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PULCHOWK CAMPUS

A THESIS REPORT ON

**STUDY OF LAND USE CHANGE IN THE BUFFER ZONE OF PROTECTED
AREAS: A CASE OF SHIVAPURI NAGARJUN NATIONAL PARK, KATHMANDU
VALLEY**

BY

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DECLARATION

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ABSTRACT

This study was aimed at understanding the land use change in the buffer zone of Shivapuri Nagarjun National Park. Temporal GIS data sets of landuse which covered the time frame between 1980 and 2020 were used. Sample household survey, review of documents and interrogation with the governing bodies was carried out to understand the drivers of land use changes and other secondary information needed. Data analysis was accomplished through the integrated use of ArcGIS software package and Microsoft Excel.

Analysis of land use change revealed the huge increment in built-up area with the depletion of cultivable land in the buffer zone. However, the coverage of forest in the buffer zone has not depleted to a great deal. Major driver of such change included influx of population due to availability of road and drinking water, proximity to workplace, education and health facilities. The existing policies on conservation of Protected Areas have been quite efficient in achieving the goal of conservation of forest cover in the buffer zone.

ACRONYMS

CBS	Central Bureau of Statistics
CDRMP	Climate and Disaster Risk Management Program
DNPWC	Department of National Parks and Wildlife Reserves
DUDBC	Department of Urban Development and Building Construction
FAO	Food and Agriculture Organization
FY	Fiscal Year
GIS	Geographical Information System
Ha	Hectares
IPCC	Intergovernmental Panel on Climate Change
	International Union for Conservation of Nature and Natural
IUCN	Resources
IUDP	Integrated Urban Development Plan
KII	Key Informant Interrogation
KV	Kathmandu Valley
LULC	Landuse Landcover
NGO	Non-Governmental Organization
NPWC	National Park and Wildlife Conservation
NTNC	National Trust for Nature Conservation
PA	Protected Area
SNNP	Shivapuri Nagarjun National Park
Sq. Km	Square Kilometer
UC	Users' Committee
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organizations
VDC	Village Development Committee
WRI	World Resources Institute
WWF	World Wildlife Fund

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CHAPTER 1 INTRODUCTION

1.1 Background

Kathmandu Valley serves as the country's core and capital. The valley consists of three districts: Kathmandu, Lalitpur, and Bhaktapur, occupying total area of 899 square kilometers. The valley's contemporary growth began in the 1950s, after it was opened to the outside world in 1951 (Tiwari, 1999). The greatest rapid migration in the Kathmandu valley occurred during the decade of political unrest that began in 1996 with the Maoists' armed movement. The armed movement in the country's rural areas prompted a mass migration of people into the Kathmandu valley in search of safety and livelihood. During the last decade, conflict caused rise in migrant population accounting to 42 % of the total population of the valley. Aside from conflict, the valley has seen a significant increase in population due to the construction of facilities like as health care, transportation, telecommunications, and other infrastructure. The Kathmandu Valley has experienced rapid population and urbanization, and is Nepal's most urbanized metropolis. Kathmandu's primate nature, as well as the valley's political, administrative, and economic importance, continue to attract more migrants, and it now houses more than three million people in its eighteen municipalities. Between 1952 and 1954, 47.4 percent of the total Kathmandu valley population lived in urban areas, rising to 60.5 percent in 2001 and as of now the whole population of valley is urban (Sharma, 2003). The influx of population needed more land for settlement development and hence caused rapid expansion of urban area in the valley.

An spatiotemporal analysis of population growth and land conversion using satellite data has revealed that the urban area expanded by more than 400% between 1989 and 2016, with 31% of agricultural area converted into built area accounting for the majority of this growth. (Ishtiaque et al., 2017). Between 1989 and 2009, most of this growth took place (Anish et al., 2013). The growth is expanding towards the northern foothills of the valley bounded by the Shivapuri Nagarjun National Park. The effect of spillover population from the core area has caused transformation of the fertile agriculture lands lying in the northern part to low density and sprawling built up area (Koirala, 2018). In search of cheaper land, the informal land developers have been moving further to the steeper land lying in the buffer zone of the Shivapuri Nagarjun National Park.

In recent times, the steep slope lands within the buffer zones have been undergoing radical change as a result of haphazard cutting of slopes. This trend is most visible in the recent satellite images of Tarakeshwor, Tokha and Budhanilkantha municipalities. Although, specific acts, regulations and directives govern buffer zones of the protected areas, development pressure from adjoining land and human interventions have posed severe risks in the buffer zones. In simple terms, buffer zones are the area outside the parks, designated to protect the park (Prins & Wind, 1993). These were planned firstly as conservation approach along with their development component as a means to achieve conservation goal. However, many buffer zone definitions make specific references to development. A most widely

cited definition of buffer zone is “a zone, peripheral to a national park or equivalent reserve, where restrictions placed upon resource use or special development measures are undertaken to enhance the conservation value of the area” (Sayer, 1991).

There are currently a number of voices from the public concerned about current and proposed development projects near sensitive natural areas, such as the varying scale land developments on going in the buffer zone of Shivapuri Nagarjun National Park in Jitpurfedi, Kavresthali, Sangla, Narayanthan and Gokarneshwor.

It is difficult to justify whether development near the protected areas will impair the ecological and scenic values of these lands in the long run, even with improved management support. Nonetheless, prevention is always better than cure, and in light of land scarcity and development pressure for housing, community facilities, and infrastructure, it is critical to increase the protection of protected areas from urban development consequences.

1.2 Significance of Research

The governments, policymakers, and civil society have faced major challenges in ensuring the sustainable development of the Kathmandu Valley due to substantial increase in population. The haphazard expansion of cities poses insurmountable challenges in terms of preserving the ecological and scenic values of the protected areas. Despite the identification of development pressures on protected areas and the establishment of buffer zones by protected area authorities, their efficiency in managing development in buffer zones may be called into doubt. Lands near protected areas should be carefully designed since land use zoning directly affects the activities of a particular land and, as a result, the level and type of negative externalities that may be generated. The research attempts to examine the protection of protected areas from development threats from adjoining land.

1.3 Problem Statement

Due to haphazard growth in Kathmandu from which spillover population has gone to the neighboring municipality which caused urban sprawl as the major problem of the valley. Areas inside the ring road transformed into built up during the decade of 2001 to 2011. With increase in land price in the core, urbanization in the valley shifted outwards (Koirala, 2018). Mostly development of sprawl is in the north east and north west side. The newly developed areas were connected to the central areas with the development of road networks and transportation facilities. Landscapes closer to the road network benefited from improved connectivity, leading in the conversion of other landscapes to built-up areas. With future road improvement, more built-up areas are anticipated to be created along the road (Tannier et al., 2012). Hence, more built-up areas are being developed in those new areas. This has attracted the private and informal land developers towards these areas. Such new areas in the northern part of valley mostly lie in the buffer zone of Shivapuri Nagarjun National Park (SNNP).

The satellite image below shows several patches of informal land developments ongoing in the buffer zone of the National Park. The buffer zone regulations only allow development of the private land with minimal or no effect to the surrounding environment. Such patches of land development have been increased with time and hence interventions from the SNNP authorities and local government are required to minimize the detrimental effects. So, in order to slow the city's development toward these buffer zones, it is vital to make local government and affiliated agencies aware of these facts, examine them, and provide appropriate answers. As a result, this research could be valuable to the local administration and National Park authorities to make amendments in the legislations.

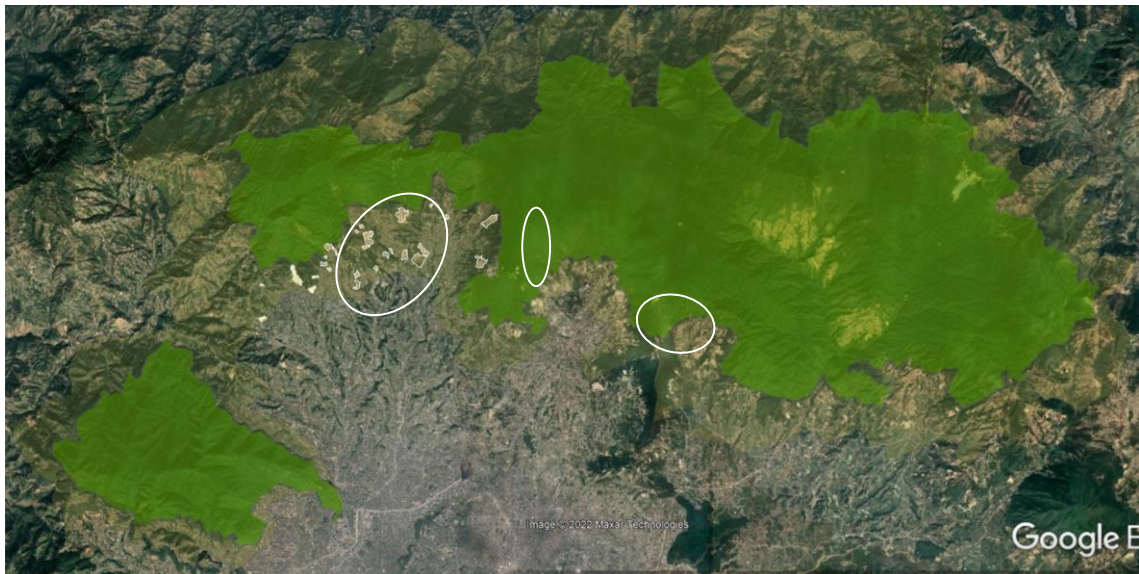


Figure 1: Google Earth Image of SNNP and its buffer area with informal land development (white bounded patches)

