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Development Management in Emerging Town Along BP Highway: A Case of Bhakundebesi

by

Sandra Joshi

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The undersigned certify that they have read, and recommended to the Institute of Engineering for acceptance, a thesis entitled "Development Management in Emerging Town Along BP Highway: A Case of Bhakundebesi" submitted by Sandra Joshi in partial fulfilment of the requirements for the degree of Master in Urban Planning.

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DECLARATION

I hereby declare that the thesis entitled “Development Management in Emerging Town Along BP Highway: A Case of Bhakundebesi”, submitted to the Department of Architecture in partial fulfilment of the requirement for the degree of Master Science in Urban Planning, is a record of an original work done under the guidance of Assoc. Prof. Dr. Ajay Chandra Lal, Institute of Engineering, Pulchowk Campus. This thesis contains only work completed by me except for the consulted material which has been duly referenced and acknowledged.

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ABSTRACT

The construction of the BP Highway has significantly influenced the spatial and economic landscape of settlements along its route, particularly in Bhakundebesi. Originally a rural area with scattered settlements, Bhakundebesi is now rapidly urbanizing. The flatlands around Bhakundebesi are emerging as the main local market center, gradually transforming into an urban area. This shift is driven by the strategic location of Bhakundebesi along the highway, making it a crucial marketplace and service hub for surrounding rural settlements. The trend of urban growth is gaining momentum, fueled by economic activities, migration, and rising commercial opportunities along the highway. This growth is largely driven by increasing migration from remote regions, where people seek economic opportunities in trade, services, and small-scale industries. This type of growth is often accompanied by adverse effects such as environmental degradation, loss of agricultural land, and social inequities. This study utilizes a mixed-method approach, incorporating census data, field surveys, and stakeholder interviews to assess urbanization trends. Findings indicate rapid land use transformation, increasing commercial activity, and infrastructure deficits. Without proper planning, continued growth could lead to unmanaged expansion, resource strain, and environmental degradation. The study highlights the need for strategic urban planning to mitigate these challenges and ensure sustainable development along the BP Highway.

Keywords: Bhakundebesi, Urban, Development Management, Emerging Towns, Spatial Transformation, Highway-Oriented Development

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
CBD	Central Business District
DEGURBA	Degree of Urbanization
EV	Electric Vehicle
FSM	Fecal Sludge Management
GI	Galvanized Iron
GIS	Geographic Information System
ICIMOD	International Centre for Integrated Mountain Development
MTMP	Municipal Transport Master Plan
NSO	National Statistic Office
PHC	Primary Health Care
ROW	Right of Way
UK	The United Kingdom
UN	United Nations
WASH	Water, Sanitation and Hygiene

CHAPTER ONE: INTRODUCTION

1.1 Background

The relationship between transportation networks and spatial development has been important for the understanding of development of urban area and the spread of economic activity on the periphery of transport network (Khanna, 2014). Urban development within a country depends on the extent of spatial transport across regions. Upgrading the transit networks actually allows regions that are further away to develop, suggesting that there may be positive regional growth for policies that invest in infrastructure projects. Initially, economic activity was concentrated around well-connected cities, but over time, it has expanded to neighboring areas that are farther away. The findings suggest that although significant spatial inequalities still exist, there is now potential for rapid transformation. The rate of convergence has been quicker than typical rates observed in peripheral areas of highways, due to the spillover effects of economic activity from neighboring areas. Development is driven by transportation.

The B.P. Highway or NH13 highway is the shortest route connecting Kathmandu valley and the Madhesh Province that connects the Koshi Province with the capital of Nepal. Named after former Nepalese leader B.P. Koirala, this route is crucial as it serves as the primary eastbound exit from the densely populated Kathmandu Valley. With the increase in vehicular flow many market centers are being created. The major centers along the route include Dhulikhel, Bhakundebesi, Mulkot, Khurkot, Khaniyakharka, Chiyabari, Sindhuli Madi, Bhiman, and Bardibas, each located within different municipalities. These centers serve as important nodes for trade, transportation, and urban expansion along the highway.

Historically, Nepal's urban growth centered on the Kathmandu Valley and Terai plains, but recent decades have seen emerging towns proliferate along highways, driven by improved connectivity and migration from remote regions. The BP Highway, completed in 2015, exemplifies this trend. Stretching 158 km, it connects Kathmandu to the eastern Terai, traversing mid-hill regions like Kavrepalanchok District, where Bhakundebesi is located. This transformation mirrors global patterns of highway-induced development, where improved accessibility spurs land-use changes, economic

clustering, and population influx. However, Bhakundebesi's case is unique. Unlike planned cities, its growth is organic and largely unregulated.

1.2 Rationale

1.2.1 Need of Research

Urbanization studies in Nepal have largely centered on Kathmandu and Terai cities, overlooking the transformation of hill towns like Bhakundebesi, where rapid growth is shaped by highway expansion, informal land transactions, and environmental vulnerabilities. Despite global research on highway-induced urbanization—such as Cervero's induced travel theory and Hirschman's polarization effects—these frameworks have not been critically examined in Nepal's context, where weak zoning regulations influence development patterns.

Bhakundebesi's evolution along the BP Highway highlights the urgent need for research that bridges this knowledge gap. Without a nuanced understanding of how highways drive spatial transformation, policymakers risk mismanaging growth, leading to unregulated expansion, social disparities, and environmental degradation. A focused study on land use dynamics, infrastructure shifts, and economic trends in Bhakundebesi is crucial for guiding sustainable urban development in highway towns which are emerging.

1.2.2 Importance of Research

This research is essential for understanding the development patterns of emerging towns along major highways and the challenges they face. As Bhakundebesi undergoes rapid transformation due to the influence of the highway, it becomes increasingly important to analyze its urban expansion and the spatial transformations occurring in the area. Highways play a significant role in shaping the growth of settlements by driving economic opportunities, attracting migration, and influencing land use changes. However, without proper planning and management, this growth can lead to unregulated urban sprawl, congestion, and strain on essential infrastructure. This study seeks to examine how the BP Highway is affecting land use and infrastructure in Bhakundebesi, providing valuable insights into the relationship between transportation networks and urban development.

By evaluating the spatial transformation and economic shifts in Bhakundebesi, the research will help urban planners, policymakers, and local authorities devise effective strategies for managing urban growth in a sustainable manner. Infrastructure development is a crucial factor in shaping the economic landscape of emerging towns, but it also brings challenges such as increased demand for housing, commercial spaces, and public services. Understanding these dynamics will enable stakeholders to plan for balanced growth that maximizes economic benefits while minimizing negative consequences such as environmental degradation, inadequate public services, and declining living standards.

Furthermore, this study will help identify gaps in essential services such as transportation, water supply, waste management, and housing, ensuring that future investments are directed toward the most pressing needs. Properly planned urbanization can improve the quality of life for residents, enhance economic opportunities, and create a resilient urban environment. By addressing potential challenges early, the study aims to contribute to the sustainable growth of Bhakundebesi and serve as a reference for managing urbanization in other emerging highway towns in Nepal. The findings will support evidence-based decision-making, helping ensure that development occurs in an organized, efficient, and environmentally responsible manner. Ultimately, this research will provide a framework for integrating infrastructure planning, land use management, and sustainable development principles to create well-planned, thriving urban centers along Nepal's highway corridors.

1.3 Problem Statement

The recent construction of the BP Highway has significantly altered the spatial and economic landscapes of the settlements along its route, with Bhakundebesi being a prime example of such transformation. Once a rural settlement with scattered dwellings, Bhakundebesi is now experiencing rapid urbanization due to its strategic location along this key transportation corridor. Positioned as a convenient stop for travelers, Bhakundebesi is emerging as a commercial and service hub, attracting economic activities and facilitating migration from more remote areas.

However, this rapid urban growth brings with it a set of complex challenges. While the highway has spurred economic development and improved connectivity, it also presents issues such as environmental degradation, loss of agricultural land, and growing socio-

economic disparities. Understanding the specific developmental dynamics that characterize the evolving urban landscape of Bhakundebesi is vital for comprehending the broader implications of highway expansion on local socio-economic structures. While increased accessibility can drive economic growth, it also poses significant challenges (Song et al., 2016). Research indicates that unregulated urban expansion typically results in negative consequences, including inadequate infrastructure, traffic congestion, and strained social services, alongside declining living standards (Abram et al., 2022; Pratama et al., 2022a). Without effective urban management strategies, Bhakundebesi risks uncontrolled land-use changes that may compromise its ecological integrity and quality of life for its residents. If left unmanaged, Bhakundebesi faces the risk of uncontrolled urban sprawl that could harm its ecological balance and social fabric.

The highway's influence has triggered substantial changes in the settlement pattern and land use, underscoring the need for effective planning and management. This research aims to explore the spatial transformation of Bhakundebesi, examine the development dynamics of this emerging settlement, and identify potential strategies to guide its growth in a sustainable direction. A comprehensive understanding of these dynamics is crucial for developing informed policies that can address the challenges posed by rapid urbanization and ensure long-term socio-economic and environmental stability.

1.4 Research Questions

This study explores the spatial transformation of Bhakundebesi following the construction of the BP Highway, examining how improved accessibility has influenced land use, settlement patterns, and urban expansion. It investigates the key factors driving development dynamics, including transportation access, land market trends, economic activities, and migration. Additionally, the research seeks to identify potential planning interventions to manage and guide sustainable urban growth, ensuring balanced development while addressing infrastructure needs and regulatory challenges.

So, the research questions for this research are:

1. How spatial transformation occurs after road (BP Highway) construction?
2. What are the development dynamics of the emerging settlement (Bhakundebesi)?
3. What are the possible interventions to manage the development?

1.5 Research Validity

This research on Bhakundebesi as an emerging highway town provides crucial insights into the impacts of infrastructure development on urban growth and land use changes along transportation corridors in Nepal. By focusing on the spatial transformation, land subdivision practices, and urban expansion patterns, this study contributes to understanding the dynamics of emerging settlements influenced by road networks, particularly the BP Highway.

The findings of this research are not only relevant to Bhakundebesi but also extend to other similar towns developing along major highways in Nepal. The study offers valuable lessons in managing rapid urbanization and provides a framework for balanced development. This research contributes to the broader objective of promoting sustainable urban development in Nepal, helping policymakers and planners manage growth in emerging urban areas while ensuring that development is well-planned, organized, and aligned with national strategies for balanced regional development.

1.6 Limitations

The study on the urban growth and development dynamics of Bhakundebesi has several limitations. First, the geographical scope is limited to Bhakundebesi, making it difficult to generalize the findings to other emerging towns in Nepal, as each location may have unique socio-economic and geographical factors.

Additionally, the research mainly emphasizes the role of transportation infrastructure, potentially overlooking other factors like local economic activities, social dynamics, and environmental constraints. The study also does not fully explore the policy context or the effectiveness of urban planning frameworks in managing emerging towns' development. Despite these limitations, the study provides valuable insights into Bhakundebesi's development, laying a foundation for further research and policy discussions on managing urban growth in Nepal's transportation corridors.

CHAPTER TWO: METHODOLOGY

A research paradigm refers to the underlying framework or approach that guides the entire research process. It shapes how a researcher views the world and approaches the problem at hand, influencing how knowledge is gathered, analyzed, and interpreted.

2.1 Research Paradigm

Pragmatism is a flexible and practical paradigm that blends elements of both positivism and interpretivism (Legg & Hookway, 2024). It is not bound by a particular method but instead focuses on the research question and uses whatever methods (qualitative or quantitative) are most effective in answering that question. Pragmatism is ideal for research that seeks practical outcomes and solutions.

This research adopts a pragmatic paradigm. The pragmatic approach is particularly suited for applied research that seeks to address real-world problems by selecting the most effective strategies for obtaining meaningful data. In this context, the pragmatic paradigm allows the researcher to draw from both qualitative and quantitative methods, enabling the exploration of the spatial transformation and development dynamics in Bhakundebesi. Pragmatism focuses on the research problem rather than the methodological purity of either qualitative or quantitative methods. The objective is to obtain practical knowledge that can inform development management practices in emerging towns, particularly with regard to the influence of infrastructure like the BP Highway. Given that Bhakundebesi's development is influenced by multiple factors, a pragmatic approach helps to capture the complexity of these interactions effectively.

Ontology defines the research framework, epistemology determines the research questions, and methodology provides the research methods (intgrty, 2020).

2.2 Ontology

Ontology is the philosophical study of being. It refers to your view of reality and to what extent it exists ‘out there’, to be captured through research. Ontology is concerned with what is true or real (Open Learning, n.d.). It explores fundamental questions about what exists and the relationships between different entities. As stated from Britannica: "ontology, the philosophical study of being in general, or of what applies neutrally to everything that is real" (Britannica, 2025) .

From an ontological perspective, this research operates under the assumption that reality is both objective and socially constructed. While spatial and infrastructural changes can be measured objectively, the perception of development and its management is shaped by human interactions, policies, and governance structures. The study recognizes that Bhakundebesi's transformation is driven by a combination of measurable physical changes and subjective human experiences.

2.3 Epistemology

Epistemology, the study of knowledge, examines its nature, sources, and limitations, shaping how we understand reality and acquire information. Different epistemological perspectives influence research methodologies. Pragmatism integrates multiple perspectives, allowing researchers to use both qualitative and quantitative methods depending on the research problem (Tashakkori & Teddlie, 1998).

Epistemologically, this research follows a pragmatic epistemology, which emphasizes that knowledge is gained through both empirical observation and contextual understanding. Data is gathered through quantitative means (e.g., land use mapping, infrastructure assessment, and demographic analysis) and qualitative approaches (e.g., interviews with stakeholders, case studies of business expansion, and observations of settlement patterns). This mixed approach allows for a more comprehensive understanding of how the BP Highway has influenced Bhakundebesi's development.

2.4 Methodology

The study employs a mixed-method approach, combining both qualitative and quantitative techniques to provide a well-rounded analysis.

2.5 Research Method

The research employs a mixed-methods approach, combining quantitative and qualitative data to gain a holistic understanding of the subject.

1. Quantitative Analysis
    - To study spatial transformation
    - To study existing infrastructure
    - To quantify demographic changes
    - To assess economic impacts
2. Qualitative Analysis

- To understand local perceptions
- To explore the reasons behind spatial and economic changes
- To study social dynamics and challenges
- Contextualizing the spatial transformations

2.5.1 Methods and Tools

2.5.1.1 Articles/ Documents review

A review of relevant policies, plans, and research documents will be conducted to support the study's objectives.

Focus Areas:

- Analyze urban development policies, road expansion plans, and municipal guidelines related to settlement growth along highways.
- Review land use regulations, infrastructure planning frameworks, and development strategies that impact Bhakundebesi.
- Identify key challenges, opportunities, and gaps in existing studies related to highway-driven urbanization.

2.5.1.2 Interviews

To gather primary data, interviews and surveys will be conducted with key stakeholders, including:

- **Local residents and migrants** to understand settlement patterns, economic activities, and access to services.
- **Business owners** to explore commercial growth, rental trends, and infrastructure demands.
- **Municipal officials and urban planners** to assess governance, regulatory frameworks, and development interventions.

2.5.1.3 Geospatial Analysis

Geospatial analysis using GIS tools such as ArcGIS or QGIS will be employed to map and assess spatial changes in Bhakundebesi. This includes:

- Mapping land use transformation before and after the highway construction.
- Identifying commercial growth hotspots and the spatial organization of emerging settlements.

- Analyzing roadside development trends and infrastructure expansion patterns.

2.5.1.4 Field Observation

Field observations in Bhakundebesi will offer firsthand insights into the interaction between infrastructure, economic activities, and settlement growth. This will involve:

- Documenting **building typologies, land utilization, and commercial activities** along the highway.
- Assessing the condition and usage of **roads, transport facilities, and public spaces**.
- Observing settlement expansion and the adaptation of **residential and commercial spaces** to highway connectivity.

2.6 Research Strategy Framework

Table 1 Research Strategy Framework

Aspect	Details	Primary Sources	Secondary Sources	Purpose
Demography	Population size, age structure, migration patterns, household composition	Census data, household surveys, field observations	Municipal demographic reports, census data, migration studies	To analyse how population dynamics are influenced by highway development
Land Use	Residential, commercial, industrial, and open spaces	Field observations, surveys, GIS data	Municipal land use maps, satellite imagery, GIS databases	To understand the highway influence land use changes and urban form
Housing and Settlements	Patterns of residential development, rental housing, and informal settlements	Household surveys, field observations	Municipal housing records, historical land transaction data	To study the impact of highways on residential patterns and settlement dynamics

Commercial Establishments	Number, type, and spatial distribution of businesses (shops, hotels, restaurants, industries, etc.)	Business surveys, direct observations	Municipality business registration data	To analyse how highways impact the clustering of commercial activities and urban form
Infrastructure Development	New roads, parking spaces, electricity networks, water supply systems, and public infrastructure changes	Field observations, municipal infrastructure records	Municipality data, infrastructure planning reports	To evaluate how highways drive infrastructure development

CHAPTER THREE: LITERATURE REVIEW

3.1 Urban Growth and Transportation Infrastructure

Transportation and urban growth are strongly related. It plays a strong role in urban development. There is a reciprocal relationship between transport and urban growth (Aljoufie et al., 2011). Transportation systems facilitate mobility and drive economic growth by enhancing land accessibility, shaping development patterns, and influencing spatial distribution (Meyer & Miller, 2001). Urban growth and transport are strongly interred dependent. Transport infrastructure encourages urban development, while at the same time, urban growth and increasing populations lead to higher travel demand and the necessity for additional transport expansion. (Aljoufie et al., 2011). The understanding of relation between urban dynamics and transportation is necessary to develop urban development strategies.

The nature growth of urban area is dynamic and complex. They grow in different ways, including physically, economically, and in population size, which is known as urban growth. Urban growth is a complex process that involves spatial temporal changes of urban areas socio-economic and physical components (Han et al., 2009). There are many factors of growth among which transportation is considered as a major one. Advancement in the transport system have reduced the cost of commuting within urban areas and encouraged urban scattering and equally, transportation infrastructure expansion has stimulated urban growth and land use changes (Bhatta, 2010).

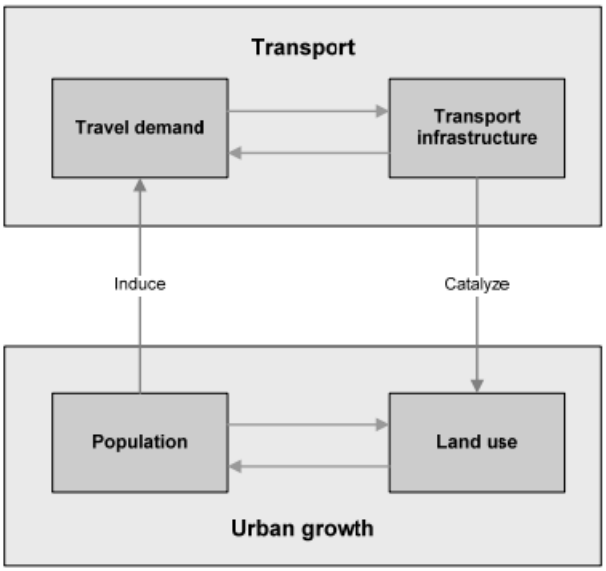

Figure 1 Relationship between Transport and Urban Growth

Aljoufie et al., 2011 conducted a study in Jeddah, Saudi Arabia, revealed that highways and main roads have a significantly greater influence on spatial expansion and land use changes than secondary roads. The research found a strong correlation between the development of transport infrastructure and factors such as population growth, spatial

expansion, and shifts in land use. Similarly, the Interstate Highway System launched in the United States during the 1950s played a pivotal role in transforming metropolitan landscapes by promoting suburbanization and the decentralization of economic activities (Mohl, 2004). Also, in China, the expansion of expressways has fueled urban sprawl. In cities like Beijing, highways have shifted growth toward suburban areas, leading to scattered development and increased land fragmentation (Xiangzheng Deng et al., 2010).

With urban growth, highway development also gives rise to equity concerns. In most cases, development prioritizes wealthy suburbs over underdeveloped urban cores. The highway construction in the 20s in the US divided black neighborhoods and created spatial segregation (Stewart, 1991). Also, the environmental trade-offs further complicate highway-driven urban growth. With the improvement in regional connectivity, highways contribute to habitat fragmentation, air pollution, and socio-economic division.

3.2 Highway Induced Development

Highway Induced Development, in general, refers to the development that occurs when a new highway is constructed or the existing ones improve their accessibility. It causes changes in land use, economic activity, population distribution, etc. Improved accessibility leads to an increase in land value and attracts various types of development activities. These developments can include urbanization, industrial growth, and increased accessibility. For example, as noted in a report on growth-induced land development under the National Environmental Policy Act (NEPA), new highways can create opportunities for growth by enhancing accessibility, which in turn attracts new developments such as shopping centers at interchanges (Mandelker, 2013). According to Banister & Berechman, 2001, improved transportation infrastructure enhances accessibility, which in turn attracts businesses, industries, and residential developments.

One of the major impacts of highway-induced development is the transformation of land use along transportation corridors. As observed in studies, areas adjacent to highways experience increased land value and urban expansion (Giuliano & Hanson, 2017). Highways often stimulate commercial activities such as retail centers, logistics hubs, and service industries, leading to rapid urbanization in formerly rural areas. This trend has been particularly evident in developing countries, where highways serve as

lifelines for economic growth. According to Cervero (2003), roadway investments not only improve travel speeds but also lead to significant land-use shifts over time. His research indicates that while immediate effects may be observed shortly after road improvements, substantial land-use changes often take several years to materialize due to the time required for planning and permitting processes (Cervero, 2003a). Additionally, highway development influences migration patterns. One of the most visible effects of highways is the rise of highway-centric settlements, such as ribbon development—where commercial and residential properties line both sides of a highway. However, uncontrolled expansion can lead to urban sprawl, environmental degradation, and socio-economic disparities (Litman, 2024).

3.2.1 Mechanisms of Highway-Induced Development

Cervero (2003) employed a path model to analyse the causal links between freeway investments and urban development in California. The study revealed that the expansion of roads increased travel speed and shifted land use, including real estate development along the improved freeway corridor. This phenomenon is referred to as "induced investment," which means the increased accessibility attracts more developers and businesses near the highway area (Cervero, 2003a).

A study on “Highway expansion and urban sprawl in the Jakarta Metropolitan Area” confirmed that the expansion of the highway created urban sprawl within a 40-50 km radius from city centers. Improved highway access increases suburbanization by reducing travel expenses, which promotes population and employment growth in fringe areas (Pratama et al., 2022b). This aligns with Baum-Snow's findings on U.S. metropolitan areas, where highways encouraged decentralization by shifting jobs and residents to suburban regions (Haughwout & Boarnet, 2001).

3.2.2 Economic Impact

Improvement of highway infrastructure leads to increased productivity and hence increases economic output. A study by RAND corporation indicates that highway infrastructure allows producers to reach market centers at low cost, increase their market area, and have a broader choice of suppliers (Shatz et al., 2011). Similarly, highways significantly influence property values. A study in toll roads in Orange Country, California, found that improved accessibility creates an "accessibility premium" reflected in higher land prices. Buyers are willing to pay for increased access

provided by roads, which creates new development patterns (Boarnet & Chalermpong, 2001). In Nigeria, Highway expansion attracted new residents and business, increasing the property demand and raising its value. Additionally, by allowing workers to reside further away from their places of employment and select from a greater variety of career possibilities, highway infrastructure can increase employment prospects. The distribution of these employment advantages, however, may be unequal; inner city neighborhoods may see economic collapse, while suburban job growth frequently disproportionately benefits higher-income groups.

3.2.3 Demographic Impacts

Highway-induced development has equally important demographic effects, especially in terms of suburbanization and population redistribution. Research by Baum-Snow demonstrates that the introduction of a new highway through a central city can lead to an approximate 18% reduction in its population. Improved highway access not only attracts new residents to previously less accessible areas but also leads to population growth in suburban and rural regions connected by highways. This shift in demographics is influenced by various factors, including age demographics. Overall, highways can cause population decline in central cities while promoting growth in suburban and some rural areas.

3.2.4 Environmental Impacts

Highway-induced development often leads to environmental degradation. To analyze changes in land use and the impact on vegetation, a study was performed in California using remote sensing technology. The findings revealed a notable decline in vegetation cover near expanded highways, largely due to urbanization pressures. The conversion of agricultural and forested areas into urban development highlights the ecological costs associated with these highway projects.(San Jose State University et al., 2023).

In the Pearl River Delta region, researchers emphasized the importance of protecting river systems during infrastructure construction to reduce ecological damage caused by land-use changes near transportation corridors. (Liu et al., 2019).

3.3 Urban Sprawl

Urban Sprawl refers to the uncontrolled expansion of urban areas into surrounding rural or undeveloped land, often characterized by low-density housing, single-use zoning, and increased reliance on private automobiles for transportation. It typically involves the conversion of open spaces into built-up areas, leading to a range of social, environmental, and economic impacts. It sometimes happens as a part to accommodate the rising population but in some urban areas it the result of desire of people for increased living space. Some view sprawl as a sign of economic vitality, supporting decentralization, employment distribution, and infrastructure expansion, while others see it as uncontrolled, uncoordinated growth that leads to environmental degradation, inefficient land use, and urban service shortages.

