, Japan, G-Cans Project (Metropolitan Area Outer Underground Discharge Channel) | A massive underground tunnel system designed to manage excess stormwater and prevent urban flooding. |

| | |
|---|---|
| | Impact: Protects Tokyo from heavy rains and typhoons by redirecting floodwaters to nearby rivers. |

Invest in modern drainage networks with improved capacity to handle increased runoff from urbanized areas.

9.2.5 Urban Road Design

The road along Satdobato-Thecho is declared as urban road by DOR, so the possible works be done on the existing road by both federal and local collaborative planning. Road expansion was planned but it cannot go through due to lagging intervention and enforcement of local government. This need to go as plan so that road be paved with all street furniture in it, so that there be not conflict between pedestrian and car people, in addition, origin and destination time keeping must be strict on its duty so that people might prefer public transport over private vehicle. Initiatives by Kathmandu Metropolitan city be good example for expansion and for beautification of urban roads.

9.2.6 Low-Impact Development (LID)

Promote urban designs that reduce impervious surfaces and encourage eco-friendly construction. This is possible alternate solution which need federal and province level involvement and participation that need to address on planning phase.

| | |
|---|---|
| Copenhagen, Denmark, Cloudburst Management Plan | Implementation of permeable pavements, underground reservoirs, and stormwater parks to manage extreme rainfall.<br><br>Impact: Protects the city from heavy rain-related flooding while improving urban resilience. |
| Chicago City Hall Green Roof (USA) | A 38,800 sq. ft. green roof installed to manage stormwater and reduce heat effects.<br><br>Impact: Lowers urban temperatures, absorbs rainwater, and improves energy efficiency. |

| | |
|---|---|
| China, Wuhan Sponge City Project | Integration of green roofs, permeable pavements, and wetland restoration to absorb rainwater and prevent flooding.<br><br>Impact: Improves urban water management and resilience against extreme weather events. |

### 9.3 Future Research Direction:

Due to the limitation of scope and the time frame, the data of this study can further be used for more comprehensive studies and there exist additional scope for the further research.

- It is recommended that future research be conducted on analysis and evaluation of social and economic transformation of the area.
- Further on the transforming Social-structure and its implication on planning.
- This research can be used for comparison analysis to forecast future decadal results, presuming comparable circumstances and specific constraints.

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# ANNEX

# ANNEX I: Key informants Interview

**TRIBHUVAN UNIVERSITY**

**INSTITUTE OF ENGINEERING**

**PULCHOWK CAMPUS**

**Checklist and Interview**

This checklist questionnaire has been developed as a requirement during the master's thesis study in urban planning under Department of Architecture, Pulchowk Campus, Lalitpur, I.O.E., T.U.

**Title of the Thesis**: DYNAMICS OF LAND USE CHANGE OF URBAN FRINGE AND POSSIBLE INTERVENTION: A CASE STUDY OF DHAPAKHEL, LALITPUR

**Objective**: The main objective of my research is to gain understanding of the urban dynamics of fringe area in national and global scenario and suggest for possible interventions taking Dhapakhel as example. So there will be use of GIS application for the analysis and the study will need some of your opinions based on your past experience and knowledge related to the study area.

**Date and Time of Interview**: _____

**Name of the Student/Interviewer**: Bhagyashree Maharjan

**Name of the Supervisor**: PROF. DR. JIBA RAJ POKHAREL

**Name of the Key Informant to be interviewed**:_____

**Working Profession/Field of the Expert**: _____

**Address**: _____

1. What role does ward play on collection of demographic information conduction (recent and past decades too)?

2. Who were participated on land use determination and its decision and what rules and policies are implied?
3. Are you aware of requirement of planning permits for any Land development projects and what factors need to be considered for it?
4. What is the status of accessibility of basic services such as road, water supply, drainage and energy?
5. Are there any river corridor planning and management happening or needed in this area?
6. Are you aware of any such research conducted on land use management and their implication and interventions?
7. In your opinion, what should be the future role of architects and planners land development and infrastructure planning and what intervention be made by government level for sustainable environment?

| **S. No.** | **Name** | **Address** | **Position** |
|---|---|---|---|
| 1 | Jiban Maharjan | Dhapakhel | Ward 23 Chair-Person |
| 2 | Mahendra Kumar Khadka | | Administration head of Ward 23 |
| 3 | Sumit Bista | LMC | Surveyor Officer |
| 4 | Sahadev K.C. | Dhapakhel | Old / Knowledgeable |
| 5 | Uma Khadka | Dhapakhel | Activist |

**Table 17: KII's key responses 1**

| S. No. | Name | Address | Position | Views |
|---|---|---|---|---|
| 1 | Jiban Maharjan | Dhapakhel | Ward Chair-Person of 23 | The change is phenomenal, people are filling over the area as result of urban expansion in this area. I grew up here and I feel bad to lose land that I used to work in but, sooner I realized it is the cost of urbanization. As a ward chairperson, I tried my best to fulfill basic services in all residential area but there still lagging, only local government cannot tackle in all matters alone. Our area was declared as residential zone during zoning in accord of all community and their participation. After me being elected as representative, I have not issued any plannings permits in this area and I am not aware of any such activities. We have shelter for street dogs in associated by Sneha Kakha, as street dog arose safety issues for walking and riding two wheelers. Planning permits are issued by KVDA we have not performed such activities. |
| 2 | Mahendra Kumar Khadka | | Administration head of 23 | I am government officer and I have worked a lot in this metropolitan city, focusing on this area there is numerous increases in housing about average of 81 within 2 years. Taking about migrated population before 2074, record was negligible but after promoting of facility of elderly people and single people within every residency of this ward record went up to 237 by 2080.Today among all wards of LMC this dhapakel is declared as *'Jestha Nagarik ra Ekal Mahila Maitri wada'.* |
| 3 | Sumit Bista | LMC | Surveyor of LMC | I have worked as surveyor about 7 years, land fragmentation is prompt in outskirt of ring road. Taking about this area the agriculture land been plotted and converted into built-up unknowingly in small scales and individual. Some land are developed by group developers that pressured |

| | | | | |
|---|---|---|---|---|
| | | | | the owner to contribute their land as all peripheral land are being adjusted and there is no further possibility of crops. |
| 4 | Sahadev K.C. | Dhapakhel | old residence 23 | This is my permanent residence, I grew up working in those fields due to growing trend of plotting in this area, I also sold land down there but I bought in rural to grow crops but no one is interested in agriculture today so those are on rent for tunnel farmers. We use to play in those rivers and used in domestic purposes but now no one can use it even willing to go near. Road been connected everywhere but most are narrow and steep and need of upgrading it also some roads are without purpose. Drinking water is supplied twice a week but amount is much lesser as feeding population is growing insignificantly, in our area there are 3 public underground wells but now been used only for domestic purpose. |
| 5 | Uma Khadka | Dhapakhel | Activist | Change is good today our land grew money instead of crops. On saying that I am not fully supporting this transformation as every coin have two faces. I often felt problem of drinking water in my house as it is in higher elevation so Melamchi w/s cannot reach there and water from lele is not sufficient, my land is in down side so often filled with storm water and renter are badly affected by it. I am actively involved in trainings and other community programs of municipality as well. In this area there been lots of training provided such as terrace farming, organic farming, plumbing, electrician, bakery, sewing, knitting, pickle making, soap making and more. |

| | | | | |
|---|---|---|---|---|
| 6 | Ekdev Ghimire | Lamjung | User Committee | First time its been decades, I came here to buy land with broker, I liked this place as this space reflected as my lamjung residence, all over agriculture field, tar, pakho and doll, rivers and open spaces. But now it seems as Kathmandu core area, building everywhere no open places to play for kids and chat for someone old like me, all are isolated in their terrace. When I built house, my wife was scared to live here because only 2/3 houses were in nearer vicinity but today houses are like mushroom pads. Drinking water pipe been laid years ago but water have not reached yet we use tankers and these drains are also laid by our community effort. Roads here are of 13 ft only and they are muddy in rainy and dusty in windy. To know condition of road you should visit in monsoon, my grandson do not want to go school wearing those ugly boots. |

| **S. No.** | **Name** | **Address** | **Position** |
|---|---|---|---|
| 1 | Dinesh Jung Pandey | Dhapakhel | Ward 24 Chair-Person |
| 2 | Udaya San Napit | | Administration head of Ward 24 |
| 3 | Udhav Basnet | LMC | Public Representative |
| 4 | Meen Man Shrestha | Dhapakhel | Old / Knowledgeable |

**Table 18: KII's key responses 2**

| **S. No.** | **Name** | **Address** | **Position** | **Views** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Dinesh Jung Pandey | Dhapakhel | Ward Chair-Person of 24 | This ward is in developing state in compare to ward 23, here developers who willing to develop the land and plots are allowed to do so with certain charge determined by LMC boards. Plotting have been done are still in process in small scale for large scale KVDA gives the planning permits. These small scale plotting consist min. plots size and 20ft road but no other facilities are associated there by. Land use in Dhapakhel is decided as residential so our focus is to provide basic services to people here. KUKL and a local institution is active for water supply, local w/s is isolated in makundol area. We are actively processing road expansion so the road be dust free by coming year. Storm water drain are laid along the road side and thus for household septic tank in most in each household. FAR and land fragmentation regulation has considered as land use intervention in this area. |
| 2 | Udaya San Napit | | Administration head of Ward 24 | Dhapakhel is new for me about change and transformation but the census implies this place as peri-urban, increasing migrants and so the demand is, we are in process to meet their demand. Elderly people and widows are in priority for providing facilities. Health post servers as health infrastructure for major issued Sumeru Hospital and Patan Hospital are in vicinity. LMC provide sponsorship and scholarship for students within institutes of LMC. Taxation been implied in every small to big business activities. On our digital data 238 households are added as migrants from 2073 to 2081 in record but there are many household which are of migrated people but did not recorded. |

| | | | | |
|---|---|---|---|---|
| 3 | Udhav Basnet | LMC | Public Representative | Houses are increasing and demand of basic services are increasing. Small(5 lakh) to big budgeted projects been conducted and most are in road improvement works. Some road are needed to be aligned and some need uplifting, and along comes drainage. There are enough sector to be constructed but budget limitation is still on pick. Federal and provincial government has also been investing on infrastructures. Houses are permitted as per building bylaws 2064. |
| 4 | Meen Man Shrestha | Dhapakhel | Old / Knowledgeable | I am oldest residence so far in this locality, I saw all changes here from tracks to road to now expansion. When I use to work, I was afraid to come back home on my pay day as the area now sumeru/gems is most dangerous place as prominent for robbing, those place was all bamboo forests. This area has majority of bamboo forests, now all these new planning and plotting were conducted by destroying those, those lands might be public owned or private. Roads are as serpents here and condition as tracks of brick factories dusty and muddy. Most of the houses are increased as family size increase but expand around residential these new settlements are aroused due to people's habit of selling and enjoying life. River down there are for irrigation, fishing, domestic water use, rejoicement and societal activities, but now no body need river, they need river as drainage, its polluted now. |

# ANNEX II: Focused Group Discussion

**TRIBHUVAN UNIVERSITY**

**INSTITUTE OF ENGINEERING**

**PULCHOWK CAMPUS**

**Checklist and Interview**

This checklist questionnaire has been developed as a requirement during the master's thesis study in urban planning under Department of Architecture, Pulchowk Campus, Lalitpur, I.O.E., T.U.

**Title of the Thesis**: DYNAMICS OF LAND USE CHANGE OF URBAN FRINGE AND POSSIBLE INTERVENTION: A CASE STUDY OF DHAPAKHEL, LALITPUR

**Objective**: The main objective of my research is to gain understanding of the urban dynamics of fringe area in national and global scenario and suggest for possible interventions taking Dhapakhel as example. So, there will be use of GIS application for the analysis and the study will need some of your opinions based on your past experience and knowledge related to the study area. All can feel free to share problems and challenges facing and can come along with any option for mitigation.

**Date and Time of Interview**: _____

**Name of the Student/Interviewer**: Bhagyashree Maharjan

**Name of the Supervisor**: PROF. DR. JIBA RAJ POKHAREL

**Name of the Key Informant to be interviewed**:_____

**Working Profession/Field of the Expert**: _____

**Address**: _____

**Dynamics of Land use change of Urban fringe and Possible Intervention: A Case Study of Dhapakhel, Lalitpur**

**Focus Group Discussion Questionnaire**

**केन्द्रित समूह छलफल प्रश्नावली**

1 How long have you been residing in this area?

१ तपाईं यस क्षेत्रमा कति समयदेखि बस्दै हुनुहुन्छ?

2 What difference do you find in area here and nearby, which you find better?

२ यहाँ र नजिकैको क्षेत्रमा तपाईले के फरक पाउनुहुन्छ, कुन राम्रो पाउनुहुन्छ?

3 What changes have you observed in your area over the past decade?

३ विगत एक दशकमा तपाईको क्षेत्रमा कस्ता परिवर्तनहरू देख्नुभएको छ?

4 How do you perceive the growth of your city? And How has urban expansion affected your daily life and your community?

४ तपाईको शहरको विकासलाई तपाई कसरी हेर्नुहुन्छ र शहरी विस्तारले तपाईको दैनिक जीवन र समुदायलाई कसरी असर गरेको छ?

5 What factors do you believe are driving the changes in land use in your area?

५ तपाईको क्षेत्रमा भूमि प्रयोगमा परिवर्तन आउनुमा कुन कारकहरू प्रमुख छन् जस्तो लाग्छ?

6 How have these changes impacted the environment in this region?

६ यी परिवर्तनहरूले यस क्षेत्रको वातावरणमा कस्तो प्रभाव पारेको छ?

7 What socio-economic effects have you or your community experienced due to these change

७ यी परिवर्तनहरूका कारण तपाईं वा तपाईको समुदायले कस्तो सामाजिक-आर्थिक प्रभाव भोग्नु परेको छ?

8 What steps do you think could be taken to manage land use changes in a more sustainabl

८ भू-उपयोग परिवर्तनलाई अझ दिगो तरिकाले व्यवस्थापन गर्न कस्ता कदमहरू चाल्न सकिन्छ जस्तो लाग्छ?

9 Would you support interventions such as zoning regulations, land-use restrictions, or urban growth boundaries? Why or why not?

९ के तपाईं क्षेत्र निर्धारण नियमन, भूमि-उपयोग प्रतिबन्ध, वा शहरी विकास सीमा जस्ता हस्तक्षेपहरूलाई समर्थन गर्नुहुन्छ? किन वा किन नगर्ने?

10 Are there any community-driven initiatives or programs in your area focused on managing land use changes?

१० के तपाईको क्षेत्रमा भू-उपयोग परिवर्तन व्यवस्थापनमा केन्द्रित कुनै समुदाय-संचालित पहल वा कार्यक्रमहरू छन्?

11 What do you think the area will look like in the next 10 years if current trends conti

११ यदि अहिलेको प्रवृत्ति यस्तै रह्यो भने आगामी १० वर्षमा यो क्षेत्र कस्तो देखिनेछ जस्तो तपाईलाई लाग्छ?

12 Do you have any other suggestions for addressing the challenges

१२ चुनौतीहरूलाई सम्बोधन गर्न तपाईसँग अरू कुनै सुझाव छ?