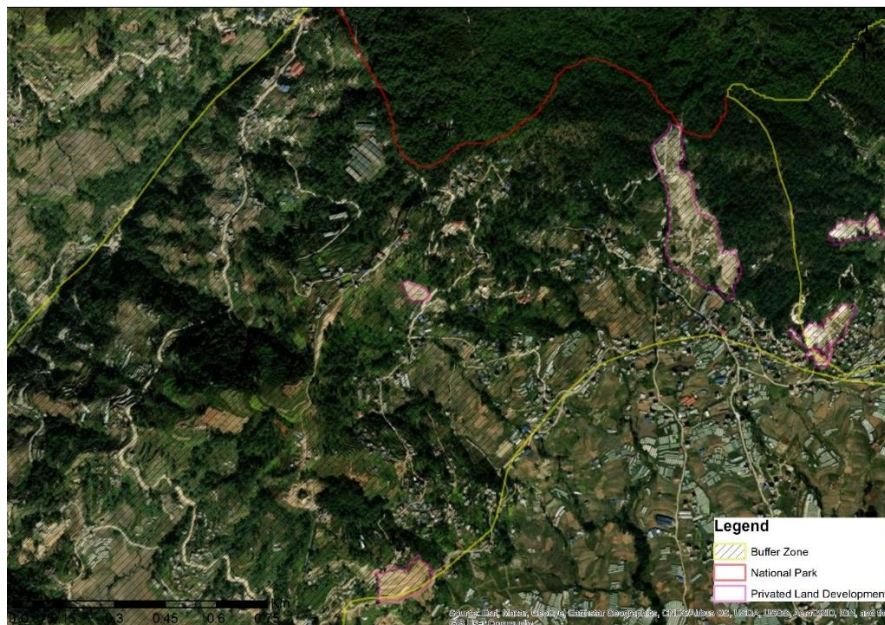


Figure 2: Informal Land Development in Jitpurfedi of Tarakeshwor Municipality

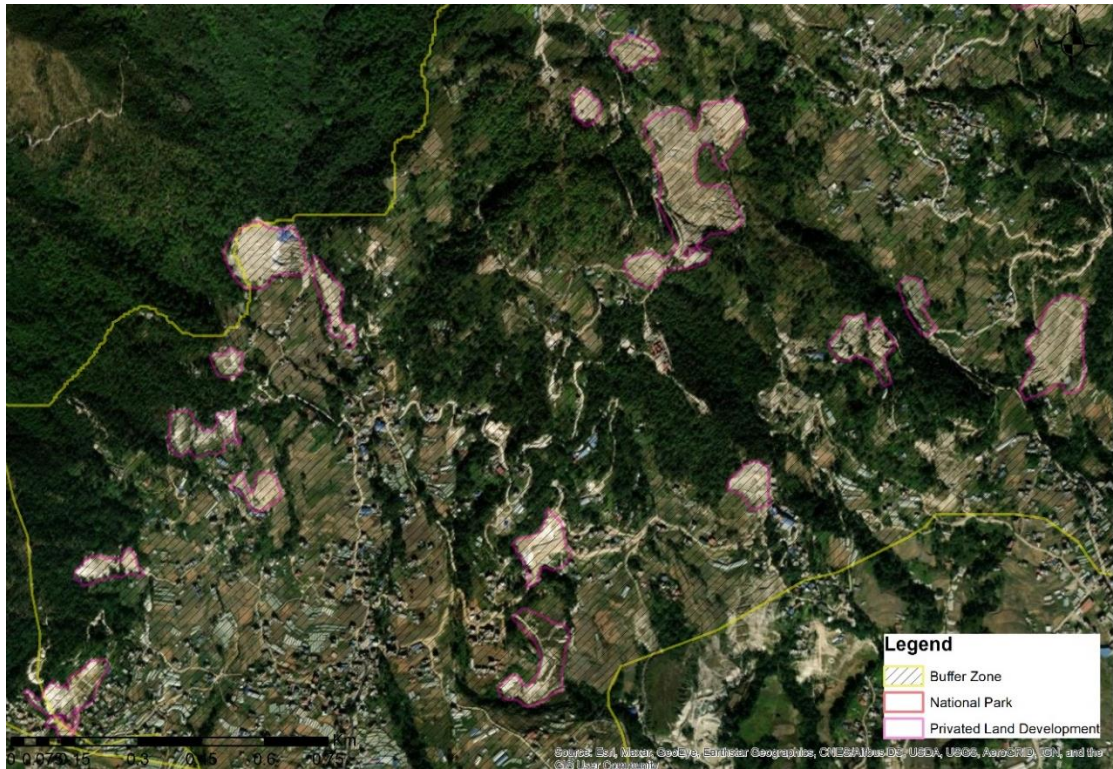


Figure 3: Informal Land Development in Kavresthali of Tarakeshwor Municipality

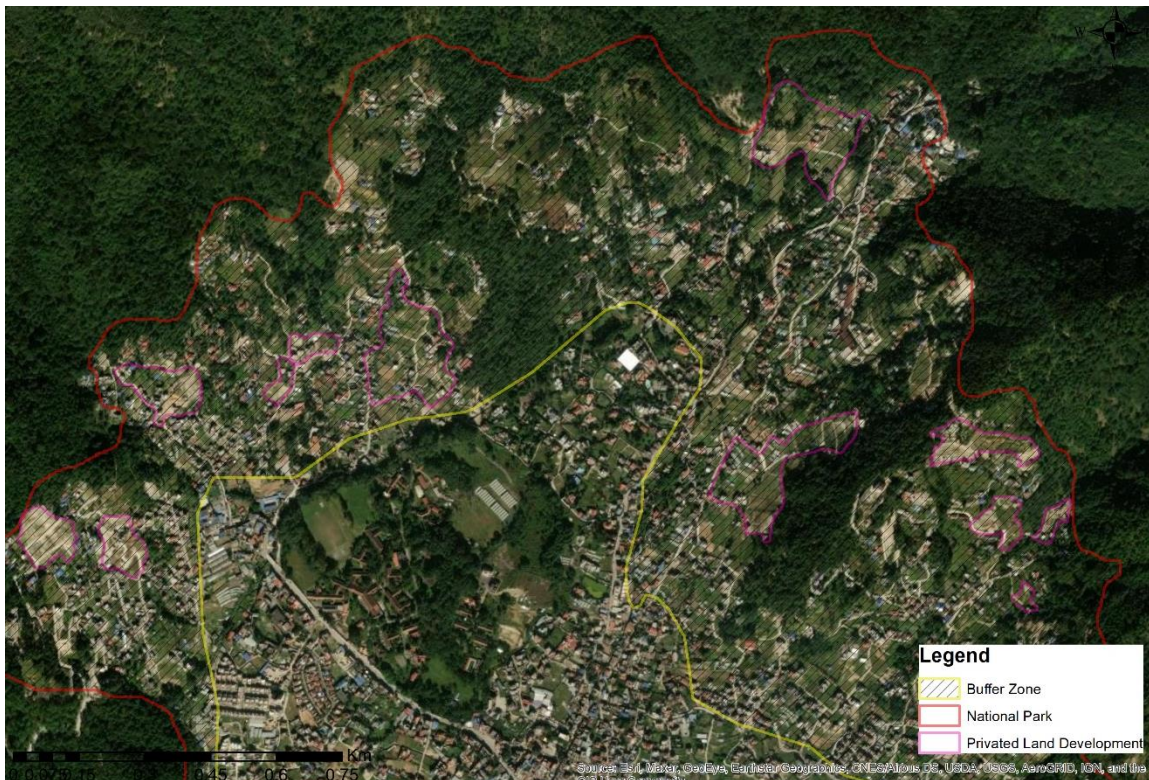


Figure 4: Informal Land Development in Narayanthan of Budhanilkantha Municipality

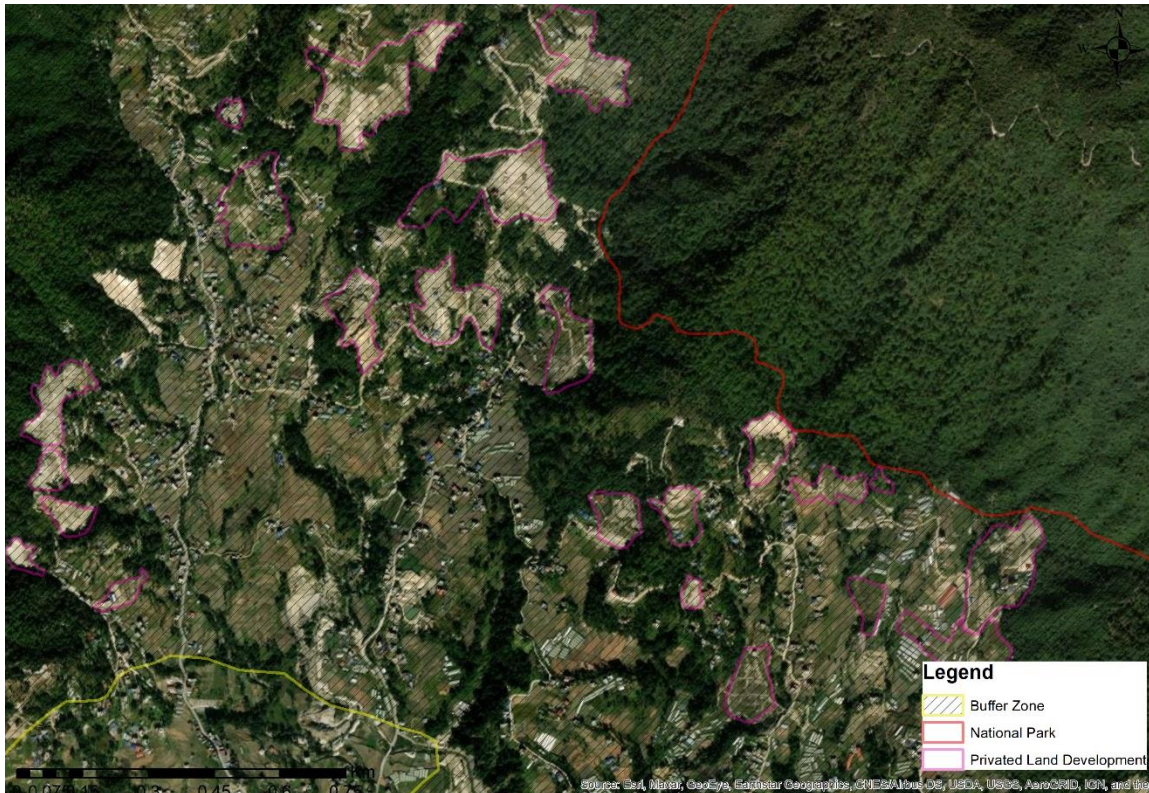


Figure 5: Informal Land Development in Gokarneshwor Municipality

1.4 Statement of Purpose

Objectives

- *The study aims to assess the landuse change in the buffer zone of SNNP and to identify the drivers of land use changes.*