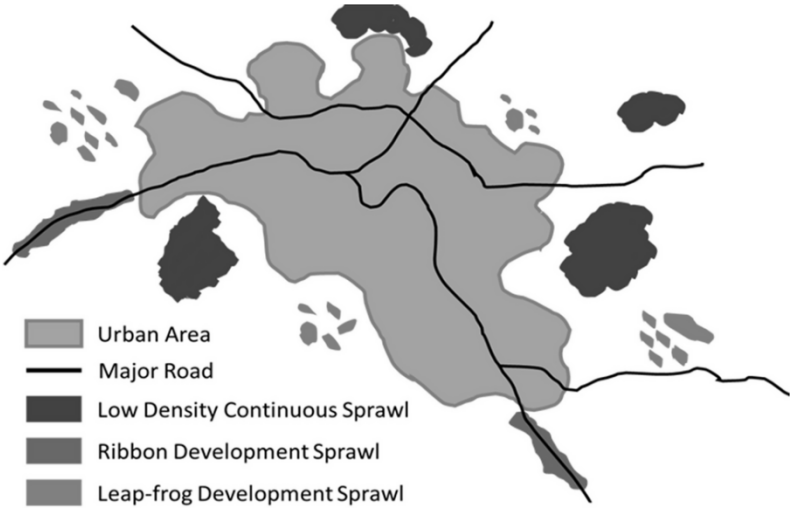

Figure 2 Urban Sprawl

The general causes of urban sprawl are lower land cost, improved infrastructure, rising living standards and population growth. The cheaper land cost in sub urban areas compared to urban areas attract development. Similarly, when there is improved infrastructure, the investments in roads and other facilities, it promotes outward expansion causing sprawl.

Historically, industrialization played a major role in urbanization, particularly in developed countries during the 19th and 20th centuries, where rural populations migrated to cities for employment, providing cheap labor for newly established industries. Today, similar trends are observed in developing nations, where cities attract a large influx of migrants due to concentrated investments and job opportunities.

However, rapid urbanization often leads to high-density settlements with poor infrastructure and finally initiates urban sprawl.

Some organizations and planners argue that sprawl helps reduce overcrowding and allows people to live in larger homes with green spaces, others stress the need for better urban management to prevent unregulated expansion and ecological damage. Ultimately, the consequences of urban sprawl depend on how well it is planned and managed, balancing economic growth with sustainability.

3.4 Ribbon Development

Ribbon development refers to the linear expansion of settlements along transportation routes, such as highways, railways, canals, or coastlines. This form of development creates elongated patterns resembling a "ribbon," with buildings constructed in continuous rows alongside roads or other communication routes. It started during industrial revolution specifically during 1920s, and 1930s, when cities started to develop along transportation routes such as railways and highways (Archi-Monarch, 2022). First observed in London also referred as London's "Metro-Land", it became prevalent in many countries like the UK, Russia, the United States. It was initially seen as a convenient way to develop land but later criticized for inefficiencies and its role in urban sprawl (Designing Buildings, 2020).

Figure 3 Ribbon Development

Ribbon development often leads to inefficient land use, as it encourages the construction of buildings along roadways while leaving large areas behind these structures undeveloped. It limits the future planning opportunities of the land behind the ribbon. This can result in urban sprawl, where cities expand horizontally rather than vertically, consuming valuable agricultural or natural land (Law Insider, n.d.). Also providing infrastructures and utilities becomes difficult due to scattered pattern.

It often prioritizes automobile access, which can lead to a car-dependent culture. This reliance on cars can diminish the viability of public transport options and create challenges for non-motorized transport users, such as pedestrians and cyclists. The linear nature of ribbon development can result in fragmented communities where social interactions are limited due to the separation of residential areas from commercial and recreational spaces. This fragmentation complicates community cohesion and can lead to a lack of public spaces for social interaction.

3.5 Leapfrog Development

Leapfrog development refers to a pattern of urban growth where new developments occur on land that is not contiguous with existing urban areas. This often involves skipping over undeveloped or less desirable land to build on more attractive, often cheaper land further away from city centers. This results in discontinuous urban growth, leaving undeveloped patches between established urban areas and new developments. This can create a scattered pattern of growth that complicates planning and resource allocation. New developments often require the extension of public facilities such as roads, water, and sewer systems from their existing endpoints to reach the new sites.

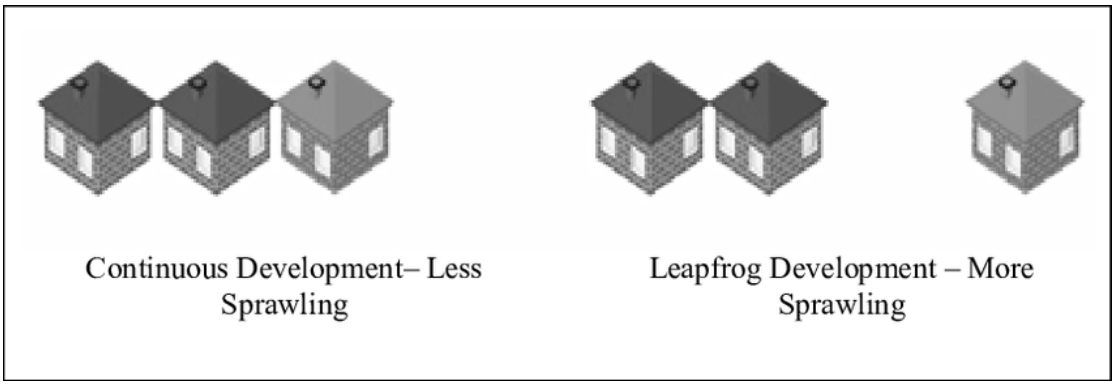

Figure 4 Leapfrog Development

Extending infrastructure to support leapfrog developments can strain municipal budgets. The costs associated with building new roads and utility lines can be substantial, especially if these extensions traverse undeveloped land (Law Insider, 2020). As new developments arise further from existing urban centers, they can contribute to increased traffic congestion on major arteries as residents commute to work or access services in the city. This can lead to longer travel times and greater reliance on automobiles, exacerbating environmental concerns related to emissions and fuel consumption. The separation of new developments from existing communities can

create social isolation for residents in leapfrog areas, limiting access to essential services like schools, healthcare, and recreational facilities.

3.6 Urban Land Use Models

Urban land use models are conceptual frameworks that help explain and predict the spatial distribution of different activities within a city. These models offer theoretical frameworks that help dissect the organization of space and activities, shedding light on the factors influencing the distribution of residential, commercial, and industrial areas.

3.6.1 Thünen's Model of Agricultural Land Use

Thünen's model was created before industrialization and is based on the following assumptions:

- Centrally located city serves as the primary market.
- The state is self-sufficient with no external influences.
- Surrounded by uninhabited wilderness, with no settlements beyond a certain distance.
- The terrain is completely flat, with uniform soil quality and climate across the region.
- No rivers or mountains to obstruct movement or influence land use.
- Farmers transport goods directly to the city using oxcarts, as there are no roads.
- Profit maximization determines the spatial distribution of agricultural activities.

In an Isolated State, with the conditions mentioned above, Thünen proposed that a pattern of concentric rings would form around the city.

1. Ring 1: Perishable goods such as vegetables, fruit, and dairy are produced closest to the city to ensure quick delivery and prevent spoilage.
2. Ring 2: Wood is placed in the second ring since it is heavy and difficult to transport, requiring proximity to the market.

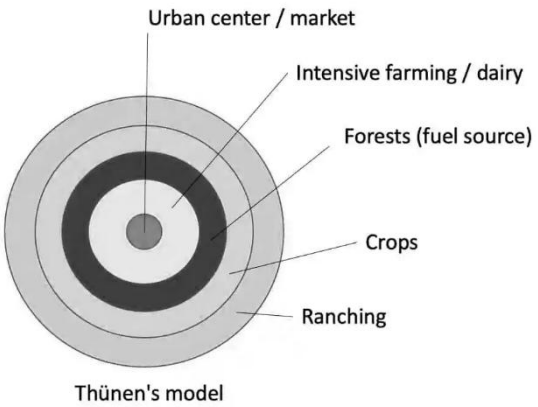

Figure 5 Agricultural Land Use Model

3. Ring 3: Grains, which are lighter and have a longer shelf life than dairy, are cultivated further away to minimize transport costs.
4. Ring 4: Livestock farming occurs in the outermost ring, as animals can walk to the market, reducing transportation challenges.
5. Beyond the 4th ring lies the unoccupied wilderness, which is too great a distance from the central city for any type of agricultural product.

3.6.2 Ernest Burgess's Concentric Ring Model (1925)

Ernest Burgess's Concentric Ring Model, is a theoretical model of urban land use that was first proposed in 1925. It is also called Concentric Zone Model, The model suggests that cities expand outward from a central business district (CBD) in a series of concentric circles, with each circle designated for different land uses and social groups. As the city grows, the inner rings are typically occupied by higher-income residential areas and businesses, while the outer rings house lower-income housing, industrial zones, and other types of development. This growth pattern illustrates how cities organize space based on their proximity to the CBD and the varying needs of different socioeconomic groups. (Drew (PhD), 2022).

The innermost ring which is the Central Business District includes office buildings, retail shops, and other businesses. The second ring, the transition zone, includes lower-density residential areas. The third ring in the model represents the working-class zone, followed by the fourth ring, which is designated as the residential zone. The outermost ring is the commuter zone, where individuals reside in suburban areas and commute to the city for work. This model was developed by Ernest Burgess as part of the Chicago School of sociology, which focused on understanding the dynamics of rapidly growing

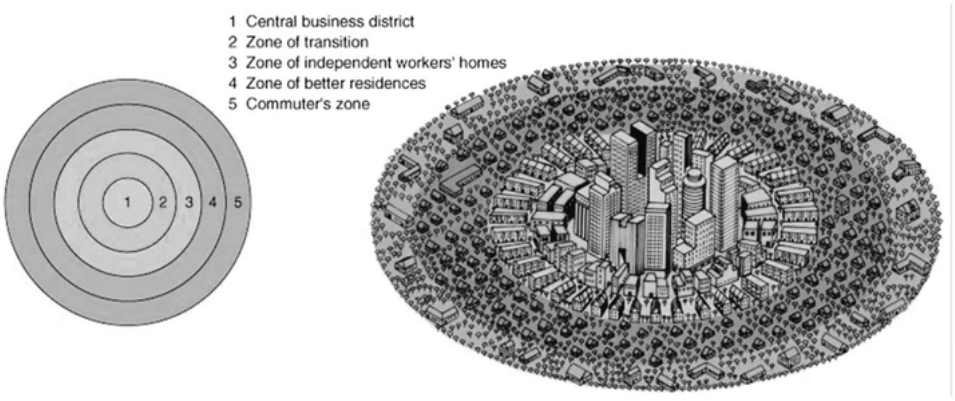

Figure 6 Concentric Ring Model

urban areas and how the living environment influences human behavior. The concentric zone model provides a helpful framework for analyzing the spatial organization of cities and the factors influencing land use patterns. Nonetheless, the model has notable limitations when applied to contemporary cities, particularly those outside North America and Australia, where different urban forms and development patterns are prevalent (Adulla, 2022).

3.6.3 Hoyt's Sector Model (1932)

The Hoyt Sector Model, developed by economist Homer Hoyt in 1939, is an urban land use model that explains how cities grow and organize themselves spatially. It builds on the earlier Concentric Zone Model (by Ernest Burgess) but introduces a more nuanced perspective, suggesting that cities expand outward in sectors or wedges rather than concentric rings. The model conceptualizes urban areas as a series of wedge-shaped sectors developed from the core of the city to the outskirts, with each sector representing different land uses and socioeconomic characteristics. In the Sector Model, the central business district (CBD) remains at the core of the city, but as the city grows, industries and residential areas expand outward along transportation routes. The model proposes that people will settle in different sectors based on their income levels, with each sector maintaining a consistent land use. The idea is that similar types of land use, such as residential or industrial, will cluster together, as "like attracts like." This creates distinct sectors for various types of activities, with the city's growth pattern being influenced by transportation routes and income-based residential distribution. The high-class sector remains exclusive due to its desirability, ensuring that only the wealthy can afford to reside there. Similarly, the industrial sector continues to serve industrial purposes, as it benefits from strategic advantages such as railway access or proximity to a river. The

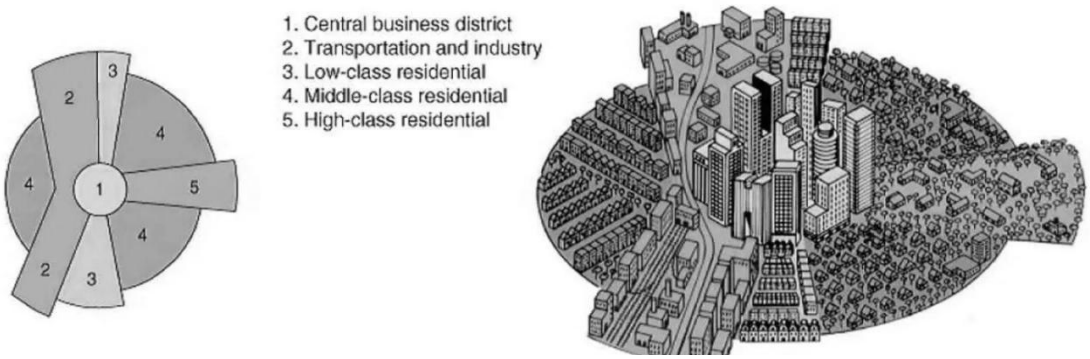

Figure 7 Sector Model

sector model provides valuable insights into the spatial structure of urban areas and the key factors shaping land use distribution.

3.6.4 Harris and Ullman's multiple nuclei model (1945)

Harris and Ullman's Multiple Nuclei Model, proposed in 1945, is an urban land use model that suggests cities grow and develop around multiple centers, or "nuclei" (Harris & Ullman, 1945). This model improves upon the concentric zone model proposed by Ernest Burgess in 1925, which conceived of cities as expanding outwards from a central business district (CBD) (Drew (PhD), 2022). The main objective of the Multiple Nuclei Models was to diverge from concentric zone model and provide actual representation of the complex nature of urban areas.

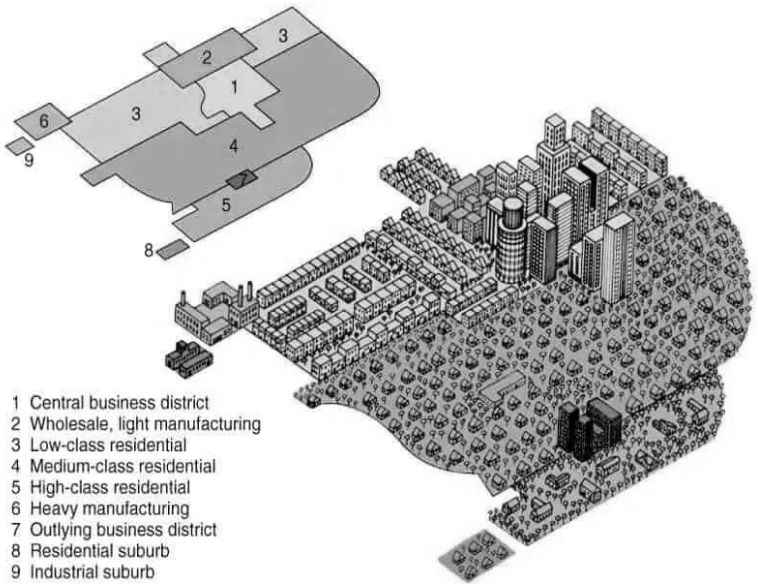

Figure 8 Multiple Nuclei Model

The model posits that cities grow around several separate nuclei rather than a single central point. Each of these nuclei serves as a growth hub, with economic activities spread across multiple central business districts (CBDs). Multiple nuclei emerge because certain industries require large land areas, often located away from residential zones. These nuclei can include ports, universities, airports, parks, neighborhoods, business districts, and government centers. Developed with Chicago as a reference, the model assumes that increased car ownership leads to greater mobility, which in turn fosters the specialization of regional centers (e.g., heavy industry, business parks, retail zones). The strengths of the Multiple Nuclei Model include explaining the existence of multiple CBDs within a city, the growth of suburbs and satellite towns, and making practical assumptions about urban development. However, it falls short in addressing

the development of slums and informal settlements, which play a significant role in most urban landscapes.

3.7 Economic Theories

3.7.1 Central Place Theory by Walter Christaller

Walter Christaller introduced the Central Place Theory in 1933 to explain how cities and settlements are distributed across geographic space. His primary focus was on understanding the spacing and evolution of settlements of different sizes, particularly in urban systems where marketing and trade are dominant functions.

Core Ideas of Central Place Theory

1. Christaller's theory was developed based on his study of the Bavaria region in Germany.
2. Settlements are arranged in a hierarchical order, with larger cities at the top and smaller settlements below.
3. Metropolitan cities sit at the apex of this hierarchy, serving as the primary economic and service hubs.
4. Each large city is surrounded by multiple smaller cities, and as one moves down the hierarchy, the number of settlements increases.
5. Higher-order cities offer specialized services, while lower-order cities cater to more basic needs.
6. The theory incorporates elements from both the Primate City Concept and the Rank-Size Rule.

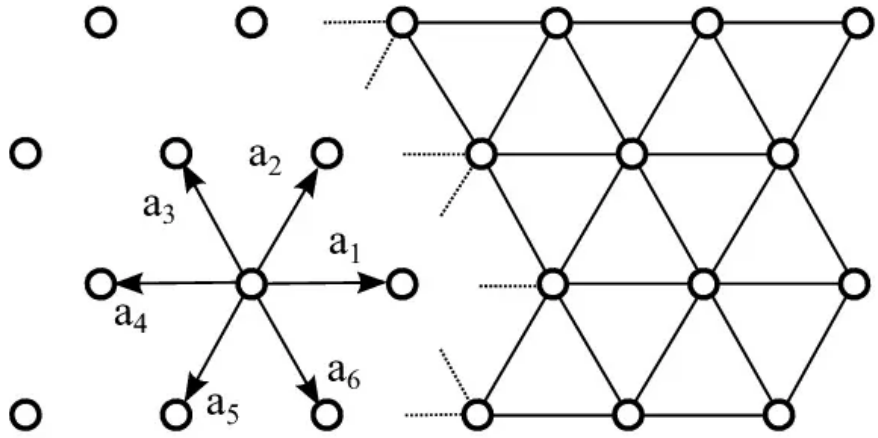

Figure 9 Triangular Lattice in Central Place Theory

Key Assumptions of the Theory

1. **Isotropic Plain:** The model assumes a completely flat and homogeneous landscape, free from geographical barriers such as rivers, mountains, or valleys.
2. **Even Population Distribution:** People are spread out uniformly across space, ensuring that settlements develop at regular intervals.
3. **Uniform Demand for Goods & Services:** Every individual in the region requires similar goods and services, such as food, healthcare, and clothing.
4. **Distance Decay:** People prefer to purchase goods and services from the nearest settlement, minimizing travel distance.
5. **Identical Income**: The model assumes that all consumers have the same purchasing power, leading to uniform spending patterns.
6. Settlements are positioned in a perfectly organized pattern, ensuring efficient service distribution across space.

Four Key Concepts of Central Place Theory

1. **Threshold:** The minimum amount of business or customer base required for a firm to operate profitably.
2. **Complementary Area:** The additional service area a city covers beyond its threshold population, extending its economic reach.
3. **Range of Goods:** The maximum distance consumers are willing to travel for a product or service. Higher-value goods have a greater range, while everyday goods have a smaller range.

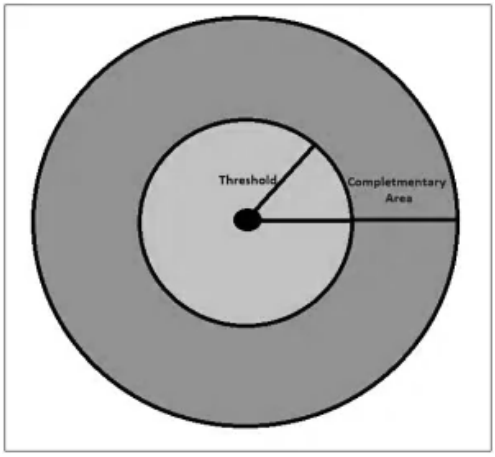

Figure 10 Threshold, Complementary Area and Range of Goods

4. **Central Goods & Services:** Some services, such as specialized healthcare (e.g., heart surgery), higher education, or luxury shopping, are only available in larger cities, forcing residents from smaller settlements to travel.

Two Fundamental Principles of Central Place Theory

1. **Principle of Centralization:** Just as all natural systems have a core (e.g., atoms have nuclei, the Earth has a core), settlements also function with a central place serving as the nucleus for surrounding areas.
2. **Principle of Hierarchy:** The universe is structured in hierarchical layers (e.g., planets, stars, galaxies). Similarly, cities follow a hierarchical pattern, where larger cities dominate smaller towns, offering higher-order goods and services

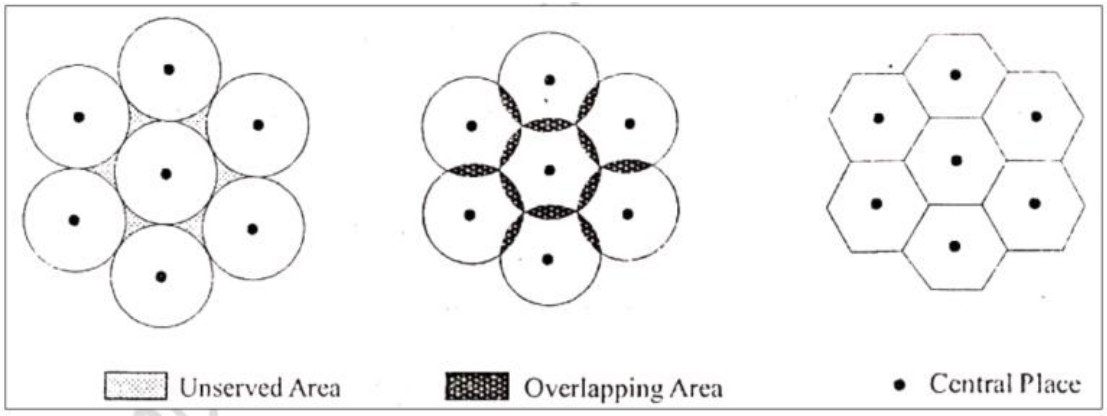

Figure 11 Formation of Hexagons in Central Place Theory

that are not available in lower-order settlements.

3.7.2 Perroux's Growth Pole Theory

The concept of growth poles was first introduced by Francois Perroux in 1949, focusing primarily on economic aspects rather than geographical considerations. However, researchers across various disciplines, including economists, geographers, and regional development experts, have differing perspectives on the nature and impact of growth poles. In its broadest sense, a growth pole can be an industry, a cluster of industries, or

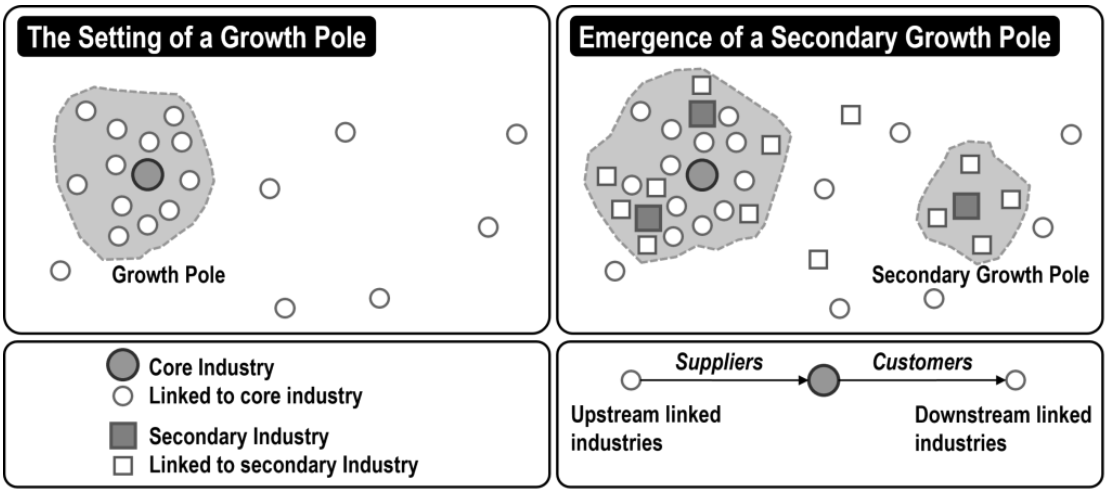

Figure 12 Growth Pole Theory

even a single firm, driving regional economic expansion. Perroux conceptualized growth poles in terms of abstract economic space, which he classified into three types: an economic plan, a field or force of influence, and a homogenous aggregate.

Core Idea of Growth Pole Theory

The theory suggests that economic development is not evenly distributed across a region but instead concentrates around specific poles (or clusters) (Gavrilă-Paven & Bele, 2017). These poles consist of key industries that attract linked industries through direct and indirect effects:

- Direct effects occur when core industries purchase goods and services from upstream suppliers or sell products to downstream customers.
- Indirect effects arise when workers and businesses within the pole generate demand for additional services such as retail, housing, and transportation.

Key Assumptions and Dynamics

1. Multiplier Effects: Leading industries create ripple effects, stimulating other sectors that depend on the core industry.
2. Economic Linkages: Growth poles establish strong forward and backward linkages, ensuring a continuous cycle of economic expansion.
3. Agglomeration Economies: Clustering of firms within a pole enhances efficiency, innovation, and competitiveness, leading to regional economic dynamism.

Role of Growth Poles in Regional Development

Historically, growth pole strategies gained popularity in the 1960s, particularly in Latin American countries, where governments saw them as a tool for economic expansion and social progress (Angotti, 2001). Planners, inspired by naturally occurring growth poles, began intentionally establishing new growth centers to promote regional development. These poles usually arise in urban areas with robust economic foundations, leveraging agglomeration economies to extend prosperity from central hubs to surrounding regions. As development progresses, secondary growth poles can emerge, particularly when new industrial sectors evolve and form interconnected industry networks.

Five Key Factors Influencing Growth Poles

1. Economic Base: Growth poles must have a sustainable economic foundation, often based on natural resource exploitation (e.g., minerals, agriculture) (Svotwa & Sithole, 2009).
2. Linkages with Hinterlands: Strong forward and backward linkages between the growth pole and surrounding regions enable inclusive economic benefits.
3. Resource Availability: The presence of adequate physical and human resources is critical for long-term sustainability.
4. Industrial Decentralization: Growth poles can reduce regional economic disparities by attracting investment to new industrial zones.
5. Government Support: While growth poles emerge naturally in some cases, government intervention is often necessary to stimulate and sustain economic expansion until the region becomes self-sufficient.