Group Discussion 1

No. of Group: 6

Dhapakhel-23

| S.No. | Name | Gender | Age |
|---|---|---|---|
| 1 | Sabita Paudel | F | 38 |
| 2 | Tara Gurung | M | 50 |
| 3 | Gayetri Thapa | F | 35 |
| 4 | Bharat Singh Thapa | M | 42 |
| 5 | Bhim Narayan Gurung | M | 53 |
| 6 | Chandan Dhoj Rana | M | 62 |

Group Discussion 2

No. of Group: 6

Dhapakhel-24

| S.No. | Name | Gender | Age |
|---|---|---|---|
| 1 | Sudarsan Ghimire | M | 56 |
| 2 | Gita Shrestha | F | 42 |
| 3 | Parbati Thapa Basnet | F | 59 |
| 4 | Krishna Hari Maharjan | M | 47 |
| 5 | Ram Maharjan | M | 65 |
| 6 | Hari Sharan Giri | M | 58 |

## ANNEX III: Survey Questionnaire

### Socio Demographic

**Identity / Name**

_____

**What is your gender?**

- ◯ Male
- ◯ Female
- ◯ non-binary
- ◯ prefer not to say

**How old are you?**

- ◯ 18-25
- ◯ 25-40
- ◯ 41-60
- ◯ above 60

**What is the your education level?**

- ◯ No formal education
- ◯ primary
- ◯ secondary
- ◯ Graduate
- ◯ post graduate or higher

**What is the size of your household?**

- ◯ Nuclear
- ◯ Joint

**What is your primary source of income?**

- ◯ Agriculture
- ◯ Salaried employment
- ◯ Business/Trade
- ◯ Daily wage labor
- ◯ Other (please specify)

**if other then specify**

_____

**Do you own or rent your residence?**

- ◯ Own
- ◯ Rent

**How long have you been residing in Dhapakhel?**

- ◯ recently
- ◯ 5-10years
- ◯ 10-20 years
- ◯ more than 20 years

**Do you own any other land in this area?**

- ◯ Yes
- ◯ NO
- ◯ Prefer not to say

**Are you a member of any community or social group?**

- ◯ Yes (specify)
- ◯ No

**Specify if Yes**

_____

**Do you participate in any local decision-making processes?**

- ◯ Regularly
- ◯ Occasionally
- ◯ Rarely
- ◯ Never

## Perception of Land Use Change

**Are you aware of any land use changes in your area over the past 5–10 years?**

- ◯ yes
- ◯ no
- ◯ unsure

**How would you describe the changes in your area in the last 5-10 years?**

- ◯ Rapid urbanization
- ◯ Moderate development
- ◯ Minimal change
- ◯ No change

**Do you feel that urban development has affected your way of life?**

- ◯ positively
- ◯ negatively
- ◯ No impact

**Do you think land use change in your area is planned or unplanned?**

- ◯ Planned
- ◯ Unplanned
- ◯ Unknown

**What are the most noticeable impacts of land use change in your area? (Select all that apply)**

- [ ] Loss of agricultural /farmland
- [ ] Improved infrastructure
- [ ] Increased traffic congestion
- [ ] Higher property values or rents
- [ ] Environmental degradation
- [ ] Drainage problem
- [ ] Other (please specify)

**Other (please specify)**

_____

**Has land use change affected your access to basic services**

- ◯ Improved access
- ◯ Reduced access
- ◯ No noticeable impact

## Environmental Impacts

**What environmental changes have you noticed due to land use changes? (Select all that apply)**

- [ ] Loss of greenery or natural habitats
- [ ] Increase in pollution (air, water, noise)
- [ ] Changes in water availability
- [ ] Increased risk of flooding or other natural disasters
- [ ] Other (please specify)

**Other (please specify)**

_____

**How do you perceive the overall environmental impact of land use changes in your area?**

- ◯ Very positive
- ◯ Somewhat positive
- ◯ Neutral
- ◯ Somewhat negative
- ◯ Very negative

**What measures, if any, have been taken to mitigate environmental impacts of land use changes?**

- [ ] Creation of green spaces
- [ ] Implementation of pollution controls
- [ ] Improved infrastructure for waste management
- [ ] River corridor enhancement
- [ ] Other (please specify)

**Other (please specify)**

_____

**What additional measures should be taken to minimize negative impacts of land use changes?**

- ◯ Stricter zoning and land use regulations
- ◯ Promotion of sustainable development practices
- ◯ Public consultation and participation in planning
- ◯ Preservation of green spaces and natural habitats
- ◯ Other (please specify)

**Other (please specify)**

_____

## Possible Intervention

**Are you aware of any government or community initiatives addressing land use changes in this area?**

- ◯ Yes
- ◯ No

**How do you Evaluate the effectiveness of the existing land use change or the Land Intervention Practice for governing the rate and extent of Land Use Dynamics in Urban fringe Areas ?**

- ◯ Highly effective
- ◯ Effective
- ◯ Moderately Effective
- ◯ Ineffective
- ◯ Undecided

| **How do you evaluate the Impacts of the existing Land Use Intervention Processes in this area?** | Strongly Disagree | Disagree | Undecided | Agree | Strongly Agree |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **Affecting the livelihood of Local Communities of fringe** | ◯ | ◯ | ◯ | ◯ | ◯ |
| **Improvement in access to basic services** | ◯ | ◯ | ◯ | ◯ | ◯ |
| **Affecting the Socio structures of Local Communities in fringe** | ◯ | ◯ | ◯ | ◯ | ◯ |
| **Increased in water and energy stress in your area** | ◯ | ◯ | ◯ | ◯ | ◯ |
| **Creating fragmented institutional responsibilities** | ◯ | ◯ | ◯ | ◯ | ◯ |
| **Consequence of gap in Infrastructure Development** | ◯ | ◯ | ◯ | ◯ | ◯ |

**What interventions do you think could address for this change?(Select all that apply)**

- [ ] Encouraging mixed-use development
- [ ] Promoting compact city planning
- [ ] Enhancing public transportation
- [ ] Green Infrastructure Development
- [ ] Sustainable Land Use Policies
- [ ] Integrated Urban-Rural Planning
- [ ] Other

**other then specify**

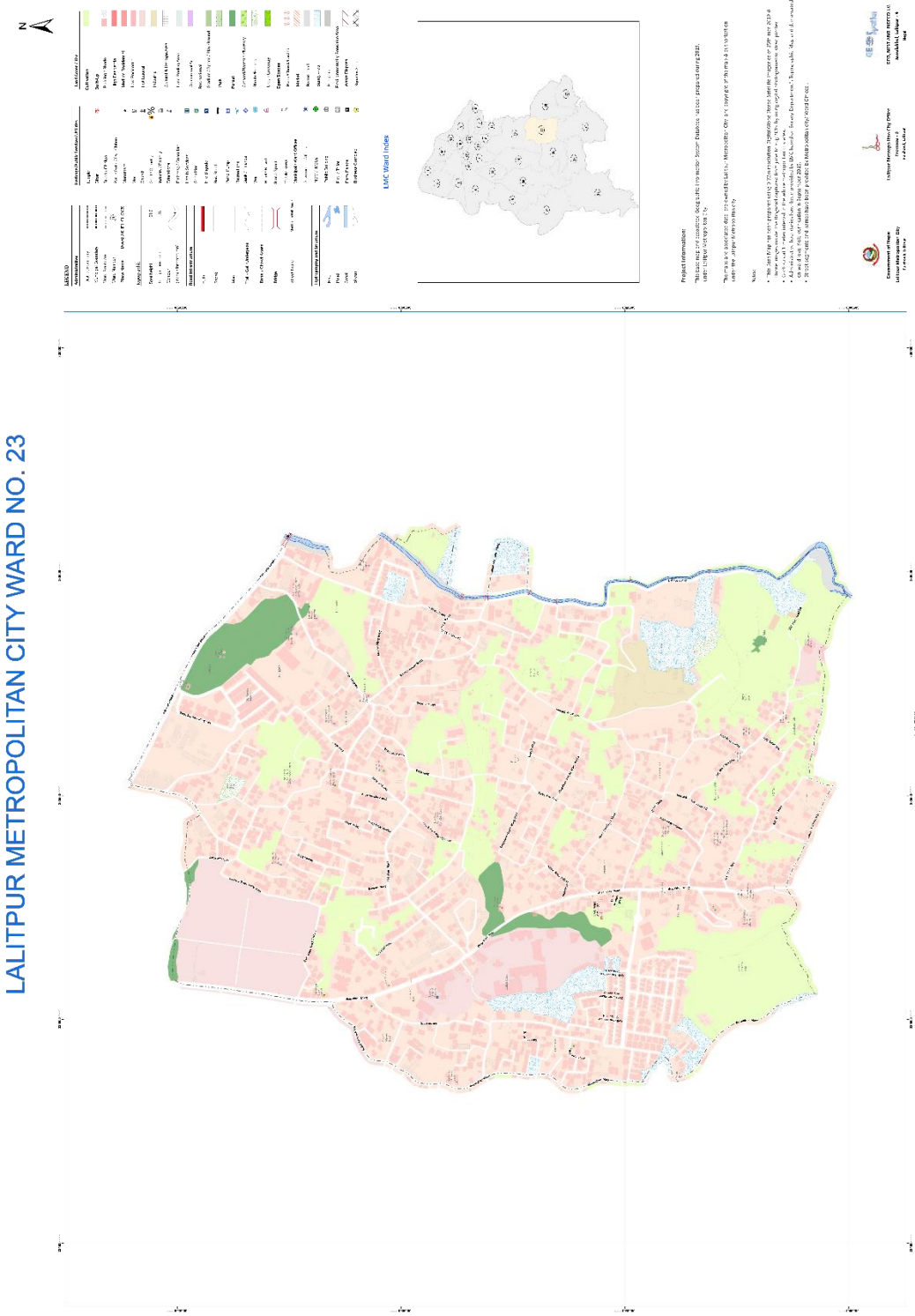
_____

**What possible interventions do you believe that are necessary to ensure a balance between urban development and environmental conservation?**

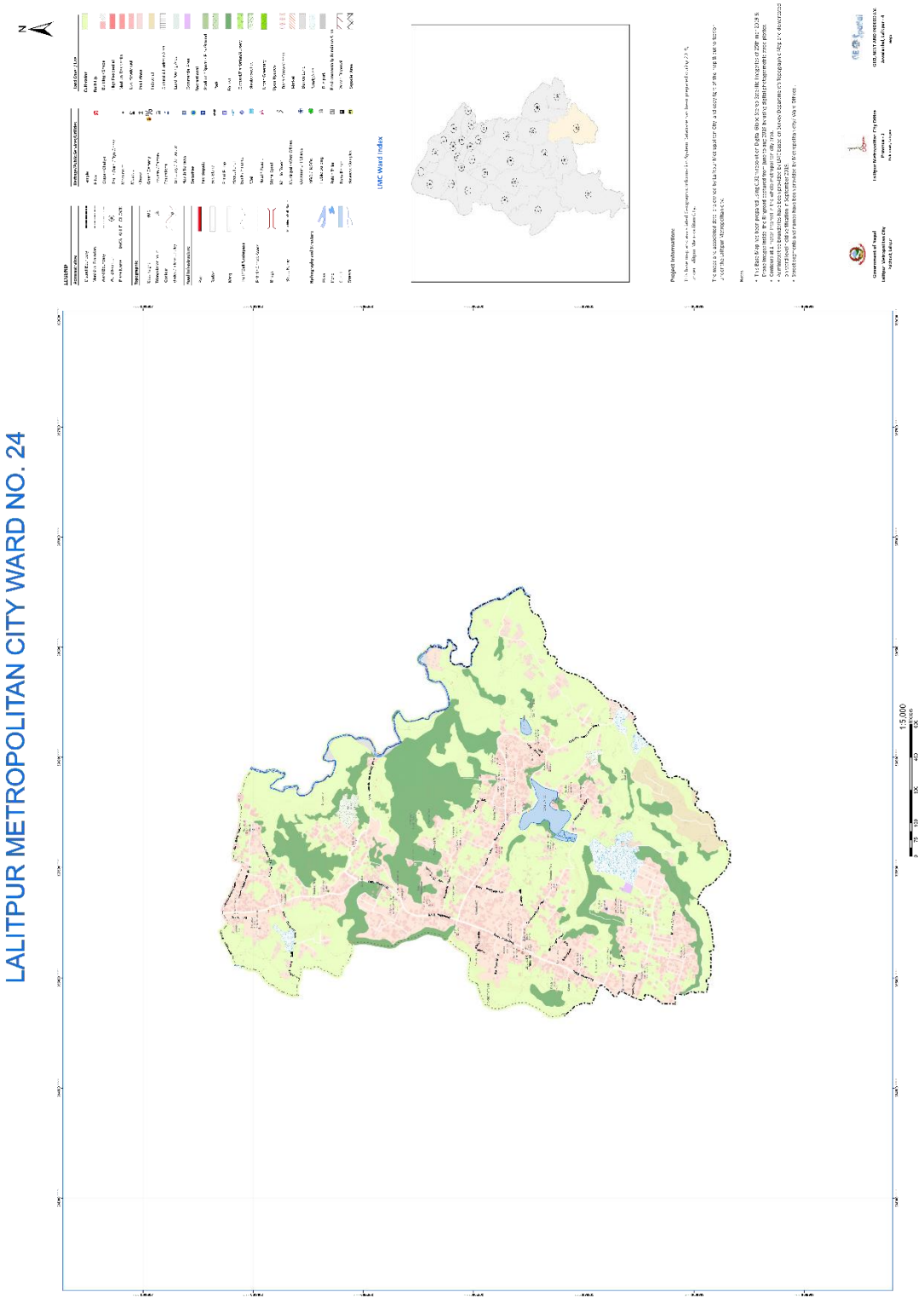
_____

# ANNEX IV: Maps

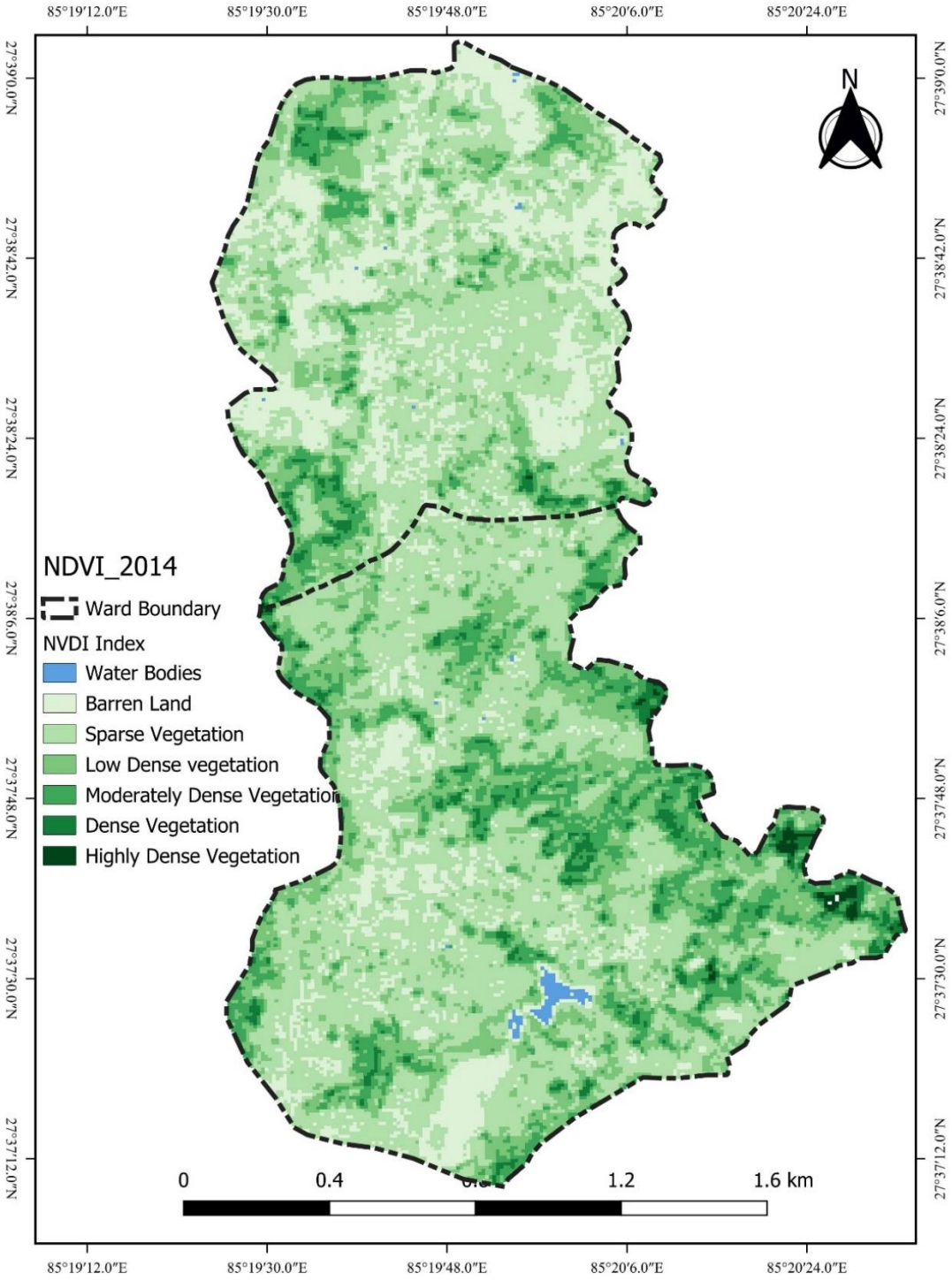
**Administrative Map of Dhapakhel-23** (Source: https://lalitpurmun.gov.np/)