And the research questions are as follows:

- Have the legal provisions of conservation been successful in regularizing landuse (intended) in the buffer zone?
- To what extent land use in the buffer zone has been regularized?
- What measures can be taken to regularize the intended land use in the buffer zone?

1.5 Scope and Limitations of Study

The study area was limited to the boundary of Buffer Zone of SNNP within Kathmandu Valley. The information was gathered only on land uses and their spatial changes since 1980 till 2020. Also, since the buffer zone of SNNP covers very large area, detailed study on the drivers of landuse changes was limited to the area of buffer zone lying in three municipalities viz; Tarakeshwor Municipality, Budhanilkantha Municipality and Gokarneshwor Municipality. Primary data collection was also limited to the aforementioned areas.

CHAPTER 2 CONCEPTUAL FRAMEWORK AND METHODOLOGY

2.1 Research Methodology

Paradigm is a loose collection of logically connected assumptions, ideas, or propositions that serves thinking and research (Mackenzie & Knipe, 2006). Some mostly talked about research paradigms are discussed to select the most appropriate paradigm for this research i.e., positivist, and post positivist, constructivist, interpretivist, transformative and pragmatist paradigm. Selection of paradigm for this research is done with 'selection by rejection' principle.

Positivism is referred to as 'scientific method' or 'science research' and is "based on the rationalistic philosophy (Mackenzie & Knipe, 2006). In positivism, there is an objective relation between researcher and the research and the knowledge produced are of nomothetic nature.

Interpretivist /constructivist approaches to research have the intent to understand the world of human experiences (Mackenzie & Knipe, 2006) suggesting that "reality is socially constructed". The interpretivist/constructivist researcher tends to rely upon participants' views of the situation being studied"(Mackenzie & Knipe, 2006) and recognizes the impact of the background and experiences of the people on the research in a subjective manner. The research objective needs the active interaction with the concerned stakeholders viz; SNNP authorities, respective municipalities authorities and the local residents to analyze the drivers and impact of fringe development on the SNNP. The knowledge and views of these stakeholders will be socially constructed and the research deals with multiple realities, interpretivist paradigm is adopted.

According to transformative researchers, research must be entwined with politics, have a political agenda, and include an action agenda (Mackenzie & Knipe, 2006). This paradigm tries to reform the lives of the participants, the institutions in which individuals work or live, and the researcher's life (Mackenzie & Knipe, 2006).

The ontology of the research demands a clear understanding of the situation. Such an understanding needs valid source of knowledge (epistemology) of existing situation. Ontology, which examines the nature of reality, is referred to as "the science or study of being." An ontology is a set of beliefs that expresses a person's perception of what constitutes a fact. Ontology, put simply, is concerned with the fundamental issue of whether social entities should be viewed as objective or subjective. The ontological claim for the research is in order to conserve the buffer zone, assessment of landuse change is necessary.

As a branch of philosophy, epistemology is concerned with the sources of knowledge. Epistemology, in particular, is concerned with the possibilities, nature, sources, and limitations of knowledge in a field of study. Alternatively, epistemology can be defined as the study of the criteria used by researchers to

classify what constitutes and does not constitute knowledge. The valid source of knowledge for landuse changes will be the analysis of temporal satellite images of the buffer zones. The drivers of landuse changes will be obtained from on-site observations, interviews with stakeholders, questionnaire surveys and interpretation of secondary data and documents (Acts, Policies, Rules, etc.).

2.2 Analytical Framework and Methods

The study begins with the literature reviewing on conservation, urbanization and buffer zone planning in order to understand their interrelationship. Several existing acts, policies, regulations, working policies related to conservation are reviewed. A parallel analysis is done to quantify the land use changes in the buffer zone in the GIS platform from the data obtained from secondary source. After that, detailed case studies are also conducted to investigate the causes of changes in the adjacent land use of the national park buffer zone in order to evaluate whether the existing legislations have been effective to maintain the intended land use in the buffer zone.

While at the end of the study, suggestions for improving the current conservation legislations of the buffer zone will be drawn.

2.2.1. Literature Review

A literature review is a critical analysis of a portion of a published body of knowledge that includes summarizing, categorizing, and comparing prior research studies, reviewing literature, and writing theoretical articles. Initial works of any research for literature review will be collection of relevant literature, which will help to understand basic concept of that research. For this research major sources of literature were extracted from internet, municipal document, acts, policies, guidelines relating to the operation and management of Protected Areas and their buffer zones, book published by different government agencies. The published and unpublished documents from these bodies was studied. Different research paper published in similar subject in similar context was also reviewed. Credible source was entertained for literature review and were verified by triangulation method.

2.2.2. Data Collection

Both primary and secondary data were collected for the purpose of study. Secondary data and information required for the study such as legal provisions (Acts, Policies, Regulations, Directives, Guidelines, etc.) were collected from the internet and websites of respective offices. Previous studies, journals, articles and papers The GIS data of landuse of Kathmandu Valley of different time periods were obtained from previous study on Urban Growth of Kathmandu Valley by UNDP under Comprehensive Disaster Risk Management Program and IUDP of 14 municipalities project (Package 11) of DUDBC. GIS data on administrative boundaries of municipalities were retrieved from

Department of Survey and the boundaries of SNNP, buffer zone and its users' committee jurisdictions were obtained from map published by DNPWC.

Primary data on the drivers of landuse changes was collected through questionnaire survey of the households and Key Informants Interrogation. Since, the buffer zone covers large area inside Kathmandu Valley, the study area was limited to 3 municipalities lying in the buffer zone for sample household survey. The three municipalities were selected on the basis of their current trend of development and availability of services and facilities. Both structured and unstructured questionnaire was prepared with open and close ended questions for sample household survey and Key Informants Interrogations. Key Informants were identified on the basis of study of literatures which included the governing institutions (who prepare acts, policies viz. DNPWC), the implementing agencies (SNNP Office) and the beneficiaries (Users' Committee, Buffer Zone Management Committee). Similarly, for the potential impact and evaluation of effectiveness of existing legislations, KII method will be used. The potential key informants will be officials from DNPWC, SNNP, Users' Committee of SNNP Buffer Zone, respective municipality.

The total households in the study area for sample household survey were as shown in the table below. Hence for each users' committee, the number of samples was calculated using Slovin's formula with 7% margin of error which resulted the sample size as shown in the table below. However, due to limitation of time the survey samples were limited to as shown in the table.

Table 1: Population and households within Users' Committee (Source:(SNNP, 2017))

SN	Users' Committee Name	Population	Total HH	Calculated Sample Size	Surveyed Samples	Remarks
1	Goldhunga Jitpur	6,860	1,698	117	30	Surveyed Jitpur Area only
2	Bishnu Chapali	2,552	626	105	61	
3	Sundarijal Shivapuri	4,869	1,229	114	111	
	Total	14,281	3,554	336	202	

2.2.3. Data Analysis

The analysis will begin with map research in order to achieve the primary objective. In the study, the pattern of land use change in the buffer zone over time due to urban expansion of city core was examined. Through interviews with protected areas related entities and local government officials, this study was verified and data were added. The data on landuse change is quantified in GIS platform and analyzed in MS-Excel. In order to investigate the drivers of such changes, on site observations along with interviews and questionnaire survey was be used. Data of household sample survey is also analyzed in MS-Excel.

CHAPTER 3 LITERATURE REVIEW

3.1 Definition of Terms

Buffer Zone

The word buffer has been used in different contexts from environmental to military (Kozłowski & Peterson, 2018). Hence, there are many definitions of buffer zone. In this report, buffer zones mainly refer to the areas outlying to protected area, where restrictions are placed on use of resources and special development measures need to be undertaken in order to enhance the conservation value of the protected area. As defined by (Kozłowski & Peterson, 2018) buffer zone is a useful planning mean to “conserve the values of protected areas and other remnant habitats and aquatic ecosystem”. This is a designed and additional land layer which usually encompasses PAs to protect the high environmental value of the core area through mitigating impacts originated from the surrounding landscape, such as noise pollution, fire and development (Kozłowski & Peterson, 2018). The buffer's development should be strictly regulated (Lynagh & Urich, 2002). However, this layer also offers chances for a variety of low-disturbance uses to promote socioeconomic development along natural limits (Lynagh & Urich, 2002).