3.7.3 Boudeville Growth Pole Theory

Boudeville expanded the concept of growth poles by giving them a clear geographic and regional identity, unlike Perroux's original theory, which remained focused on abstract economic space. In his works, such as The Contemporary Economy and The Regional Economy (published in the late 1950s), Boudeville aimed to bridge the gap between economic theory and real-world geography, offering a more practical perspective on regional development.

François Perroux described a growth pole as a concentration of dynamic, expanding industries located within an urban area that stimulates economic development in the surrounding regions. However, his model lacked a clear spatial definition, focusing more on economic influence rather than physical geography. Boudeville built upon this idea by grounding it in actual urban and regional spaces, showing how growth poles take shape in real-world locations rather than just in theoretical economic zones.

Boudeville also classified the externalities of urban agglomeration into three key categories:

1. Firm-Specific Externalities: Advantages that directly benefit a single company, such as economies of scale and exclusive technological innovations.

2. Industry-Wide Externalities: Benefits that extend to all firms connected to a major industry, such as supply chain efficiencies, shared infrastructure, and expanded markets.
3. Urban-Wide Externalities: Broader benefits available to all firms in an urban region, including access to skilled labor, advanced infrastructure, reliable utilities, and research institutions that create a thriving business environment.

3.7.4 Hirschman's Trickling-Down and Polarization Effect

Albert O. Hirschman's unbalanced growth theory explains how external economies drive investors to focus on growth poles, leading to a divide between developed and underdeveloped regions within a country. This phenomenon, known as economic dualism, results in certain areas advancing rapidly while others lag behind. Hirschman argued that geographical growth points generate forces that influence other regions, which can be classified into two categories:

1. **Favorable Forces (Trickling-Down Effect)**

These forces help extend economic progress from growth poles to less developed regions over time. The key mechanisms include:

- **Inter-regional trade** that fosters economic linkages between developed and underdeveloped areas.
- **Capital transf**ers that help stimulate investment in backward regions.
- **Migration of labor** from struggling areas to growth poles, reducing population pressure in underdeveloped regions and creating employment opportunities.

2. **Adverse Forces (Geographical Polarization)**

On the flip side, concentrating economic activities around growth poles can create imbalances and hinder development in surrounding areas due to:

- **Competitive disadvantages** for industries in the hinterland, which struggle against well-established firms in growth centers.
- **Investment bias**, where capital and resources flow mainly toward growth poles, leaving peripheral areas underdeveloped.
- **Brain drain**, as skilled workers migrate to urban centers, depriving rural or less-developed regions of human capital.

Despite these imbalances, Hirschman believed that, over time, external diseconomies—such as industrial congestion, rising costs, and limited market size—would emerge in growth centers. These pressures, combined with economic linkages between regions, would eventually encourage a more balanced spread of development, reducing regional disparities.

3.7.5 Myrdal's Theory

Gunnar Myrdal argued that in a developing economy, if market forces operate without external interventions, economic activities such as commerce, industry, and finance will naturally concentrate in specific regions, leaving other areas economically disadvantaged. Growth typically begins at a single point, and over time, businesses and industries cluster in that location due to internal and external economies of scale.

Myrdal identified two key effects that shape the relationship between prosperous and lagging regions:

1. **Spread Effect (Positive Impact)**

- Acts as a centrifugal force, where economic expansion from a developed region spreads to less developed areas.
- Encourages technological advancements and knowledge transfer to underdeveloped regions.
- Helps stimulate economic activities in lagging areas, fostering balanced development.

2. **Backwash Effect (Negative Impact)**

- Occurs when growth in one region causes stagnation or decline in another.
- Migration, capital investment, and trade flows shift toward developed areas, further draining resources from less developed regions.
- The growth center absorbs skilled labor, capital, and production, while peripheral regions struggle to compete.

Myrdal emphasized that in some cases, these opposing forces may balance out, leading to economic stagnation in a region. However, this balance is unstable, meaning even minor changes in economic conditions can trigger a cumulative cycle of growth or decline. He also observed that underdeveloped countries experience weaker spread

effects compared to advanced economies, making regional inequalities more pronounced unless policy interventions are introduced to counteract these disparities.

3.7.6 R.P. Mishra's Growth Foci Model

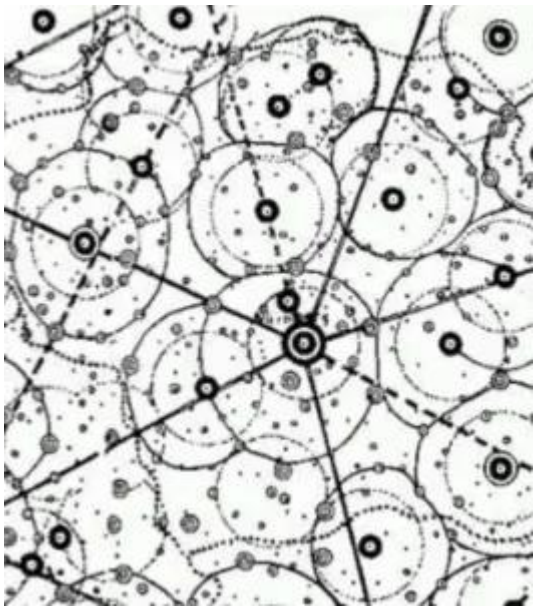

Figure 13 Spatial view of Growth Foci

The Growth Foci refers to a central place that serves a threshold area and the population residing within it. The threshold represents the minimum population or area size required for businesses to operate profitably and sustainably. If the population falls below this threshold, demand remains insufficient, leading to business failures. Growth foci are arranged in a hierarchical structure, where lower-order centers function within the threshold of higher-order centers. These nodal points play a crucial role in economic expansion, innovation diffusion, and market exchange, allowing growth and development to trickle down to smaller settlements (Singh, 2022).

Mishra expanded on this idea, arguing that growth does not directly reach the smallest settlements, such as villages, but rather flows through multiple urban centers of varying sizes. He emphasized that growth poles are limited in large underdeveloped nations like India, and their influence does not directly connect to all regions. Instead, economic development spreads gradually through a network of hierarchically structured service centers, each serving its own hinterland.

Five Levels of Nodal Points in the Growth Hierarchy (Mishra's Model):

1. **Growth Pole**

- The largest economic hub in the region, where research and development activities take place.
- Typically, a major financial or administrative center with a population exceeding 500,000.
- Acts as the primary engine of economic growth in the region.

2. **Growth Center (Regional Level)**

- Second-order city, subordinate to the growth pole, with a population between 50,000 and 500,000.
- Supports a larger population (up to 1.2 million) and exhibits strong industrial activity.
- Often serves as a district or state headquarters.

3. **Growth Point (Sub-Regional Level)**

- A smaller economic center with a population between 10,000 and 50,000.
- Supports five service centers or a population of around 150,000.

4. **Service Centers**

- Small towns with a population of around 5,000, catering to five central villages or 30,000 people.
- Provide agricultural input services, including fertilizer supply, machinery repairs, and a marketplace for farm products.

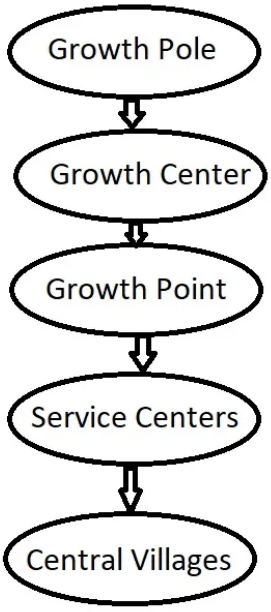

Figure 14 Hierarchy of Growth Foci

5. **Central Villages**

- Large villages with a population of around 6,000, serving six smaller villages.
- Function as local hubs for marketing, recreational, and socio-cultural activities.

This hierarchical model explains how economic impulses and innovations are transmitted step by step from growth poles to smaller settlements, ensuring gradual regional development. Each level of nodal points plays a unique role in supporting its surrounding hinterland, fostering balanced and structured growth within a region.

3.8 Case Studies

3.8.1 Hetauda

Hetauda, strategically located along Nepal's East-West Highway and serving as a key link to urban centers like Birgunj and Kathmandu, has undergone significant spatial transformation due to improved connectivity. The expansion of road networks has reinforced Hetauda's role as a transportation hub, facilitating trade and migration while reshaping land use patterns. As people from rural areas moved closer to the highway for better access to services, commercial activities such as retail markets, petrol stations,

and service industries flourished along the corridor. Additionally, the establishment of the Hetauda Industrial Estate has played a crucial role in attracting factories and businesses, boosting local employment and strengthening the regional economy (Adhikari & Lal, 2021). The government's plan to develop a new zone dedicated to industrial activities in Mayurdhap, Hetauda, aims to accommodate around 100 additional manufacturing units, further bolstering the industrial capacity of the region (Bista, 2017). Hetauda's vision to evolve into a smart city encompasses the integration of digital technologies into urban infrastructure. This includes the development of efficient and clean urban mobility services, modern public facilities, and the

Figure 15 Aerial view of Hetauda

enhancement of social infrastructure such as hospitals and educational institutions (Investment Board Nepal, 2019). The adoption of smart technologies aims to improve governance, transportation, and service delivery, ensuring a higher quality of life for residents.

However, rapid urbanization has introduced challenges, including traffic congestion, inadequate infrastructure, and environmental degradation. Overcrowded streets, lack of proper zoning, and insufficient parking facilities have disrupted mobility, highlighting the need for improved traffic management and urban planning (Khatiwada & Aryal, 2024). Environmental concerns have also emerged, particularly the depletion of green spaces and the rising urban heat island effect. Studies indicate that changes in land use have contributed to increased surface temperatures, underscoring the need for urban forestry initiatives (Singh et al., 2024). Yet, policy gaps and financial constraints have hindered their implementation, emphasizing the importance of well-structured policies and community involvement in sustainable urban development (Sapkota et al., 2020).

To address these challenges while fostering economic growth, Hetauda has prioritized industrial expansion alongside environmental conservation. Plans for a new industrial zone in Mayurdhap aim to accommodate additional manufacturing units, further enhancing the city's industrial capacity (Bista, 2017). At the same time, efforts are being made to integrate environmental safeguards into urban planning, ensuring that development does not compromise ecological sustainability. By balancing economic expansion with responsible urban management, Hetauda is positioning itself as a model for sustainable development along Nepal's highway corridors.

3.8.2 Muglin

Mugling, located in Nepal's Chitwan District at the confluence of the Marshyangdi and Trishuli rivers, has evolved from a tranquil fishing village into a vital transportation hub. Following the development of the Prithvi Highway and the Madan Ashrit Highway (Mugling–Narayanghat section), Mugling emerged as a crucial junction where two major highways intersect—linking Kathmandu with the Terai region (Chaudhary, 2024). Its strategic location facilitates connectivity between key cities such as Kathmandu, Pokhara, and Bharatpur, positioning it as a central hub for both commerce and transportation. The town's significance has been further enhanced by infrastructure projects such as the South Asia Subregional Economic Cooperation (SASEC) Mugling–Pokhara Highway Improvement Phase 1 Project. Supported by the Asian Development Bank, this initiative aims to upgrade the 81-kilometer stretch between Mugling and Pokhara, improving road safety and reducing travel time (adbheadhoncho, 2019).

Mugling’s location, nestled between two rivers, places it in a vulnerable position when it comes to environmental risks.

The rapid urbanization and construction, particularly along the highway routes, have led to deforestation and the destabilization of slopes, increasing the risk of landslides during the monsoon season. The erosion of land, along with inadequate slope protection in some areas, has created significant challenges for maintaining the road infrastructure (World Bank Group, 2025). In recent years, targeted development strategies have been implemented to bolster Mugling's infrastructure. To ensure the durability of road infrastructure, slope stabilization techniques have been employed along critical sections. These measures mitigate landslide risks, ensuring uninterrupted transit and safeguarding economic activities dependent on these routes (World Bank Group, 2025). Also, recognizing the socio-economic challenges faced by local communities, the government has implemented Vulnerable Community Development Plans. These plans aim to uplift marginalized groups through targeted programs, fostering inclusive growth alongside infrastructural advancements.

Figure 16 Aerial view of Muglin

3.9 Policy Review

3.9.1 Nepal Urban Road Standard- 2076

The Nepal Urban Road Standard was developed to ensure uniformity in the design and construction of urban roads across the country. The primary focus lies on analyzing the volume and composition of urban traffic, with particular attention to pedestrians and non-motorized vehicles, alongside the essential requirements for urban services such as water supply, sewage, drainage, electricity, and related infrastructure. The previous Nepal Road Standard- 2070 was focused on the urban roads and the standards were designed specifically for strategic roads and do not adequately address the diverse and complex requirements of urban environments. To satisfy this gap NURS-2076 was developed which applied to all the urban roads being constructed within urban areas. However, this standard still lacks provisions for urban expressways, as well as strategic and rural road networks.

The reason for standardization was the lack of uniformity in road construction, as different governmental bodies are responsible for building roads, leading to inconsistencies in design and quality. Additionally, footpaths are frequently occupied by street vendors, parking, and other amenities, which reduces pedestrian space and compromises safety. There is also a significant shortage of designated parking areas, resulting in disorganized and unsafe parking practices. Moreover, the present road does not adequately consider the needs and movement of non-vehicular traffic, such as pedestrians and cyclists, which is crucial for ensuring safe and inclusive road infrastructure.

The NURS has classified the urban roads into four categories:

Table 2 Classification of Urban Roads

S.N.	Classification	Recommended Right of way width, m	Design Speed (km/hr)
1	Arterial	50	40-50
2	Sub Arterial	30	30-40
3	Collector	20	20-30
4	Local	10	10-20

3.9.2 Land Use Policy, 2015

The Government of Nepal's Ministry of Land Reform and Management (MoLRM) located in Singhdurbar, Kathmandu, has issued a policy document focusing on the protection and optimal use of Land and Land Resources (LLRs). This policy aims to address challenges such as migration, urbanization, encroachment, disaster risk, and food security. The National Land Use Policy 2013 (2069 B.S.) emphasizes the protection of arable lands to ensure food security.

The policy aims to ensure the effective and sustainable use of Land and Land Resources (LLRs) to promote balanced social, economic, and environmental development, contributing to the nation's overall prosperity. It seeks to achieve this by establishing a well-defined land use system through the preparation and implementation of Land Use Plans (LUPs).

Key aspects of the policy relevant to your thesis include:

Land Use Zoning

The policy mandates the classification of land into specific zones based on suitability and sustainability criteria. These zones include agricultural, residential, commercial, industrial, forest, public use, and others. The objective is to ensure optimal land utilization while preventing haphazard development.

In the context of Bhakundebesi, the rapid urbanization along the BP Highway underscores the need for such zoning to manage growth effectively and protect agricultural lands from being converted into unplanned urban areas.

Planned Urbanization

The policy emphasizes the development of hygiene, well-facilitated, and safe human settlements. It advocates for planned urbanization that aligns sustainable development goals, aiming to create livable cities with adequate infrastructure and services.

For Bhakundebesi, this implies that urban expansion should be guided by comprehensive planning to ensure that infrastructure development keeps pace with population growth, thereby enhancing the quality of life for residents.

Environmental Conservation

The policy underscores the importance of preserving natural resources and maintaining ecological balance. It promotes environmentally friendly development practices to prevent degradation of land, water, and forest resources.

In Bhakundebesi, the surge in urbanization necessitates measures to manage solid waste, protect water sources, and maintain green spaces to ensure environmental sustainability.

Agricultural Land Protection

To ensure food security, the policy prioritizes the protection of arable lands from being converted into non-agricultural uses.

This is particularly relevant for Bhakundebesi, where the expansion of urban areas along the BP Highway could encroach upon fertile agricultural lands. Implementing land use plans that safeguard these areas is essential to maintain agricultural productivity and livelihoods.

Implementation of Land Use Plans

The policy calls for the development and execution of land use plans at federal, provincial, and local levels. These plans are to be formulated based on scientific assessments and with the involvement of local communities to ensure they meet the specific needs of each area.

For Bhakundebesi, localized land use planning can address unique challenges and opportunities arising from its strategic location along the BP Highway.

CHAPTER FOUR: STUDY AREA

In Nepali, "Besi" (बेसी) refers to a lowland or valley area, typically located between hills or mountains, near the river basin (Shailendrarijal, 2021). It is generally flat or gently sloping land suitable for settlement and agriculture. Besi areas are often preferred for habitation due to their warmer climate, access to water sources, and fertile soil compared to higher-altitude settlements.

Figure 17 Location map of Namobuddha Municipality

Bhakundebesi is a key settlement in Namobuddha Municipality, primarily situated in Ward 2 and Ward 7, with slight extensions into Ward 3 and Ward 4. It serves as the municipal center of Namobuddha Municipality.

4.1 Geographical Location

Geographically, the site is located at approximately 27° 33' 43" N (27.561984178474383) latitude and 85° 38' 24" E (85.6426083961117) longitude. It is naturally enriched by Roshi Khola, the major river flowing through the region. Additionally, several smaller streams, such as Dapcha, Khoti, Hele, Shyangu, Dahile, Samanure streams contribute to the local water system.

Figure 18 Ward division of Namobuddha Municipality

4.2 Connectivity

Bhakundebesi is accessible from Kathmandu via the Arniko Highway to Dhulikhel and then along the BP Highway. The distance between Kathmandu and Bhakundebesi is approximately 46 km, or 49.5 km by road. The BP Highway runs directly through Bhakundebesi, making it a key transit point for vehicles traveling between Banepa, Sindhuli, and Bardibas. Various internal roads connect Bhakundebesi to nearby settlements like Dapcha, Saping, and Bachchhakot. Additionally, Bhakundebesi is 46 km from Tribhuvan International Airport (TIA) and 80 km from Manthali Airport, enhancing regional connectivity.

Proximity to Key Urban Centers:

Banepa: ≈ 24 km

Dhulikhel: ≈ 20 km

Kathmandu: ≈ 50 km

Sindhulimadi: ≈ 102 km

Figure 19 Connectivity of Kathmandu and Bhakundebesi

4.3 Slope and Elevation

The slope of Bhakundebesi is characterized as almost flat to gentle, which makes the area suitable for urbanization and infrastructure development.

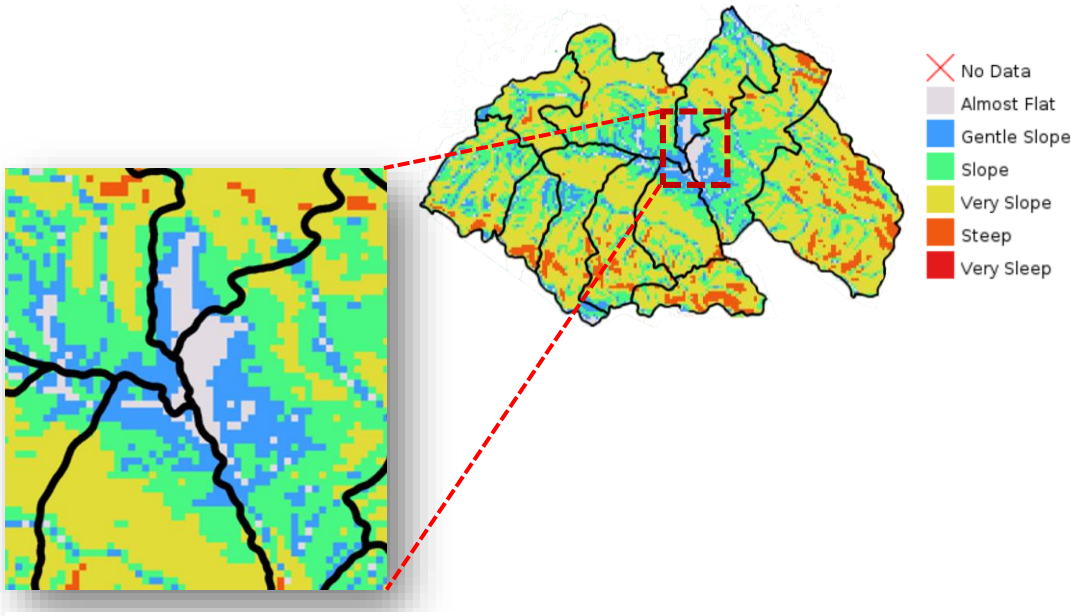

Figure 20 Slope map of Namobuddha municiplaity

The elevation of the settlement ranges between 500 to 1,000 meters, providing a moderate climate and favorable conditions for both agriculture and habitation. The region enjoys distinct seasonal variations, with warm summers, cool winters, and a monsoon season bringing significant rainfall.

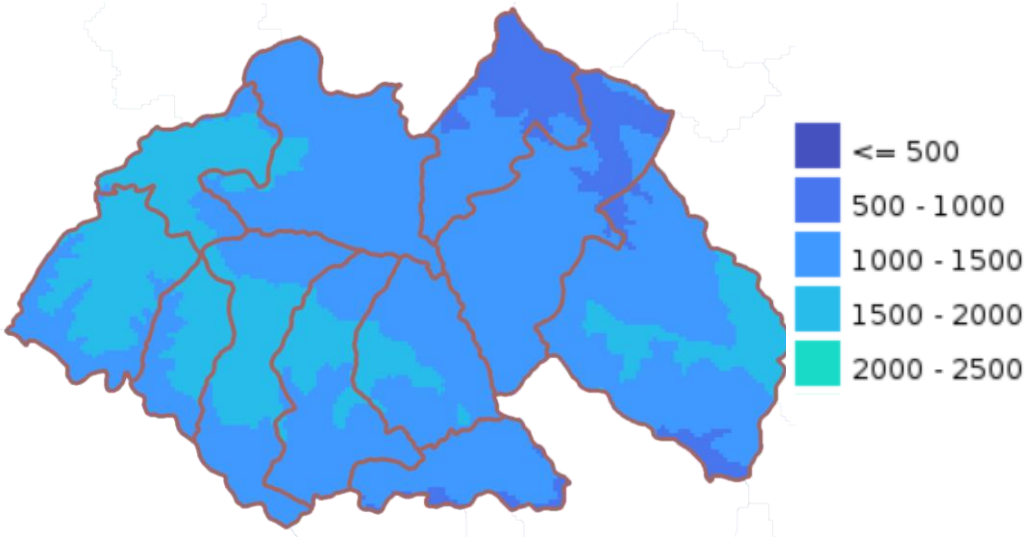

Figure 21 Elevation map of Namobuddha Municipality

4.4 Administrative Division

Administrative Division:

Province: Bagmati Province

District: Kavrepalanchok

District Headquarters: Dhulikhel

Municipality Center: Bhakundebesi

Neighboring Municipalities

East: Temal Rural Municipality

West: Dhulikhel and Panauti Municipality

North: Panchkhal and Dhulikhel Municipality

South: Roshi and Bethanchowk R. Municipality

Figure 22 Administrative division of Kavrepalanchok

4.5 Demography

4.5.1 Population and Household Distribution

According to the census 2021, the population of Namobuddha Municipality is 2610 and the number of households is 7148.

Table 3 Ward wise population distribution 2021

Ward	Area (sq. km.)	Population (2021)	Male	Female	Household
1	5.74	1611	776	835	436
2	12.36	3839	1834	2005	1006
3	7.74	2133	996	1137	571
4	13.66	2463	1198	1265	62
5	18.76	3305	1638	1667	915
6	5.22	1319	621	698	360
7	7.6	3663	1786	1877	1008

8	8.64	1913	867	1046	557
9	9.23	1684	760	924	530
10	4.38	1830	899	931	484
11	9.05	2400	1121	1279	660

4.5.2 Population Density

According to NSO, the overall population density of the municipality is 256 people per square kilometer, while Bhakundebesi, particularly in Ward 2 and Ward 7, has a significantly higher population density. **Ward 2** has a population density of **311 people per square kilometer**, which is about **1.2 times** the municipality's average density. **Ward 7** has a population density of **482 people per square kilometer**, which is about **1.88 times** the municipality's average density.

4.5.3 Population Pyramid

The population pyramid for Bhakundebesi Municipality, along with its specific wards (Ward 2 and Ward 7), exhibits a larger base, indicating a relatively high proportion of the population in the younger age groups, particularly up to 40 years of age. As we move upward through the age groups, the pyramid gradually decreases, reflecting a lower number of individuals in older age categories. The population structure is typical of a region experiencing development, where the younger population forms the backbone of the workforce, while the elderly population remains relatively small.

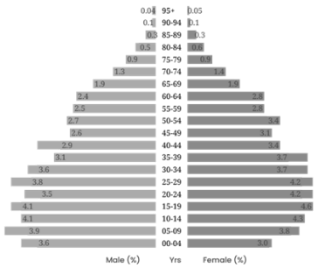

Figure 23 Municipality

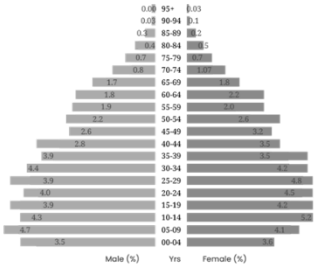

Figure 24 Ward 2

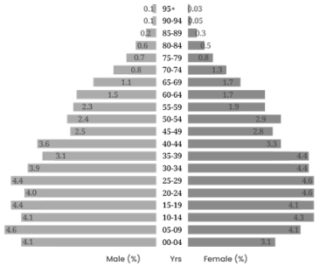

Figure 25 Ward 7

4.5.4 Caste and Ethnicity

The Tamang community constitutes the largest ethnic group, making up 45% of the population. Following them are the Brahman community at 23.5%, Newar community

at 10.9%, Kshetri at 10.9%. Additionally, smaller communities such as Mijar, Vishwakarma, and Pariyar further enhance the cultural richness of the area, though their proportions are less significant.