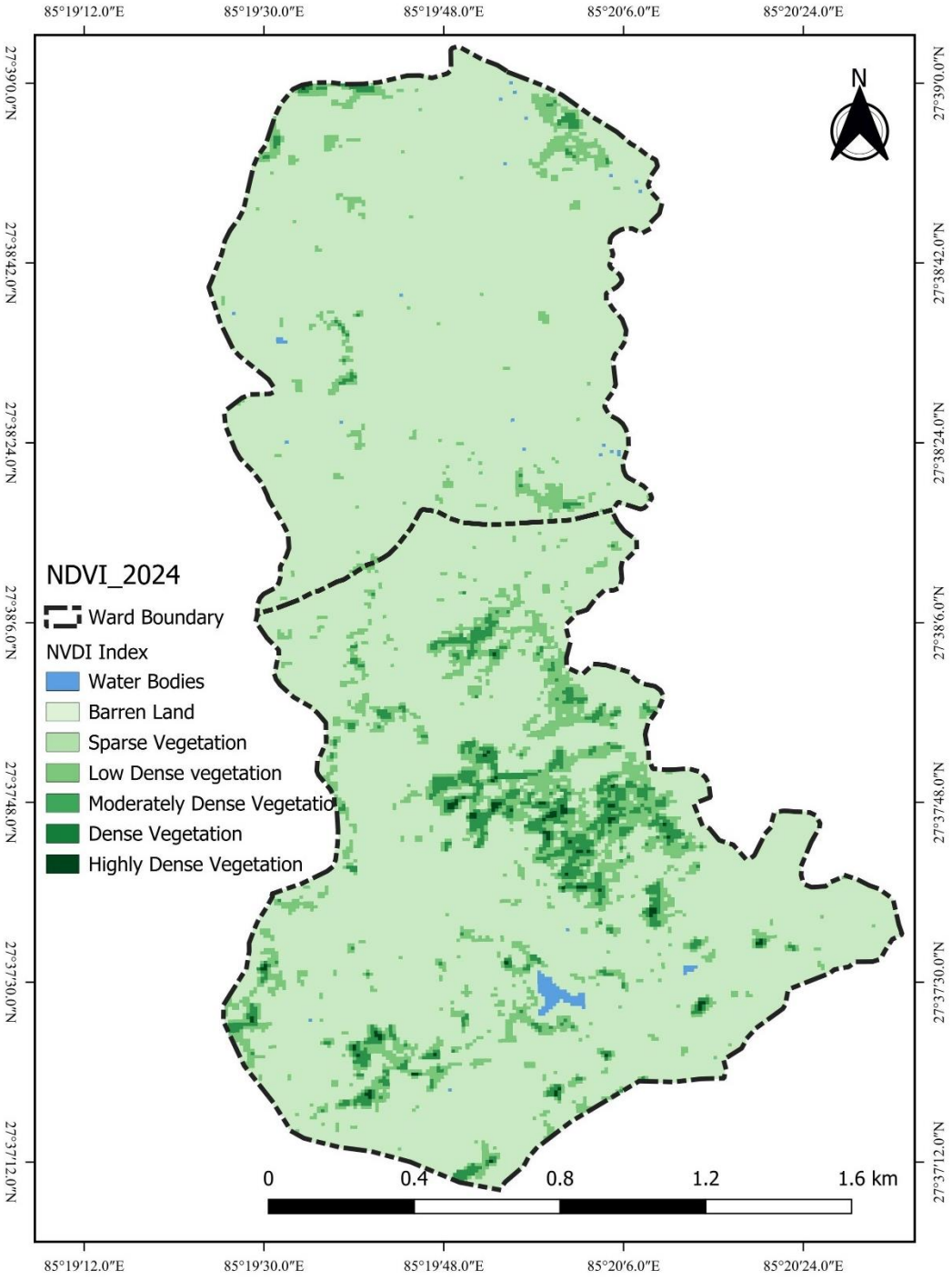
**Administrative Map of Dhapakhel-24** (Source: https://lalitpurmun.gov.np/)



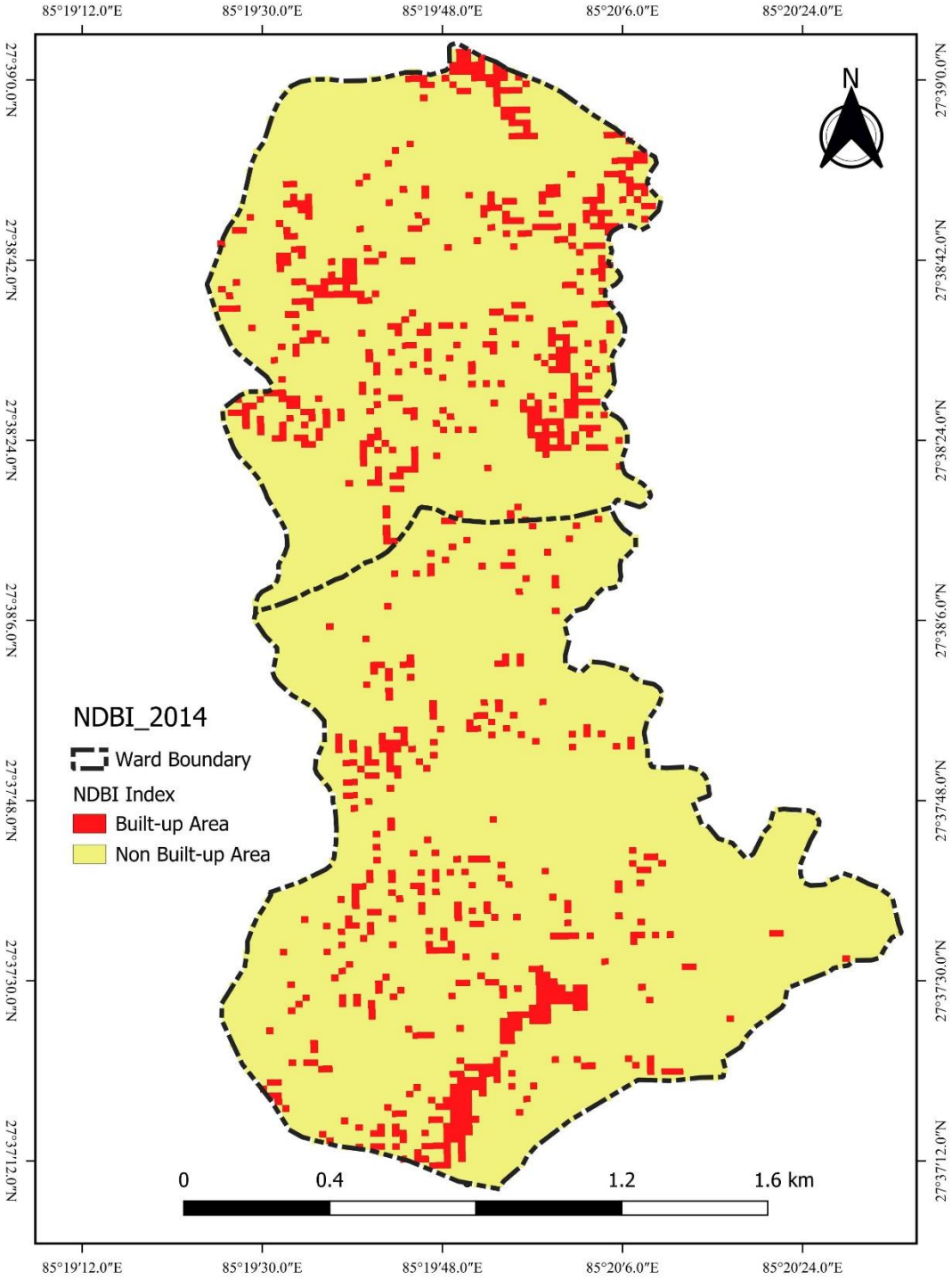
**Normalized Difference Vegetation Index (NDVI) Map of Dhapakhel 2014**



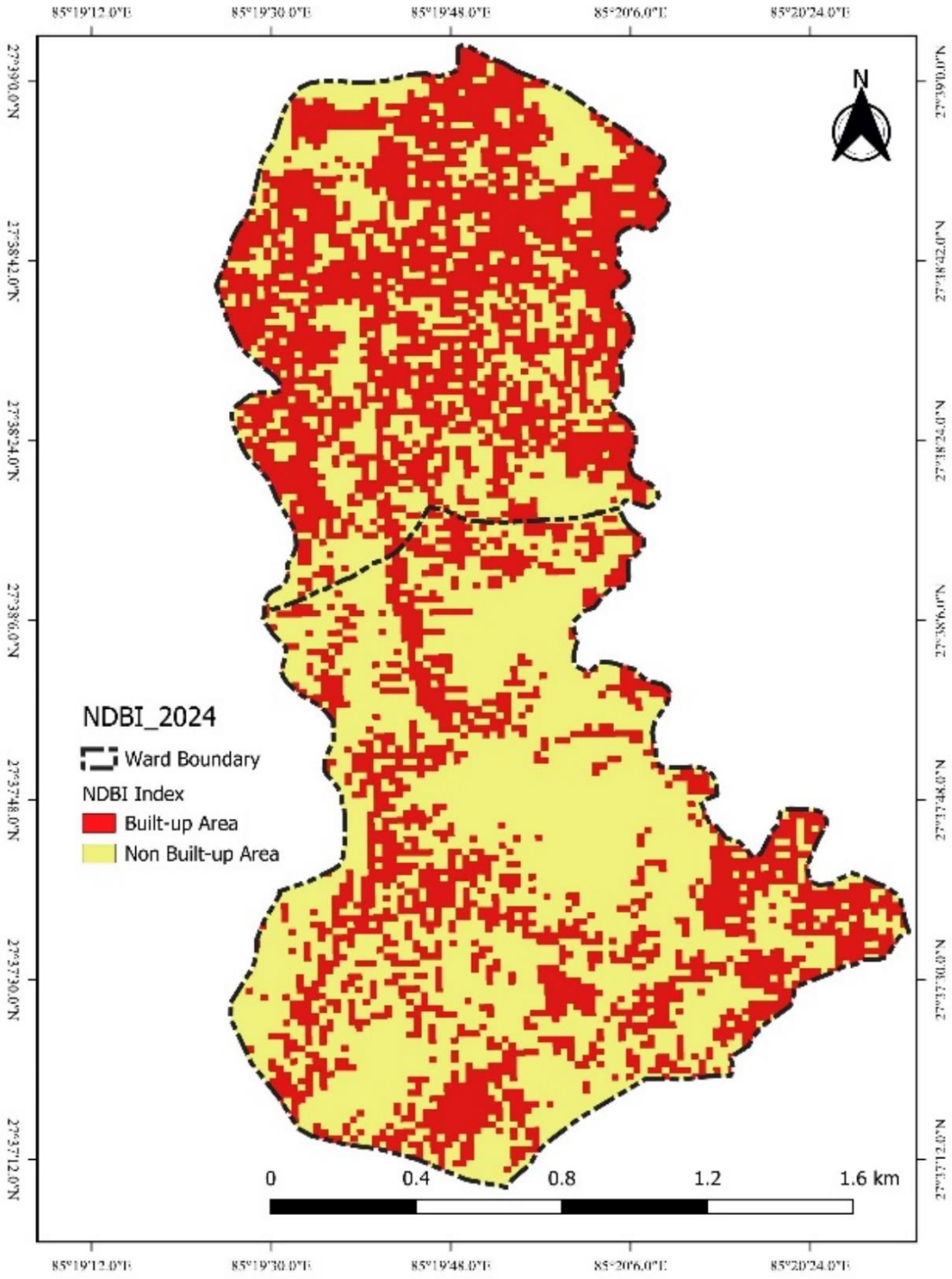
**Normalized Difference Vegetation Index (NDVI) Map of Dhapakhel 2024**



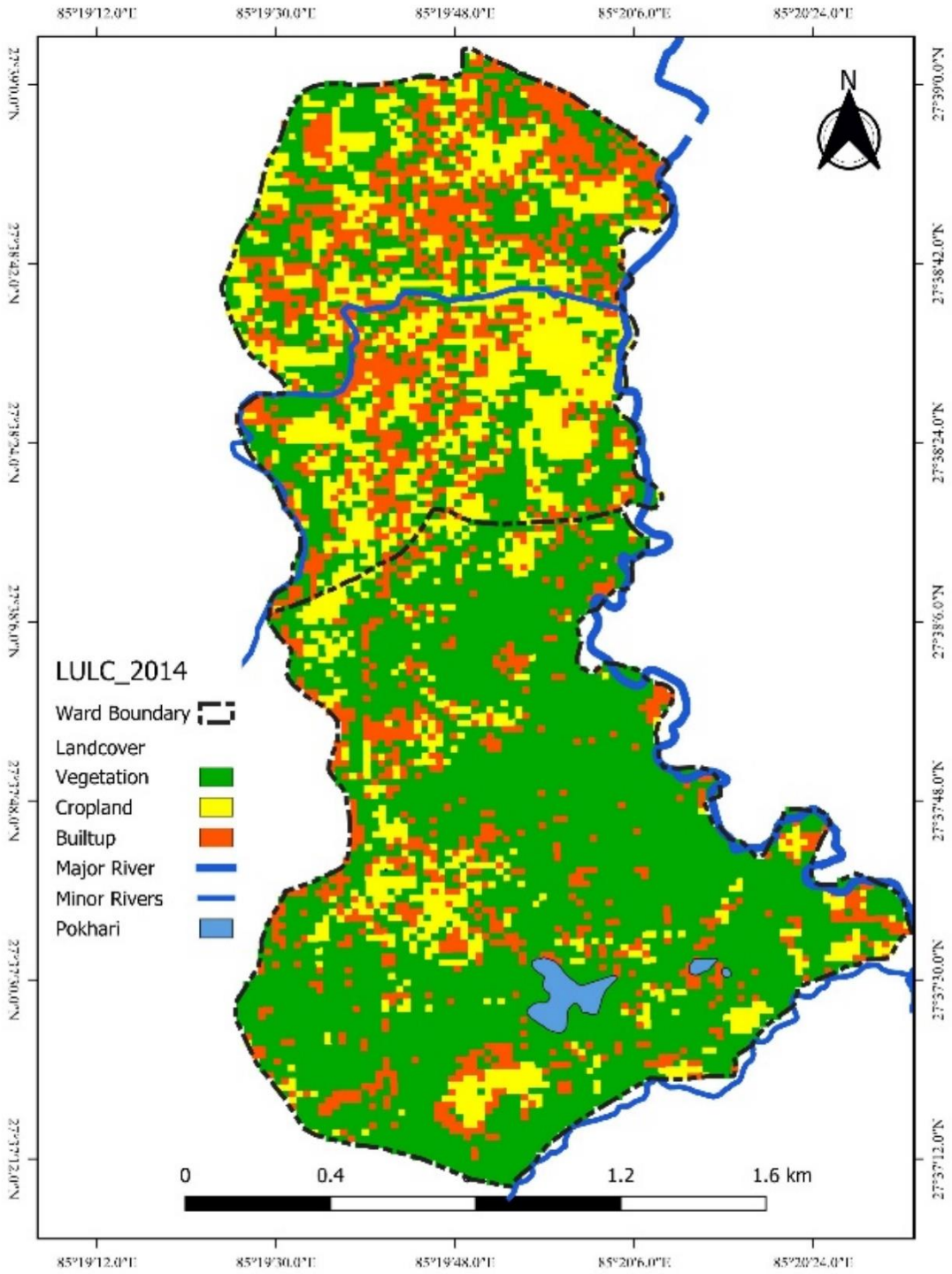
**Normalized Difference Built-up Index (NDBI) Map of Dhapakhel 2014**