Conservation

It is defined as the efficient use of resources to achieve the highest level of quality, and it includes both use and protection. It is rather different from preservation which seeks protection of nature from use.

Protected Area

A clearly defined geographical space, recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (Dudley & Stolton, 2008).

Land use and Landcover

Land use refers to the purpose that land is utilized while land cover is the combination of biological and physical condition of land.

Urbanization

This is a multifaceted procedure. It entails people migrating from rural to urban areas, the expansion of urban centers due to natural population growth, and the extension of their boundaries.

National Park

An area designated for the conservation, management, and use of flora, fauna, and scenery, as well as the natural environment.

3.2 Protected Areas

Generally, protected areas (PA) are the area allocated by the government for a level of protection of ecosystems, biological process and species. PAs like national parks, wildlife reserves, and conservation

areas are now among the most crucial ways to preserve biological diversity on a global scale. Protected areas not only enhance biodiversity and provide ecological services, but they can also generate job and economic opportunities. The International Union for Conservation of Nature and Natural Resources (IUCN) definition of Protected Area is as follows: “An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.” This definition incorporates all the requirements for declaration of Protected Area. A Protected Area should have definite boundaries, formally recognized in civil law as being dedicated to conservation, incorporating conservation activities; from strict nature protection through sustainable use of resources, consisting different variety of life, consisting the elements of natural and cultural heritage organized to achieve protection and maintenance goals. The classification of protected areas as per IUCN is as shown in the figure below:

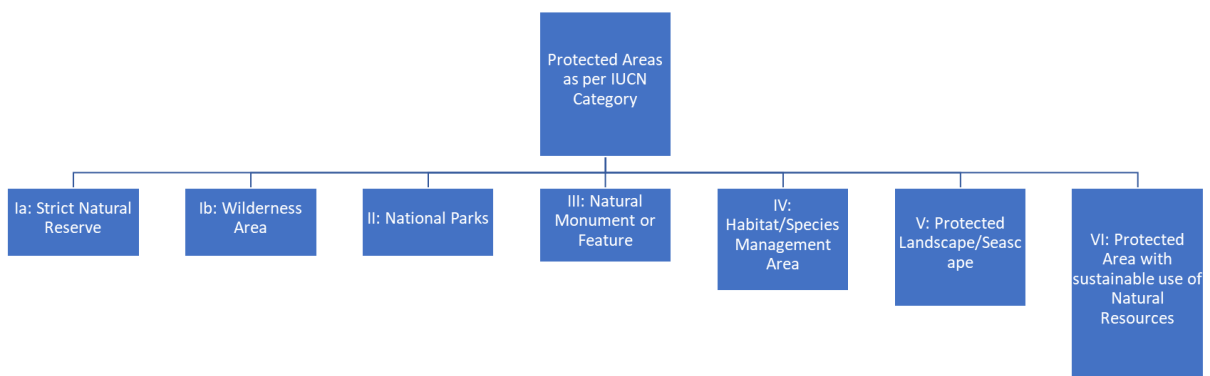


Figure 6: IUCN Classification of Protected Areas

Category Ia (Strict Natural Reserve): A region of land or water with notable or representative ecological, geological, physiological, or biological characteristics that is principally used for environmental monitoring or scientific research.

Category Ib (Wilderness Area): A vast region of land or water that has not been altered much or at all, has retained its natural character and influence, is not permanently home to many people, and is protected and managed to keep it that way.

Category II (National Parks): Natural area of land and/or sea, designated to: (a) safeguard the ecological integrity of one or more ecosystems for future generations; (b) prohibit exploitation or occupation incompatible with the purposes of designation; and (c) serve as a foundation for spiritual, scientific, educational, recreational, and visitor opportunities, all of which must be environmentally and culturally compatible.

Category III (Natural Monument/ Feature): Areas are comparatively small sites that concentrate on a single stand-out natural feature and the ecology that surrounds it, as opposed to a larger ecosystem.

Category IV (Habitat /Species Management Area): Natural area that concentrate on conservation and survival of one or more species of nationally/locally important flora; one or more species of resident or migrating fauna and or their habitats.

Category V (Protected Landscape/ Seascape): A protected region that has great ecological, biological, cultural, and scenic value as a result of long-term interactions between humans and nature. To safeguard and sustain the area, it is essential to preserve the integrity of this relationship.

Category VI (Managed Resource Protected Area): Protected area managed mainly for the sustainable use of natural ecosystems.

Nepal has a rather broad network of protected areas that cover 23.39 percent of its total land area, or 34,419 km², in light of the expanding significance of the PA system globally. This consists of thirteen buffer zones, six conservation areas, one hunting reserve, and twelve national parks. Degradation of habitats, wildlife crime, human encroachment, and human-animal conflict are the main obstacles to managing protected areas. The National Parks and Wildlife Conservation Act 2029 of Nepal uses six different designations. They are Buffer Zone, Strict Nature Reserve, National Park, Wildlife Reserve, Hunting Reserve and Conservation Area. Nepal's protected areas are classified as Category II National Parks, Category IV Wildlife Reserves, Category VI Conservation Areas, Buffer Zones, and Hunting Reserves by the IUCN.

Table 2: Nepal Protected Area Categories (Source: (DNPWC, 2020)

IUCN Category	Nepal's PA	Area (Km²)	Percentage
Category II	National Parks	11,806.02	34.30%
Category IV	Wildlife Reserves	175.00	0.51%
Category VI	Hunting Reserves, Conservation Areas and Buffer Zones	22,438.73	65.19%
Total		34,419.75	

3.3 Buffer Zone

The significance of buffer zones for protected areas has grown in response to the enormous population size, rising consumption rate, and rapid urbanization because these protective zones can serve as useful planning tools for biodiversity conservation, eco-management, and land use regulation for the natural area (UNEP; WRI; IUCN, 1992).

Buffering strategies for natural areas were developed in the 1940s in order to conserve the habitat of waterfowl in the United States (Hilditch, 1992). Since the 1950s, they have spread to Africa and Asia (Sayer, 1991). However, the phrase "buffer zone" didn't become widely known until Man and the Biosphere (MAB) program, a biosphere reserve model, was introduced in 1971 by the United Nations Educational, Scientific and Cultural Organization (UNESCO) (Kozłowski & Peterson, 2018);(Lynagh & Ulrich, 2002). This initiative is particularly significant since it connected protected area conservation with development and established the significance of buffer zones for the preservation of biodiversity (Kozłowski & Peterson, 2018);(Lynagh & Ulrich, 2002).

The Fourth World Congress on National Parks and Protected Areas in 1982 stressed the significance of buffer zones even more since they can connect the traditional isolation practice of conservation planning and development planning (IUCN, 1992) which can alter the pressures from the inappropriate land use perimeter to the protected areas (Jorgensen, 2009). As time passed, there are voices arguing for the expansion of the scale that the buffer zone should serve—not just for a single core habitat, but also to its surroundings landscape and seascape (UNEP; WRI; IUCN, 1992). Such an expansion could aid in the creation of comprehensive protected area design and management as it helps to preserve breeding sites, dispersal or travel routes that are especially beneficial in maintaining genetic diversity, and locations that are necessary for specific activities in accordance with the life histories of particular species. By increasing coverage, one may preserve the connectedness and integrity of the ecosystem and prevent the edge effect from deteriorating the high-quality habitat (Ficetola et al., 2009).

Buffer zones can be used as a location for people to learn about and participate in nature conservation, even if its primary goal is to lessen the effects of external threats on sensitive natural regions. Education, tourism, and research are low-disturbance activities that should be permitted. According to the buffer, with appropriate zone management, development and conservation may be accomplished, which would be advantageous for the long-term preservation of the sensitive natural regions (Lynagh & Urich, 2002).

3.4 Buffer Zone Planning Approaches

Buffer zones are relatively new planning and landscape management concept. Several approaches to buffer zone planning have emerged. The design and width of the buffer zone should determine the type of ecological function (sensitive area or biodiversity) to be protected. Similarly, it determines the delineation and content of buffer zone. However, the ecological function to be protected could be more than one in most of the cases, so prioritization based on the importance of ecological function is necessary to decide whether or not a buffer zone should be implemented. The prioritization process should be based on scientific data and analysis. Two types of buffer zones are introduced in this study described as under:

3.4.1 Separation Zone

This zone is most commonly used in planning regulation to separate conflicting land uses and particularly does not apply in protection of protected areas. It is mostly chosen surrounding the source area where there is greater possibility to cause negative impact. The width of this zone is used to determine the negative impact of the source on adjacent land (Kozłowski & Peterson, 2018). The green belt is one of the most well-known zones for separating urban rural land uses.

Green Belt was introduced by Ebenezer Howard at the end of nineteenth century in his Garden City concept. Garden cities by its name is clear that it means cities within gardens. Howard conceptualized urban areas to grow continuously in the open rural lands rather the expansion of original city boundary. However, there exists Green Belt as a zone separating the rural and urban lands. The concept of Green

Belt was adopted in UK since 1955 AD. This belt was defined as the strip separating the new developments from historic towns where construction of new buildings was restricted. The main purpose of green belts were to prevent the urban sprawl of London, prevent the coalescence of settlements and preserving the open areas between the settlements (Crestwood Environmental Ltd., 2018). Under the Planning Policy Guideline, green belts also have specific objectives of securing nature conservation interest (Crestwood Environmental Ltd., 2018).