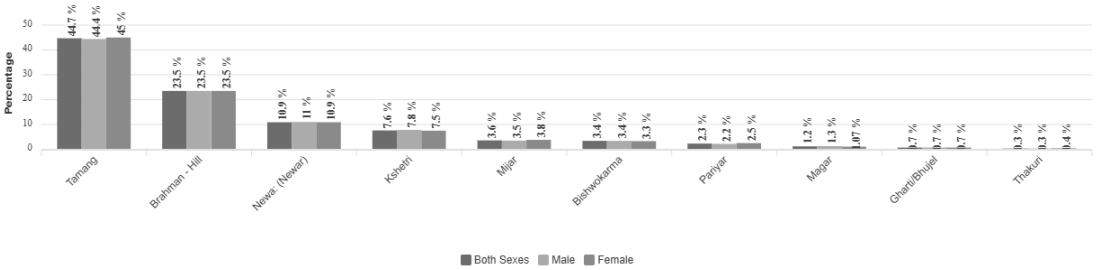

Figure 26 Population by major ten caste/ethnic-groups and sex

4.5.5 Religion

The majority of the population practices Hinduism, making up 56% of the community. Buddhism follows as the second-largest religion, with 41.7% of the population identifying as Buddhist. Smaller religious groups, including Islam, Kirat, and Christianity, collectively account for 2.2% of the population.

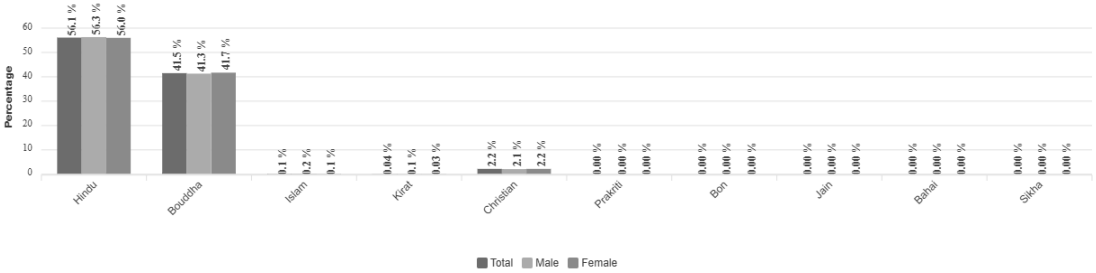

Figure 27 Population by major ten Religion and sex

4.5.6 Language

The majority of the people speak Tamang, with 44.6% of the population using it as their primary language. Nepali follows closely at 43.9% serving as the national language and widely spoken in the region. Nepalbhasha is spoken by 10.2% of the population,

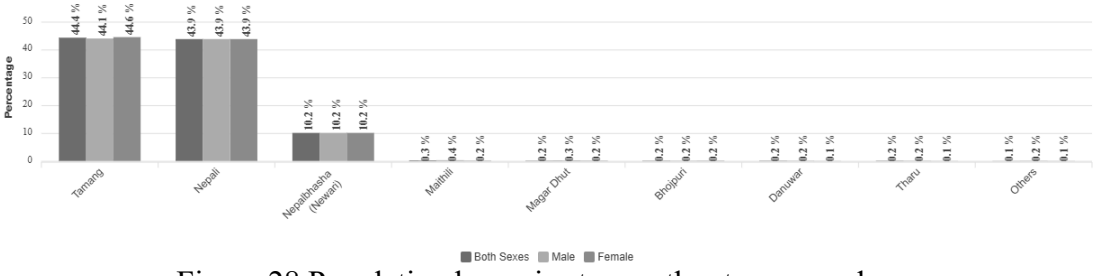

Figure 28 Population by major ten mother tongue and sex

particularly by the Newar community. In addition, smaller communities speak languages such as Maithili, Magar Dhut, Bhojpuri, Danuwar, and Tharu.

4.5.7 Migration

Migration patterns in Namobuddha Municipality show that a significant portion of the population, 59.9%, has migrated from within the same municipality. 27.6% of the population has moved from other municipalities within the same district, indicating a degree of internal migration within Kavrepalanchok. A smaller portion, 12.2%, has migrated from other districts.

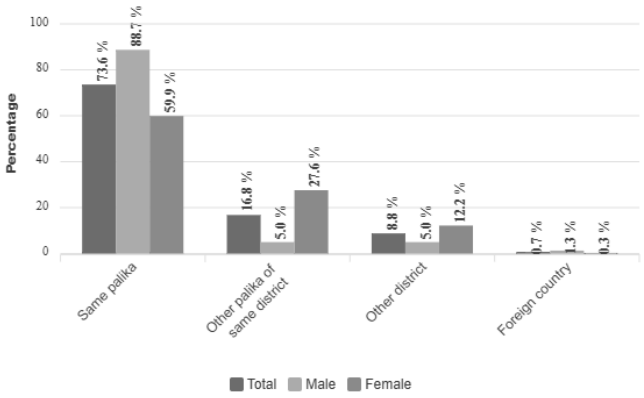

Figure 29 Population by former place of residence

In Bhakundebesi, that a significant number of people have come from nearby Roshi and Temal municipalities, contributing to the area's population growth. Additionally, a substantial portion of the population has migrated from within the same municipality, but from different wards, reflecting internal movement as people settle in Bhakundebesi for its growing opportunities and strategic location along the BP Highway.

4.5.8 DEGURBA

According to the Degree of Urbanization (DEGURBA) report in Nepal, all wards of Namobuddha Municipality are classified as rural, except for Ward 1 and Ward 10, which are categorized as peri-urban (NSO, 2023).

Table 4 DEGURBA Report of Namobuddha Municipality

2959	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	1	Hill	Peri Urban
2960	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	2	Hill	Rural
2961	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	3	Hill	Rural
2962	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	4	Hill	Rural
2963	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	5	Hill	Rural
2964	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	6	Hill	Rural
2965	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	7	Hill	Rural
2966	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	8	Hill	Rural
2967	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	9	Hill	Rural
2968	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	10	Hill	Peri Urban
2969	Bagmati	KAVREPALANCHOK	Namobuddha	Nagarpalika	11	Hill	Rural

4.6 Physical infrastructure

4.6.1 Road Infrastructure

The major road connecting Bhakundebesi is the BP Highway, which begins in Dhulikhel and extends to Bardibas. In addition to the highway, Bhakundebesi is connected by other roads such as the Bhakunde-Chhatrebajh Sadak, Bhakunde-Dapcha Sadak, Naubise-Karke Sadak, and Timal Road.

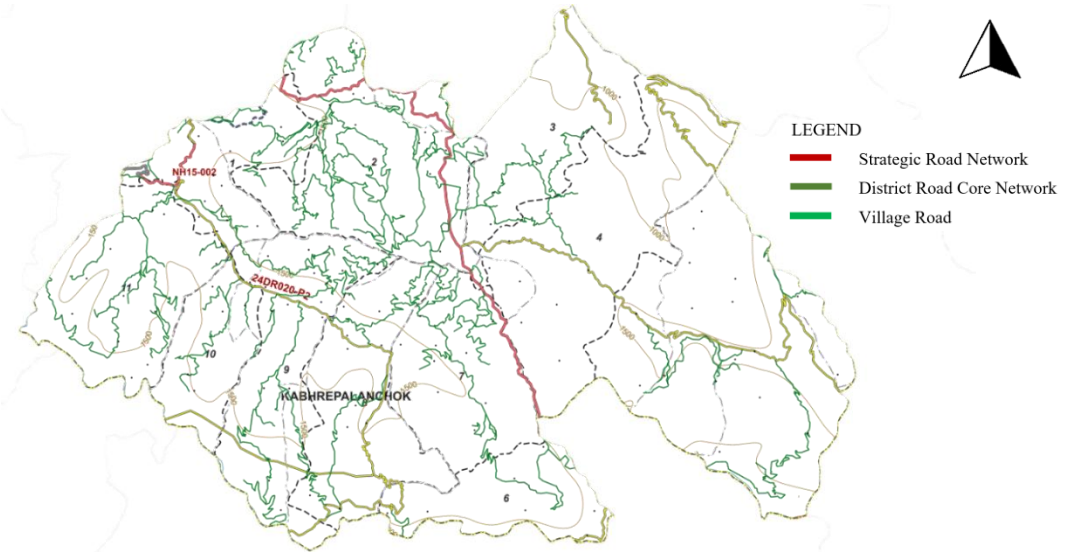

Figure 30 Road Network

4.6.1.1 Road Surface

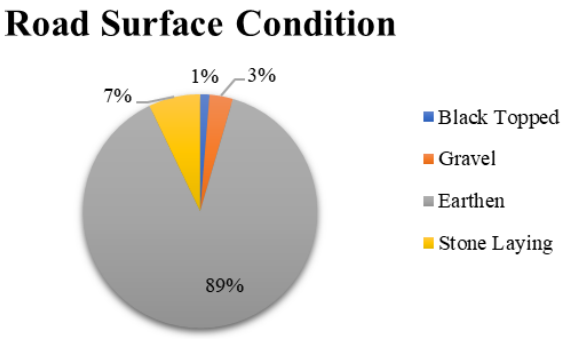

Figure 31 Road Surface Condition

According to the Municipal Transport Master Plan (MTMP), the overall road network in the municipality consists of 89% earthen roads, 7% stone-paved roads, 3% gravel roads, and only 1% blacktopped roads. In Bhakundebesi, most of the roads are earthen, except for the BP Highway and a few key routes, including the road connecting Methinkot Hospital (Amarnibas Road) and the road leading to the municipality office.

4.6.1.2 Road Width

The BP Highway, in the market area, features a 4-lane road with a divider. This width spans approximately 250 meters through the market zone, facilitating smooth traffic flow and access to local businesses. Beyond the market area, the road transitions to an intermediate lane width. According to the Nepal Urban Road Standards, the Right of Way (ROW) for the highway is 50 meters, with property lines beginning after this boundary. A mandatory 3-meter setback is required for constructing permanent structures from the property line.

Since the full width of the road has not been constructed, parts of the ROW are utilized for walking, parking, and temporary structures. Many hotels and other businesses have capitalized on this space along the highway. Within the market area, businesses cater to everyday needs, including shops selling daily household items, medical supplies, and banking services. Outside the market area, business activity is more focused on serving highway operations, with establishments such as hotels and garages playing a significant role in supporting the needs of travelers and vehicles.

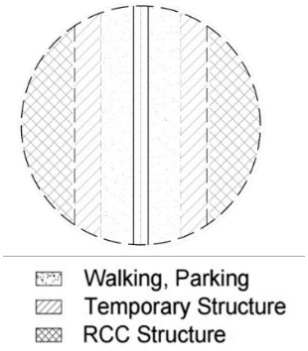

Figure 32 Use of road and its nearby land

Other than BP highway, the road widths in Bhakundebesi vary significantly, ranging from a minimum of 3 meters to 6 meters. However, these dimensions do not consistently adhere to the prescribed guidelines, resulting in uneven road widths along the entire alignment.

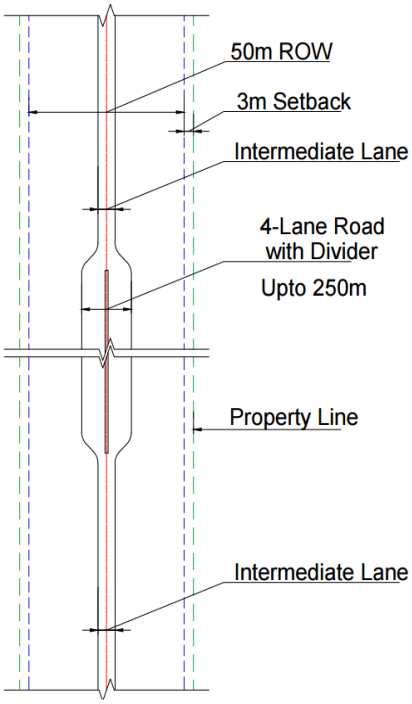

Figure 33 Plan of Highway around Site area

Figure 34 Structures along Road

4.6.1.3 Bus Park and Parking Situation

There is no designated parking spaces observed along the alignment of the BP Highway or other roads in Bhakundebesi. Similarly, there is no dedicated bus park in the area. As

Figure 35 Existing Bus Stop/ Bus Park

a result, vehicles are often parked along the roadside due to the lack of separate parking facilities in both roadways and market centers. While some offices have their own parking spaces, the market centers face a shortage of adequate parking.

4.6.1.4 Fuel Stations

Bhakundebesi has two fuel stations catering to the growing vehicular movement along the BP Highway. Additionally, with the increasing adoption of electric vehicles, one EV charging station has been established to accommodate the shift towards sustainable transportation.

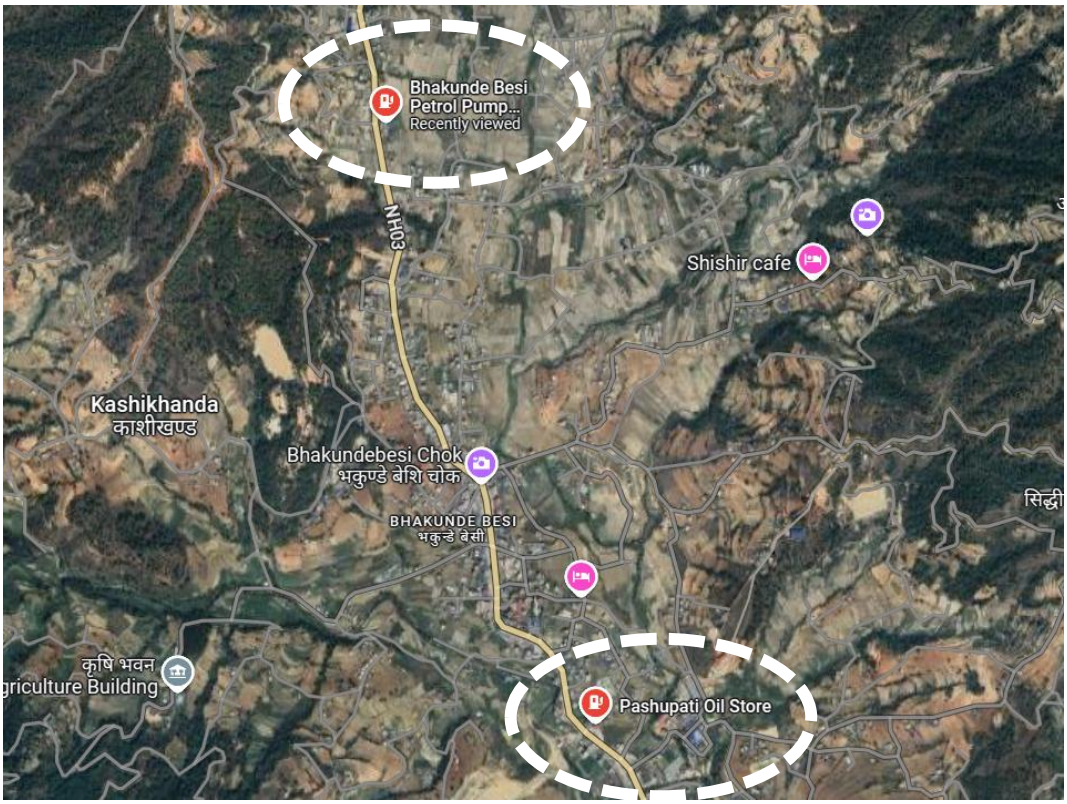

Figure 36 Location of Fuel stations

4.6.1.5 Public Transport Operation

Public transportation in Bhakundebesi connects the area to various cities in Kavrepalanchowk and Kathmandu. Transport operations are more frequent during the morning peak hours, with reduced operations during the evening peak hours. Buses and minibuses run from Bhakundebesi to Banepa at 30-minute intervals. However, the transportation route from Timal to Bhakundebesi to Banepa has been affected by ongoing road construction and recent flooding. Additionally, most households in the area own two-wheelers, which are commonly used for personal transportation.

Table 5 Public Transport Operation Route

S.N.	Route Description	Vehicle Type
1	Bhakundebesi – Dhulikhel - Banepa and reverse same route	Bus, Mini Bus
2	Tima- Dhulikhel - Banepa and reverse in same route	Bus, Mini Bus
3	BP highway operated transport from Kathmandu to the eastern part	Bus, Mini Bus, Micro bus, Tata Sumo

4.6.1.6 Road Traffic Accidents

There are no such locations identified as high frequency of occurring accident. But there are some vulnerable road users (i.e. pedestrians, bicycle riders, motorbike riders) were found the major victims of accidents. Major involved vehicles are tippers and motorbikes along the road traffic.

4.6.2 Water Infrastructure

The water supply system in Bhakundebesi and Namobuddha Municipality relies primarily on wells, rivers, and a local piped system. Most households are connected to a piped water supply system, but due to challenges in access, water is supplied on alternate days. According to locals, water is uplifted from boreholes and distributed through pipelines. However, there are significant issues with irrigation as the current water infrastructure does not fully meet the agricultural needs of the area. Despite efforts to improve water access, including a project to bring water from Roshi Khola, delays have occurred due to flooding. Some businesses rely on tanker deliveries from Banepa, while households fetch water from nearby rivers for non-drinking purposes.

Recently, a WASH (Water, Sanitation, and Hygiene) plan has been prepared for the area, which aims to address these ongoing water supply issues and improve the overall

Figure 37 Private Tankers delivering Water

infrastructure for water management. The plan focuses on ensuring better access to clean water, improving sanitation facilities, and enhancing hygiene practices in the community. There are expectations to complete the Roshi Khola water supply project in the next six months, which will help alleviate some of the existing challenges.

According to data from the National Statistics Office (NSO) for Namobuddha Municipality,

2011- about 60% of households had access to taps or piped water with accessibility varying across the municipality. Covered well 12%. Uncovered well 20.2%

2021- 44.1% of household with tap/pipes water within compound and 33.7% outside compound, covered well 4.1%, uncovered well 7.6%

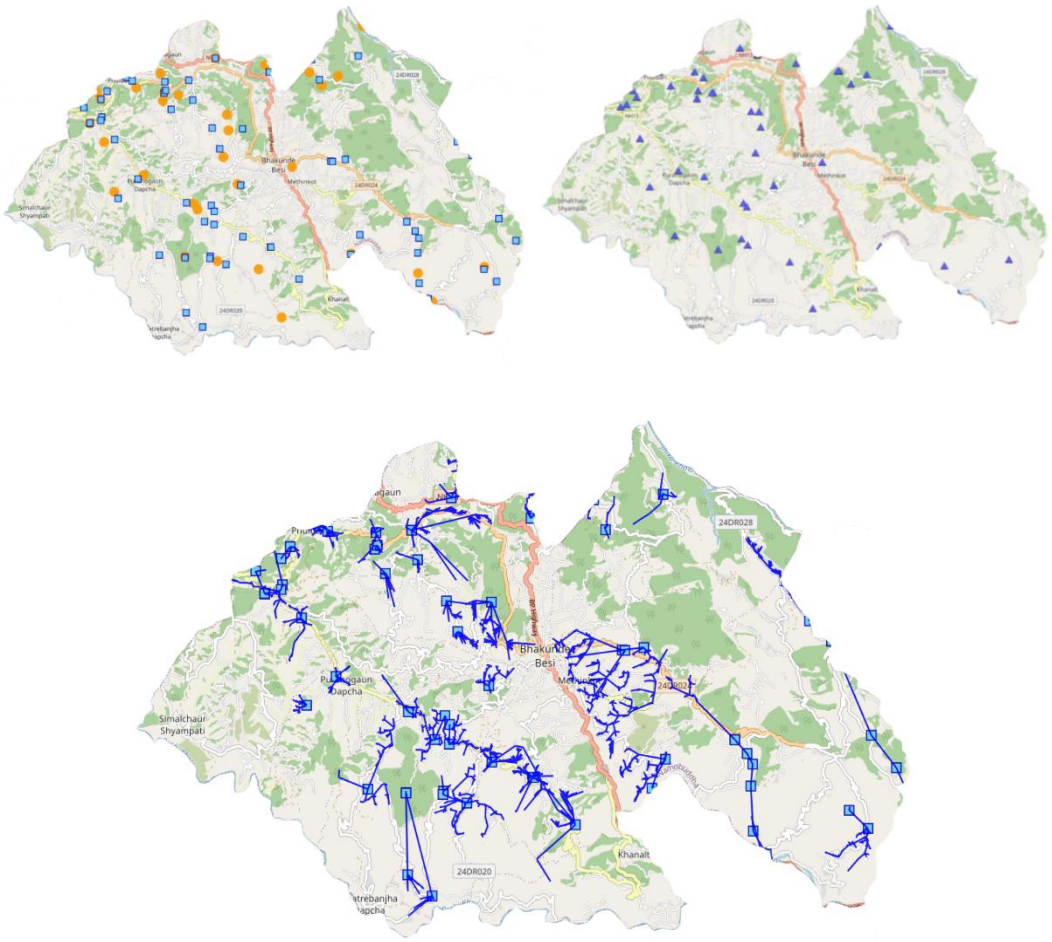

Figure 38 Water Supply projects, Reservoirs, Source and Pipe Network

4.6.3 Educational Infrastructure

Within Namobuddha Municipality, a total of 48 community and private educational institutions are in operation. Among them, 3 are Early Childhood Development Centers, 31 are Basic Level Schools, 10 are Secondary Level Schools, and 4 are Higher Secondary Level educational institutions. Altogether, approximately 5,218 students are enrolled across these educational institutions.

Bhakundebesi is home to three schools, including a Higher Secondary School, which offers education up to the higher secondary level, a Secondary School providing education up to the secondary level, and a Gramin Pathsala, which caters primarily to primary education. In addition to these, there are around 15 other schools within close proximity to the site, creating a robust educational network in the area.

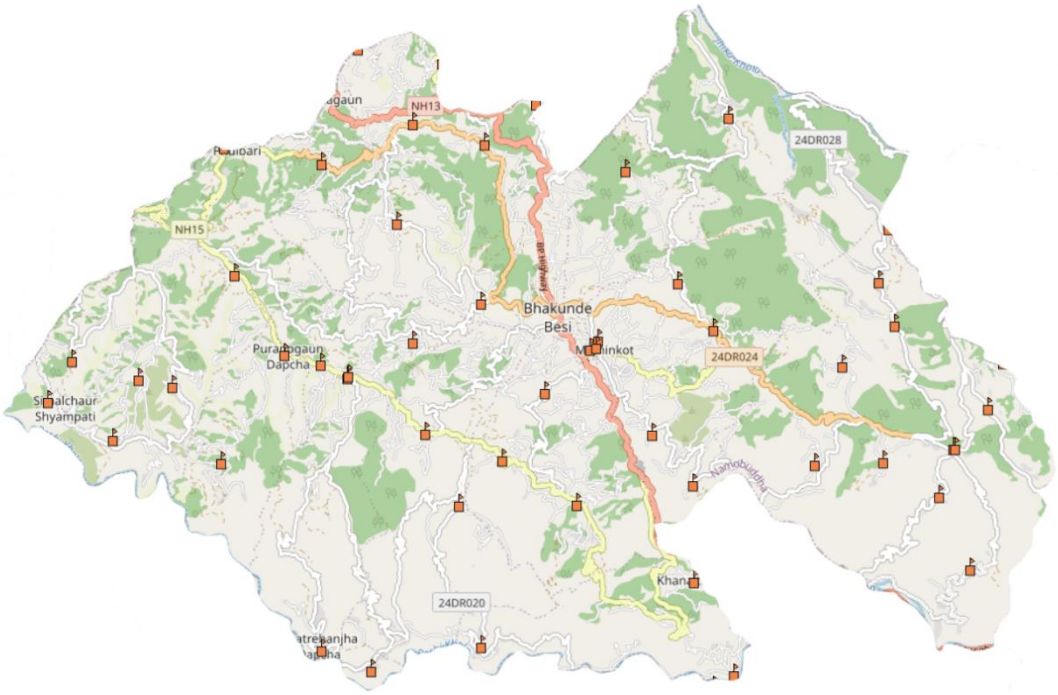

Figure 39 Location of Educational Infrastructure in Municipality

4.6.4 Health Infrastructure

Namobuddha Municipality has 16 hospitals, two of which are located in Bhakundebesi: Methinkot Hospital and Bhakunde Hospital. Methinkot Hospital was first established as a Primary Health Center (PHC) in 2054 B.S., upgraded to a 15-bedded District Hospital in 2066 B.S., and further expanded into a 50-bedded Provincial Hospital in 2077 B.S. This hospital provides 24-hour services, including emergency care,

laboratory, pharmacy, minor surgeries and mental health services on specific days. Bhakunde Hospital, on the other hand, is a privately-run facility that caters to the medical needs of the local population and nearby areas.