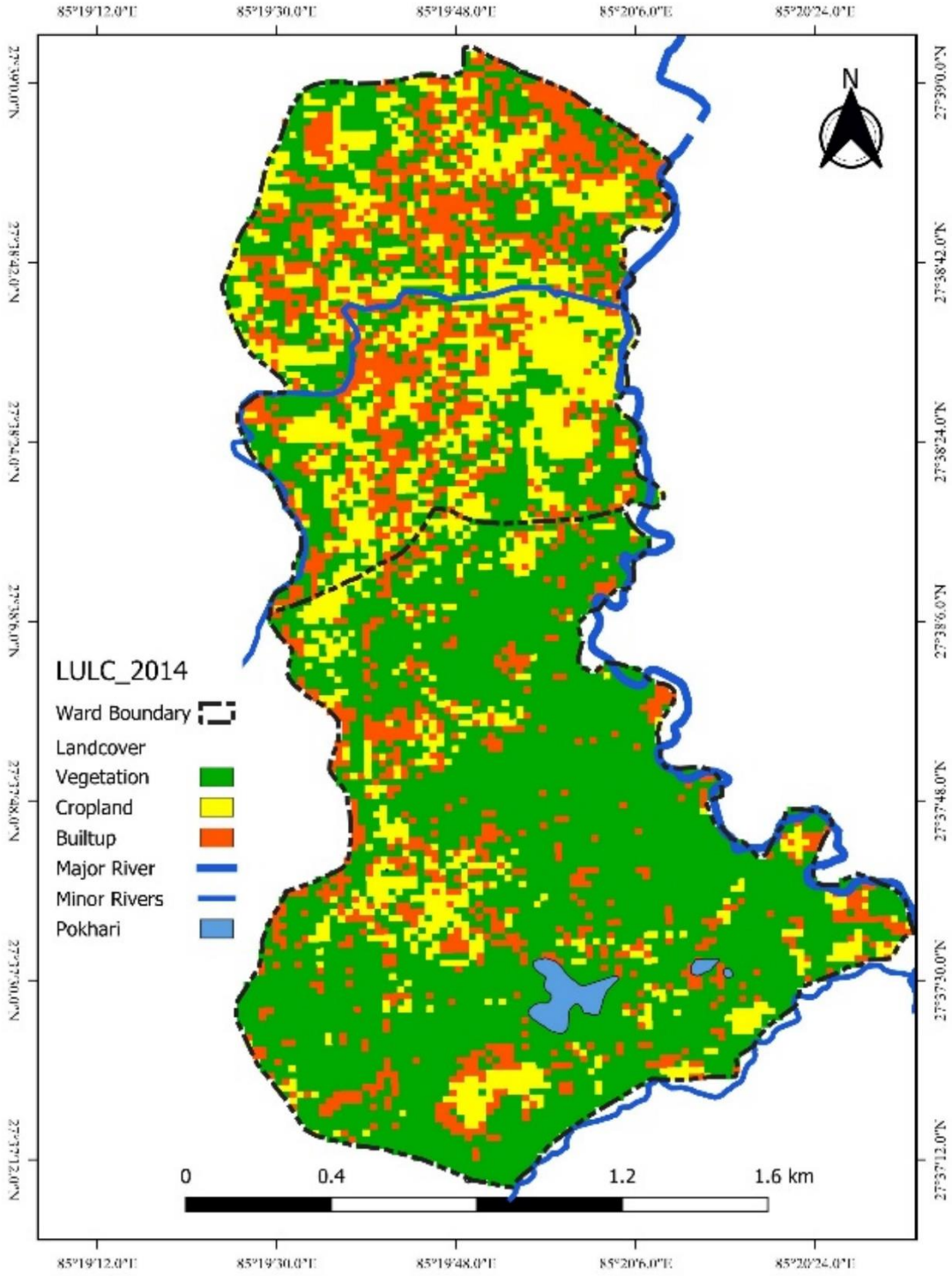
**Normalized Difference Built-up Index (NDBI) Map of Dhapakhel 2024**



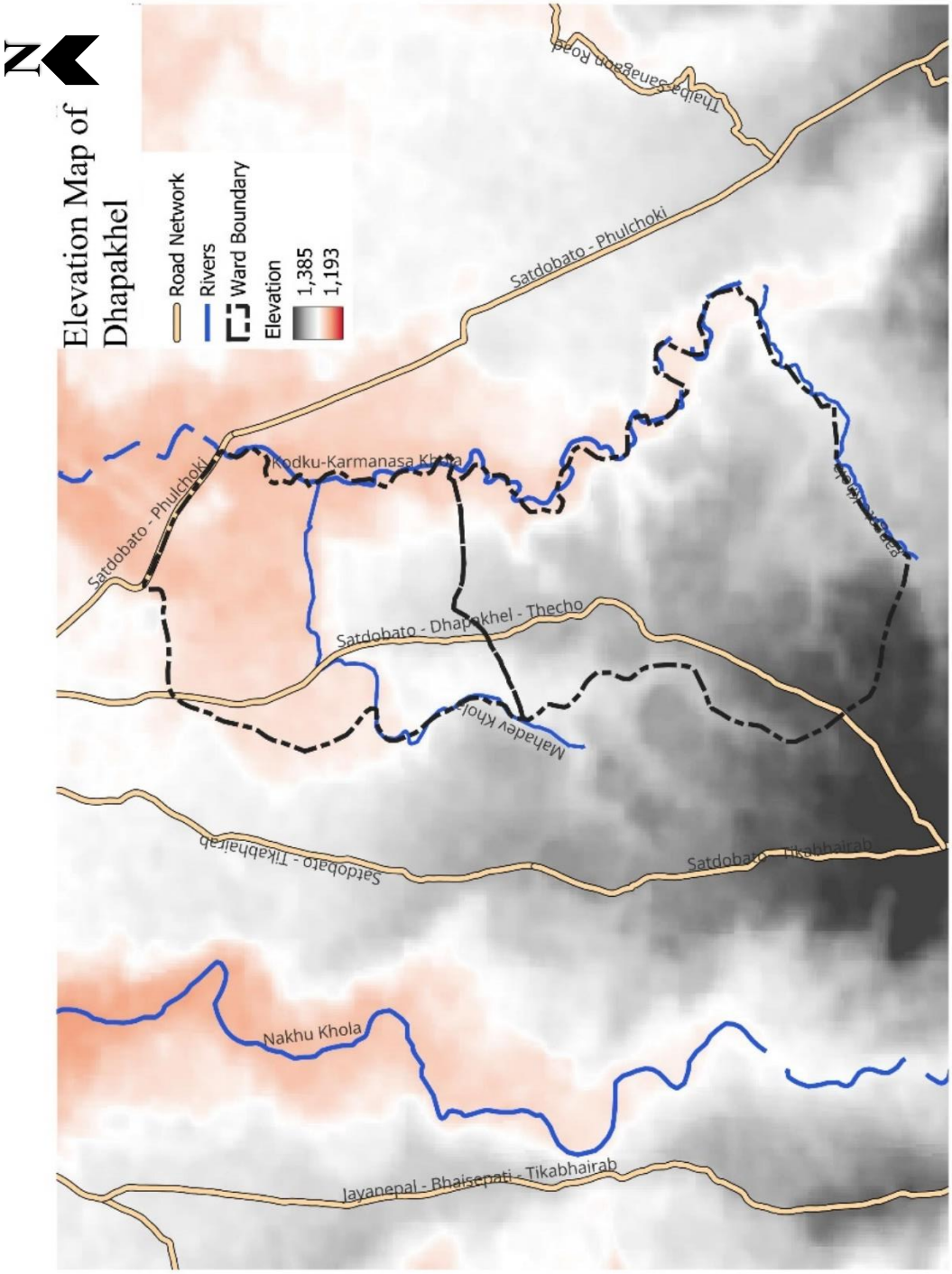
**Land-use/ Landcover (LULC) Map of Dhapakhel 2014**



**Land-use/ Landcover (LULC) Map of Dhapakhel 2024**



**Elevation Map of Dhapakhel**



# ANNEX V: Photography

Ward 23, Ward Chairperson

Ward 23, Surveyor

Ward 24 ,Engineer


Ward 24, Administrative Head

Women Activist

Ward 24, Ward Chairperson

# ANNEX VI: Plagiarism Check Report

# 3% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

## Match Groups

- 27 Not Cited or Quoted 2%
  Matches with neither in-text citation nor quotation marks
- 7 Missing Quotations 0%
  Matches that are still very similar to source material
- 0 Missing Citation 0%
  Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

## Top Sources

2% Internet sources
1% Publications
0% Submitted works (Student Papers)

## Top Sources

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

| | | |
|---|---|---|
| 1 | Internet | www.mdpi.com <1% |
| 2 | Internet | censusnepal.cbs.gov.np <1% |
| 3 | Internet | conference.ioe.edu.np <1% |
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| 5 | Internet | link.springer.com <1% |
| 6 | Internet | mrc.cap.utah.edu <1% |
| 7 | Internet | epsg.io <1% |
| 8 | Internet | www.nepjol.info <1% |
| 9 | Internet | www.isca.in <1% |
| 10 | Publication | "Communication Technologies and Security Challenges in IoT", Springer Science ... <1% |

11 Publication

Nekkanti Haripavan, Subhashish Dey, Chimakurthi Harika Mani Chandana. "Integ... <1%

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# ANNEX VII: IOEGC Acceptance Letter and Paper

त्रिभुवन विश्वविद्यालय
Tribhuvan University
इन्जिनियरिङ्ग अध्ययन संस्थान
Institute of Engineering
थापाथली क्याम्पस
THAPATHALI CAMPUS
Accredited By University Grants Commission (UGC) Nepal, 2024

GPO Box- 280, Thapathali, Kathmandu
Tel: 01-5339766
E-mail: info@tcioe.edu.np
Website: www.tcioe.edu.np
गोश्वारा पो. नं. २८०, थापाथली, काठमाडौं
फोन: ०१-५३३५७६६

Date: April 21, 2025

**To Whom It May Concern:**

This is to certify that the paper titled **"Dynamics of Land Use Change of Urban Fringe and Possible Intervention: A Case Study of Dhapakhel, Lalitpur"** (Submission# **132**) submitted by **Bhagyashree Maharjan** as the first author, which had been accepted for presentation after the peer-review process, has successfully been presented at the 16th IOE Graduate Conference held during April 18 - 20, 2025. Kindly note that the final revision of the papers and publication process of the conference proceedings is still underway and hence inclusion of the accepted manuscript in the conference proceedings is contingent upon timely response to further edits during the publication process.

INSTITUTE OF ENGINEERING
16th IOE Graduate Conference, 2025
THAPATHALI CAMPUS

Dr. Raj Kumar Chaulagain,
Convener,
16th IOE Graduate Conference

# ANNEX VIII: Final Presentation Slides

**IOE Graduate Conference**
**[Placeholder for Publication Information]**

# Dynamics of Land Use Change of Urban Fringe and Possible Intervention: A Case Study of Dhapakhel, Lalitpur

Bhagyashree Maharjan[a], Dr Jiba Raj Pokharel [b],

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[b] *Department of Architecture,IOE,Pulchowk Campus,TU,Nepal*
[a] maharjan06bg@gmail.com, [b] jibaraj@gmail.com,

**Abstract**

Dhapakhel, located in known traditional district Lalitpur of Bagmati province of Nepal has developed mixed character of urban and rural, most suitably called as urban fringe of Lalitpur metropolitan city. This study is important to understanding the drivers of growth can help predict future urbanization trends and can possibly fill data gaps related to urban-rural interactions. However, this particular area has not been studied yet and need to know the underlying factors of land-use change in this area and problem arises by the transformation. The main objective of the study is to gain understanding of the urban dynamics of fringe area in regional and national scenario and suggest for possible interventions taking Dhapakhel as an example. Primary data were collected using focus group discussions and key informant interviews; in addition, spatial data including Sentinel-2 imageries of 2014 and 2024 were utilized to determine the Land-use change and transformation scene by performing land use land cover mapping for Dhapakhel for 2014 and 2024 by using the Semi-automatic Classification Plugin using GIS Software. Land use change, population growth and migration and inadequate infrastructure are known a dynamic of urban fringe.Further, analysis revealed that rapid urban expansion, unplanned infrastructure development, and population growth in the areas of this study significantly impact on water resources; change in natural flow pattern of storm water consequence of transformation; agriculture/vegetation to built-up, drainage management in low lying area has been a problem in the case of Dhapakhel. Congestion is also an underlying problem arisen from the land use chnage, as a population demand for transportation infrastructure. The finding suggest that, the implementation of integrated urban planning strategies that prioritize sustainable drinking water and storm water management through a technical and economic solution and road expansion is an immediate way to deal with congestion abide by the national urban road standards prevailing in the area. The results indicate possible future implications on sustainable development management in Dhapakhel, Lalitpur, also regularly analyzing the spatial growth of built-up areas and other land use changes can serve as a crucial tool for effective land use management and informed decision-making.

**Keywords**

Land use, Urban fringe, Land use Classification,GIS, Intervention

## 1. Introduction

The world is urbanizing fast. Today, half of the world's population and over a third of Asia's population live in urban areas. Urbanization does not take place in thin air, and it requires the consumption of enormous amount of rural land. Unlikely, Urbanization can be categorized into two types in Nepal, first type of urbanization is where people from rural areas have migrated to market centers, towns, and cities, primarily in search of better employment and other opportunities, this is a more natural urbanization model. Second type of urbanization has been through government declarations such as 7 provinces and 77 districts with 293 municipalities in Nepal among which 6 are metropolis, 11 are sub-metropolis and 276 are municipal councils, other than that there are 460 rural municipalities totaling 753 local level government within Nepal. Government's official delineation of several human settlements as new urban areas has been questionable because many important criteria such as urban infrastructure and services, open space, population

density, and economic viability are not thoroughly analyzed while defining what is urban. Many settlements in Nepal officially defined as urban, often driven by political considerations, are operating in the rural framework forming ruralo polises[1]. This research addresses the inadequate infrastructure in growing residential and commercial spaces due to dynamics of land-use change within demand of growing population and expansion in urban fringes. The responsibility of the government is to start urban infrastructure projects[2]. The rapid expansion of urban populations, driven by the aspiration for better living conditions, has intensified the need for comprehensive urban infrastructure and services.

### 1.1 Problem Statement

The urban fringe, a transitional zone between urban and rural areas, is undergoing rapid and often unplanned land use changes driven by urban expansion, population growth, and economic development which lack in coherent planning and governance exacerbates challenges such as urban sprawl, environmental degradation, and socioeconomic inequalities.The dynamics of land use change in the urban fringe are poorly understood, with limited data on the drivers, patterns, and impacts of these transformations.