3.4.2 Buffer Zones for Environment Sensitive Areas

There are several buffer zones design methods under this category described as under:

a. Wildlife Specific Buffer

These buffers are recommended for the protection of specific species and their habitat. The main objective of this buffer is to reduce the interference from outside the protected area so as to separate the conflicted landuse from the core of protected area. However, for effective implementation of such buffer, regular monitoring about habitat and lifecycle of the species is required (Kozłowski & Peterson, 2018).

b. Buffer Zone Planning (BZP) Method

The buffer zone method is an analytical technique for determining how green areas in urban buffer zones should be used in a balanced manner and how deficiencies should be addressed. It does not involve community participation in planning of buffer zone. The following seven steps are involved in design of buffer zone using this method:

Table 3: Steps of Buffer Zone Planning Procedure (Source: (Kozłowski & Peterson, 2018))

Step	Process
1	Identification of particular values and characteristic features of the given area under protection.
2	Identification of interrelations between the area and its surrounding to determine existing and potential threats.
3	Preliminary formulation of the criteria for demarcating and defining the principles of land use within analytical protection zones (APZ) ¹ to protect particular values.
4	A synthesis of the criteria and principles on the basis of the type of negative influence to determine elementary protection zones (EPZ) ² .
5	Demarcation of elementary protection zones (EPZs) and the definition of the principles of land use within their boundaries.

¹ APZ is a zone which shows the extent of external threats to the protected areas to a specific elements or feature.

² EPZ is a zone blended from APZs of particular threat to the protected area with methods and principles suggested for minimizing or eliminating the threat.

Step	Process
6	Delineation of buffer zone surrounding the area based on a synthesis of the EPZs identified in previous step.
7	Formulation of guidelines or principles concerning different forms of use and activities within the buffer zone and introduction of these principles into development plans, which becomes legally binding after the plan's formal approval.

It is a scientific method which has been adopted for conservation of wetlands, habitats in several countries. However, implementation of such buffer without considering the geography and relationship of protected area with its surrounding will be in vain. Also, this method being a top-down approach, without community participation the sustainability of the buffer could be in doubt.

c. Biosphere Reserve

The model is one in which core reserves are surrounded by a series of nested buffer zones, with increased distance from the core allowing for more intensive human uses. Under this model, destructive human intervention is not allowed in the core protection area and buffer zones become the protecting layer of the core which ensures the compatibility of land use with conservation. Participation of local communities and interested stakeholders in planning and management is ensured in this model. Hence, regulations for the conservation of core area of protected area could be achieved and could be acceptable as it involves participation of local community.



Figure 7: Biosphere Reserve Model (Source: <https://en.unesco.org/biosphere/>)

3.4.3 Buffer Zone in Nepal

In 1984, DNPWC suggested the idea of buffer zones for Nepal's protected regions. In the buffer zone concept, area around 2km radius of the park could benefit from park revenue (30-50%) in exchange for the community participating and assisting in park management activities. After the National Parks and Wildlife Conservation Act of 1973's fourth amendment was passed in 1992, the notion was given a clear legal boost and the Buffer Zone Area Management Regulation and Guideline were published. Buffer Zone Management Regulation, 1996 has provided provisions for user committees, forest development, community development, and buffer zone management plans; this has shown the strategy of incorporating locals in buffer zone management. Through community development, the Regulation has attempted to address the issues of those whose way of life is negatively impacted by the parks and reserves. This marked a significant shift in government policy from one that prioritized protecting wildlife to one that put the needs of the community first. In this regard, Nepal is one of the first nations to put the buffer zone idea into practice, fusing conservation objectives with local needs (Rayamajhi, 2001). The DNPWC has implemented community-based conservation programs since the introduction of the buffer zone concept in 1993 to reduce conflicts between park visitors and wildlife in protected areas.

The DNPWC is executing different infrastructure, socioeconomic, and natural resource management operations in designated buffer zones with the assistance of UNDP, WWF/Nepal, CARE/Nepal, National Trust for Nature Conservation (NTNC), line agencies, local government organizations, and NGOs. By minimizing the current conflict between the park and the residents in buffer zones, these partners help to improve the socioeconomic status of the populations living in such areas and help to the protection of biodiversity (Nepal & Weber, 1995).

The interventions that the park and people programs have undertaken include strengthening buffer zone institutions, encouraging targeted community development activities, and enhancing the capability of both the communities and park/reserve workers. Numerous initiatives/programs have been carried out to preserve and improve buffer zones.

3.5 Landuse / Landcover Change

One of the primary ways that humans affect the environment is via the usage of land. Land use modifications or alterations have a significant negative influence on the environment due to their effects on soil composition, water quality, microclimate, methane emissions, and CO₂ emissions (Awasthi, 2004). A key element of contemporary methods for managing natural resources and tracking environmental changes is the shift in land use and land cover. The biogeochemistry of the Earth's systems and patterns of climate change on a global scale are greatly influenced by land cover and human- or naturally-occurring changes to it. Changes in the land surface can affect the Earth's radiation balance by changing the surface albedo as well as the emission or removal of CO₂ from the atmosphere.

Changes in the land surface may also affect how much sensible and latent heat is released into the atmosphere, which affects how much energy is distributed throughout the climate system and, ultimately, how the climate behaves on a local, regional, and even global scale. According to estimates, land cover changes like deforestation account for one-quarter of the anthropogenic carbon dioxide emissions to the atmosphere (IPCC, 2001). More and more scientific knowledge and resources are available to address the larger policy consequences of land surface interactions within the climate system.

Land-use and land-cover changes have significant implications for natural resources due to their effects on soil and water quality, biodiversity, and global climate systems (UNEP, 2001). The number of people who rely on agriculture is increasing, and as a result, agricultural land has expanded, primarily by encroaching on forest regions (UNEP, 2001). Deforestation and agricultural growth in Nepal's marginal areas are particularly severe in the mountain region. One of the country's key issues is determining how to protect forest resources. Some initiatives, such as community forestry, have done outstanding work in protecting forest resources; on the other side, there are activities that have contributed to the country's forest resource depletion. Some initiatives, such as community forestry, have done outstanding work in protecting forest resources; on the other side, there are activities that have contributed to the country's forest resource depletion. In this context, it is critical to understand the current state of land use and, in particular, forest resources in terms of use and misuse, actions taken to manage the forests, and future initiatives outlined by the national government.

3.6 Drivers of Land Use Change in the Buffer Zone

Understanding the drivers of land use changes is necessary to formulate policies to combat its ill effects. The most common reason for land use changes in the periphery of protected areas is the development pressure from adjoining land lying outside the protected area (Palomo et al., 2013). The other key drivers contributing to land use change are weak implementation of existing legislations, development of tourism activities followed by lack of co-ordination among the governing bodies and complex administrative system (Palomo et al., 2013).

From similar studies conducted in Tanzania, it was found that population growth in the buffer zone which subsequently increased the demand of resources from nearby forest has caused decrease in forest cover (Herman & Nyanda, 2015). The locals residing nearby the protected area buffer zone of Tanzania are mostly involved in charcoal business as an important source of income. The forest land is cleared for charcoal production and have turned into isolated bare ground pockets.

3.7 Case Study

3.7.1 Impact of Urbanization on the Migratory Corridor of Nairobi National Park

Nairobi National Park established in 1946 with an area of 117 km² to protect wildlife from human activities and threats. However, the park has not been free from the threats posed by rapid population upsurge in its surrounding which has subsequently caused land use change in the peri urban area. These threats are more noticeable within the wildlife migratory corridor.

This study was carried out to: identify land use changes and their spatial trends within the wildlife corridor; investigate the current human - wildlife interactions; and examine the correlation between human population in Isinya and the population of migratory wildlife in the national park. This study is based on the analysis of temporal satellite images of the migratory corridor from 1995 to 2002 and to examine the wildlife human interaction scenario, household and institutional survey was also carried out in the area.

The study findings show that land use changes have occurred in different stages, starting with change in land tenure policy from community to private ownership followed by subdivisions and sales of land. This has been intensified by rapid population growth and lack of land use plan for the area. The current new dominant land uses are residential, irrigated large-scale floriculture and quarrying.

The study shows that human population in has negative impact on the population of migratory wildlife of the national park. Human population has been responsible for fragmentation of land in the migratory corridor and increasing the risks of pollution and soil erosion. The trend shows decrease in the population of migratory wildlife in the park which was initiated with the increase in human population of the study area.

The trend indicates that other land uses will continue to take more land than traditional pastoralism and wildlife migration, enclosing all wildlife in the park. An enclosed small-sized park is likely to cause an ecological crisis, rendering Nairobi National Park's conservation unsustainable. The study suggests: a) stopping land subdivision, b) encouraging conservation lease programs, c) developing the Nairobi Metropolitan Open Space System (NMOSS), and d) mandatory corridor land acquisition by the government. The first two are for short-term planning, whereas the latter is for long-term planning. The study also recommended determining the required corridor width for Nairobi National Park's migratory wildlife.

3.8 Acts, Policies, Regulations and Guidelines Regarding Protected Areas in Nepal

Prior to 1957, little attention was given to regularize the use of forest and hence in promoting sustainable forest management as the population was small and the resources were abundant. The government encouraged people to convert forest areas to cultivable land to increase food production and to collect

land tax as the source of revenue (Gautam et al., 2004). The trend of conversion of forest land to agriculture land was continued till the Ranas Regime (1846 to 1950). The timber from cleared forest were even exported to India to collect revenue until 1920s. After Rana Regime was overthrown, the democratic government drafted policy to initiate reforestation in the hills and soil conservation in the Siwaliks with the assistance of Food and Agriculture Organization (FAO) (Gautam et al., 2004). But the policy was not enacted and the export of timber from Terai continued.