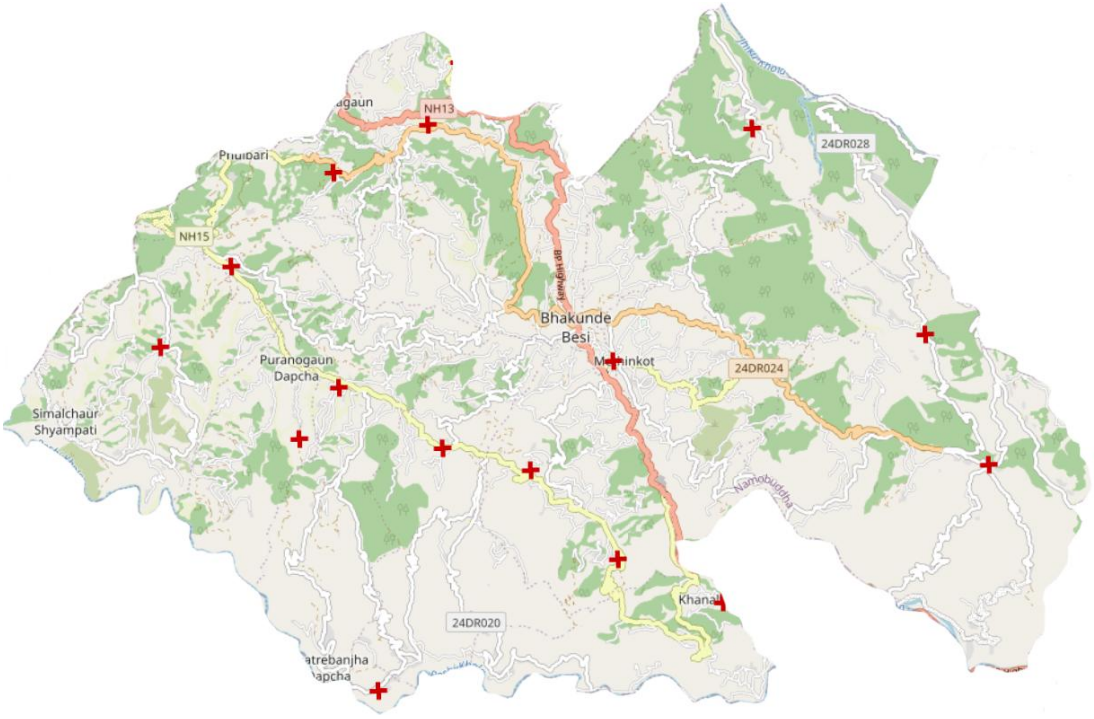

Figure 40 Location of Health Infrastructure in Municipality

4.6.5 Waste Management

In Bhakundebesi, fecal sludge management (FSM) methods have been adopted for the management of human waste. They primarily use septic tanks or pits for waste disposal. When the tanks are full, a septic tanker service is used to transport the sludge, although the exact disposal location is unknown. There is no facility for households to connect their wastewater to a sewage treatment plant. The municipality currently does not have a sewer network or wastewater treatment facility in place.

Figure 41 Landfill site

The municipality collects daily household waste door to door using its own vehicles and dumps it at a landslide-affected area located 600 meters from the BP Highway. At the site, waste is compressed, and gabion walls are installed on the sides for stabilization. A similar site previously managed in this way has now been converted into a volleyball court. Some locals have also reported that waste is being dumped along the banks of the Roshi Khola, near the BP Highway.

Figure 42 Riverside Dumping

4.6.6 Commercial Establishments

Bhakundebesi, though not an independent administrative unit, consists of multiple wards within Namobuddha Municipality, primarily Ward 2 and Ward 7. The following table shows the registration status of every ward over various fiscal year of Namobuddha Municipality.

Ward / **Fiscal Year**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
75/76	1	7	2	1	5	2	16	14	10	4	4
76/77	2	10	0	3	2	3	9	1	1	0	0
77/78	1	10	0	2	7	0	13	4	13	4	2
78/79	6	24	4	10	9	3	67	10	15	4	8
79/80	9	30	13	8	7	6	42	9	10	2	2
80/81	10	7	1	4	4	5	17	2	7	0	0
81/82	5	9	0	1	3	0	18	2	2	4	1
Total	**34**	**97**	**20**	**29**	**37**	**19**	**182**	**42**	**58**	**18**	**17**

4.6.7 Brick Industries in Bhakundebesi

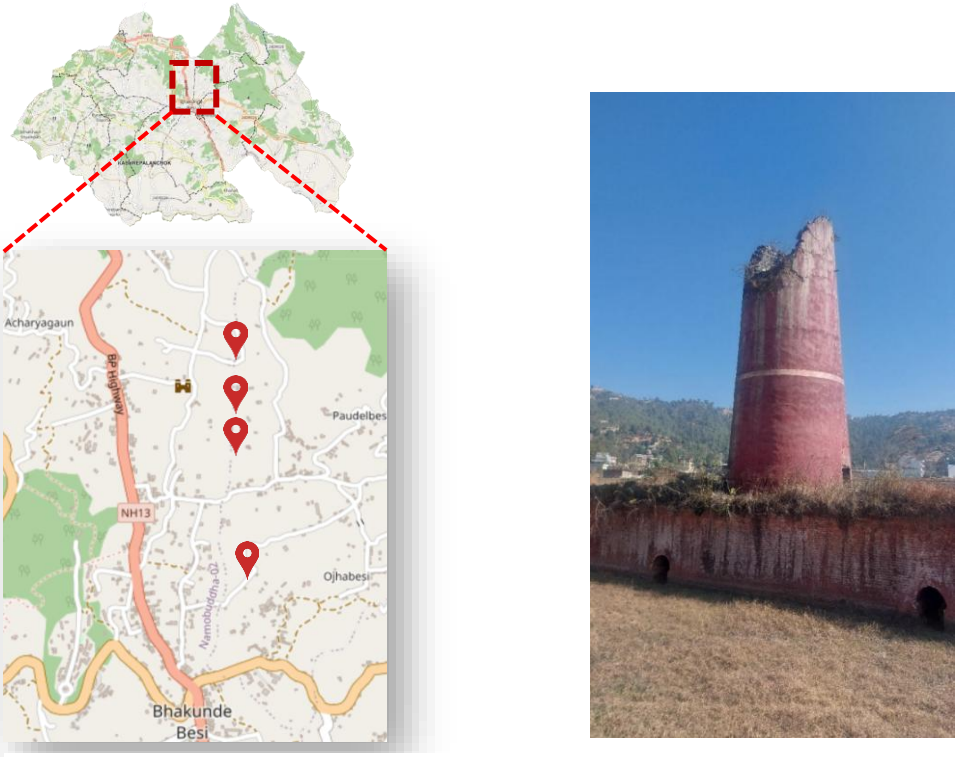

Figure 43 Location of Brick Industries

Five brick industries were established in Bhakundebesi after 2015, namely Panchyakanya Itta Udhyog, Radhe Shyam Brick Industry, Shankar Itta Udhyog, Ma Bhagwati Itta Udhyog, and Jagabaijeshwor Baluwa Udhyog. These industries operated for a period of 3 to 4 years. However, due to concerns regarding pollution, the municipality intervened and dismantled the operations of these industries. Currently, one of the sites is undergoing the process of plotting. The decision to close the brick industries was made to address environmental issues, particularly related to air pollution and the impact on the local community.

Figure 44 Condition of Brick Kilns

4.6.7.1 Commercial Agriculture

Bhakundebesi has a growing commercial agriculture sector, primarily driven by migrant farmers who engage in large-scale production. The key agricultural activities include mushroom farming, tunnel farming, poultry, and livestock farming. These commercial farms supply produce to markets in Kathmandu, Sindhuli, and Janakpur.

Figure 45 Commercial agriculture

Additionally, dairy farming is a significant economic activity, with more than 30 dairy collection centers operating in the area. Daily milk collection ranges from 200 to 1,000 liters per center, with some directly supplying Kathmandu, while others sell to local households. A Krishi Upaj Sankalan Kendra (Agricultural Produce Collection Center) is also present in Bhakundebesi. The building was constructed by the municipality, but it is operated privately. This center collects vegetables from local farmers, facilitating their distribution. Farmers with high production volumes directly supply their produce to Kathmandu, while those with smaller yields sell at the collection center, which then transports the goods to Kathmandu.

Figure 46 Krishi Upaj Sankalan Kendra

CHAPTER FIVE: FINDINGS AND ANALYSIS

5.1 Demography

The population of the municipality has been steadily declining over the past two decades, from 30,571 in 2001 to 29,519 in 2011 and further down to 26,160 in 2021. Despite this decline, the number of households has been increasing, rising from 5,631 in 2001 to 6,584 in 2011 and reaching 7,148 in 2021.

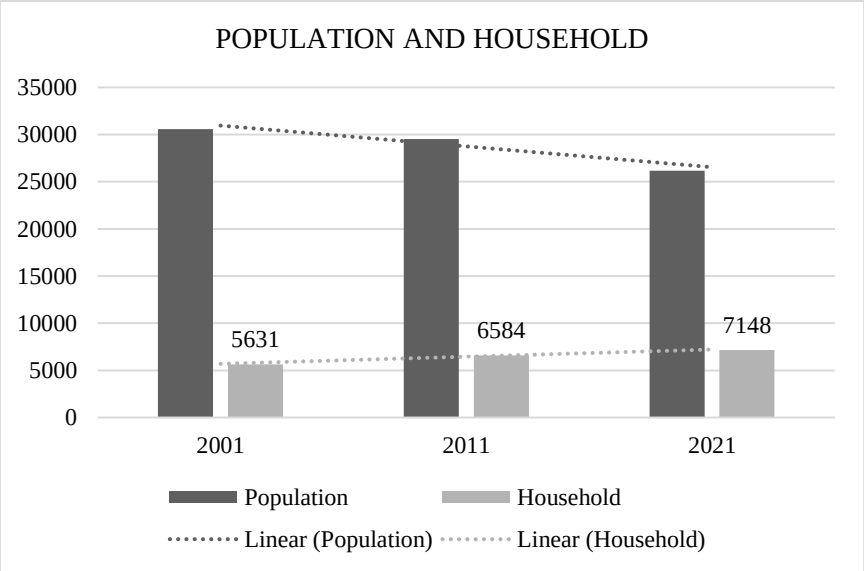

Figure 47 Population and Household

5.1.1 Ward wise Population Distribution

While most wards have seen a decline, Bhakundebesi, primarily located in **Ward 2 and Ward 7**, has experienced population growth. Ward 2 increased from 3,422 in 2011 to 3,839 in 2021, and Ward 7 grew from 3,193 to 3,663 in the same period. In contrast, other wards, including Ward 1, 3, 5, 6, 8, 9, 10, and 11, have

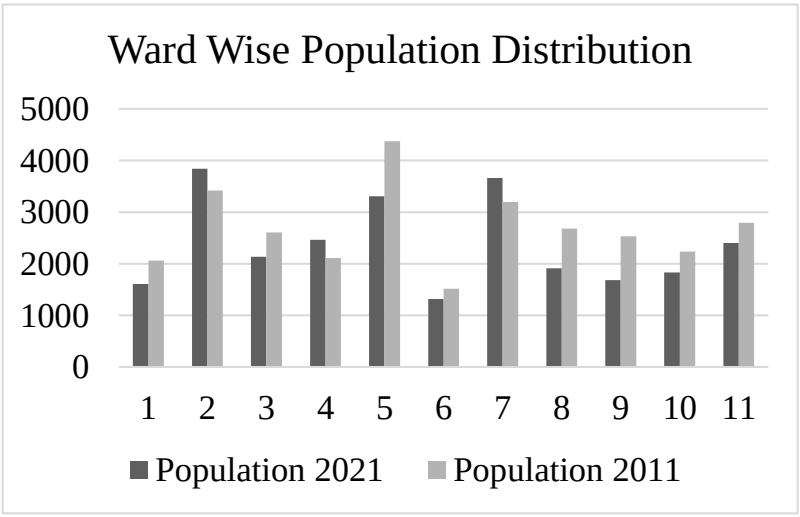

Figure 48 Comparative data of ward wise population distribution

recorded a decrease in population. Ward 5, which had the highest population in 2011 at 4,376, saw a notable decline to 3,305 in 2021. This trend indicates a shift in population concentration within the municipality, with Bhakundebesi emerging as a growing settlement.

5.1.2 Age Sex Composition

The 2011 population pyramid of Namobuddha Municipality displays a classic expanding structure, characterized by a broad base that gradually narrows at the top. This indicates a high birth rate and a relatively young population. The largest population groups are within the 0–14 years and 15–24 years categories, suggesting that a significant portion of the population is either dependent or preparing to enter the workforce. The elderly population (65+ years) is notably small, reflecting lower life expectancy at the time.

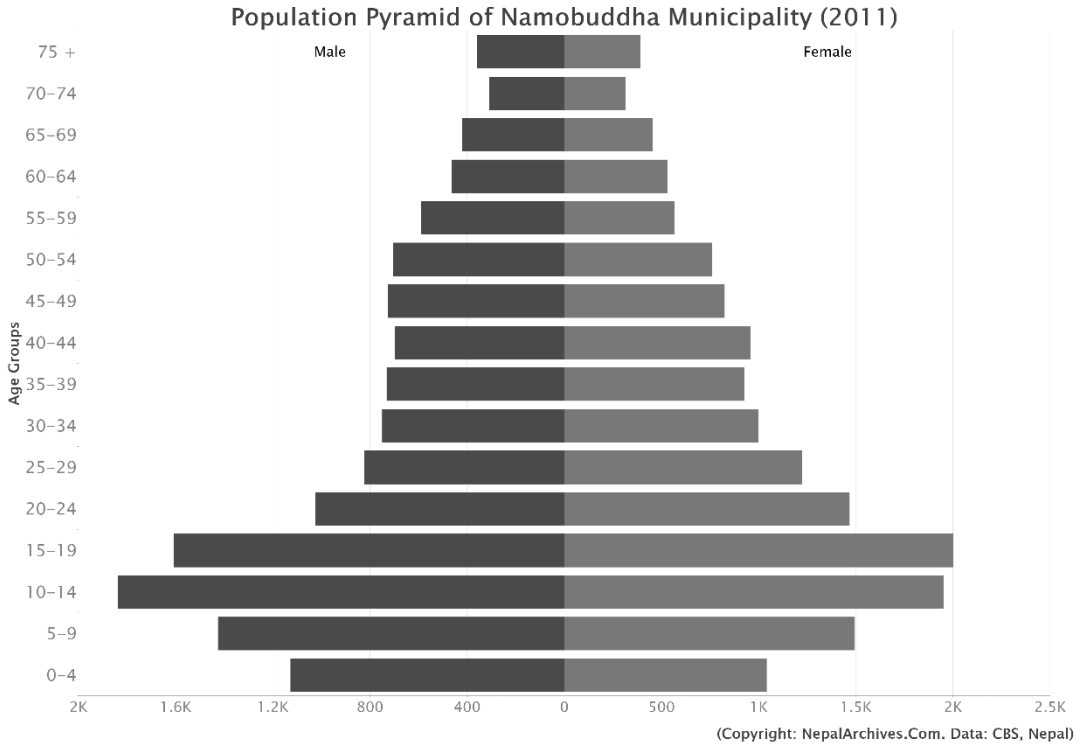

Figure 49 Population Pyramid 2011

The recent population pyramid exhibits a more constricted base, indicating a declining birth rate. The largest age groups have shifted to 25–44 years, reflecting a growing working-age population. Additionally, the proportion of elderly individuals has slightly increased, suggesting improvements in healthcare and life expectancy. The population

distribution between males and females remains fairly balanced across most age groups, though there is a slightly higher female population in older age categories, a common trend due to longer female life expectancy.

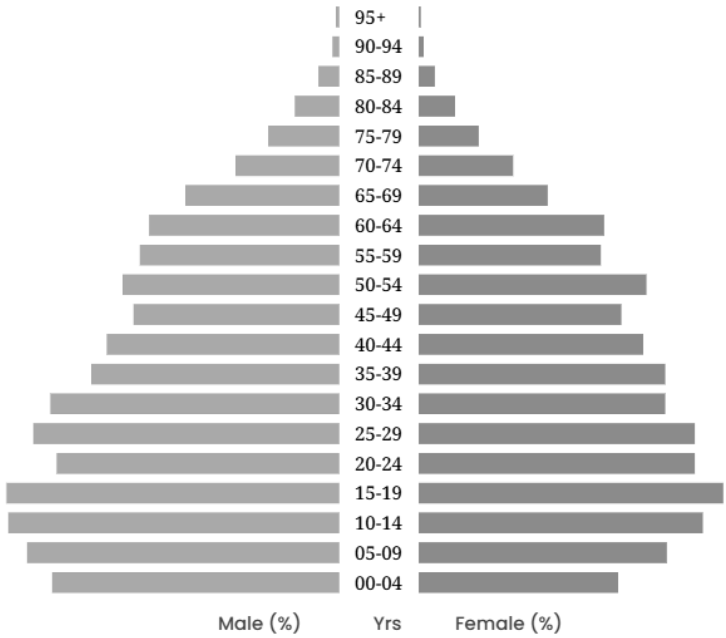

Figure 50 Population Pyramid 2021

5.1.2.1 Analysis

The comparison between the 2011 population pyramid and the recent population structure of Namobuddha Municipality highlights significant changes in the working-age population (15–59 years) and the influence of migration. Over time, the proportion of the working-age group has increased, especially in the 25–44 years category, indicating a **shift toward a more economically active population**. In contrast, the younger age groups (0–14 years) have relatively decreased, suggesting a decline in birth rates and a gradual demographic transition.

Migration has played a crucial role in shaping the current population structure. The increase in the working-age group is likely due to in-migration, as people from surrounding rural areas move into the municipality in search of better employment opportunities. The presence of commercial activities, agriculture, and trade may have attracted a workforce from different regions, contributing to the growth of the economically active population. This trend is evident in the shift away from a predominantly youth-heavy population in 2011 to a more balanced structure with a stronger working-age presence.

5.2 Language

The linguistic distribution in Namobuddha Municipality has also undergone noticeable changes over the past decade. In 2011, the Nepali-speaking population accounted for 44.67% of the total population, which slightly decreased to 43.9% by 2021. The Tamang-speaking population made up 43.37% in 2011, with a slight increase to 44.4% by 2021. The Newar-speaking population, on the other hand, saw a minor decrease, dropping from 11.18% to 10.2% during the same period.

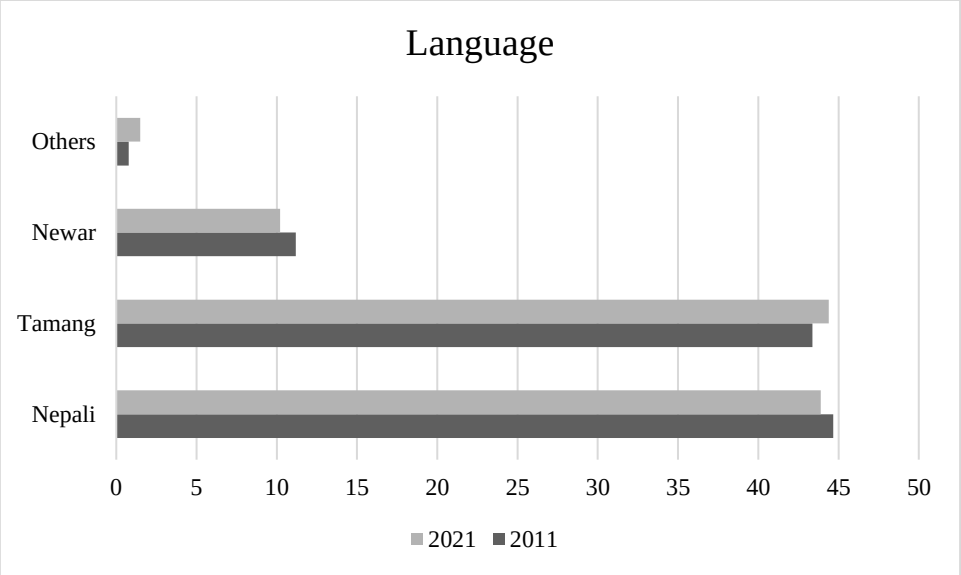

Figure 51 Comparative data of Language spoken

5.2.1.1 Analysis

The slight decrease in the Nepali-speaking population suggests a small but noticeable shift in the linguistic and cultural makeup of Namobuddha Municipality, though Nepali speakers remain the dominant group. The growth in the Tamang-speaking population indicates an increase in either natural population growth or migration within the municipality, strengthening the presence of the Tamang community. The slight decrease in the Newar-speaking population could be due to out-migration or internal demographic changes, though Newar remains an important linguistic group in the area. The decrease in the proportion of Newar speakers, despite the increase in the Newar population, suggests a potential shift in language preference. While the Newar population has grown, there could be a tendency for the younger generation or new settlers from other areas to adopt Nepali as their primary language for practical or social reasons.

5.2.2 Caste and Ethnicity

The caste and ethnicity distribution in Namobuddha Municipality has also seen notable shifts over the past decade. In 2011, the Tamang community made up 44.7% of the total population, which slightly decreased to 43.83% by 2021. The Brahman Hill caste group was 23.5% in 2011, with a slight increase to 24.81% in 2021. The Newar community accounted for 10.9% in 2011 and rose to 12% in 2021. The Kshetri community made up 7.6% of the population in 2011 and grew slightly to 8.1% by 2021.

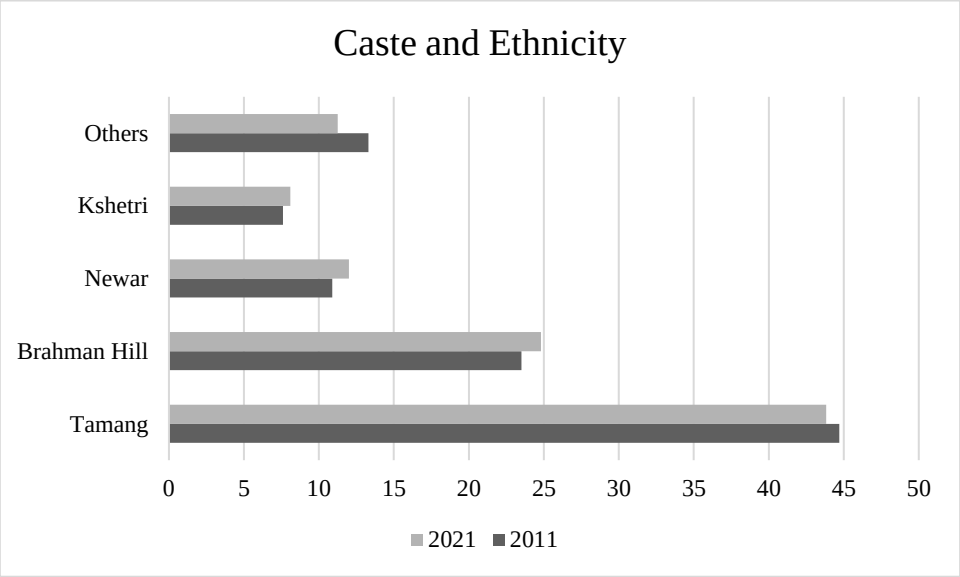

Figure 52 Comparative data of Caste and Ethnicity

5.2.2.1 Analysis

The minor decrease in the Tamang population suggests that while they remain the largest group, their growth rate has slowed compared to other communities. The Brahman Hill group's increase, though modest, reflects their growing presence in the municipality, possibly due to in-migration or natural population growth. The rise in the Newar population could indicate a continued migration or settlement trend in the area, particularly as urbanization in surrounding areas increases. The Kshetri group's modest growth mirrors broader national trends of urbanization and migration, as more Kshetri individuals may be moving to the municipality for economic opportunities.

5.3 Land Use

The image below depicting land use in the context of urban hierarchy reveals the interconnected growth patterns along a transport corridor. Kathmandu, as the core urban center, is the primary economic and cultural hub, exerting a significant influence on its surrounding areas. Dhulikhel, as a secondary urban center, absorbs part of Kathmandu's population spillover, offering a more relaxed environment while still providing essential services and economic opportunities. This migration and the resulting urban pressure on Kathmandu have stimulated the growth of Bhakundebesi, an emerging town strategically located along the BP Highway. Bhakundebesi serves as a local trade and service hub, benefiting from the inflow of migrants and businesses seeking proximity to both Kathmandu and Dhulikhel. The land use patterns reflect a blend of commercial, residential, and industrial functions, with a heavy emphasis on agricultural activities in the outskirts, while urbanized areas near the highway are gradually shifting towards more permanent structures. This land use transformation demonstrates the spillover effects of Kathmandu's growth and its impact on the surrounding towns and emerging nodes along the transport corridors, fostering a multi-tiered urban growth structure.

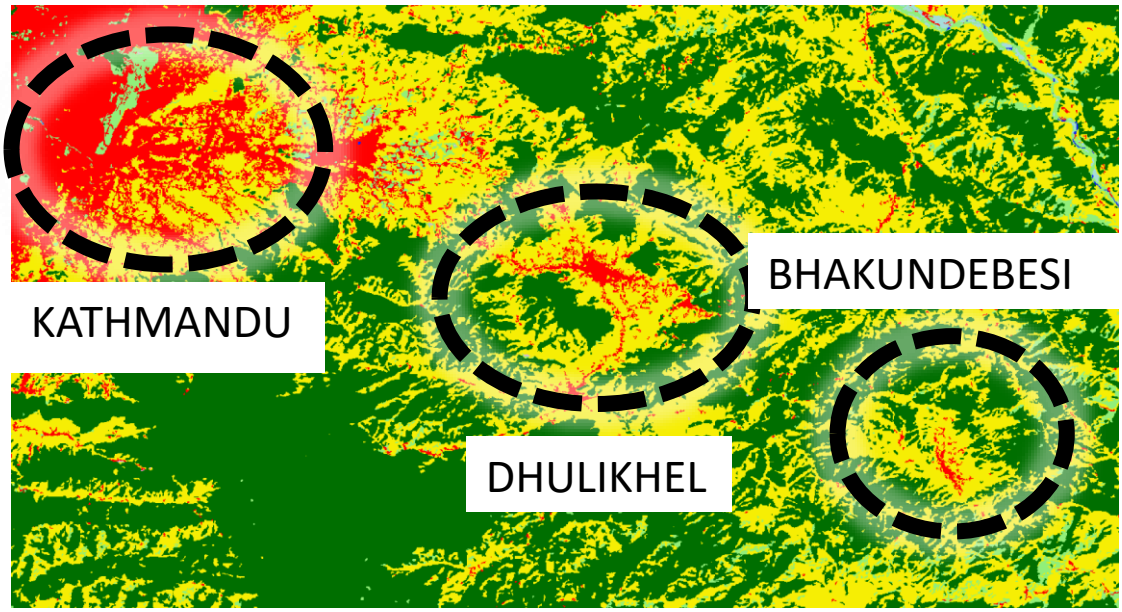

Figure 53 Land Use Map

5.3.1 Findings

The analysis of both ICIMOD land use maps from 2000, 2010, and 2019, and Google Earth timeline images from 2010 to 2024, reveals significant changes in development

patterns within the study area. Until 2010, development was minimal, with most of the land remaining in its natural state. However, by 2019, a distinct ribbon-like development emerged along the BP Highway, showing how road infrastructure began influencing urban growth. The built-up areas expanded primarily along the highway, following a linear settlement model. Google Earth images from 2010 to 2024 further illustrate this trend, with a dramatic increase in settlement density along the highway and a gradual expansion of development further inland by 2024. This shift highlights the role of infrastructure improvements in spurring urbanization, with new developments emerging beyond the highway corridor as transportation networks and accessibility improved.