### 1.2 Research Question

The main objective of this research is to gain understanding of the urban dynamics of fringe area in regional and national scenario and suggest for possible interventions taking Dhapakhel as example.

1. What are the urban dynamics in general and that in urban fringes in particular area?

2. What are the problems that arise out by Land-use change and transformation scene?

3. What can be the possible interventions to address the above anomaly in Dhapakhel?

### 1.3 Scope and Limitation of Research

This research focuses exclusively on the physical aspects of urban development and expansion of urban forms, land-use patterns, and the availability of infrastructure and services in the urban fringe area and does not take into account the impacts of climate change, such as weather changes or extreme conditions. Furthermore,the scope of the study is confined to the inner fringe of the Lalitpur Metropolitan City, which means that it does not extend to the outer suburbs.

## 2. Literature Review

### 2.1 Urbanization and Urban Fringe

The stage of urbanization is associated with a fundamental development (industrial revolution) and has led to the concentration of companies and residents in fast-growing cities. Over time, the increasing pollution, land prices and nuisance of the industrial city progressively led a sub-urbanization stage in which residents steadily moved to suburbs (the city's hard ring) while keeping most of the jobs in the central city; this spatial change has been underlined by another set of fundamental developments[3]. Distortions are commonly identified as causes of inefficient spatial expansion of urban areas (unpriced traffic congestion, uninitialized open-space externalities, and under priced suburban infrastructure) also cause an inefficient shortfall in housing reinvestment and maintenance in the central city [4]. Specifying under which conditions population growth is more likely to lead to increased human insecurity and social unrest in urban centers is a natural and important next step[5]. Urban fringe or Metropolitan fringe areas (fig.1) are widely considered to be transitional in nature-suggesting a patterned sequence of uses that become progressively more agrarian in orientation as one recedes from the urban center and the patterns of development found on the metropolitan fringes in Bangkok, Jakarta, and Santiago diverge widely[6] .

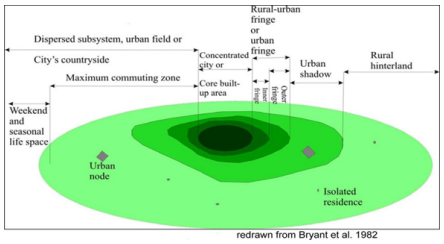


**Figure 1:** Rural-urban fringe scheme

### 2.2 Urban Sprawl: Form of Fringe Development

As the costs of sprawl have become more apparent, the term urban sprawl has gone from urban planning construct to public policy concern. But what exactly is urban sprawl? In the early 1990s, sprawl was

defined qualitatively for purposes of growth management in Florida (Ewing 1997). The definition ultimately adopted by the State encompassed the following urban forms [7]: (1)leapfrog or scattered development, (2) commercial strip development, (3) expanses of low-density development, and (4) expanses of single-use development Cities began to see the value in their old urban fabrics with the need to redevelop back in and create much better quality public transport, walking and cycling in their cities. The public responses to planning insisted that planners now had to do something about place-making in special places, and had to try and control urban sprawl[7]. The urban fringe presents highly valuable resources such as land, space, and landscape for the wealthy and powerful class, and for the low class, the urban fringe area is only a garbage dump that pollutes production and low-cost shelters away from various social resources available in city centers[8]. Sui and Lu(2021) [8] have analyzed the urban fringe in various aspect and proposed of 7 different expansion–contraction dynamics model for study of urban fringe under 3 major constrains: Population, Socio-economy and Spatial environment.

## 2.3 Factors Influencing Growth in Urban Fringe

Earth system depends on an understanding of past land use practices, current land use patterns, and projections of future land use,as affected by human institutions, population size and distribution, economic development, technology, and other factors.Rather of all, **Population**, **Transportation** and **Land**, are core three factor affecting Iinfluencing growth and expansion in Urban fringe area. Population induces the travel demand increasing transport infrastructure as land is catalyst for all demand induced by people . The urban–rural fringe is a dynamic environment where urban expansion limits the provision of landscape services. Economic valuation of these services is proposed to quantify the impact of urbanization and inform planners of the potential losses that attribute to these land-use changes[9].

## 2.4 Dynamics of Land Use Change in International context

Urban land use must be seen as dynamic pattern rather than a static entity. In Srinagar city, continuous shift of land from non-developed natural categories to the developed land use is usual affair of urban sprawl characterized by severe land transformations which are in response to the demands of the main City [10]. In Bangladesh the conversion from agricultural land to standing water-bodies in the southwest region was mainly driven by urban household dynamics, population growth, distance to cities and major roads, and precipitation dynamics[11] .

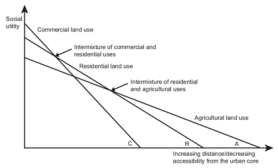


**Figure 2:** Bid rent model of Land use (Source: Barlowe 1978)

The growth in forest area in Bhutan from 1990 to 2010 was much higher than the loss of forest, mainly due to the annual plantation activities throughout the country. Agriculture is expanding very slowly due to the limited population growth [12]. Land cover data for the urban-rural fringe south of Bogotá shows that human-made or human-influenced structures and patterns gained spatial significance: the spatial extent of farmland increased with a strong variability among the different phenological states of the land cover classes, and natural vegetation generally decreased [13]. The five anthropogenic driving forces of land-use change in China are population growth, urbanization, industrialization, changes in lifestyles and consumption, and shifts in political and economic arrangements and institutions. The intention is to demonstrate the broad range of factors other than bio geophysical conditions that will affect future land-use patterns in China [14].

## 2.5 Land use change and its Impact

Growing population results on consumption of more land by the people and spread towards the fringe areas. Urban land use must be seen as dynamic pattern rather than a static entity.Continuous shift of land from non-developed natural categories to the developed land use is usual affair of urban sprawl but Srinagar City is also characterized by severe land transformations which are in response to the demands of the main City [10].Land use changes can stimulate growth through infrastructure development but the unplanned way has consequences on the water availability, urban flooding,congestion, pollution and environmental degradation. Newly developed areas to

the existing drainage structures puts areas at risk which have not been endangered by flooding before (Ashley et al., 2005). For a comprehensive adaptation of urban water infrastructure to constantly changing and evolving systems a detailed simulation of the dynamics in city development is crucial.

### 2.6 Land use Interventions and its implications

Land Interventions are typically designed to promote socially desirable outcomes, such as affordable housing, environmental protection, or efficient land allocation..”To avoid creating artificial scarcities, such zoning laws must respond to market forces in determining the overall allocation of land to residential,commercial, and industrial uses,the density regulations (including FAR limits) that are usually part of zoning ordinances can foster orderly land use by ensuring uniformity of development in an area. Ideally and such regulations should approximately match the area’s free market densities, serving more as a guide to development than as a binding constraint. Similarly, urban growth boundaries can play a beneficial role to the extent that they discourage scattered, noncontiguous development rather than serving as binding limits on the total amount of land available for conversion to urban use” [15] fig. 3&4. Similarly, zoning restrictions given by study of[16]height restriction implication by [17] and study of vacant land management by study of [18] gave the practical interact with complex urban real estate markets in unpredictable ways.

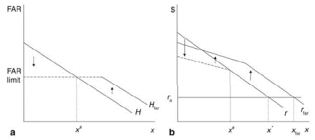


**Figure 3:** Floor area ratio limit (a) Effect on building height, (b) Effect on land rent;Source[15]

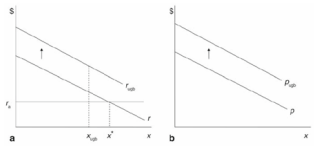


**Figure 4:** Urban growth boundary (a) Effect on land rent, (b) Effect on housing price;Source[15]

## 3. Research Methodology

This research method uses constructivist paradigm which offers a complementary understanding urban fringe development while guiding data collection and analysis throughout the research process. It focuses on developing knowledge or solutions that are intentional, user-focused, and aligned with the research goals. **An ontological claim:** Urban fringes are dynamic spaces shaped by the interplay of social, economic, environmental, and political forces. **Epistemological claim:** Understanding urban fringes requires both quantitative data (e.g., population growth rates, land use changes) and qualitative insights (e.g., perceptions of communities, governance challenges). Conducting interviews with the people residing there to explore problem facing by them and consideration of favorable policy to make life there easier in fringe area, this gives perception of local on land use policies and programs as qualitative method and quantitative geographical data analysis utilizing GIS as a tool.Validation of data is elaborated in section 5.4.

## 4. Study Area

Dhapakhel lies in South west region of Lalitpur Metropolitan City including two Different wards 23 and 24 (fig. 5). Previously it was Dhapakhel village Development committee, wards 1 and 2 are merged to form LMC ward-23 and wards 3,4,5,6,7,8 and 9 were merged to form LMC ward-24. On boundaries on North: LMC ward-15, East: LMC ward-28 and 29, West: LMC ward-26 and 27 and on South:Godawari Municipality with total area of 3.671 Sq Km. Lagankhel is nearest market space from Dhapakhel which is 4km way. Geographically it lies in 27.64 N latitude and 85.33 E longitude with lowest elevation of 1259 m and highest elevation of 1381 m.

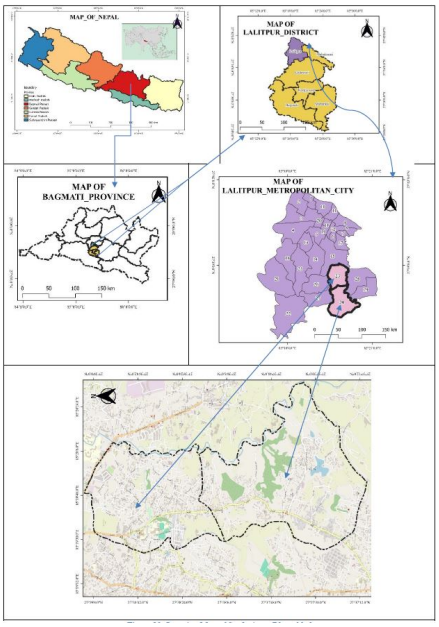


**Figure 5:** Location Map of Study Area, Dhapakhel

## 5. Site Observation and Data Collection

| | | | |
|---|---|---|---|
| 1 | Interviews of Concerned Persons | Interview of five persons from each ward. Including Public elective representatives, Old Knowledgeable and surveyor. | This summarized as they showed concern about the basic services and some key points on implementation of building by laws and land fragmentation system. |
| 2 | Focus Discussion with Residents | Discussions were with the residents in 2 group of 6 regarding the living experience problems of wards. | The male respondents raised the issue of gap in development, marrow roads and inadequate services. The female respondents showed their concern about local training and participation biasness, street light and garbage disposal. |

**Figure 6:** Response of Focus Group Discussion and Interviews

### 5.1 Primary Data Collection:

This method is related to the impact and effectiveness of the existing urban fringe land use and intervention process, land use policy, land use changes and decisions related to land were collected using focus group discussions (FGDs) and interviews and questionnaires too. An FGD and interview were conducted to complement the results in the questionnaire and spatial data analysis. FGD was held with selected residence with guidance of local representatives was conducted with consent of photo and recording. The response was validated by summarizing of the discussion to the participants afterward. The purpose of the interview was to know the perceptions, experiences, and recommendations land-related authorities and land zoning on urban fringe and undertaken land use intervention [19]. Questionnaire, both open and closed-ended questionnaires were developed, and primary information related to the impact and effectiveness of the existing urban fringe land use change and intervention process.

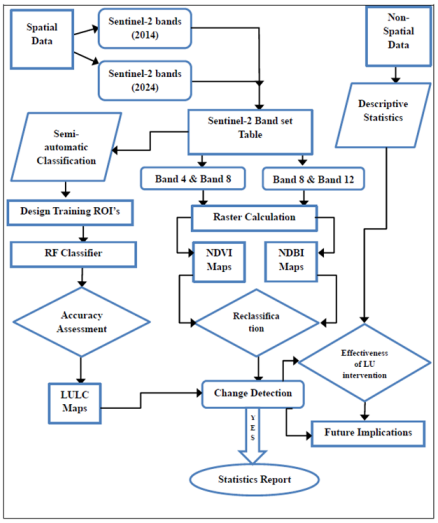


**Figure 7:** Methodological flow chart

### 5.2 Spatial/Secondary Data:

To assess LULC and NDVI and perform change detection analysis for Dhapakhel, research conducted a study using satellite imagery data. Satellite product availability was investigated and Level A Sentinel-2 satellite multi spectral data images from the years 2014 and 2024 was downloaded from the USGS Earth Resources Observation and Science (EROS) Centre website (https://ers.cr.usgs.gov/). The selection of satellite images considered a cloud coverage range of 0-5 % specifically targeting the drier months to minimize cloud interference[20, 21].The rest process and integration are done as described in the chart shown in fig.7.

### 5.3 Data Projection and Processing:

GIS is utilized in the current project to determine the coordinate reference system (CRS) of the study area using EPSG:4326-WGS 84 / UTM Zone 45N. This CRS is part of the Universal Transverse Mercator (UTM) system and divides the earth's surface into 60 zones, each covering a range of 6 degrees of longitude. Between 84°E and 90°E, northern hemisphere between equator and 84°N, onshore and offshore, Bangladesh, Bhutan, China, India, Kazakhstan, Mongolia, Nepal, Russian Federation. This CRS is based on the World Geodetic System 1984 (WGS 84) ellipsoid, a popular reference ellipsoid for worldwide positioning and mapping applications. This

coordinate reference system, specific to the designated UTM zone, offers a precise and localized foundation for various GIS operations, including mapping, spatial analysis, and data integration as shown in fig.7.

### 5.4 Validation:

In this study of LULC, here implies rapid validation method using the true color composite from the 2024 Sentinel-2 image and Open Street Map (OSM) data. The building foot print of the built-up class was partially taken into account during the validation. To validate the LULC map, two sets of building polygons were used. The pixel resolution was of 10m and 20m, which is of lesser clarity the significant majority of building shapes that aligned with pixels were reclassified as built-up on LULC map of Dhapakhel. This method complies in the study area, as the area has not much varying and does not consist unique features of land covers.

## 6. Land Use Change Analysis and Discussion

### 6.1 Patterns and Spatial of Vegetation Areas

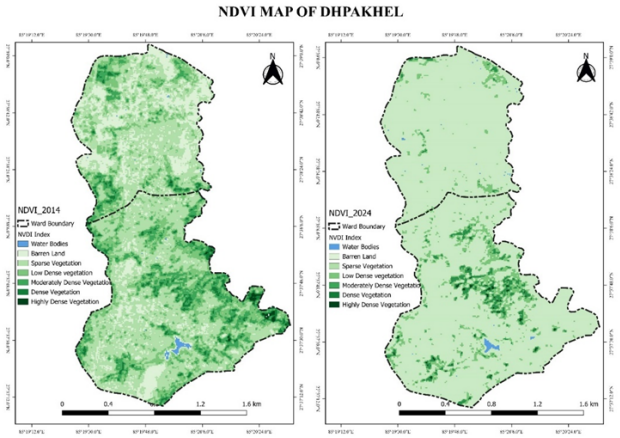


**Figure 8:** Map showing Vegetation Areas of Dhapakhel

The shades are clearer in 2014 but the change is clearly seen in the 2024 map (fig.8), further the map was reported in data form which showed us that there is random change in the vegetation cover over the decade. From fig.9, 2014 to 2024 barren land has increased by 2.559 Sq. km area resulting to change the space from 0.6327 Sq km to 3.1922 Sq km, which indicate the dynamic in change of land cover.Out of total area in 2024, 86.96 % cover is been classified as land which indicate in loss of green spaces and there might consequences of it.

| Vegetation Index | Vegetation of 2014 | | Vegetation of 2024 | | Spatial Change in Sq Km |
|---|---|---|---|---|---|
| | Area in Sq Km | % covered | Area in Sq Km | % covered | |
| Water Bodies | 0.0129 | 0.35 | 0.0112 | 0.31 | -0.0017 |
| Barren Land | 0.6327 | 17.24 | 3.1922 | 86.97 | 2.5595 |
| Sparse Vegetation | 1.7133 | 46.68 | 0 | 0 | -1.7133 |
| Low Dense Vegetation | 0.8031 | 21.88 | 0.3408 | 9.29 | -0.4623 |
| Moderately Dense Vegetation | 0.4007 | 10.92 | 0 | 0 | -0.4007 |
| Dense Vegetation | 0.0945 | 2.57 | 0.1163 | 3.17 | 0.0218 |
| Highly Dense Vegetation | 0.0128 | 0.35 | 0.0098 | 0.27 | -0.003 |
| Total | 3.6704 | 100 | 3.6704 | 100 | |

**Figure 9:** Spatial Change in Vegetations of Dhapakhel

Also factors like climate, soil type, topography, and human intervention shape these spatial distributions, influencing biodiversity, ecosystem stability, and land management practices.