In 1957, the Private Forests Act and the first Wildlife Law (Mahal, 1992) was enacted and this was the first attempt made by the government towards conservation with the primary objective; to prevent deforestation and to ensure protection, maintenance and utilization of private forests (Gautam et al., 2004) and the wildlife law offered the legal protection to rhino and their habitat (Mahal, 1992). Although, Ministry of Forestry was established in 1959, it could not control the widespread deforestation that was occurring in the remote areas of the country. (Gautam et al., 2004). Following the change of regime in 1961, Forest Act 1961 was promulgated which had divided the forest into different categories, spelled out the roles and responsibilities of the forest department and provisions for punishments based on the listed offences. However, these efforts made by the government were not fruitful due to poor enforcement. In 1964, rhino sanctuary was established in Chitwan along with the introduction of a special patrolling force called the *Gaida Gasti* (Mahal, 1992) .

In the late 1960s, a long-term wildlife conservation project was supported by King Mahendra with assistance of FAO and UNDP and initiated the Trishuli Watershed Project in 1968. The government was more concerned towards decreasing number of wildlife and their habitat loss. Hence, appointed a foreign advisor from 1970 to 1973 who surveyed some areas. This subsequently led to the beginning of National Parks and Wildlife Conservation Project. The major objectives of the project were to develop National Park and Wildlife Reserve system, manage and conserve wildlife and their habitats effectively and develop Department of National Park and Wildlife Conservation, which was previously under the Department of Forestry (Mahal, 1992). The most notable contribution of the project was its role in the formulation and implementation of National Parks and Wildlife Conservation Act 1973.

3.8.1 National Parks and Wildlife Conservation Act 1973 (1973)

The act promulgated in 1973 has 34 sections and has provisions for the protection of protected areas and species in Nepal. Section 2 of the act has described different types of protected areas and definitions of terms that are used in the later sections of the act. Section 3 has provisions of rights to DNPWC to create these reserves and declare the surrounding areas as Buffer Zones. Buffer zones are defined as the designated area around National Parks and Wildlife Reserves to facilitate the local residents to make regular use of forest products. The management and conservation activities in the buffer zones should be as per the management plan approved by the department and should be prepared in consultation with the users' committee. However, the land ownership of the local people shall not be altered. **Activities that do not have harmful effects to the environment and wildlife such as hotel, lodge, public**

transport, or any similar type of services and industries as prescribed can be operated in the buffer zone. However, for carrying out aforementioned activities, the department shall prepare standards in consultation with the concerned users' committee. The services and industries operating in the buffer zone shall be regularly inspected. The Users' Committee also shall be involved during monitoring and inspection.

Section 4 and 5 of the act has provisions for entry into the national park and wildlife reserves with an entry permit and activities that are prohibited such as building dwelling, cultivation, cutting or removing plants, making fires, hunting, land clearing, grazing livestock, extraction of minerals/ construction materials, alter the flow of river, streams inside the national parks/ wildlife reserves. However, as per the category of protected area, use of roads, grazing land, water sources, irrigation and embankment that the locals have been using before the declaration of protected areas shall be permitted without hindering the well-being of forest and wildlife inside the park. Permission for the collection of wild edible vegetables and fishing shall be provided as per the rules. Section 6 has provisions for operating such as hotels, lodge, public transportation and other similar activities under special permit. The act has not made clear indication of to what extent the impact on environment is not harmful.

3.8.2 National Parks and Wildlife Conservation Regulation 2076 (2019)

National Parks and Wildlife Conservation Regulation 2076 has been promulgated as per section 33 of the National Parks and Wildlife Conservation Act 2029 (1973) and has been named so as per the 5th amendment. The regulation has further elaborated the operation of permitted uses in the national park/ wildlife reserves. For operation of services as per section 6 of the NPWC act 2029, notice of sealed tender shall be published in major newspaper with time frame of 35 days including the terms and conditions for operation of services. The proposal with the largest amount of revenue to the park shall be accepted. After the 5th amendment, a sub rule 5 has been added with the provision of conducting environmental study as per the prevailing laws by the government for operating the permitted services inside the park. If any sorts of construction are required for operation of permitted activities in the national park, the detailed project report shall be prepared and approved by the government.

3.8.3 Buffer Zone Management Regulation 2052 (1996)

Buffer zone management regulation has been promulgated as per section 33 of the National Wildlife Conservation Act 2029 (1973). The purpose of this Regulation is to ensure effective buffer zone management. To that aim, it calls for: (a) the area to be divided into units based on its status, extent, and user settlement; and (b) the establishment of a buffer zone management work plan for community development, environmental protection, and the rational use of forest resources. All of the provisions specified in Part-3 (among others, description of the forest, description of the land, resources for the implementation of the plan, description of population, etc.). must be included in the management plan, which must be submitted to the DNPWC The warden is in charge of conservation of wildlife, natural

environment and resources, biodiversity, forests, and development projects. Users' Committees and sub-committees created, registered, and maintained in accordance with the provisions of the current Regulation may help the warden. The buffer zone might be designated as buffer community forest and controlled by the Users' Committee, or it could be designated as buffer religious forest. The owner may develop buffer private forest with the aid of the warden. Further provisions affect the management of forest products by the warden. Part 5 of the regulation mentioned the activities that are prohibited in the buffer zone.

- Occupy any land without legal ownership, clear forest, cultivate forest land
- Any acts that damage forest resource, make fire in the forest
- Extract stone, earth, sand or mine any minerals
- Introduce any harmful chemicals or explosives into river, stream or any other water sources
- Illegal hunting and damage to wildlife

Users' Committee shall be responsible to report any activities in the nearest vicinity of buffer zone that cause or can possibly cause harmful effects on the land use, public health, natural environment and conservation of natural resources. The warden has the authority to stop or make amendments on such activities as recommended by the Users' Committee. No one shall harm or cause damage to the public properties such as road, bridge, notice/ information boards, fences of the buffer zone. It is required to take permission from the department prior to operation of any industries other than cottage-based industries. According to Part-7 criteria, the Ministry should propose the proportion to be distributed for community development of local people from the sum earned by national parks, reserves, or conservation areas. For operation of services as per section 6 of the NPWC act 2029, notice of sealed tender shall be published in major newspaper with time frame of 35 days including the terms and conditions for operation of services. The proposal with the largest amount of revenue to the park shall be accepted. If any sorts of construction are required for operation of permitted activities in the national park, the detailed project report shall be prepared and approved by the government. The warden shall implement land use system in the pre-determined areas as per the management plan after agreement with the users' committee. The land owners of tenants agreeing to the land use system shall be rewarded with various technical and other assistances.

3.8.4 Shivapuri Nagarjun National Park Buffer Zone Management Directive, 2073 (2016)

The following are the key provisions of the directive:

- Considerations for Delineating Buffer Zone
 - If some portions of a settlement, village or ward lies inside the buffer zone, whole part of the village, town or ward should be delineated inside the buffer zone.
 - Also, ecological importance and the eco-tourism potential of the area should be considered while delineating inside the buffer zone

- Factors Defining Impact Zone of NP
 - Areas that are affected by restriction of use of forest products
 - Areas that are affected by restriction of Grazing the cattle
 - Areas that are affected by the wildlife from the National Park
- Provisions on Division, Formation, Operation of Units, Users Groups, Users Committee, Sub Committees, are mentioned in the Directive
- Provisions of Preparation of Work Plan of Users' Group for 5 years with the given proportions of budget allocation
 - Conservation Program (Watershed, Water Sources, Forest Conservation) 15%
 - Human Wildlife Conflict Reduction 25%
 - Community Development Program 20%
 - Eco tourism, Income generating and skill development program 20%
 - Conservation Education Program 10%
 - Administrative, Services, Facilities and Awards Expenses 15%

3.8.5 Working Policy for Construction and Operation of Physical Infrastructures inside Protected Areas, 2065 (2008)

The following are the key provisions of the working policy:

- IEE/EIA is mandatory for construction and management of physical infrastructure inside protected area
- No land from National Parks and Wildlife Reserve shall be made available for any projects except for construction and operation of National Pride Projects.
- In case of Hydropower Generation from the river/stream flowing through the protected area, several provisions of the strategy must be met.

3.8.6 Buffer Zone Standard (For Establishment and Operation of Industries), 2062 (2005)

According to the standard, the following industries are permitted inside the buffer zone:

- Cottage Industries based on Forest Products
- Tourism Based Industries
- Animal Husbandry
- Health related
- Education related
- Based on Water Resources (Micro hydro, etc.)
- Mines and Minerals Based (Crusher, Brick Kiln (1km away from boundary))
- Garments/Carpet Industry
- Paints, Soap, Paper, Shoe etc.

3.9 Land use plan of Kathmandu valley

Land use plan with building bye laws and standards were prepared during land use plan of Kathmandu valley. Land use plan of Kathmandu valley 1976 was prepared along with building construction standards. Kathmandu valley town development committee was established to enforce the plan.

Development of inner and outer ring road with various residential and protection zone were proposed in the plan. Kathmandu valley town development committee was established with its three district offices.