5.3.2 Analysis

The shift from minimal development in 2000 and 2010 to significant growth by 2019, particularly along the BP Highway, demonstrates the pivotal role that infrastructure, specifically road networks, plays in driving urbanization. The combination of ICIMOD land use data and Google Earth imagery clearly illustrates how transportation accessibility fosters concentrated urban growth along corridors. By 2019, a linear development model emerged, with the built-up areas expanding along the highway. As roads were developed, urban growth concentrated primarily in those areas, reinforcing the notion that transportation infrastructure is a key determinant in shaping land use and settlement patterns. By 2024, the expansion shifted from a strictly linear pattern to a more dispersed settlement layout, as improved accessibility and internal infrastructure allowed development to spread further inland. This progression marks a clear transformation in the area, transitioning from natural landscapes to urbanized spaces influenced heavily by infrastructure development.

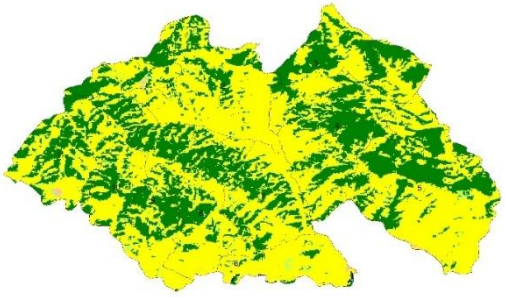

Figure 55 Land Use Map- 2000

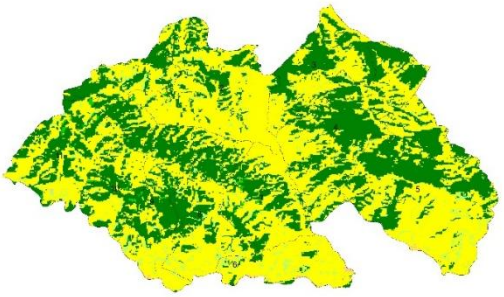

Figure 57 Land Use Map- 2010

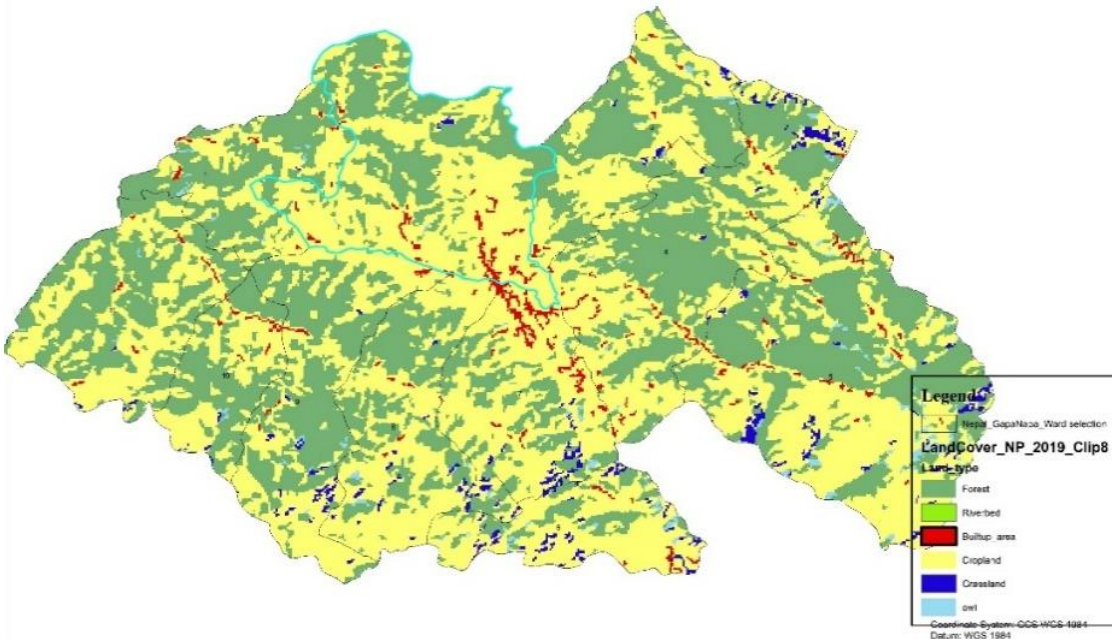

Figure 54 Land Use Map- 2019

Figure 56 Built up area along road

Figure 58 Google Earth Image of 2010

Figure 59 Google Earth image of 2024

5.4 Settlement and Housing

In 2024, Bhakundebesi had a total of 2,885 buildings, with 449 of these buildings located within the designated buffer zone, which extends 2.5 km north and south from Bhakundebesi Chowk. This buffer zone for study is defined as a 50-meter area on each side of the road centerline. The proportion of buildings in the buffer zone represents 16% of the total number of buildings in Bhakundebesi. Over the years, the number of buildings in the buffer zone has seen a steady increase, from 130 in 2010 to 225 in 2017, and then to 449 in 2024. This demonstrates a noticeable growth in construction along the highway corridor, highlighting the influence of improved infrastructure and accessibility on urban development in the area.

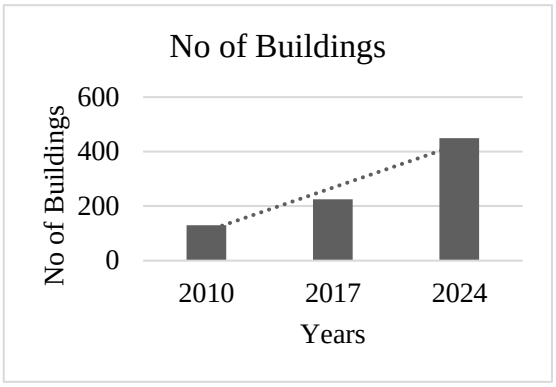

Figure 60 No. of buildings along highway over years

5.4.1 Settlement in Hilltops

Traditionally, the settlement in the hilltops of Bhakundebesi followed the hilly architectural style, with houses built using locally available materials like stone, wood, and mud, suited to the hilly terrain. These settlements were dispersed, with houses

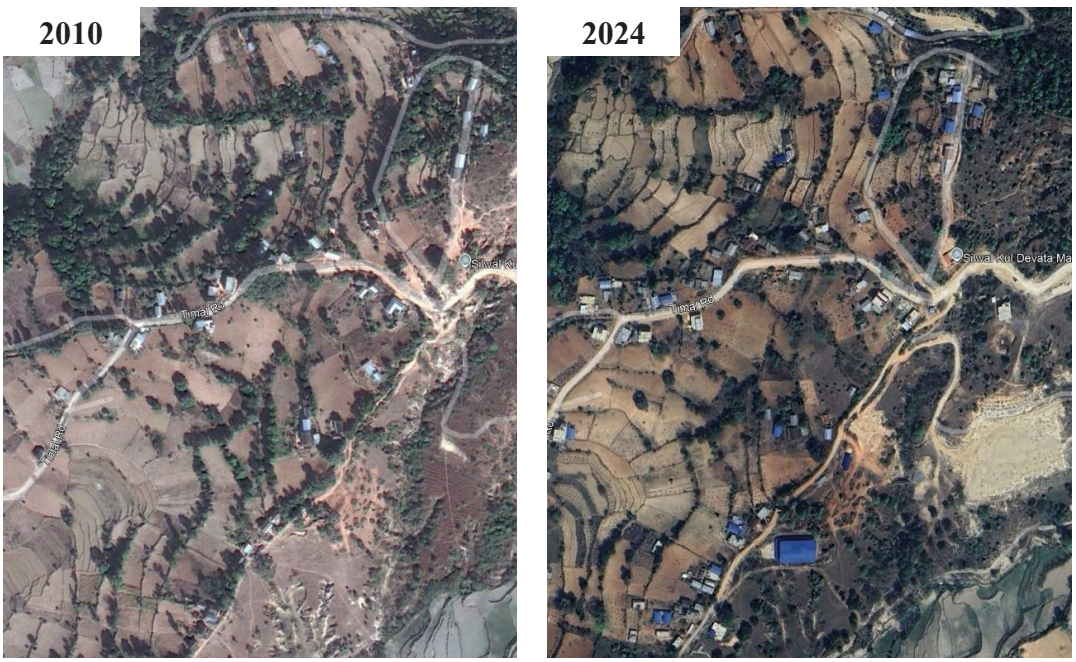

Figure 61 Google Earth image of settlement in hilltops

scattered across the landscape, primarily situated on the higher elevations to take advantage of the natural environment. Since 2010, there has been minimal addition of new buildings in these areas, indicating limited urbanization. The slow rate of construction reflects a resistance to significant change in settlement patterns in these regions, with the traditional, low-density, dispersed pattern still largely intact.

5.4.2 Settlement in along Besi

In contrast, the settlement along the Besi area has seen a significant transformation. Modern houses, now constructed with reinforced cement concrete (RCC) structures, have emerged, reflecting a shift from traditional to contemporary building methods. These new buildings are denser and are concentrated along the road, particularly following the development of infrastructure such as the BP Highway. The denser settlement pattern along the road corridor indicates a clear shift towards more urbanized development as people move closer to transportation hubs for better access. Furthermore, new construction has extended into agricultural land, which was previously not built upon, marking a notable change in land use. This shift suggests that urban expansion is increasingly encroaching upon agricultural zones, likely driven by the enhanced accessibility and economic opportunities that the transportation infrastructure provides.

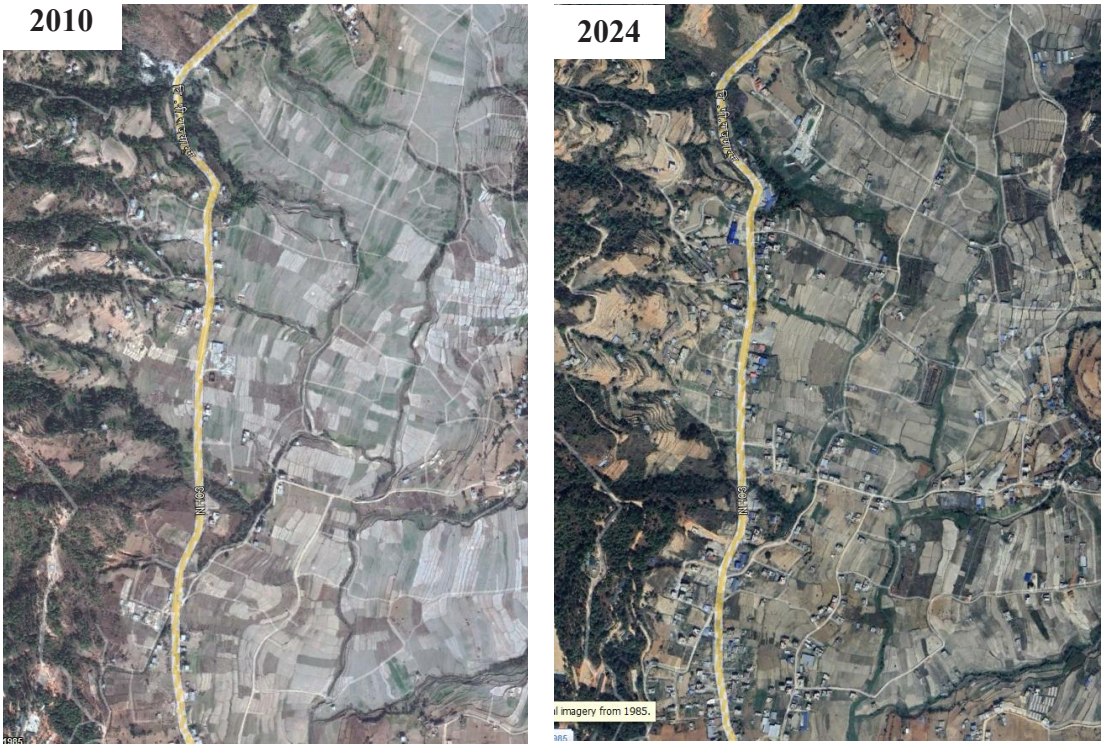

Figure 62 Google Earth image of settlement in hilltops

5.4.3 Analysis

The settlement patterns in Bhakundebesi reflect distinct trends influenced by infrastructure development, particularly the BP Highway, and the terrain's characteristics. The growth along the highway corridor has been particularly prominent, with a clear shift towards denser, modern construction. This urban expansion, particularly in the buffer zone, is driven by the accessibility and convenience provided by the road network, making it an attractive location for both residential and commercial development. The increase in the number of buildings along the highway signifies the growing importance of transportation infrastructure in shaping land use, as areas closer to the road become more desirable for urban development.

In contrast, the hilltop settlements have remained largely resistant to change. These areas continue to follow a traditional, dispersed settlement pattern, with minimal new construction since 2010. This reflects a strong adherence to the existing lifestyle and architectural style, which is deeply rooted in the natural environment and terrain. The slow pace of urbanization in the hilltops highlights the challenges posed by the geography, which limits expansion and development. The traditional, low-density settlement in these areas persists, indicating a clear distinction from the more urbanized growth seen along the road corridor.

The shift in land use from agricultural to urban along the Besi area underscores the significant impact of infrastructure development on urban sprawl. The conversion of agricultural land for new construction indicates a trend where urban growth is increasingly encroaching on previously undeveloped zones. This transition demonstrates how improved access to transportation corridors influences the local economy and settlement patterns, with people increasingly drawn to areas with better connectivity and opportunities. Overall, the analysis shows how infrastructure development not only shapes the physical growth of a settlement but also alters the underlying economic and social dynamics of the area.

5.4.4 Land Sub-division

In Bhakundebesi, land plotting is occurring independently, where large land parcels are being subdivided into smaller plots of 4-5 anna, and these newly created plots are subsequently being sold. This practice is widespread across multiple locations within the area. However, the municipality has not approved these land subdivisions, and they are being carried out without official authorization. According to the municipality, such activities do not meet the legal and regulatory requirements for land division. In response, the municipality issued a notice on 2081/9/29, warning that these unauthorized land subdivisions violate existing regulations. The notice also highlighted that continued non-compliance would lead to the withdrawal of municipal services, prohibition of further developments, and the imposition of strict enforcement measures. The municipality's primary aim is to ensure planned and systematic urban development, rather than allowing unchecked, haphazard growth.

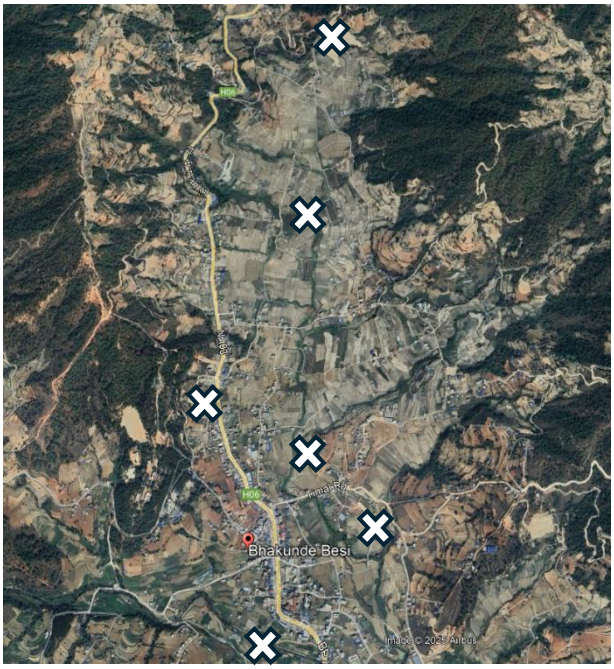

Figure 64 Location of Plotting

Figure 63 Land Sub division

5.4.4.1 Analysis

The independent land subdivision and plotting activities in Bhakundebesi represent a growing concern in the area, driven by the increasing demand for residential plots due to rapid urbanization and improved infrastructure. The practice of dividing land into smaller plots and selling them without municipal approval suggests that local landowners and developers are capitalizing on the area's rising land value and anticipated growth. This trend reflects a broader pattern of informal land use practices that often arise in rapidly urbanizing areas where official planning and regulatory frameworks struggle to keep pace with the demand for development.

The fact that these subdivisions are occurring without official authorization reveals a gap between local government regulations and the practical realities of urban growth, where market forces are often ahead of formal planning processes. It also highlights the challenges municipalities face in controlling rapid, often unauthorized, urban development in areas with high growth potential. If these practices are not curbed, they could lead to further challenges in land management, infrastructure provision, and overall urban sustainability in Bhakundebesi.

5.4.5 Housing

In Bhakundebesi, the settlement along the BP Highway has evolved significantly, with traditional houses giving way to more modern construction styles. A few traditional houses still remain, but many have been adapted to meet the growing commercial demand by converting ground floors into shops.

Figure 65 Adaptation measures of traditional houses along highway

The buildings, now reinforced with cement concrete (RCC), typically feature three or more stories. The ground floors of these RCC buildings are predominantly used for commercial purposes, such as shops, with shutters for easy access, while the upper floors are reserved for residential use. This trend has resulted in a denser settlement

pattern along the highway. In contrast, areas further away from the highway still retain residential buildings primarily used for rental purposes.

The transition to RCC buildings along the highway reflects the shift towards more modern, multi-story constructions. Many landowners, who have transitioned to these new RCC houses, continue to own land and traditional houses in the hilltops, where livestock farming remains a key activity. Furthermore, temporary structures made of CGI (corrugated galvanized iron) sheets can be seen along the highway, serving commercial purposes, further contributing to the urbanization of the area.

Figure 66 Modern RCC houses alongside highway

Over time, the materials and techniques used for construction in Bhakundebesi have transformed significantly. According to data from the National Statistics Office (NSO) for Namobuddha Municipality,

- In 2011, 89% of houses had outer walls made of mud-bonded bricks or stones, while less than 4% had cement-bonded walls. By 2021, only 54% of houses remained mud-bonded, whereas 40.5% had shifted to cement-bonded structures.
- In 2011, 71% of houses had galvanized iron sheet (GI) roofs, while 19% had tile/slate roofs, and only 7% had reinforced concrete roofs. By 2021, GI sheet roofing had decreased to 63.3%, while concrete roofing increased significantly to 32.2%, indicating a preference for more durable and earthquake-resistant structures.

This data aligns with the visible transformation in Bhakundebesi, where traditional construction materials have been largely replaced by modern, more durable alternatives.

5.4.5.1 Analysis

The shift from traditional to modern construction along the highway highlights a broader pattern of urbanization and commercialization in Bhakundebesi. The conversion of ground floors into commercial spaces signifies the growing demand for retail and business opportunities driven by improved infrastructure and accessibility, particularly due to the BP Highway. As the road has made the area more accessible, the demand for commercial properties has increased, leading to the widespread adoption of mixed-use buildings that cater to both residential and commercial needs. This trend is indicative of the growing role of the highway as a catalyst for economic activity, with commercial spaces becoming more prevalent in previously residential areas.

Additionally, the presence of temporary structures made of CGI sheets reflects the informal aspect of commercial development in Bhakundebesi. Those structures are likely built within the Right of Way (ROW) of the highway, which is typically meant for road expansion and infrastructure development. These structures provide a means for businesses to capitalize on the high foot traffic and visibility along the highway, even if they cannot invest in permanent, legally approved buildings. This reflects the dynamic and informal nature of development in Bhakundebesi, where the demand for commercial space is pushing development in areas not formally zoned for such use. Despite being temporary, these structures are vital for local entrepreneurs, offering a

cost-effective solution in a rapidly growing, yet still largely unregulated, urban environment.

Figure 67 Temporary Structures along highway

5.4.6 Land Value

Land pricing in Bhakundebesi varies significantly based on proximity to the BP Highway. Land located directly along the highway (0 meters) is the most expensive, with prices ranging from NPR 20–25 lakh per anna. As the distance from the highway increases, land prices decrease: at 500 meters, the price drops to NPR 10–12 lakh per

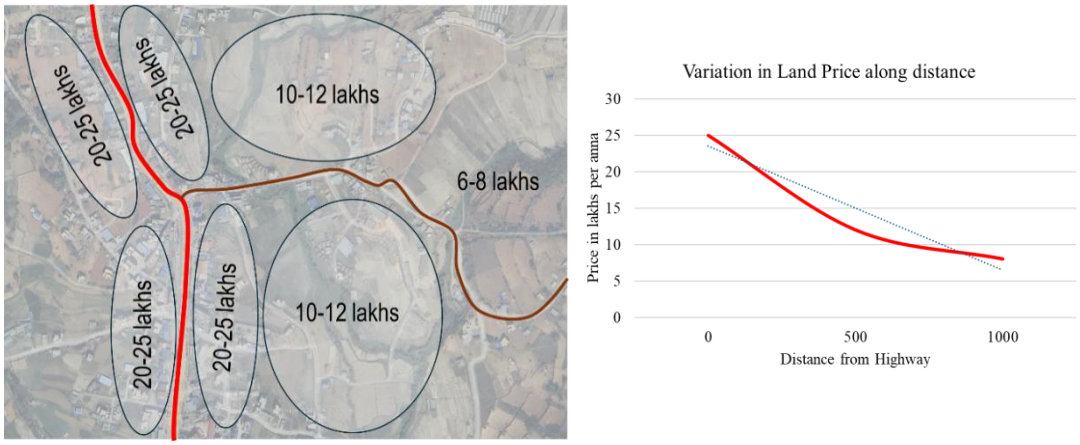

Figure 68 Variation in Land Value

anna, and at 1,000 meters, it further decreases to NPR 6–8 lakh per anna. Before the completion of the BP Highway in 2015, land prices were much lower, ranging between NPR 1–2 lakh per anna. After the highway's completion, land values experienced a

sharp rise, particularly due to improved accessibility and development opportunities in the area.

5.4.6.1 Analysis

The significant rise in land prices in Bhakundebesi following the completion of the BP Highway can be linked to well-established concepts in land value theory. The bid rent theory (1960) explains this phenomenon. It posited that land values decrease as distance from the urban center increases, as higher transport costs for goods and people reduce the desirability of more distant locations. The sharp increase in land values in Bhakundebesi supports this idea, as the road improved accessibility, reduced transportation costs, and expanded development potential, making land closer to the highway significantly more desirable.

Moreover, the New Urban Economics literature highlights the role of transportation networks in shaping urban growth patterns and land values. Research by Cervero, 2003b shows that areas with improved transit access tend to experience higher land values, as they facilitate greater commercial activity and residential development. This concept aligns with the observed shift in Bhakundebesi, where the highway's completion spurred both urban growth and increased demand for land, particularly along the highway corridor.

Thus, the observed land price trends in Bhakundebesi reflect established theories in urban and real estate economics, where improved transportation infrastructure directly boosts land values by enhancing accessibility and economic opportunities. The correlation between infrastructure development and land value increase is well documented in the literature, making the changes in Bhakundebesi a practical example of these theoretical concepts.

5.4.7 Rental value

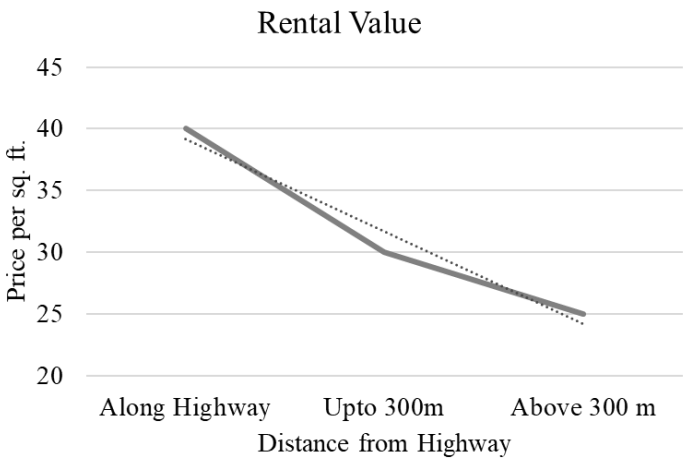

Figure 69 Variation in Rental Value

According to the National Statistics Office (NSO), the majority of households in Namobuddha Municipality have traditionally lived in self-owned houses. In 2011, over 95% of households owned their homes, with less than 4% living in rented accommodations. By 2021, this trend had slightly shifted, with ownership declining to 93.8% and rented housing increasing to 5.7%. While the overall ownership rate remains high, the growing rental sector indicates an emerging trend of housing demand among non-residents.

In Bhakundebesi, the rental value of land is currently set at NPR 13,000 per ropani. The cost of renting rooms varies significantly depending on their location relative to the highway. Rooms located along the highway, where accessibility and visibility are higher, are rented at the rate of NPR 40 per square foot per month and are generally used for business purposes. In contrast, rooms situated further away from the highway, in less prominent or accessible areas, are rented at a lower rate, approximately NPR 2,500 per month. These rooms are primarily used for residential purposes, with workers who come to the area for employment—mostly in agriculture-related or other businesses—using them as housing.

5.5 Commercial Establishment

5.5.1 Findings

The selected two wards (2 and 7) have witnessed higher commercial establishment growth compared to other wards, making them the key commercial hubs of the area. This is largely attributed to their direct access to the highway, which has facilitated the growth of both traditional agriculture-based businesses and commercial establishments. Out of the total 533 commercial establishments recorded over the years, 52.08% (277 establishments) are located in these two wards alone.