### 6.2 Patterns and Spatial Expansion of Built-Up Areas

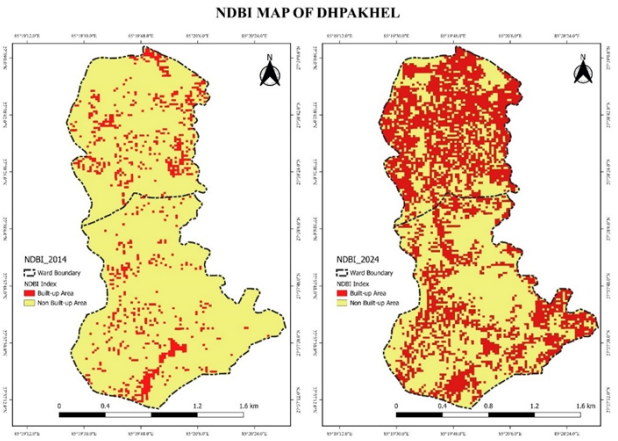


**Figure 10:** Map showing Built-Up Areas of Dhapakhel

As from the NDBI mapping,(fig.10) this result on the sprawl of the built-up area, preliminary stage it was liner along the main road, then gradually the space was developed, north area seems to obtain saturation in near future where south area is partially built-up and partially non-built-up forms. From the tabular data change id built-up area in Dhapakhel has changed from 0.37 Sq km in 2014 to 1.629 Sq km in 2024, which is nearly 77% change (fig. 11). This area indicates houses and roads which gives the picture of construction of road lead the people to build houses and vice versa.The results here depict that processes of built-up expansion do not only determine the horizontal urban expansion but also they determine the nature of people-to-land relationships, which involves both formal and informal processes of built-up expansion.

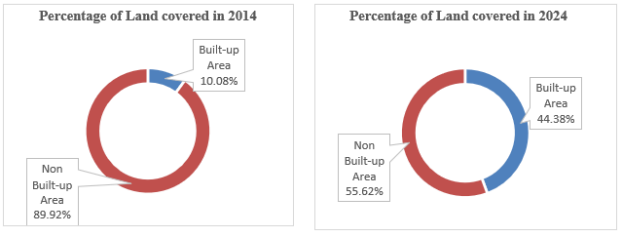


**Figure 11:** Graphical Representing Change in Built-up area of Dhapakhel

### 6.3 The Spatial Dynamics of Urban Fringe Land

From 2014 to 2024, vegetation i.e. forest are decreased from 2.2196 Sq km to 0.856 Sq km resulting in increase of cropland from 0.7208 Sq km to 1.271 Sq km and built-up from 0.73 Sq km to 1.5432 Sq km. in comparison the built-up areas have drastically increased from 2014 to 2024.For the past decade 1.363 Sq km land was converted to either cropland or built-up area with regular and irregular patterns, highly regular patterns of built-up expansion were observed towards south west corner and south east corner(fig.12 ). This implicit on current land intervention processes contributed to the horizontal expansion of built-up at the expenses of other land uses. Such trend of expansion in urban fringe, create the ultimate pressure on land use dynamics and leads to the deterioration of the ecosystem. The results of land use dynamics portray that the contribution of the informal land use intervention is high for the observed dynamic and high rate of conversion of urban fringe land uses[22] .

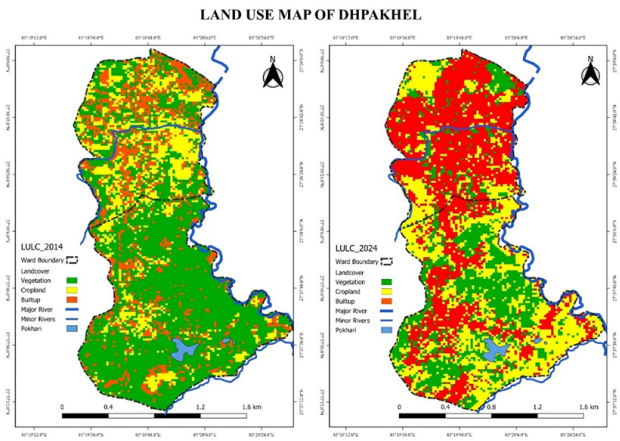


**Figure 12:** Land use/Land cover Map of Dhapakhel

### 6.4 Problem arisen by Land Use Change and Possible intervention

To evaluate the impacts of the existing urban fringe land use dynamics and intervention processes sample were taken with six different indicators that responses ranges from 5 to 1 scale (fig. 13), strongly agree to strongly disagree, respectively. The descriptive analysis here indicated that the existing urban fringe land intervention process has a negative impact on the livelihood of local communities with maximum support. Statistically, the majority of sample respondents agreed that the certain changes has improved in their access to basic services. Similarly, this change and lack of proper intervention have greatly affected on the socio- structures of local communities in fringe. The respondent strongly agreed on the increasing water and energy stress in the study area. In the same way, local government representative also stand out on increasing demand of water and unable to provide adequate and clean water on regular basis as the residents are bound to buy water from out private sources.

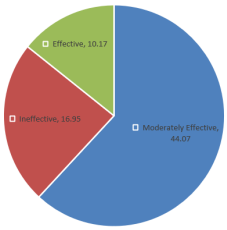


**Figure 13:** Effectiveness of the existing LU framework for governing the rate and extents of land use dynamics

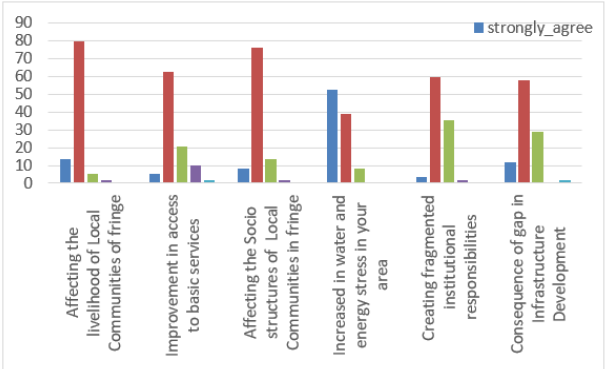


**Figure 14:** Impacts of the existing Urban Fringe land use intervention process

## 7. Findings

In case of LULC change of urban fringe, Dhapakhel showed that the transformation of land use change of vegetation has been observed more than other. The change in vegetation to cropland of 0.973 Sq km as shown 26.51 %; cropland to built-up 0.813 Sq km as

shown in 22.16 %; and change in vegetation to built-up of 0.39 Sq km as shown in 10.63 %in graph.The development often follows transportation corridors, with irregular growth influenced by legal and illegal settlements. Improved infrastructure, such as roads and public utilities, accelerates the appreciation of land value and attracts more investment.

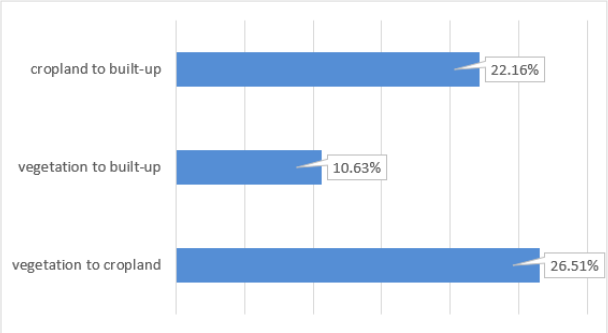


**Figure 15:** LULC transition pattern of Dhapakhel

The spatial results effectively illustrate the impact of horizontal expansion of built-up areas and land use dynamics, showing varying extents and magnitudes in the urban fringe lands. Meanwhile, non-spatial analysis helps understand the land use intervention processes, which can be considered key driving factors for the observed land use dynamics in the study area. Here, changes in land use, such as the conversion of agricultural/vegetation land into residential, commercial and industrial, have created stress on water supply systems and runoff management. About 800 households have not received water supply, although the connection was made years ago. Therefore, the required quantity can be distributed through an alternative source. Changes in land-use patterns have affected the natural flow of stormwater, with buildings and other infrastructures interrupting the flow, causing waterlogging in low-lying areas. It is estimated that stormwater flows down from an upstream area of about 1.805 square kilometers. Hence, proper drainage management is required with uplifting the present condition of streams.Another problem is congestion, which has arisen from the growth of residential and commercial areas and the increasing demand for transportation. The lack of adequate road width and dedicated pedestrian pathways, combined with poorly managed public transport and the rise in private car usage, has further contributed to the congestion.This has an adverse effect on the quality of life in the area.

## 8. Conclusion

Based on the research findings, it can be concluded that land use change, population growth and migration, and inadequate infrastructure are key factors influencing the dynamics of the urban fringe. Rapid urban expansion, unplanned infrastructure development, and population growth in the areas of this study significantly impact water resources. Change in natural flow pattern of storm water consequence of transformation; agriculture to built-up, drainage management in low lands has been a problem in the case of Dhapakhel.Congestion is also an underlying problem arisen by the change of land use, as a population demand for transportation infrastructure. The unplanned land and non-compliant infrastructure seen in this area is due to the fact that the existing land intervention initiatives lack effectiveness and no equitable implementation; this now has consequences of haphazard, disputed and unregulated land use patterns.To address these challenges, it is crucial to implement integrated urban planning strategies that prioritize sustainable drinking water and storm water management through a technical and economic solution. This includes adopting natural-based solutions, such as green infrastructure, rainwater harvesting, and upgrading drainage systems. Following the existing expansion is an immediate way to deal with congestion abide by the national urban road standards prevailing in the area. However, the interaction between formal urban planning and informal land occupation plays a critical role in shaping the spatial organization of these areas, making it essential for policymakers to implement sustainable strategies for managing urban fringe growth.This approach can be applied to other areas with similar contexts, regardless of geographic location, to develop a comprehensive land-use management policy supported by integrated follow-up alternatives.

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# ANNEX VIII: Final Presentation Slides

# Thesis Presentation

## Dynamics of Land-Use Change in Urban Fringe and Possible Intervention:
### A Case Study of Dhapakhel, Lalitpur

April, 2025

**Supervisor:**
Prof. Dr. Jiba Raj Pokharel

**Presented By:**
Bhagyashree Maharjan
079MSUrP002
Department of Architecture

## Table of Content



## Chapter-1 Introduction

- Background
- Need
- Importance
- Problem Statement
- Objectives
- Limitations

## Background

The World is urbanizing fast so do Nepal with average annual **growth rate of 0.93%** (Census 2021).

**Urbanization** does not take place in thin air and it requires the **consumption of enormous amount of rural land,** pressure on the **Urban Fringe** for growth.

In Nepal, **Urban population** has significantly increased from **22.31 % to 27.07%** between 2011 and 2021. Likewise, the **peri-urban population** has also increased from **39.19% to 39.75%.** Further, the **rural population** has decreased from **38.5% to 33.19%** in the last 10 years (DEGURBA).

In an urban context, **lack of land for development** and **lack of integrated land-use management policy** are major challenges, which further lead to haphazard urbanization and socio-economic consequences.

Meyer (1995) states that "*land use is the way in which, and the purpose for which, human beings employ the land and its resources*"

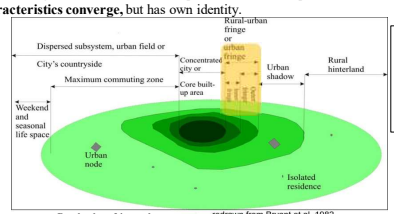
"***Land use*** *involves both the manner in which the* ***biophysical attributes*** *of the land are manipulated and the intent underlying that manipulation the purpose for which the land is used*" (Turner et al. 1995, 20).

## Background

The **urban fringe** is comprised of the land along the boundaries of a city that **transition to urban use** (Hushak 1975).

**Urban fringe** area is characterized by the **expansion of** commercial, industrial and housing areas, as well as the **loss of** green open areas and agricultural land (Burkhard et al. 2009; Nilsson et al. 2013).

**Urban fringes,** often referred to as peri-urban areas, represent **transitional zones** where **urban and rural characteristics converge,** but has own identity.




Rural-urban fringe scheme redrawn from Bryant et al. 1982

These regions have been extensively studied due to their **critical role** in **urbanization processes**, **infrastructure development**, and **socio-environmental challenges**.

**Source:** (Browder et al., 1995)

## Need

**Urban expansion into fringe areas** creates pressure on land resources.

**Environmental degradation** from unregulated development.

**Lack of updated policies** for fringe development.

**Infrastructure stress** in rapidly developing peripheries.

**Uncertainty about future growth patterns.** Urban fringes are **transitional zones** experiencing rapid growth, often outpacing planning and governance capacities

## Importance

**Understanding land use dynamics** is important to guide sustainable urban planning and control unplanned sprawl. Anticipating change is important for **timely infrastructure planning and public service delivery**. Mapping and analyzing trends helps in **forecasting and proactive governance**.

## Problem Statement

- **Urban expansion**, **population growth**, and **economic development** are driving rapid urbanization, **pushing city boundaries into fringe** areas and causing significant land use changes
- The **lack of coherent planning and governance** exacerbates challenges such as urban sprawl, environmental degradation, and socioeconomic inequalities.
- The dynamics of land use change in the urban fringe are **poorly understood, with limited data on the drivers, patterns, and impacts of these transformations**.


Unplanned Road Network


Unsuitable Land Slope


Scattered Land plots


Narrow roads


Water Scarcity


Drainage

## Research Objective

To gain understanding of the urban dynamics of fringe area in regional and national scenario and suggest for possible interventions taking Dhapakhel as example.

## Research Question

- What are the urban dynamics in urban fringes in particular context?
- What are the problems that arise out by Land-use change and transformation scene?
- What can be the possible interventions to address the above anomaly in Dhapakhel?

## Limitation

**Scope**:

- The study focus on the growth of the urban forms, land-use patterns, and the availability of infrastructure and services in the urban fringe area.
- The study covers some possible interventions for better management of the fringe area.

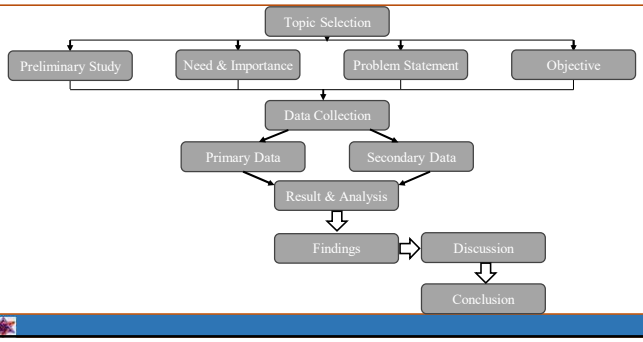
**Limitation:**

- The research area is limited to inner fringe of Lalitpur metropolitan city.
- This research exclusively focuses on the physical aspects of urban development.
- This research does not take into account the impacts of climate change such as weather changes or extreme conditions.