For physical development planning it divided the area of Kathmandu Valley into broadly three different categories in which inner core settlement of Kathmandu and Lalitpur belonged to category “Ka”, the settlements adjacent to the existing core settlements of Kathmandu and Lalitpur was termed as category “Kha” and the spread and sparse settlements of Kathmandu Valley which has to be compacted were termed as category “Ga”. (KVDA, 2016)

3.10 Kathmandu valley Urban Development plan and program 1991(2048)

Kathmandu valley urban Development plan and Program was prepared by Department of Housing and Urban Development, with technical assistance of ADB. Kathmandu valley urban development plan and program recommended Kathmandu valley to be extended form of Kathmandu city and should not be center of industrial activities. This plan aimed at densification of Kathmandu and Lalitpur settlement and reduce urban sprawl. This plan also aimed at conservation of ecology and agricultural land. This plan suggested development of inner ring road area and restrict development in wetlands and adjacent to river. (KVDA, 2016)

3.11 Environmental Plan and management of Kathmandu valley 1999

Environment plan and management of Kathmandu valley mainly dealt with environmental and ecological issues and sustainable development of valley. This plan recommended formulation of valley wide land use plan, restriction of development in environmentally sensitive areas, establishment of eco-town, development of master plan for sewerage network and conservation of traditional settlements in the valley. (KVDA, 2016)

3.12 Kathmandu Valley Long Term Development Plan, 2020

The Kathmandu Valley Long-term Development Plan, the planning document prepared in 2002, conceptualizes scenarios for developing the Kathmandu Valley by 2020. It aims to: (a) de-concentrate economic investments and employment opportunities out of the valley, in particular polluting industries (such as carpet and brick factories), to promote the development the valley as a natural, historical, cultural, tourist destination and national capital region; and (b) delineate urban growth boundaries to control urban growth and limit capital investments to urban areas only. The boundaries of the urban areas were specified based on the boundaries of the existing towns, and land reserved for urban development was clearly demarcated based on criteria such as agriculture productivity. The plan also recommended the promotion of tourism, handicrafts and agro-processing as strategic economic sectors; the introduction of preventive measures to reduce fragmentation and loss of agricultural land, including agriculture zoning; the ban of construction works in the agricultural area; and the provision of relief and facilities to support farmers. The plan recommended prohibiting development in naturally risk prone

areas such as seismically active areas, liquefaction zones, steep slopes, areas with risk of flood. To enforce implementation, the plan recommended curtailing annual budget and withholding fully or partly the grants of the governmental and semi-governmental agencies implementing programs contrary to the objectives of the plan.

The concept plan was introduced to promote Kathmandu Valley as historical, cultural and tourism capital of the country. A gap analysis to the planned and realized development must be done to assess how much the concept plan has achieved and address issues that hinder the realization of the concept plan. A new strategic plan has been prepared to address the challenging issues of the future through Kathmandu Valley Strategic Plan, 2035 which will be the guiding document in urban development works inside the valley.

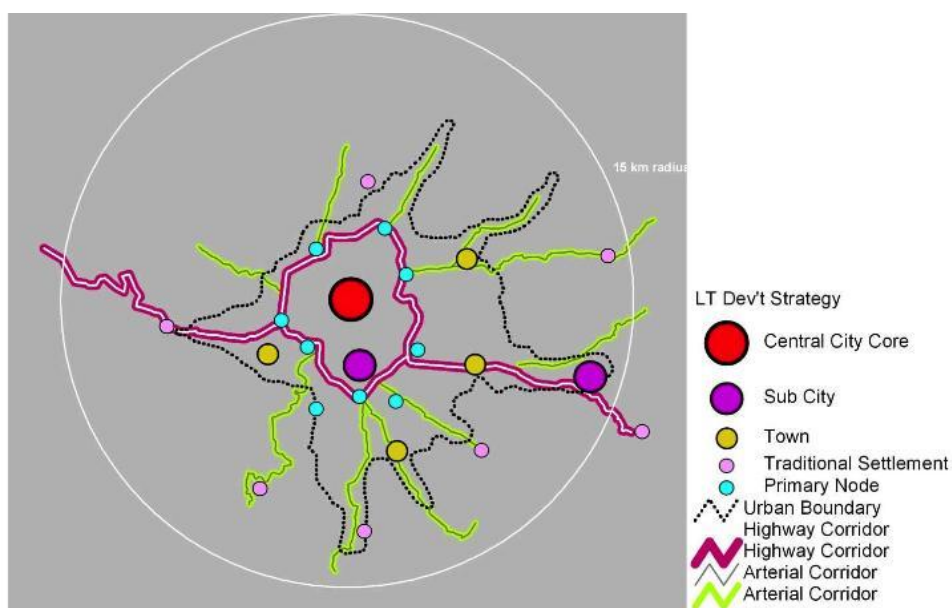


Figure 8: City Structure of Kathmandu (Source: Kathmandu Valley Long Term Development Plan, 2020)

3.13 Risk Sensitive Land Use Plan (2015)

KVDA has developed Risk Sensitive Land Use Plan (RSLUP) of Kathmandu Valley in 2015 to contribute to risk resilience development of Kathmandu Valley through development and enforcement of Risk Sensitive Land Use Plan and Building Bye Laws. The envisioned Risk Sensitive Land Use Plan (RSLUP) proposed mainstreaming of risk reduction strategies and their implementation actions at two levels of planning implementations viz. at the Kathmandu Valley level as a single planning unit, to be implemented by the KVDA as an authority for planning, developing, monitoring and regulating/prohibiting in coordination and cooperation with wider stakeholders; and at the municipalities/VDCs levels as an administrative units, to be implemented by the respective local bodies through consultative participation of the local stakeholders.

RSLUP has developed Color Zones based on hazards like earthquake, flood, landslide and liquefaction to reflect availability of risks and constraint free non built-up area in the particular region. RSLUP

provides regulations and implementation guidelines to be followed in particular land uses and identifies the area accordingly for densification and de-densification. It also recommends minimum lot size for each household to attain specified densities in areas for new development.

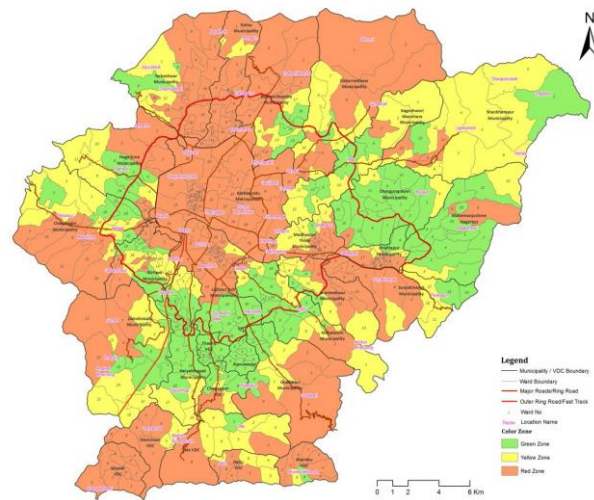


Figure 9: Color zones at municipal/VDC ward levels (RSLUP, 2015)

The RED Colour zone is designated as the High Alert Zone which has limited constraint free space available for further development. It requires managing the activities that may potentially escalate risks and prevent development to avoid exposure of lives and assets. The area may not be suitable for high rise apartments or large-scale industries. The average density in the wards falling into RED category is 145ppha. However, there's huge gap between minimum and maximum densities. The lower density means that the area is not yet built up but significant portion of which has other risks and constraints.

The YELLOW Colour zone is designated Medium Alert Zone and represents the area which is lesser sensitive than the Red Zone, but has high potentiality to becoming the Red Zone if not planned appropriately. Few high-rise buildings could be permitted and large-scale industries should be restricted. The land transaction and permit fee should be lower than the Red Zone.

The GREEN Colour zone or Residential Area Promotion Zone, mostly on the south of the valley, is the most potential residential area. Organize housing and land pooling schemes should be introduced in this zone. More than 60% of the existing area in this zone is constraint free. High rise buildings, medium and large-scale industries are suited to be should be promoted in this zone.

CHAPTER 4 STUDY AREA

4.1 Introduction

Shivapuri Nagarjun National Park is located in the northern fringe of Kathmandu Valley. It lies 12 km away from the center of capital city. The national park consists of two forests viz Nagarjun and Shivapuri. Shivapuri forest extends from 27°45' to 27°52' N latitude and 85°16' to 85°45' E longitude and Nagarjun Forest is located within 27°43' to 27°46' N latitude and 85°13' to 85°18' E longitude. The national park covers parts of 4 districts and 10 local governments; Tarakeshwor, Tokha, Budhanilkantha, Gokarneshwor, Kageshwori Manohara and Shankharapur Municipalities of Kathmandu district, Dhunebesi Municipality of Dhading district, Melamchi of Sindhupalchowk district, Kakani and Shivapuri Rural Municipalities of Nuwakot district. The elevation ranges from 960 to 2,732 from msl. This protected area lies completely within the middle mountain range and it represents its rich biodiversity.

Shivapuri has long history of introducing itself as protected area. In 1976, Shivapuri Watershed Conservation Area was declared. In 1978, it was declared as Shivapuri Protected Watershed Area. Shivapuri watershed is one of the major sources of drinking water supply of Kathmandu Valley and has been identified as the water recharge zone in the Risk Sensitive Landuse Plan of Kathmandu Valley. Hence, the main aim of previous two declarations could be for the conservation of watershed. Again in 1983, it was declared as Shivapuri Watershed and Wildlife Reserve. Later in 2002, it was declared as national park under National Park and Wildlife Conservation Act 1973 but in 2009 Nagarjun Forest area was also annexed and it was renamed as Shivapuri Nagarjun National Park. The total area covered by the park is 169 sq.km of which 15 sq.km area belongs to Nagarjun Forest. The park boundary is well demarcated with stone wall around the park running along former VDC's. The buffer zone of SNNP was declared in 2016 and covers an area of 118.61 sq.km. The park headquarters is located in Panimuhan, Budhanikantha Municipality.

However, for this study the study area is limited in the area of park and buffer zone inside the valley only which has been stated in the scope/limitation of this study. The total area of study area including both buffer zone and national park area is 119.89 sq.km.