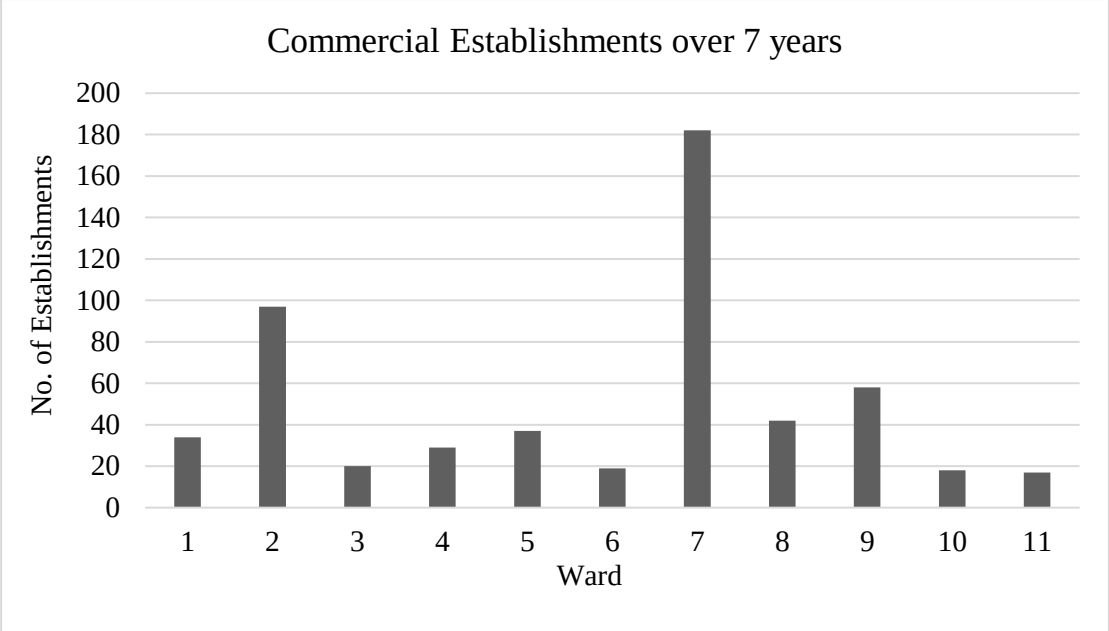

Figure 70 Commercial establishments over 7 years

From the data across multiple fiscal years, it is evident that Ward 2 and Ward 7 consistently recorded the highest number of new commercial establishments. From fiscal year 2075/76 to 2081/82, Ward 2 saw a total of 97 new establishments, while Ward 7 experienced the highest growth with 182 new businesses. In addition to commercial businesses, there has also been a noticeable rise in highway hotels, catering to travelers along the BP Highway, further contributing to the economic development of the area. While other wards, such as Ward 8 and Ward 9, saw commercial growth with 42 and 58 new establishments, respectively, none matched the scale of Ward 2 and Ward 7.

5.5.2 Analysis

The data on commercial establishments clearly shows an increasing trend in the number of businesses along the highway, particularly in Ward 2 and Ward 7, which have emerged as the key commercial hubs of the area. This growth is not limited to traditional commercial sectors but also reflects the integration of agriculture and hospitality services, with both sectors benefiting from the highway's accessibility.

The integration of traditional agriculture into the growing commercial sector has been a significant development in the area. Many local agricultural businesses have expanded their operations, benefiting from the increased accessibility provided by the proximity of the highway. This has facilitated the growth of both sectors, as agricultural businesses are able to reach larger markets while simultaneously contributing to the overall commercial development in the region. The increasing trendline in the number of commercial establishments is reflective of this dual growth.

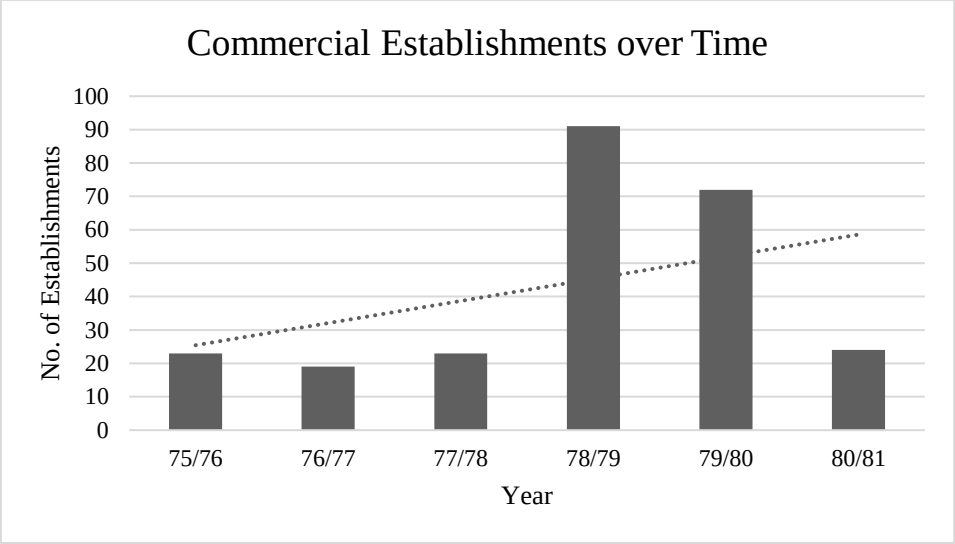

Figure 71 Commercial Establishments Trend

5.6 Infrastructure Development

5.6.1 Findings

Over the past decade, Bhakundebesi has seen considerable advancements in its infrastructure, significantly improving the quality of life for its residents and contributing to its economic growth. The town's healthcare infrastructure has expanded with the establishment of a Provincial Hospital and a private hospital, alongside the existing district hospital. The healthcare sector has greatly benefitted from these additions, with more accessible and diverse healthcare services available for both locals and people from surrounding areas.

The water supply has also improved dramatically. In 2011, 60% of households had access to piped water, and by 2021, this figure had risen to 80%. This improvement is critical, considering Bhakundebesi's increasing population, driven by migration and urbanization. Additionally, sanitation has been a major focus, with toilet access increasing from 63% of households in 2011 to more than 98% in 2021. This

improvement in sanitation, alongside the selection of a landfill site (despite the lack of proper planning for waste management), indicates progress, though challenges remain in maintaining cleanliness and sustainability.

In terms of road infrastructure, there has been a modest improvement. Before 2015, less than 1% of roads were blacktopped, but after 2015, the figure rose to about 1%. Though the increase is small, it signifies an ongoing effort to improve the town's connectivity, especially with its proximity to the BP Highway, which connects Bhakundebesi to larger urban centers.

The introduction of electric vehicle (EV) charging stations is a noteworthy development in Bhakundebesi's infrastructure. As the adoption of EVs increases across Nepal, these stations serve a dual purpose of catering to local EV owners and providing services to travelers passing through Bhakundebesi, thus promoting eco-friendly transport solutions.

5.6.2 Analysis

The infrastructure improvements observed in Bhakundebesi reflect a responsive effort to meet the challenges posed by its expanding population and economic activities. The healthcare sector's growth indicates a commitment to improving public health services, which is essential as migration increases and the demand for healthcare rises. The increase in access to piped water and sanitation services shows a significant shift towards improving living conditions, which is essential for accommodating both the existing population and newcomers. However, despite these advancements, the slow pace of road blacktopping and incomplete waste management strategies underscore the continuing infrastructural gaps that need to be addressed to support the town's rapid growth.

One of the most notable emerging issues is traffic congestion, which has intensified due to the expansion of commercial activities and the increasing number of vehicles on the road. As the town's commercial and residential areas grow, the infrastructure is struggling to keep pace with the rising demand for efficient transportation. This congestion, particularly along major roads and near commercial hubs, is affecting the overall mobility and quality of life in the area. Moreover, despite the introduction of EV charging stations, there is still a significant lack of road infrastructure to manage the increased traffic flow effectively, which may exacerbate the problem over time.

Additionally, the area's vulnerability to external factors, particularly flooding and climate-related risks, is heightened due to the inadequacy of the drainage systems and waste management infrastructure. The town's exposure to such vulnerabilities could further strain its limited resources and challenge the sustainability of its infrastructure. The increasing urbanization of Bhakundebesi, coupled with these infrastructural gaps, makes it more susceptible to such vulnerabilities, which could compromise the resilience of the growing population and its urban fabric.

In summary, while Bhakundebesi has made significant strides in infrastructure development, the growth has not been entirely proportional to the rapid urbanization. There are still areas requiring attention, especially regarding road infrastructure, waste management, traffic congestion, and the resilience of utilities against external vulnerabilities. Future development efforts should focus on addressing these gaps to ensure long-term sustainability and enhance the town's capacity to withstand environmental challenges.

5.7 Discussion

The study reveals Bhakundebesi, is undergoing a transformative phase driven by infrastructure development, migration, and shifting socio-economic dynamics. The completion of the BP Highway has been a pivotal catalyst for urbanization. Key inferences from the study include:

1. **Population Shift and Urbanization**

- Bhakundebesi (primarily in Ward 2 and Ward 7) is experiencing population growth, while most other wards in Namobuddha Municipality are seeing a decline.
- This suggests a concentration of settlement and economic activity in Bhakundebesi, making it an emerging urban center within the municipality.
- The increase in the working-age population (25–44 years) indicates economic attractiveness, driven by employment opportunities and improved infrastructure.

2. **Impact of Migration on Demographics**

- Migration has played a crucial role in shaping the population structure, with in-migrants from surrounding rural areas moving in for jobs, trade, and business.
- The growing presence of the Brahman Hill and Newar groups reflects diverse migration trends, likely linked to economic and commercial expansion.

3. Influence of BP Highway on Urban Growth

- The BP Highway has been a major catalyst for urbanization, transforming Bhakundebesi from a rural settlement into a growing commercial hub.
- Initial development followed a linear pattern along the highway, after that urbanization has taken on a dispersed form, indicating expansion beyond the immediate road corridor.
- The improved road network has significantly enhanced land value and commercial potential, attracting investments in real estate and business.

4. Transformation in Land Use and Housing

- There has been a shift from traditional hilltop settlements to modern RCC structures along the highway, reflecting changing lifestyle preferences.
- Agricultural land is being rapidly converted into urban land, particularly in the Besi area, due to increasing commercial activity.
- The rising number of mixed-use buildings, where ground floors are converted into commercial spaces, indicates a growing commercialization trend.

5. Informal Land Development Challenges

- Unregulated land subdivision and plotting are occurring in response to increasing demand, often without municipal approval.
- This unplanned urban growth poses risks such as inadequate infrastructure, legal disputes, and environmental concerns.

6. Commercial Growth and Economic Diversification

- The rise in commercial establishments, suggests Bhakundebesi is evolving into a regional trade hub. It is emerging as a commercial nucleus.

- Agricultural businesses are adapting to urban growth, integrating with commercial sectors, and benefiting from improved market access.
- The informal commercial structures along the highway highlight temporary and informal commercialization driven by demand.

7. Land Value Appreciation and Real Estate Trends

- Land prices have surged following highway construction, aligning with bid rent theory and New Urban Economics principles.
- Proximity to the highway has become a key determinant of land value, reinforcing the importance of transportation infrastructure in shaping urban land markets.
- The demand for real estate is increasing, but affordability and speculation-driven price hikes could create barriers for local residents.

8. Infrastructure and Service Improvements

- Bhakundebesi is witnessing incremental infrastructure development, including better healthcare facilities and improved water supply.
- Despite progress, unplanned growth outpaced infrastructure capacity, leading to water shortages, traffic congestion, and inadequate waste management.
- The expansion of public services indicates an effort to match the pace of urban growth, but planning gaps persist in managing sanitation, roads, and public spaces.

9. Policy-Implementation Gap

- Unauthorized land subdivisions reflect weak enforcement of zoning and building regulations causing haphazard development.
- Non-Compliance with Building Codes: Temporary CGI sheet structures dominate highway margins, violating setback norms.

CHAPTER SIX: CONCLUSION

The transformation of Bhakundebesi from a rural settlement to an emerging urban node along the BP Highway encapsulates the complex interplay of infrastructure-driven growth, socio-economic aspirations, and environmental trade-offs in Nepal's rapidly urbanizing landscape. This study underscores how transportation corridors like the BP Highway act as catalysts for development, reshaping land use, migration patterns, and economic activities. However, it also reveals the inherent risks of unplanned urbanization, where growth outpaces institutional capacity, ecological safeguards, and equitable resource distribution.

The findings highlight that Bhakundebesi's spatial and demographic evolution aligns with global patterns of highway-induced development, such as ribbon settlements, rising land values, and commercial clustering. Yet, the local context introduces unique challenges: the coexistence of traditional hilltop agrarian communities with modern RCC-based urban sprawl, the tension between informal land markets and weak regulatory enforcement, and the strain on limited water and waste infrastructure. The demographic shifts—marked by in-migration from neighboring rural areas and a prospering working-age population—reflect Bhakundebesi's growing role as a regional service hub. However, this growth has come at the cost of agricultural land conversion, environmental degradation, and social disparities.

Critically, the research exposes systemic gaps in policy implementation. Despite progressive frameworks, Bhakundebesi's development remains haphazard due to fragmented governance, resource constraints, and a lack of community participation. The municipality's inability to curb unauthorized land subdivisions or enforce building codes exemplifies the disconnect between national legislation and local execution. Furthermore, infrastructure investments—such as the BP Highway—are often planned in isolation, neglecting synergies with water, waste, or public transport systems. This siloed approach causes urban sprawl, traffic congestion, and environmental harm, undermining the potential for holistic development.

Bhakundebesi's case offers broader lessons for Nepal and similar regions navigating the paradox of highway-driven urbanization. First, infrastructure projects must be embedded within integrated regional plans that balance connectivity with ecological and agricultural preservation. Second, empowering municipalities through fiscal

devolution, technical training, and participatory governance is essential to translating policies into actionable strategies. Third, inclusive planning mechanisms are vital to ensuring that urbanization benefits all socio-economic groups, not just investors and speculators.

In closing, this study serves as both a cautionary tale and a roadmap. Without urgent interventions, Bhakundebesi risks becoming a textbook example of unsustainable sprawl, characterized by resource depletion, social fragmentation, and climate vulnerability. Yet, its strategic location and economic potential also position it as a testbed for innovative urban models—ones that harmonize highway accessibility with green corridors, mixed-use zoning, and resilient infrastructure. By bridging policy gaps, fostering multi-stakeholder collaboration, and prioritizing sustainability, Bhakundebesi can evolve into a beacon of balanced development, demonstrating how emerging towns can thrive without sacrificing their ecological and social fabric. Ultimately, the lessons from Bhakundebesi are not just local but universal, offering insights into the challenges and opportunities of 21st-century urbanization in an era of climate crises and infrastructural ambition.

CHAPTER SEVEN: RECOMMENDATIONS

Bhakundebesi, a rapidly transforming settlement along the BP Highway, is facing increasing pressure from unplanned urban expansion, rising land values, and growing demands for infrastructure and services. While its strategic location has catalyzed economic activities and population growth, the absence of a guiding development framework has led to fragmented land use, environmental risks, and underutilized economic potential. To steer Bhakundebesi toward sustainable and resilient urbanization, a set of integrated, site-specific recommendations is proposed. These recommendations focus on land management, economic diversification, basic service delivery, and institutional reform—aimed at promoting compact, inclusive, and future-ready growth.

1. **Promote Land Pooling for Planned Growth**

As Bhakundebesi continues to urbanize due to its strategic position along the BP Highway, unmanaged land subdivision and plotting are occurring at an alarming rate, especially in flat lands and former agricultural zones. This growth pattern lacks

consideration of environmental vulnerabilities and infrastructure needs, posing long-term risks. To address this, an integrated approach combining Land Pooling and Risk-Sensitive Land Use Planning (RSLUP) is essential. Land pooling can facilitate equitable urban development by enabling planned infrastructure development and ensuring fair land readjustment. When paired with RSLUP, it ensures that development is guided by topography, flood-prone areas, soil stability, and accessibility, reducing disaster risk while promoting compact and resilient growth. Such an approach is key for Bhakundebesi, where land values are rising but hazard risks and infrastructure gaps persist.

- Identify potential zones for pilot land pooling projects in already urbanizing flatlands along the highway, integrating infrastructure plans before further plotting occurs.
- Use RSLUP tools to map flood-prone zones, unstable slopes, and areas with high erosion risk, especially in hill fringes and riversides.
- Develop local land readjustment models in consultation with landowners and stakeholders, ensuring that roads, drainage, and public spaces are integrated early.
- Include minimum plot sizes and road widths in land use plans to ensure proper accessibility and avoid fragmented development.
- Designate restricted development zones in hazard-prone areas identified through RSLUP analysis and promote green buffers or agricultural belts instead.
- Align land use decisions with long-term infrastructure investment plans, including water supply, sewerage, solid waste, and EV infrastructure.

2. Commercialization of Agriculture for Urban Use

To support Bhakundebesi's evolving agro-based economy and connect it more strategically to nearby urban markets, it is essential to enhance the commercial potential of agricultural activities. The area already produces vegetables, dairy, and poultry in significant quantities, primarily driven by migrants and commercial farmers. However, lack of structured market access, post-harvest storage, and branding limits profitability. Also, the hilltop zones, once residential now remains underutilized can be suitable for horticulture and animal husbandry. Strengthening these components will improve

livelihoods and establish Bhakundebesi as a recognized agro-supplier to urban centers like Banepa, Dhulikhel, and Kathmandu.

- Operationalize the under-construction cold storage facility and ensure it is connected to existing vegetable and dairy collection centers for better preservation and bulk distribution.
- Establish a physical agro-collection hub (Haat Bazaar) along the BP Highway to facilitate direct trade between farmers and regional buyers.
- Develop and promote a regional brand identity such as "Bhakundebesi Organic" for vegetables and dairy products to enhance product value.
- Organize targeted training for agro-entrepreneurs on business planning, market linkage, and packaging.
- Encourage high-value horticulture in upper zones and support with training and input subsidies.
- Set up agro-input distribution outlets in Bhakundebesi to provide seeds, irrigation tools, and organic fertilizers easily and affordably.

3. Expansion of Off-Farm Employment and Local Economic Diversification

Bhakundebesi, due to its strategic location along the BP Highway and its growing connectivity to Banepa, Kathmandu, and other emerging markets, is witnessing a rapid increase in working-age population, particularly due to inward migration from surrounding rural municipalities such as Temal, Roshi, and even distant districts like Sunsari and Jhapa. These migrants are engaging in commercial agriculture, block manufacturing, and local services, signaling a transition towards an increasingly diversified economy. However, reliance on a narrow range of sectors remains a constraint. To reduce pressure on land and promote sustainable growth, there is a strong need to expand off-farm employment opportunities through targeted investments and support for small-scale industries, services, and value-chain-based activities. The proximity of Bhakundebesi to several villages presents an opportunity for creating a commuter-based economy, where surrounding populations can access jobs in the town without permanent relocation. This strategy also helps retain rural vitality while enhancing urban economic base.

- Identify and map Bhakundebesi's comparative economic advantages, such as availability of labor, highway access, and emerging markets, to guide investment promotion.
- Promote small and medium-scale enterprises (SMEs) linking rural production with urban markets.
- Establish a municipal-level economic diversification strategy that fosters coordination between agriculture, construction, hospitality, and transportation sectors.
- Attract private sector investment through incentives such as simplified registration, tax waivers for startups, or land for lease, especially for industries that generate jobs for women and youth.
- Promote cooperative-based business models to build equity and ownership among local populations, especially in dairy and meat processing.
- Support vocational training centers focusing on trades and off-farm skills such as masonry, plumbing, electrical works, ICT, and driving, aligning with local labor demands.

4. Water Supply and Sanitation

With rapid settlement expansion and increased population due to plotting and urban spillover, water scarcity is becoming a severe issue in Bhakundebesi. While past water availability was sufficient, overextraction and drying springs have caused supply gaps. Simultaneously, lack of adequate sanitation infrastructure in public spaces further adds to health and hygiene concerns. Improving water infrastructure and ensuring basic sanitation access are key to making the town resilient and livable.

- Promote rooftop rainwater harvesting systems across households and institutions to reduce reliance on groundwater.
- Expand the existing piped water supply system to cover new residential plots and underserved pockets created through land development.
- Build public toilet facilities in high-use areas such as the market center, highway junction, and hospital premises.
- Implement the municipality's WASH Plan by actively involving local water user committees for monitoring and maintenance.

5. Solid and Wastewater Management

As Bhakundebesi urbanizes along the BP Highway, the increase in population density and commercial activities has resulted in a rapid rise in waste generation. The current approach relies heavily on septic tanks and uncontrolled dumping, posing environmental and public health risks. Transitioning to a system that separates, processes, and recycles waste at source is critical to managing growth sustainably and reducing landfill dependency.

- Establish a recycling and composting center on the outskirts of the settlement to process household and market waste into organic manure.
- Introduce waste segregation at source by distributing color-coded bins and running community awareness campaigns through schools and cooperatives.
- Develop a dedicated solid waste collection system that separates biodegradable, plastic, and hazardous waste using small vehicles or carts.
- Train and encourage local farmers to utilize composted manure from the plant, especially in vegetable and mushroom farming.

6. Strengthen Policy Framework for Emerging Peri-Urban Settlements

Although national policies like NUDS 2017 promote compact growth and corridor-based development, they fail to directly address ribbon development patterns emerging along highways. Additionally, while the building bylaws recognize "Urban Committed Areas," there is no detailed strategy, regulatory framework, or implementation roadmap to guide their transition into well-managed urban zones. The DEGURBA classification still labels rapidly urbanizing areas like Bhakundebesi as rural, as it focused in ward level, creating a policy blind spot that overlooks their infrastructure needs and governance challenges. The recently updated National Urban Policy 2081 acknowledges urban sprawl but largely focuses on provincial capitals and large cities, neglecting emerging towns. A more refined, micro-level urban classification system is necessary to address the unique needs of these fast-transforming settlements.

- Update national and provincial policy frameworks to include explicit reference to ribbon development patterns and propose mechanisms for its regulation.

- Revise and activate the concept of Urban Committed Areas with operational guidelines, zoning regulations, and service delivery standards tailored for transitional zones.
- Develop and adopt a Micro-Level Urban Classification System that recognizes emerging urban clusters below the ward level to inform service planning and resource allocation.
- Ensure the National Urban Policy includes a specific strategy for secondary growth centers and peri-urban markets along major highways.
- Prepare targeted infrastructure development plans and land use controls for settlements on the urban-rural fringe to manage sprawl and guide compact, infrastructure-efficient growth.

The set of recommendations outlined above offers a comprehensive roadmap to manage Bhakundebesi's ongoing transition from a rural settlement to an emerging highway town. Emphasizing land pooling, agro-commercialization, off-farm employment, service delivery, and policy reform, these strategies collectively aim to balance growth with resilience. Their successful implementation will depend on multi-stakeholder collaboration, municipal capacity enhancement, and alignment with provincial and national development priorities. As Bhakundebesi evolves, these recommendations can serve as a scalable model for similar settlements across Nepal undergoing peri-urban transformation.

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APPENDIX A: CONFERENCE PAPER

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Date: April 21, 2025

To Whom It May Concern:

This is to certify that the paper titled **"Development Management in Emerging Town Along BP Highway: A Case of Bhakundebesi"** (Submission# **226**) submitted by **Sandra Joshi** 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.

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

Development Management in Emerging Town Along BP Highway: A Case of Bhakundebesi

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Abstract

The construction of the BP Highway has significantly influenced the spatial and economic landscape of settlements along its route, particularly in Bhakundebesi. Originally a rural area with scattered settlements, Bhakundebesi is now rapidly urbanizing. The flatlands around Bhakundebesi are emerging as the main local market center, gradually transforming into an urban area. This shift is driven by the strategic location of Bhakundebesi along the highway, making it a crucial marketplace and service hub for surrounding rural settlements. The trend of urban growth is gaining momentum, fueled by economic activities, migration, and rising commercial opportunities along the highway. This growth is largely driven by increasing migration from remote regions, where people seek economic opportunities in trade, services, and small-scale industries. This type of growth is often accompanied by adverse effects such as environmental degradation, loss of agricultural land, and social inequities. This study utilizes a mixed-method approach, incorporating census data, field surveys, and stakeholder interviews to assess urbanization trends. Findings indicate rapid land use transformation, increasing commercial activity, and infrastructure deficits. Without proper planning, continued growth could lead to unmanaged expansion, resource strain, and environmental degradation. The study highlights the need for strategic urban planning to mitigate these challenges and ensure sustainable development along the BP Highway.

Keywords

Urbanization Drivers, Urban, Development Management, Emerging Towns, Spatial Transformation, Highway-Oriented Development

1. Introduction

The relationship between transportation networks and spatial development is crucial in understanding economic and urban expansion along transport corridors [1]. Improved transit networks enable peripheral regions to grow, leading to spatial transformations beyond well-connected cities. While economic activity initially clusters along highways, neighborhood spillovers drive development further into surrounding areas, fostering rapid transformation [2]. Despite spatial inequalities, such infrastructure investments accelerate regional convergence, facilitating urbanization.

The BP Highway (NH13) is a key route linking Kathmandu Valley with the Eastern Terai, serving as the shortest connection between the capital and Madhesh Province. It has catalyzed the growth of market centers such as Dhulikhel, Bhakundebesi, Mulkot, Khurkot and Bardibas, reinforcing their roles as trade and transport hubs. Unlike traditional urbanization in Nepal, which was concentrated in Kathmandu and the Terai [3], the BP Highway has spurred town development in hilly regions, exemplifying global highway-induced growth patterns.

However, Bhakundebesi's case is unique due to its organic, unregulated expansion. Unlike planned cities, its growth lacks systematic land-use planning, leading to fragmented development, informal settlements, and infrastructure gaps. Existing literature on highway-driven urbanization in Nepal focuses on larger cities, overlooking emerging towns like Bhakundebesi, where rapid changes present distinct governance and planning challenges. This study addresses that gap by analyzing how Bhakundebesi's transformation reflects broader trends while revealing the risks of unplanned growth. Understanding such dynamics can inform policies for managing emerging highway towns, ensuring sustainable and equitable development.