## Chapter-2 Research Methodology

- Conceptual Framework
- Research Paradigm
- Ontology
- Epistemology
- Methodology
- Methods

## Conceptual Framework




## Research Paradigm

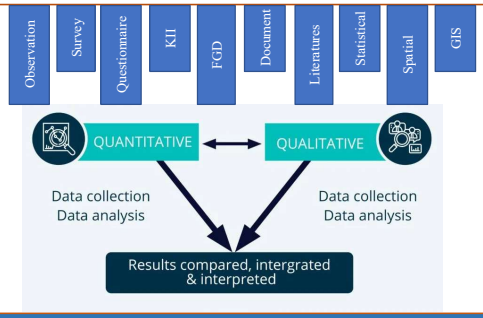
| | |
|---|---|
| Positivist | Objective patterns of urbanization |
| Post-Positivist | Leans heavily on quantitative approaches, limiting exploration of subjective realities, can be complex and resource-intensive |
| Interpretivist | Socio-cultural impacts and perceptions |
| **Constructivist** | **Co-created realities , Prioritizes community perspectives and empowerment** |
| Pragmatic | Practical solutions integrating objective |

**Ontology** — *Urban fringes are dynamic spaces shaped by the interplay of social, economic, environmental, and political forces.*

**Epistemology** — *Understanding urban fringes requires both quantitative data (e.g., population growth rates, land use changes) and qualitative insights (e.g., perceptions of communities, governance challenges).*

**Methodology** — Mixed Method with Case Study Approach

## Methods




## Chapter-3 Literature Review

- Urban, Peri-urban and Urban Fringe
- Urban Sprawl: Form of Fringe Development
- Factors Influencing Growth in Urban Fringe
- Land Use Regulations
- Land Policies in Nepal
- International Similar Cases

## Urban, Peri-Urban and Urban Fringe

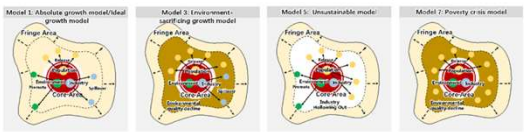
| Urban | Peri-Urban | Urban fringe |
|---|---|---|
| Urban is core city area with **dense infrastructure and development**. | It is a **transitional zone between urban and rural areas**, experiencing rapid changes. | It is the **outer edge of the city** where urban and rural characteristics blend. |
| Land-use: **Residential, commercial, industrial, and institutional areas**. | Land-use: **Mixed land use** (agriculture, informal settlements, and new developments). | Land-use: **Semi-urban** with small farms, scattered housing, and **expanding city influence**. |
| Focus on **Infrastructure development, zoning regulations, and urban renewal.** | Focus on **Managing land use transitions, infrastructure expansion, and informal settlements**. | Focus on **Controlling urban sprawl, integrating rural-urban linkages, and preserving agricultural land**. |
| **Fully developed** (roads, water, electricity, sanitation, etc.). | **Partially developed**; some areas lack basic services. | **Limited infrastructure**, often undergoing transformation. |
| **Congestion, pollution, high cost of living** are key challenges in urban | **Land conversion, informal settlements, planning conflicts** are key challenges in peri-urban. | **Loss of farmland, urban sprawl, inadequate infrastructure** are key challenges in urban fringe. |

## Urban Sprawl: Form of Fringe Development

In the early 1990s, sprawl was defined qualitatively for purposes of growth management in Florida (Ewing 1997).

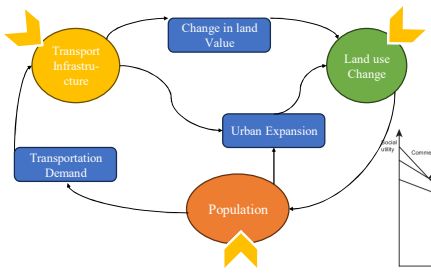
- ❑ leapfrog or scattered development,
- ❑ commercial strip development,
- ❑ expanses of low-density development, and
- ❑ expanses of single-use development

The **urban fringe** presents **highly valuable resources** such as land, space, and landscape **for the wealthy and powerful class**, and **for the low class**, the urban fringe area is only a **garbage dump that pollutes production and low-cost shelters away from various social resources** available in city centres(Sui & Lu, 2021)




Urban Growth and Fringes (Sui & Lu, 2021)

## Factors Influencing Growth in Urban Fringe




Bid rent model of landuse (Source: Barlowe 1978.)

## Impact of Land-use change in Urban Fringe

Unplanned growth in urban fringes often **leads to urban sprawl**, consuming agricultural and forested lands (Hebbert, 1986).

Increased **air and water pollution** from vehicular traffic and construction (Koirala, 2018)

Inadequate planning causes **strain on existing infrastructure**, such as roads, drainage, water supply, and sanitation systems (Newman, 2016).

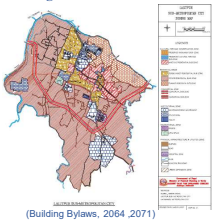
Increased demand for housing, leading to **unregulated construction and possible land-use conflicts**. (Brueckner & Helsley, 2011)

Lack of integrated land-use planning results in **fragmented development.**



## Land Use Regulations

**Zoning**



(Building Bylaws, 2064 ,2071)

Min lot size zoning>>less dense
Max lot size Zoning>> More dense

**Height Restriction**

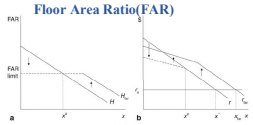
Height of building and light plane
(Building Bylaws, 2071)

**Vacant Land Tax**

**Development Fee**

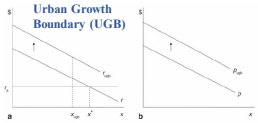
Bhawan Nirman Sambandhi Adharhut Margdarsan 2072

**Floor Area Ratio(FAR)**



Floor area ratio limit (a) Effect on building height, (b) Effect on land rent (Brueckner, 2009))

**Urban Growth Boundary (UGB)**



Urban growth boundary (a) Effect on land rent, (b) Effect on housing price (Brueckner, 2009)

## Similar Cases

Srinagar City, India (Nengroo et al., 2017)

**Objective:** To study the **dynamics of land use change** in rural-urban fringe.

**Method:** Survey of India toposheets at 1:20000 scales and CARTOSAT-I through the method of digitization in ArcView 3.2a GIS software. Global Positioning System (GPS) used in the validation

Bhopal city, India (Dhote K K et al., 2013)

**Objective:** Identification of Appropriate **Planning Intervention** for Indian Cities

**Method:** Physical, social and economic factors considered FGD and KII were major tools of qualitative research.

Bahir Dar City of Ethiopia (Haregeweyn et al., 2012b)

**Objective:** The study analyzes Bahir Dar's urban expansion (1957–2009), its **impact on land use and built-up areas** (1957–1994), and the effects on small-scale farmers in the urban fringe.

**Method:** Aerial photos for the years 1957, 1984, and 1994 as well as field mapping using GPS for the year 2009 were employed and analyzed using GIS.

Bahir Dar City of Ethiopia (Wubie et al., 2020)

**Objective:** The study **examines land use dynamics and intervention processes** in Bahir Dar's peri-urban areas, evaluating their effectiveness in controlling unwanted land use changes through socio-spatial analysis.

**Method:** impact and effectiveness of the existing peri-urban land use intervention process, land use policy, land use changes and decisions related to land were collected using Spatial and non spatial data

## Similar Cases

Gelephu, Bhutan (Tempa, n.d.)

**Objective:** To perform **land use land cover (LULC) mapping** for Gelephu for 2016 and 2023 by a Random Forest (RF) classifier, using the Semi- automatic Classification Plugin (SCP) in QGIS and identify LULC changes

**Method:** Satellite product availability was investigated and Level-A Sentinel-2 satellite multispectral data images from the years 2016 and 2023 was downloaded from the USGS Earth Resources Observation and Science (EROS) Centre website (https://ers.cr.usgs.gov/) that provided a valuable seven-year timeframe to adequately assess the dynamics of LULC and NDVI changes.

Bhutan (Gilani et al., 2015)

**Objective:** For analyzing **LC change** related to forest and protected areas which describes the decadal dynamics in LC changes at national and sub-national level in Bhutan

**Method:** By applying object-based image analysis (OBIA) techniques to 1990, 2000, and 2010 Landsat (30 m spatial resolution) data. Ten LC classes were defined in order to give a harmonized legend land cover classification system (LCCS).

## Land Policies in Nepal

| Key Land use Policies of Nepal | |
|---|---|
| National Land Act, 2019 | provide base for equitable distribution of benefits obtained from land and its resources. |
| Land Act, 2021 | Ceiling and floor of land plots, Acquisition and compensation provision. |
| KVDA Act, 2045 | Land development through Site and services, GLD and Land pooling tools. |
| Town development Act, 2045 | provide necessary services and facilities to the residents of the town by reconstructing, expanding and developing existing towns. |
| National Urban Policy 2064 | Integrated and coordinated effort for responding to the challenges posed by haphazard urbanization. |
| Local Government Operation Act, 2074 | Includes the Roles, Responsibility and Power of the Local Government in Disaster Risk Reduction and Management. |
| Building Bylaws and Guidelines : 2064, 2071 and 2072 | Consist Zoning and regulations that serves as a comprehensive reference for educational institutions and other organizations interested in understanding the building permit system and safer construction practices in Nepal. |
| Land (Survey and Measurement) Act, 2019 | This is intended to foster harmonious relationships among citizens by organizing land measurements and classification. |
| Land Acquisition Act, 2034 | The government of Nepal has the authority to acquire land for public welfare. Land acquisition can be carried out for any institution that has covered all associated costs, provided a detailed technical report, and submitted an estimated timeline. |

## Chapter-4 Case Study

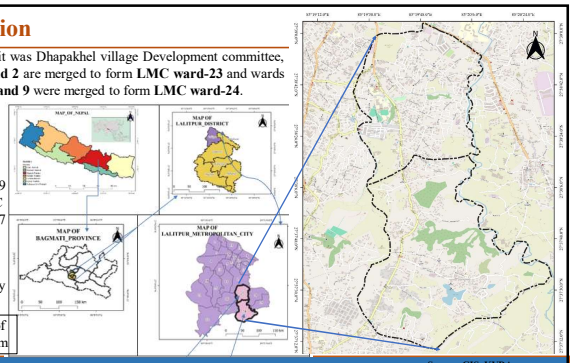
- Location
- Population
- Settlement Pattern
- Water Bodies
- Social Structure
- Institutions and Services

## Location

Previously it was Dhapakhel village Development committee, **wards 1 and 2** are merged to form **LMC ward-23** and wards **3,4,5,6,7,8 and 9** were merged to form **LMC ward-24**.

**North:** LMC ward15
**East:** LMC ward-28&29
**West:** LMC ward-26&27
and
**South:** Godawari Municipality

Total area of 3.671 Sq Km

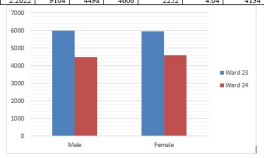




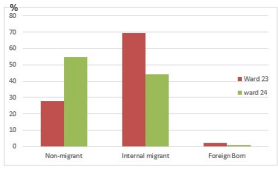

Source: GIS, KVDA

## Population

| Ward | Area (Sq Km) | Population | | | Number of households | Average household size | Population Density (per Sq Km) | Sex ratio |
|---|---|---|---|---|---|---|---|---|
| | | Total | Male | Female | | | | |
| 23 | 1.4696 | 11928 | 5983 | 5945 | 3205 | 3.72 | 8116 | 100.64 |
| 24 | 2.2022 | 9104 | 4498 | 4606 | 2252 | 4.04 | 4134 | 97.66 |




**Population distribution of Dhapakhel** *(Source: National Population and Housing Census 2021)*




**Status of Life-time Migration** *(Source: National Population and Housing Census 2021)*

## Settlement Pattern

Diminishing Traditional Pattern of Residents

Loss of older Settings

Row Housing

## Settlement Pattern

High Rise Residentials

## Water Bodies

Nagdaha

Akhi Daha

Khodku-Karmansa

Gangate Khola

Mahadev Khola

## Social Structure

This area is **common residence area for all caste**, ethnicity and religion with **majority of Newar and Chhetri** community.

Majority of Hindu is seen but other religions are also heartly welcomed here with significant Temples and Churches.

This area celebrate jatra on **Holi festival** which was originally derived from **Hatisidhhi Jatra**.

## Institutions and Services

In this study area there are **4 government school and 10 Private Schools** among them for change in the urban pattern GEMS School, IJ Pioneer School and KEC College have greater impact.

Sumeru Hospital in only hospital and for minor health care government run 2 Health post in this area.

For street dog care there is an institute called *Sneha Kaakha*.

Apart from this there are significant ***Upabhokta Samiti*** for infrastructure development, ***Samuha*** for women uplifting and other local ***Guthis*** **and** ***Mandali***.

## Chapter-5 Data Collection and Analysis

- Satellite Image
- Observation
- Collection of Data
- Data Processing
- Land Use Change Analysis
- Intervention

## Google Satellite Image

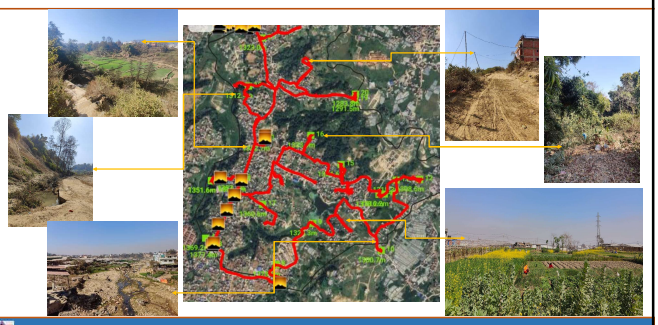

Preliminary study manifested on the **expansion and sprawl** of the study area from 2014 to 2024.

Urban expansion is observant in **northern part** being vicinity of Ring-road in compare to southern part.


## Observation [Site Observations (Ward 23)]

Source: SW Maps

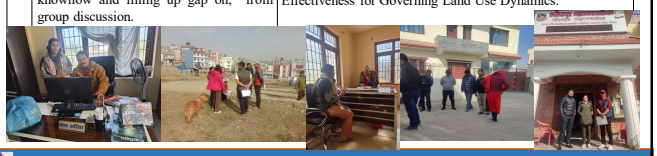
## Observation [Site Observations (Ward 24)]



Source: SW Maps

## Data Collection

| | | |
|---|---|---|
| Non- Spatial Data | Interview of five persons from each ward. Including Public elective representatives, Old Knowledgeable and surveyor. | This summarized as they showed concern about the basic services and some key points on implementation of building by laws and land fragmentation system. |
| | Discussions were with the residents in 2 group of 6 regarding the living experience problems of wards. | The male respondents raised the issue of gap in development, narrow roads and inadequate services. The female respondents showed their concern about local training and participation biasness, street light and garbage disposal. |
| | Targeted to samples for verification on knowhow and filling up gap on, from group discussion. | Updated to gather more information on interventions and its Effectiveness for Governing Land Use Dynamics. |

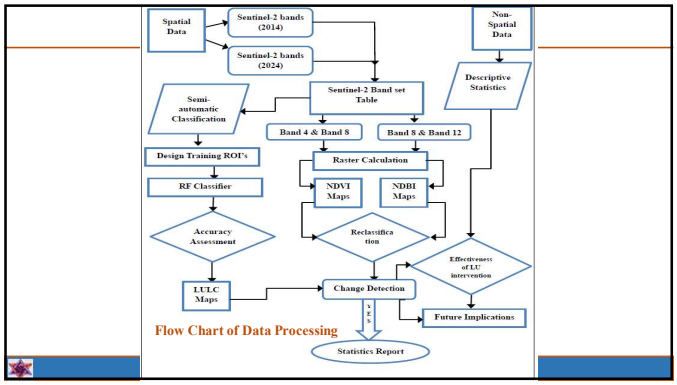


## Data Collection

| | | |
|---|---|---|
| Spatial Data | Sentinel-2 satellite multispectral data images from the years 2014 and 2024 was downloaded from the USGS Earth Resources Observation and Science (EROS) Centre website (https://ers.cr.usgs.gov/). | To assess LULC and NDVI and perform change detection analysis for Dhapakhel |

| Sentinel-2 Bands | Central Wavelength (µm) | Resolution (m) |
|---|---|---|
| Band 1 - Coastal aerosol | 0.443 | 60 |
| Band 2 - Blue | 0.490 | 10 |
| Band 3 - Green | 0.560 | 10 |
| Band 4 - Red | 0.665 | 10 |
| Band 5 - Vegetation Red Edge | 0.705 | 20 |
| Band 6 - Vegetation Red Edge | 0.740 | 20 |
| Band 7 - Vegetation Red Edge | 0.783 | 20 |
| Band 8 - NIR | 0.842 | 10 |
| Band 8A - Vegetation Red Edge | 0.865 | 20 |
| Band 9 - Water vapour | 0.945 | 60 |
| Band 10 - SWIR - Cirrus | 1.375 | 60 |
| Band 11 - SWIR | 1.610 | 20 |
| Band 12 - SWIR | 2.190 | 20 |

Sentinel-2 spectral bands (Source: https://custom-scripts.sentinel-hub.com/)



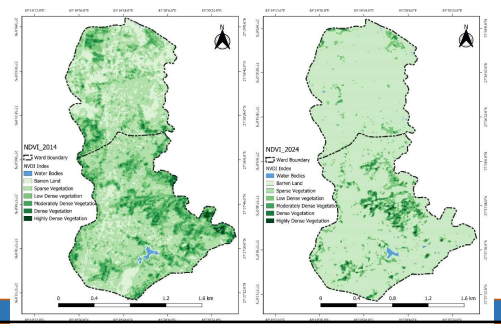

Flow Chart of Data Processing

## Land Use Change Analysis

- Patterns and Spatial of Vegetation Areas
- Patterns and Spatial Expansion of Built-Up Areas
- Spatial Dynamics of Urban Fringe Land

## Patterns and Spatial of Vegetation Areas

NDVI MAP OF DHPAKHEL



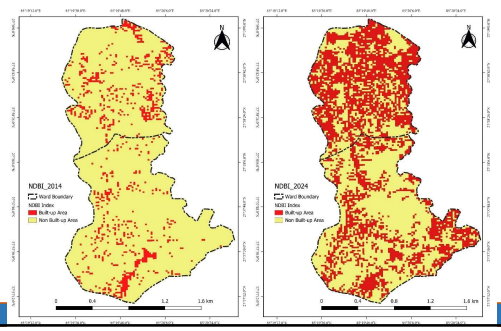

## Patterns and Spatial of Vegetation Areas

| Vegetation Index | Vegetation of 2014 | | Vegetation of 2024 | | Spatial Change in Sq Km |
|---|---|---|---|---|---|
| | Area in Sq Km | % covered | Area in Sq Km | % covered | |
| Water Bodies | 0.0129 | 0.35 | 0.0112 | 0.31 | -0.0017 |
| Barren Land | 0.6327 | 17.24 | 3.1922 | 86.97 | 2.5595 |
| Sparse Vegetation | 1.7133 | 46.68 | 0 | 0 | -1.7133 |
| Low Dense Vegetation | 0.8031 | 21.88 | 0.3408 | 9.29 | -0.4623 |
| Moderately Dense Vegetation | 0.4007 | 10.92 | 0 | 0 | -0.4007 |
| Dense Vegetation | 0.0945 | 2.57 | 0.1163 | 3.17 | 0.0218 |
| Highly Dense Vegetation | 0.0128 | 0.35 | 0.0098 | 0.27 | -0.003 |
| Total | 3.6704 | 100 | 3.6704 | 100 | |

In 2024, out of total area, **69.72 % cover** is been transformed into **barren land** which indicate in **loss of green vegetations** and green spaces which might show consequences of it in Dhapakhel.

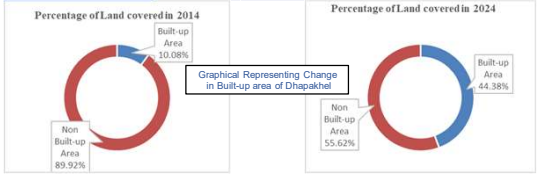
## Patterns and Spatial Expansion of Built-Up Areas

NDBI MAP OF DHPAKHEL




## Patterns and Spatial Expansion of Built-Up Areas

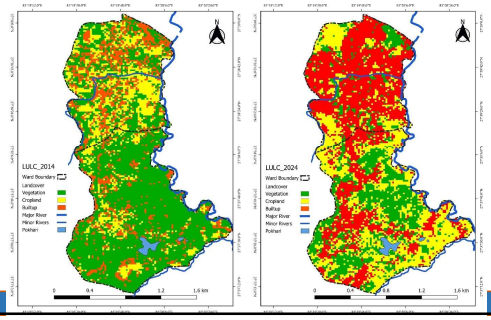
| Built-up Index | Built-up of 2014 | | Built-up of 2024 | |
|---|---|---|---|---|
| | Area in Sq Km | % covered | Area in Sq Km | %covered |
| Built-up Area | 0.3700 | 10.08 | 1.6290 | 44.38 |
| Non Built-up Area | 3.3004 | 89.92 | 2.0414 | 55.62 |
| Total | 3.6704 | 100 | 3.6704 | 100 |




Within decade, **34.30 %** area been **added** up on built-up categories, implies expansion/sprawl in Dhapakhel.

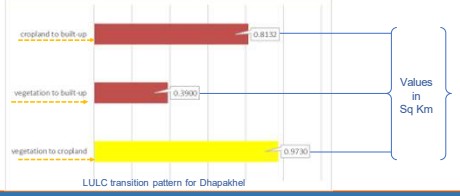
## Spatial Dynamics of Urban Fringe Land

LAND USE MAP OF DHPAKHEL




## Spatial Dynamics of Urban Fringe Land

| LULC | LULC of 2014 | | LULC of 2024 | | Spatial Change in Sq Km |
|---|---|---|---|---|---|
| | Area in Sq Km | % covered | Area in Sq Km | % covered | |
| Vegetation | 2.2196 | 60.47 | 0.8560 | 23.32 | -1.3636 |
| Cropland | 0.7208 | 19.64 | 1.2712 | 34.63 | 0.5504 |
| Built-up | 0.7300 | 19.89 | 1.5432 | 42.04 | 0.8132 |
| Total | 3.6704 | 100 | 3.6704 | 100 | |




LULC transition pattern for Dhapakhel

## Validation

LULC, rapid validation method using the true color composite from the 2024 Sentinel-2 image and Open Street Map (OSM) data.

The building foot print of the built-up class was partially taken into account w.r.t. SWmap features during the validation.

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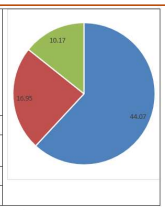
## Chapter-6 Findings and Discussion

## Perception on Effectiveness of Current Intervention

| Responses | How do you Evaluate the effectiveness of the existing land use change or the Land Intervention Practice for governing the rate and extent of Land Use Dynamics in Urban fringe Areas? | |
|---|---|---|
| | Frequency | Percentage |
| Moderately Effective | 26 | 44.07 |
| Ineffective | 10 | 16.95 |
| Effective | 6 | 10.17 |

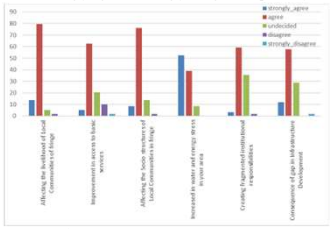



Effectiveness of the existing LU framework for governing the rate and extents of land use dynamics

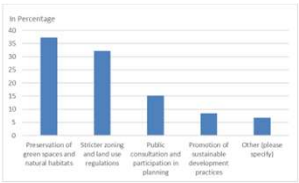
From this, it is possible to argue that the existing urban fringe land dynamics and possible intervention frameworks of Dhapakhel **are not congruent and appropriate enough** to sustainably manage the rapidly expanding informal built-ups and unwanted land use dynamics

## Perception of Interviewers on..

To evaluate the impacts of the existing urban fringe land use dynamics and intervention processes sample were taken with six different indicators that responses ranges from **5 to 1 scale**, strongly agree to strongly disagree, respectively.




Impacts of the existing Urban Fringe land use intervention process




Measures be taken to minimize negative impacts of land use changes

## Findings

| Land-use Change | | Problem risen due to change | Intervention Required On |
|---|---|---|---|
| Before (2014) | Present (2024) | | |
| Agriculture / Barren land | Residential | Demand of Housing and Infrastructures, Uneven Skyline and forms | 1. Water Supply system |
| | Roads | Low Quality, Congestion and Pollution, absence of Street furniture | 2. Drainage system |
| | Public Spaces | Inadequate Open spaces | 3. Congestion management |
| | Commercial/Small Industry | Congestion and Pollution | |
| Industry / Built-up | Mix Residential | Uneven distribution | |
| | Commercial | Congestion and Pollution | |
| | Institutions | Congestion and rental demands | |

## Stress on Water Supply

SOURCE 2

Source 1>Lele & Source 2>Melamchi

Water from lele>> 2 hrs twice in a week
**<<not sufficient >>**

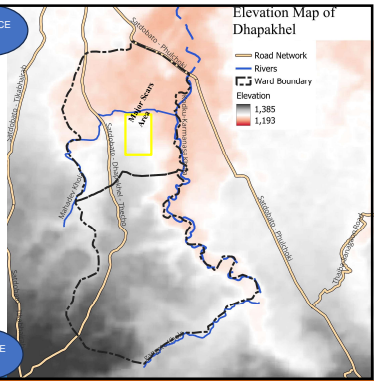
Old settlement have traditional *kuwa* and *inar* for other than drinking purpose.

New developed plots and housing depend on portable means of water supply

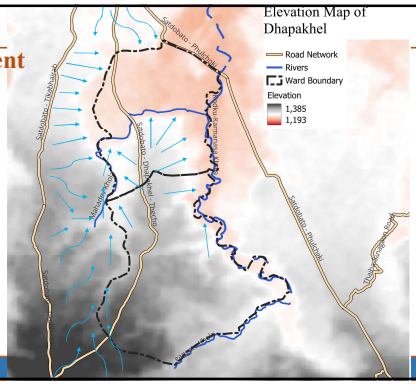
Melamchi is **alternative source** government has planned for valley.

In dhapakhel due to elevation difference its still in consideration.

SOURCE 1




## Drainage Management

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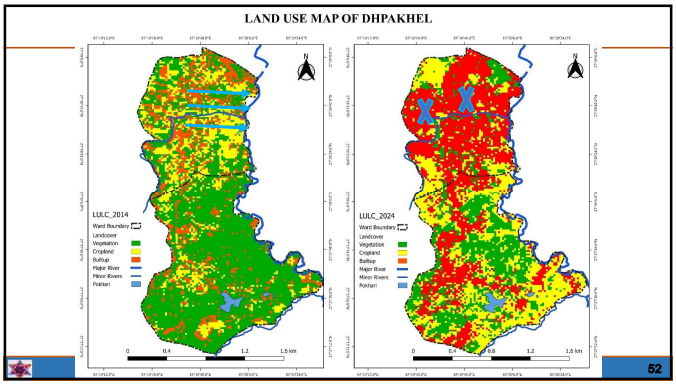


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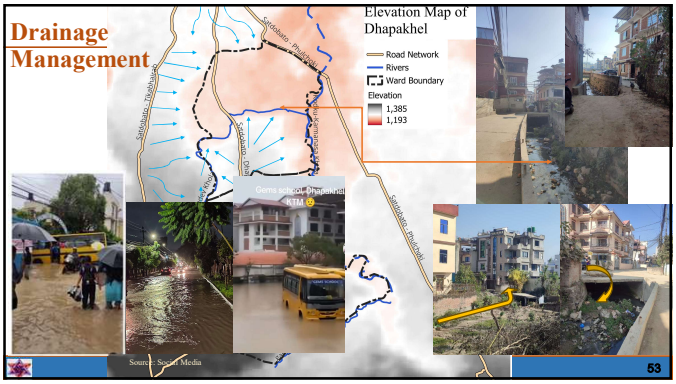
## Drainage Management

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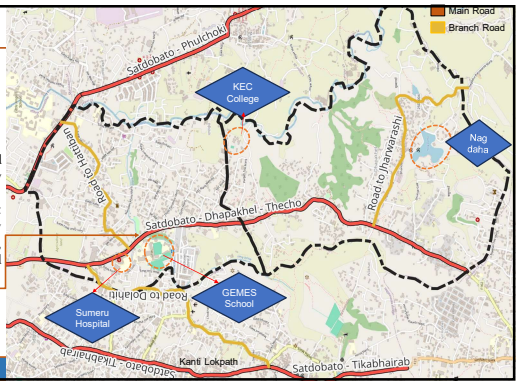
## Congestion

Expansion order for 14m wide road but **7m in site.**

Declared as urban road but without any standard>>>>**worst condition of pavement and without any components** (walkway, bus stops, median, road marking and signages….)



## Cont.

# Chapter-7 Conclusion and Recommendation

## Conclusion

| | |
|---|---|
| What are the urban dynamics in urban fringes in particular context? | ➢ Land Use Change<br>➢ Population growth and Migration<br>➢ Inadequate Infrastructure Development |
| What are the problems that arise out by Land-use change and transformation scene? | ➢ Rapid land use change has led to higher water consumption, straining existing water supply systems.<br>➢ Urban expansion has disturbed the natural flow as well as decreased permeable surfaces, limiting groundwater replenishment that has resulted in waterlogging.<br>➢ Unplanned road networks resulting Congestion and neglecting walkability. |

## Conclusion

| | |
|---|---|
| What can be the possible interventions to address the above anomaly in Dhapakhel? | ➢ Expansion and improvement of municipal water supply networks to meet growing demand and policies promoting water conservation, rainwater harvesting and efficient water distribution systems.<br>➢ Development of an integrated stormwater drainage system to prevent waterlogging and urban flooding.<br>➢ Ensuring that public transport runs frequently and reliably during peak hours which turns more attractive option than self driving also encouraging alternative forms of transport by creating safe walking and cycling routes.<br>➢ A combination of urban planning, policy measures, and community participation is crucial for long-term resource sustainability in urban fringe areas. |

## Recommendation

| | |
|---|---|
| Water Supply Management | ➢ Revitalization plan and programs of present water source.<br>➢ Community managed system for existing *Inar* and *kuwa*.<br>➢ Identify of sustainable alternative source; technical and economical feasible.<br>➢ Mandate Rainwater Harvesting (RWH) |
| Drainage Management | ➢ Artificial Groundwater Recharge/Retention Zones in upstream.<br>➢ Resurrection of natural drain with provision of right of way; strict enforcement to Prohibit Encroachments.<br>➢ Upgrading Drainage Infrastructure with proper calculation of quantity of discharge and adequate configuration of sewer.<br>➢ Low-Impact Development (LID) approach |

## Recommendation

| | |
|---|---|
| Traffic Congestion Management | ➢ Public transportation management with designated bus stops .<br>➢ Widening and improvement of road networks.<br>➢ Providing Street furniture in road with adequate lanes for walking, cycling and vehicles.<br>➢ Use Smart Traffic Solutions |
| Strengthen Land Use Policies and Planning | ➢ Governments should develop and enforce clear land use policies that prioritize environmental protection, prevent unregulated urban sprawl, and ensure responsible development. |
| Support Community Involvement | ➢ Community-led land management committees in urban fringe and rural areas to mediate land disputes, ensure equitable access, and monitor unsustainable land conversions. |


Thank You