2. Objectives

1. To study the spatial transformation in Bhakundebesi from 2000s to 2024 following the construction of the BP Highway.
2. To examine the development dynamics of Bhakundebesi as an emerging settlement, focusing on changes in land use, economic activities, and population change.

3. Methodology

This research adopts a pragmatic paradigm, allowing the integration of both qualitative and quantitative methods to analyze spatial transformation and development dynamics in Bhakundebesi. The methodologies namely literature review, case study, site observation and consultations with various stakeholders was carried out in this study of research. A purposive sampling approach was used to select Wards 2 and 7, as they exhibit significant commercial growth along the BP Highway. Key informants included local officials, business owners, residents, and infrastructure planners, ensuring diverse perspectives. Household surveys covered both indigenous residents and migrants. GIS software (ArcGIS/QGIS) mapped land use patterns and urban expansion.

Pages: 1 – 8

However, there are some limitations. Data availability issues arose due to incomplete municipal records, requiring cross-verification. Response bias in interviews was a challenge, as stakeholders may have had subjective views on development impacts. Temporal constraints limited the study to changes between 2000 and 2024, potentially overlooking longer historical trends. Additionally, informal developments lacking documentation posed challenges for precise mapping. Despite these constraints, the study ensures transparency and reliability, providing a strong foundation for future research.

Aspect	Details	Primary Sources	Secondary Sources	Purpose
Demography	Population size, age structure, migration patterns, household composition	Census data, household surveys, field observations	Municipal demographic reports, census data, migration studies	To analyse how population dynamics are influenced by highway development
Land Use	Residential, commercial, industrial, and open spaces	Field observations, surveys, GIS data	Municipal land use maps, satellite imagery, GIS databases	To understand the highway influence land use changes and urban form
Housing and Settlements	Patterns of residential development, rental housing, and informal settlements	Household surveys, field observations	Municipal housing records, historical land transaction data	To study the impact of highways on residential patterns and settlement dynamics
Commercial Establishments	Number, type, and spatial distribution of businesses (shops, hotels, restaurants, industries, etc.)	Business surveys, direct observations	Municipality business registration data	To analyse how highways impact the clustering of commercial activities and urban form
Infrastructure Development	New roads, parking spaces, electricity networks, water supply systems, and public infrastructure changes	Field observations, municipal infrastructure records	Municipality data, infrastructure planning reports	To evaluate how highways drive infrastructure development

Table 1: Research Strategy Framework

4. Literature Review

Transportation and urban growth Transportation and urban growth share a reciprocal relationship, where transport infrastructure stimulates urban expansion while rising populations increase travel demand [1]. Transportation systems facilitate mobility and drive economic growth by enhancing land accessibility, shaping development patterns, and influencing spatial distribution [4]. Highways drive urban expansion, as seen in Jeddah [1], the U.S. [5], and China [6], where major roads spurred suburbanization and land fragmentation.

While highway-induced development is well-discussed, much of the literature focuses on larger cities or more developed regions. The impact of highways on small towns or emerging settlements, particularly in developing countries like Nepal, remains understudied. The existing literatures often overlook the unique challenges and dynamics in smaller, emerging towns like Bhakundebesi, which are still in the early stages of urbanization.

Ribbon Development Ribbon development refers to a form of urban expansion characterized by the construction of buildings in a continuous line along a main road or transportation route [7]. This development pattern has significant implications for urban planning, infrastructure, and community dynamics. Ribbon development often leads to inefficient land use, as it encourages the construction of buildings along roadways while leaving large areas behind these structures undeveloped.

Ribbon development along the BP Highway is evident in the linear expansion of settlements, businesses, and infrastructure adjacent to the road. Towns like Bhakundebesi have transformed into bustling hubs, with shops, hotels, and residential buildings constructed in a continuous line along the highway. This pattern has attracted economic activities such as petrol pumps, repair shops, and small industries, leveraging the accessibility provided by the road.

Leapfrog development Leapfrog development refers to a pattern of urban growth where new developments occur on land that is not contiguous with existing urban areas. This often involves skipping over undeveloped or less desirable land to build on more attractive, often cheaper land further away from city centers. It is caused by different factors such as the physical geography which make continuous development prohibitively expensive to be executed, lower land costs, policy regulations, and demographic dynamics, as well as the desire to bypass infrastructure costs in already developed areas [8]. This phenomenon has significant implications for urban planning, infrastructure development, and environmental sustainability. It results in patches of urbanization separated by undeveloped land. This can create a scattered pattern of growth that complicates planning and resource allocation. New developments often require the extension of public facilities such as roads, water, and sewer systems from their existing endpoints to reach the new sites. This can lead to increased costs and logistical challenges for municipalities that must extend services over longer distances [9].

Rural Urban Linkage Rural urban linkage is a dynamic and multidimensional approach to deal with the relationship between rural and urban area. Rural-urban linkages are crucial for balanced development, offering economic, social, and environmental benefits that improve life quality in both rural and urban areas [10]. These linkages involve flows of people, goods, money, information, and wastes, as well as synergies between agricultural and non-agricultural sectors. According to UN Center of Human Settlement: “Rural urban linkage is an integrated approach to promote balanced and mutually supportive rural-urban development"[11].

Case Studies Comparative case studies of Muglin, Hetauda, and Damauli have been carried out, the findings of which are presented in a table 2.

	MUGLIN	HETAUDA	DAMAULI
Connectivity	Intersection of Prithvi Highway & Mugling-Narayanghat Highway	Intersection of Tribhuwan Highway & Kanti Rajpath	Along Prithvi Highway
Initial Status	Tranquil fishing village	forested and Small market & administrative center	Rural settlement, agriculture-based
Highway Influence	Major **transport hub**	Emerged as a **manufacturing & trade hub**	key trade and transport center
Major Strategies	Regional trade hub	Industrial zoning	Agro-tourism

Table 2: Comparative studies of National Cases

5. Study Area

Namobuddha Municipality lies in Bagmati Province, Kavrepalanchowk District. Bhakundebesi is a key settlement within the municipality, primarily located in Ward 2 and Ward 7, with slight extensions to Ward 3 and Ward 4 [12]. It serves as the municipal center, experiencing rapid urbanization due to its strategic location along the BP Highway. The area of the study area is 7.25 sq. km.

According to the 2021 census, Namobuddha Municipality has a population of 26,610 and 7,148 households. Ward 2 has a population of 3,839, while Ward 7 has 3,663 residents [13]. The local economy is driven by trade, commercial agriculture, and small-scale industries.

Figure 1: Location map of Namobuddha Municipality

5.1 Geographical Location

Geographically, the site is located at approximately 27° 33′ 43" N (27.561984178474383) latitude and 85° 38′ 24" E (85.6426083961117) longitude. It is naturally enriched by Roshi Khola, the major river flowing through the region. Additionally, several smaller streams, such as Dapcha, Khoti, Hele, Shyangu, Dahile, Samanure streams contribute to the local water system [12].

5.2 Connectivity

Bhakundebesi is accessible from Kathmandu via the Arniko Highway to Dhulikhel and then along the BP Highway. The distance between Kathmandu and Bhakundebesi is approximately 46 km, or 49.5 km by road. The BP Highway runs directly through Bhakundebesi, making it a key transit point for vehicles traveling between Banepa, Sindhuli, and

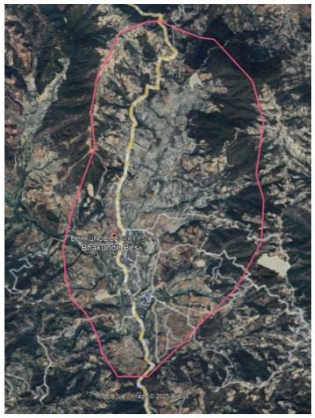

Figure 2: Study area Boundary

Bardibas. Various internal roads connect Bhakundebesi to nearby settlements like Dapcha, Saping, and Bachchhakot. Additionally, Bhakundebesi is 46 km from Tribhuvan International Airport (TIA) and 80 km from Manthali Airport, enhancing regional connectivity.

5.3 Slope and Elevation

The slope of Bhakundebesi is characterized as almost flat to gentle, which makes the area suitable for urbanization and infrastructure development. The elevation of the settlement

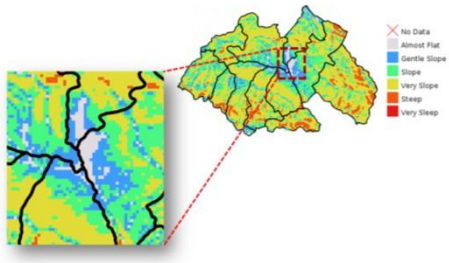

Figure 3: Slope map of Namobuddha municiplaity

ranges between 500 to 1,000 meters, providing a moderate climate and favorable conditions for both agriculture and habitation. The region enjoys distinct seasonal variations, with warm summers, cool winters, and a monsoon season bringing significant rainfall.

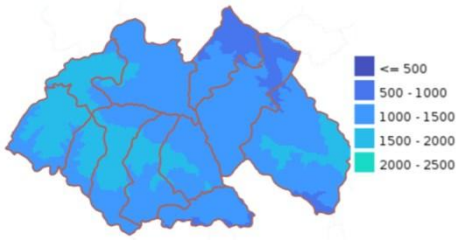

Figure 4: Elevation map of Namobuddha Municipality

6. Findings and Analysis

6.1 Demography

Namobuddha Municipality has experienced an accelerating population decline, with an annual decrease of -0.35% from 2001 to 2011, which steepened to -1.20% from 2011 to 2021. However, Bhakundebesi, primarily in Ward 2 and Ward 7, has grown at 1.2% and 1.4% per year during the same period. The municipality's overall population density is 256 people per square kilometer, while Ward 2 and Ward 7 have significantly higher densities at 311 and 482 people per square kilometer, respectively [13]. Migration has been a key factor, with 59.9% of people relocating within the municipality, 27.6% from other municipalities in the district, and 12.2% from other districts. Bhakundebesi has seen a notable influx from Roshi and Temal municipalities as well as internal migration from other wards. These trends indicate a shift in population concentration, with

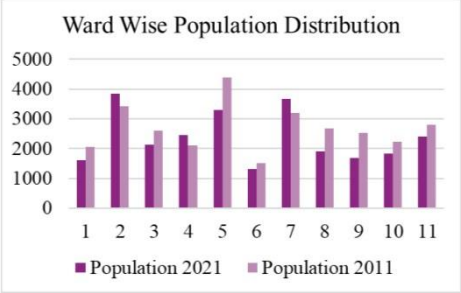

Figure 5: Ward wise population distribution

Bhakundebesi emerging as a growing settlement despite the overall decline of the municipality. Migration has played a crucial role, as people move from surrounding rural areas seeking better economic opportunities in commercial activities, agriculture, and trade. The high population densities in Ward 2 and Ward 7 highlight Bhakundebesi's increasing importance as an economic hub along the BP Highway. The growth of settlement is driven by both inter- and intra-municipal migration, reinforcing its role as a key center of development within Namobuddha Municipality.

6.2 Land Use

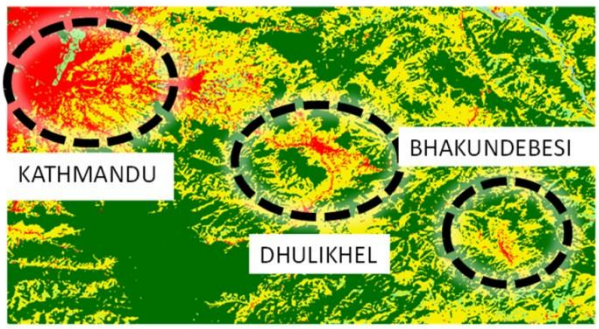

Figure 6: Land Use Map

The development along the BP Highway showcases a clear trend of ribbon development, with Kathmandu acting as the core urban hub influencing surrounding towns like Dhulikhel and Bhakundebesi as shown in figure 6. This development pattern is driven by improved transportation infrastructure,

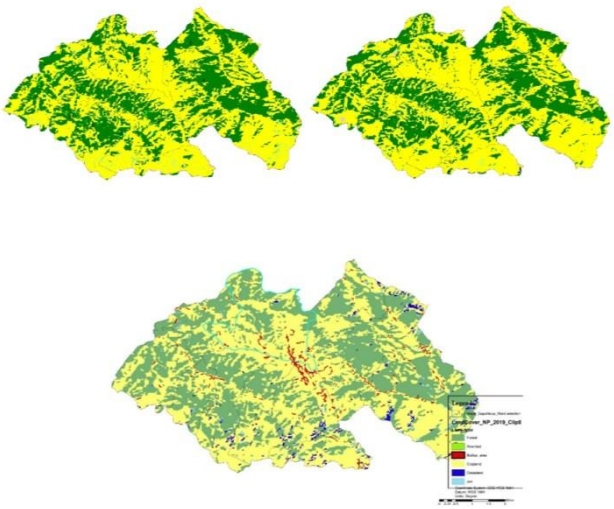

Figure 7: Land Use map of 2000, 2010, 2019

Figure 8: Google Earth image 2010(left) 2024(right)

allowing for the growth of both residential and commercial areas along the highway. Over time, areas adjacent to the highway have evolved from natural landscapes to more urbanized zones, reflecting the spillover effects of Kathmandu's expansion.

Analysis of land use maps from ICIMOD (2000, 2010, 2019) and Google Earth images (2010-2024) highlights a significant transformation. Until 2010, development was minimal, but by 2019, a linear pattern of development emerged along the BP Highway. The expansion intensified through 2024, showing a shift from a strictly linear pattern to more dispersed growth as infrastructure improved and accessibility increased. The data confirm that transportation infrastructure, such as the BP Highway, plays a crucial role in shaping land use and settlement patterns. The road network has spurred concentrated urban growth along the highway, which has spread further inland as internal accessibility improved. The gradual shift from minimal to rapid urbanization clearly demonstrates how road infrastructure can drive land use transformation, fostering the emergence of new urban nodes along transport corridors.

6.2.1 Settlement and Housing

In 2024, Bhakundebesi's built environment comprised 2,885 total structures, with a concentrated development pattern observed along the BP Highway corridor. Notably, 449 buildings (16% of total structures) were located within the immediate 50-meter buffer zone flanking the 5-kilometer highway stretch, demonstrating a clear preference for roadside construction.

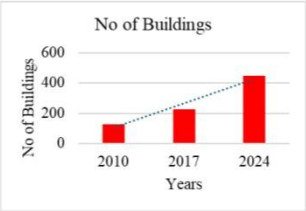

Figure 9: No. of buildings along highway over years

While traditional hilltop settlements have remained largely unchanged, modern construction, especially reinforced cement concrete (RCC) buildings, has transformed the Besi area. These areas, once agricultural, are now becoming urbanized, with commercial and residential buildings replacing traditional homes. The transition is accompanied by a noticeable encroachment on agricultural land, highlighting the urban sprawl driven by better accessibility.

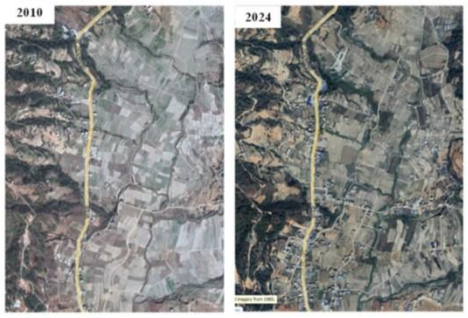

Figure 10: Google Earth image of settlement in hilltops

6.2.2 Land Subdivision

Independent land subdivision in Bhakundebesi has become widespread, with landowners subdividing large parcels into smaller plots for sale without municipal approval. This informal development often bypasses regulations and highlights a gap between rapid urbanization and formal planning.

Figure 11: Land Subdivision

6.2.3 Land Value

During the field survey and interviews with local stakeholders, it was found that land prices in Bhakundebesi have increased significantly, particularly along the BP Highway, between 2010 and 2024. In 2010, land was priced at NPR 1-2 lakh per anna, but following the completion of the highway in 2015, prices have surged to NPR 20-25 lakh per anna by 2024. This increase in land value is directly linked to improved accessibility and a higher demand for development. Interviews with local residents, business owners and site observation revealed a noticeable shift from traditional construction to modern multi-story buildings, reflecting the impact of infrastructure development on housing preferences. Many stakeholders emphasized the growing demand for both residential and commercial spaces along the highway.

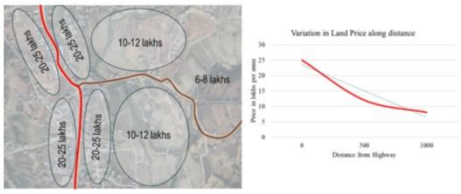

Figure 12: Variation in Land Value

6.3 Commercial Establishment

Bhakundebesi has emerged as a strategic highway stop, featuring hotels, restaurants, and garages catering to travelers. The area also hosts daily goods shops and a thriving commercial agriculture sector supplying regional markets. The traditional style of agriculture has been replace but commercial ones. At time, Bhakundebesi saw five brick industries operate between 2015-2019 before being shut down due to pollution concerns, with one site now being repurposed for plotting.

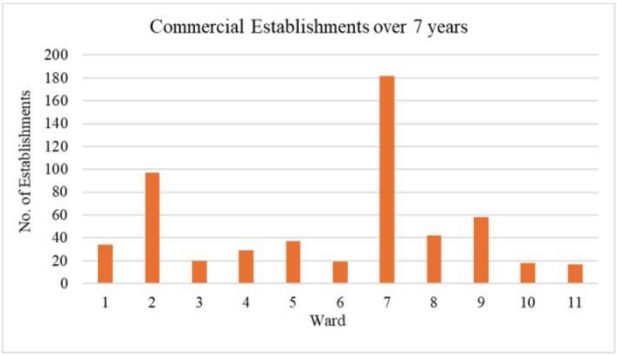

Figure 13: Commercial Establishments

According to the registered data from Namobuddha Municipality, Wards 2 and 7 have experienced the most significant growth in commercial establishments, becoming the primary commercial hubs in the area. These two wards account for 52.08% (277 out of 533) of the total commercial establishments recorded. The high concentration of businesses in these wards is largely due to their direct access to the BP Highway, which has facilitated the growth of both

agriculture-based businesses and new commercial ventures. The data reflects a shift towards greater commercialization, with a noticeable increase in various sectors, including agriculture and hospitality.

The data from Namobuddha Municipality highlights the crucial role of infrastructure in shaping local economic growth. The BP Highway has acted as a catalyst, boosting commercial activity, particularly in Wards 2 and 7. The proximity to the highway has allowed traditional agriculture-based businesses to expand their reach, while also fostering the growth of new commercial establishments, such as hotels and shops. The increase in commercial establishments, particularly in agriculture and hospitality services, demonstrates how improved connectivity has facilitated a more diverse and integrated economy in these wards. The growing trend of commercial development along the highway is a clear indication of the highway's transformative impact on the local economy.

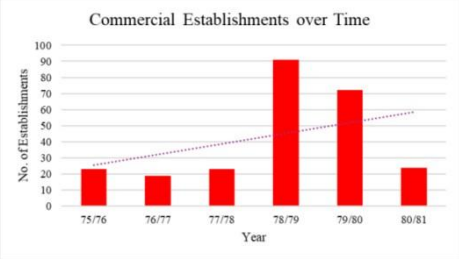

Figure 14: Commercial Establishment Trend

6.4 Infrastructure Development

Over the past decade, Bhakundebesi has made notable strides in infrastructure development, enhancing the quality of life and supporting economic growth. Key developments include:

6.4.1 Findings

Road Infrastructure: According to MTMP, Bhakundebesi has made limited progress in road development. Before 2015, less than 1% of roads were blacktopped, and now approximately 1% are improved. The BP Highway has improved connectivity, but traffic congestion has worsened, particularly near commercial hubs. The increase in commercial activity and vehicle numbers has strained the existing infrastructure.

Healthcare Infrastructure: The establishment of a Provincial Hospital which was the upgradation of the existing district hospital and a private hospital has significantly improved healthcare access [14]. A local resident shared, *"The hospital has improved, making things easier, but for many cases, patients are still referred to Dhulikhel, which is expensive."*

Water Supply and Sanitation: Bhakundebesi has made progress in water supply and sanitation, with piped water access increasing from 60% to 80% between 2011 and 2021, and toilet access rising from 63% to 98% [13]. Despite these improvements, waste management remains an issue, with one local shop owner commenting, *"Public buses operate, but there are no bus stops or public toilets. Passengers often come to my shop looking for a toilet, which I can't provide. If I let them use mine, it gets blocked."* So, challenges remain in wastewater management.

Figure 15: Location of Hospitals

Figure 16: Landfill Site

Most households rely on septic tanks, with sludge transported by tanker, though the disposal site is unknown. The municipality lacks a sewage network or wastewater treatment facility. Waste is collected daily and dumped at a landslide-prone site 600 meters from the BP Highway, where it is compressed and stabilized with gabion walls. Some locals also report waste being dumped along the Roshi Khola.

Electric Vehicle (EV) Charging Stations: The introduction of EV charging stations reflects Bhakundebesi's efforts to promote eco-friendly transportation. However, there is a lack of road infrastructure to manage the growing number of vehicles, which could increse traffic congestion.

6.4.2 Analysis

The infrastructure improvements observed in Bhakundebesi reflect a responsive effort to meet the challenges posed by its expanding population and economic activities. The healthcare sector's growth indicates a commitment to improving public health services, which is essential as migration increases and the demand for healthcare rises. The increase in access to piped water and sanitation services shows a significant shift towards improving living conditions, which is essential for accommodating both the existing population and newcomers. However, despite these advancements, the slow pace of road blacktopping and incomplete waste management strategies underscore the continuing infrastructural gaps that need to be addressed to support the town's rapid growth.

One of the most notable emerging issues is traffic congestion, which has intensified due to the expansion of commercial activities and the increasing number of vehicles on the road. As the town's commercial and residential areas grow, the infrastructure is struggling to keep pace with the rising demand for efficient transportation. This congestion, particularly along major roads and near commercial hubs, is affecting the overall mobility and quality of life in the area. Moreover, despite the introduction of EV charging stations, there is still a significant lack of road infrastructure to manage the increased traffic flow effectively, which may increase the

problem over time.

Additionally, the area's vulnerability to external factors, particularly flooding and climate-related risks, is heightened due to the inadequacy of the drainage systems and waste management infrastructure. The town's exposure to such vulnerabilities could further strain its limited resources and challenge the sustainability of its infrastructure. The increasing urbanization of Bhakundebesi, coupled with these infrastructural gaps, makes it more susceptible to such vulnerabilities, which could compromise the resilience of the growing population and its urban fabric.

In summary, while Bhakundebesi has made significant strides in infrastructure development, the growth has not been entirely proportional to the rapid urbanization. There are still areas requiring attention, especially regarding road infrastructure, waste management, traffic congestion, and the resilience of utilities against external vulnerabilities. Future development efforts should focus on addressing these gaps to ensure long-term sustainability and enhance the town's capacity to withstand environmental challenges.

7. Conclusion

Bhakundebesi's evolution along the BP Highway encapsulates both the promise and perils of infrastructure-led development in Nepal. While the highway has spurred economic growth and urbanization, it has also revealed the consequences of unplanned expansion—ecological pressures, and governance shortcomings. The town's trajectory mirrors global patterns of transport-driven development, yet its local context introduces unique complexities: the tension between traditional agrarian livelihoods and modern urban sprawl, the rise of informal land markets, and the strain on basic infrastructure.

This case study advances scholarly understanding by bridging theoretical frameworks of highway urbanization with empirical evidence from Nepal, particularly highlighting the on-the-ground realities. For planners, Bhakundebesi offers critical insights into managing growth in similar highway towns across Nepal—emphasizing the need for integrated approaches that synchronize infrastructure with land-use planning, environmental safeguards, and institutional capacity-building.

Without urgent interventions, Bhakundebesi risks becoming a textbook example of unsustainable sprawl, characterized by resource depletion, social fragmentation, and climate vulnerability. Yet, its strategic location and economic potential also position it as a testbed for innovative urban models—ones that harmonize highway accessibility with green corridors, mixed-use zoning, and resilient infrastructure. By bridging policy gaps, fostering multi-stakeholder collaboration, and prioritizing sustainability, Bhakundebesi can evolve into a beacon of balanced development, demonstrating how emerging towns can thrive without sacrificing their ecological and social fabric. Ultimately, the lessons from Bhakundebesi are not just local but universal, offering insights into the challenges and opportunities of 21st-century urbanization in an era of climate crises and infrastructural ambition.

8. Recommendation

To ensure sustainable urban development in Bhakundebesi, it is recommended to implement effective land use planning through a multi-hazard risk assessment for landslides, floods, and earthquakes, leading to the preparation of a Risk ans Inclusion Sensitive Land Use Plan (RISLUP) that designates zones based on risk levels. Establishing ecological buffers along the river and highway will prevent encroachment while protecting natural resources and agricultural land. Infrastructure upgrades should prioritize blacktopping secondary roads, improving water supply and sewage systems, and developing organized public transport facilities such as bus parks and parking areas to reduce congestion. Economic diversification should be promoted by supporting agro-based industries like dairy cooperatives and hydroponic farming, setting up Krishi-Upaj Plazas near the highway for direct farmer sales, and establishing a Freight Consolidation Center to enhance market access. Additionally, proper zoning for brick kilns will balance economic activity with environmental protection. These measures will foster Bhakundebesi's growth as a well-managed, economically vibrant, and environmentally sustainable urban center.

Future Studies This study opens several avenues for future research on highway-induced urbanization in Nepal. Scholars could extend this work through comparative analyses of other BP Highway settlements to identify regional urbanization patterns. Longitudinal studies tracking migration trends, livelihood changes, and environmental impacts over time would provide valuable insights into the long-term consequences of such transformation.

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APPENDIX B: PLAGARISM CHECK REPORT

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