Table 4: Area Coverage of SNNP for the Study

Municipality	Buffer Zone (sq.km)	National Park(sq.km)	Grand Total(sq.km)
Budhanilakantha	4.97	12.23	17.21
Gokarneshwor	7.84	37.40	45.24
Kageshwori Manahora	6.13	3.09	9.22
Nagarjun	4.07	8.83	12.91
Shankharapur	5.82	1.95	7.77
Tarakeshwor	12.47	6.02	18.49
Tokha	5.90	3.16	9.06
Total	47.19	72.69	119.89

4.2 Topography and Drainage

The topography of SNNP is predominantly hilly, with steep slopes of more than 30% in at least half of the park's entire area. Because of the park's steep slope and the composition of the soil, soil erosion is severe, particularly in the north (Samundradevi, Sikre and Talakhu villages). Construction of roads on steep southern and northern slopes, seasonal excessive forest fires, and deforestation are major sources of such risks (SNNP, 2017).

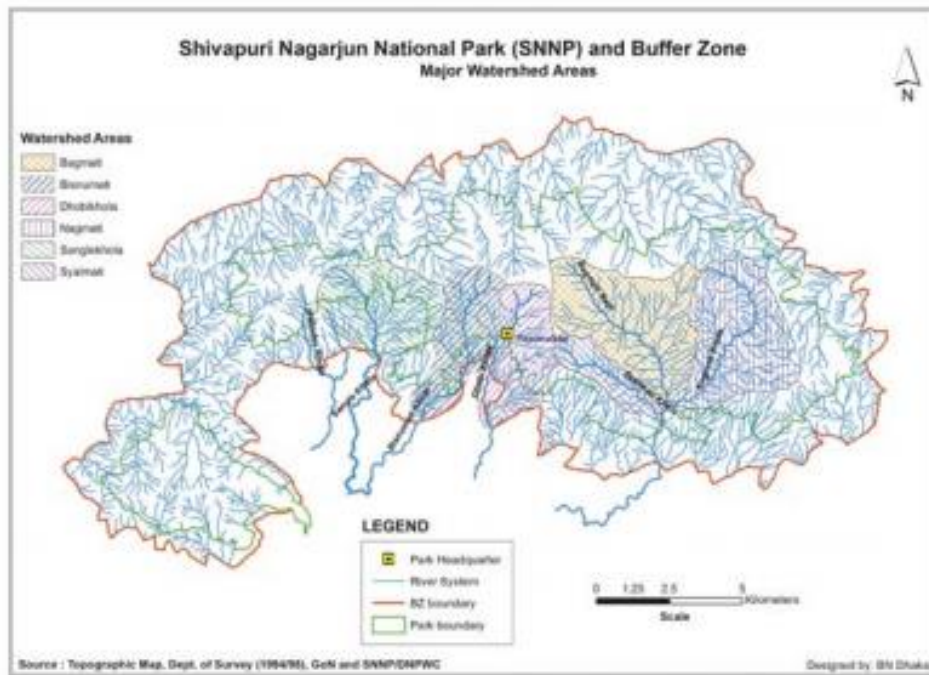


Figure 10: Watershed of SNNP (Source:(SNNP, 2017))

Shivapuri is the source of several major rivers, including the Bagmati, Bishnumati, Nagmati, Syalmati, Rudramati, and Ikshumati. Rudramati, Mahadev, Chahari, Yagyamati, Sani and Thuli shyalmati, and Dhobi Kholas are some of the tiny stream sub-watersheds. The Park also feeds the Likhu and Sindhu Khola tributaries that flow to the north. The majority of the wetlands flow to the Bagmati watershed, with a few draining to Trishuli via Likhu khola to the north and Indrawati via Sindhu Khola to the east. Bagmati, Syalmati, Nagmati, Bishnumati, and Allekhola drain into the Bagmati, whereas Chisapani Khola, Rolche Khola, and Kakani Khola drain into the Trishuli river. Rivers such as the Nhyukhola, Thado Khola, and Haibung khola join the Indrawati. Reservoirs and ponds, both man-made and natural (e.g., Sundarijal and Dhap), are used for certain reasons such as hydropower, drinking water, and agriculture. Rivers, streams, and reservoirs offer drinking water for animals, livestock, and humans, as well as irrigation for agricultural land and hydropower generation.

4.3 Biodiversity Status

The park is the biodiversity hotspot of central Nepal's mid-hill. The park represents a high level of ecological and cultural variety. It has 1,402 plant species in total, with 16 of them being indigenous. With 1,114 species, angiosperms represent the park's dominant flora. The park's flora and fauna include

30 species of animals, six of which are endangered. Two species of pangolin, the leopard cat, the clouded leopard, and the Assamese monkey which are listed under protected animals are also found here. The park is home to the Common Leopard, Langur, Himalayan Black Bear, Yellow Throated Martin, Barking Deer, and Sambar Deer. Similarly, there are 320 bird species (SNNP, 2017).

4.4 Road and Transportation

The SNNP is connected via road and walking trails. To get to the park's entrances, public buses and minibuses are available from the city core. Visitors can access the park by the following 9 entrance points: Chisapani, Jhule, Sundarijal, Mahankal, Panimuhan, Tokha/lipikot, Jagaat/Gurjebhanjyang, Kakani, Mudhku, and Fulbarigate. Most of the entry points of the park are connected by Feeder Road. Sundarijal, Budhanilkantha, Tokha, Kakani, and Nagarjun are some of the valley's key road networks that connect to SNNP. Within the Park, there are 95 km of forest road, 83 km of foot trails in Shivapuri, and 33 km of forest road and 10 km of foot paths in Nagarjun, all of which are designed for trekking and village tours. As a result, the park has considerably enhanced its road network and trails, making it more accessible.

4.5 Landcover

Forest dominates the land use pattern in and surrounding SNNP, followed by shrub land, cultivated land, and grass land. Forest land covers 118.391 km² (74.45%), followed by bush/shrub land at 32.52 km² (20.45%), grassland at 5.13 km² (3.22%), cultivated land at 2.86 km² (1.80 %), and other features such as cliffs, buildings, and ponds/lakes at 0.088 km² (0.055%) (SNNP, 2017)

4.6 Cultural Heritage

Both Hindus and Buddhists worship Shivapuri Peak and Jamacho, and the holy rivers Bagmati and Bishnumati flow from Bagdwar and Bishnupaduka, respectively. Famous religious sites in the park include Jamacho, Buddha Gufa, Pachali Bhairab, and Nagarjun. Other religious sites in the park include Baghdwar, Bishnudwar, Sundarimai, Kageshowori, Manichud, Tarakeshowr, and Nagigumba.

4.7 Tourism Status

The stunning view, biodiversity, forest environment, wildness, avifauna, spiritual fitness, religious site, trekking, hiking, and mild adventure are the park's key draws. Furthermore, the park has a strong potential to create an ecotourism hub, which might provide financial resources for park administration as well as income-generating possibilities for residents. Domestic tourism is currently being promoted on the outskirts of key religious sites such as Baghdhowar, Bishnudwar, Shivapuri peak, Nagiguma, Sundarijal, Jamacho, and others, as well as picturesque areas such as Kakani and Chisapani.

According to SNNP tourist statistics, the park has had an average of 1,67,500 visitors each year during the previous five years. The overall number of visitors to the park has increased from 10,850 in FY 2051/52 to 209717 in FY 2073/74 (SNNP, 2017). Similar to the overall tourist flow in Nepal, foreign tourists visit this park in two main seasons: September/October and April/May.

CHAPTER 5 DATA COLLECTION AND ANALYSIS

5.1 Temporal Landuse Change Analysis

The landuse data of different timelines were obtained from the UNDP/CDRMP 2013 project. The boundary of the national park and its buffer zone was obtained from the website of DNWPC in hard copy. The obtained map was digitized in GIS platform and the boundaries of national park, buffer zones, users' committee was prepared. Landuse information was quantified in the whole region firstly, then it was quantified municipality wise and then according to the Users' Committee of the buffer zone.

5.2 Temporal change in Landuse in the buffer zone

Land use has been significantly changed from the year 1980 till date as shown in maps below: Temporal Landuse Changes (Data Source: UNDP/CDRMP 2013 & IUDP of 14 municipalities package 11). The buffer zone of SNNP, which was only covered by cultivation and forest area some 20 years ago with no traces of builtup, have now drastically converted into one of the urbanizing areas of Kathmandu valley. For the purpose of this study, the landuse map of the Kathmandu valley prepared by UNDP CDRMP have been adopted for landuse of the years 1980, 1990, 2000 and 2010. The current landuse was adopted from the GIS database prepared for the IUDP of 14 Municipalities and updated.

5.2.1 Landuse in 1980

The landuse map of the SNNP and its buffer zone in 1980 depicts that there were very few settlements accounting to just 0.07% and 0.79% respectively inside the buffer zone and within the park itself. The dominant land use in the buffer zone was agricultural covering 77.49% of the buffer zone followed by 22% forest. The landuse composition of the area during 1980 suggests that primary occupation was agriculture during that time and non-agricultural uses were negligible.

Table 5: Land use composition in 1980 A.D

Landuse	Buffer Zone	%	National Park	%
Agricultural	3,660.70	77.49%	380.36	5.24%
Forest	1,039.64	22.01%	6,877.11	94.67%
Industrial			0.01	0.00%
Military			0.49	0.01%
Others	10.29	0.22%		0.00%
Recreational / Open Space		0.00%	0.15	0.00%
Residential	3.15	0.07%	0.79	0.01%
Transportation	3.84	0.08%	5.01	0.07%
Waterbody	6.34	0.13%	0.47	0.01%
Grand Total	4,723.98		7,264.38	

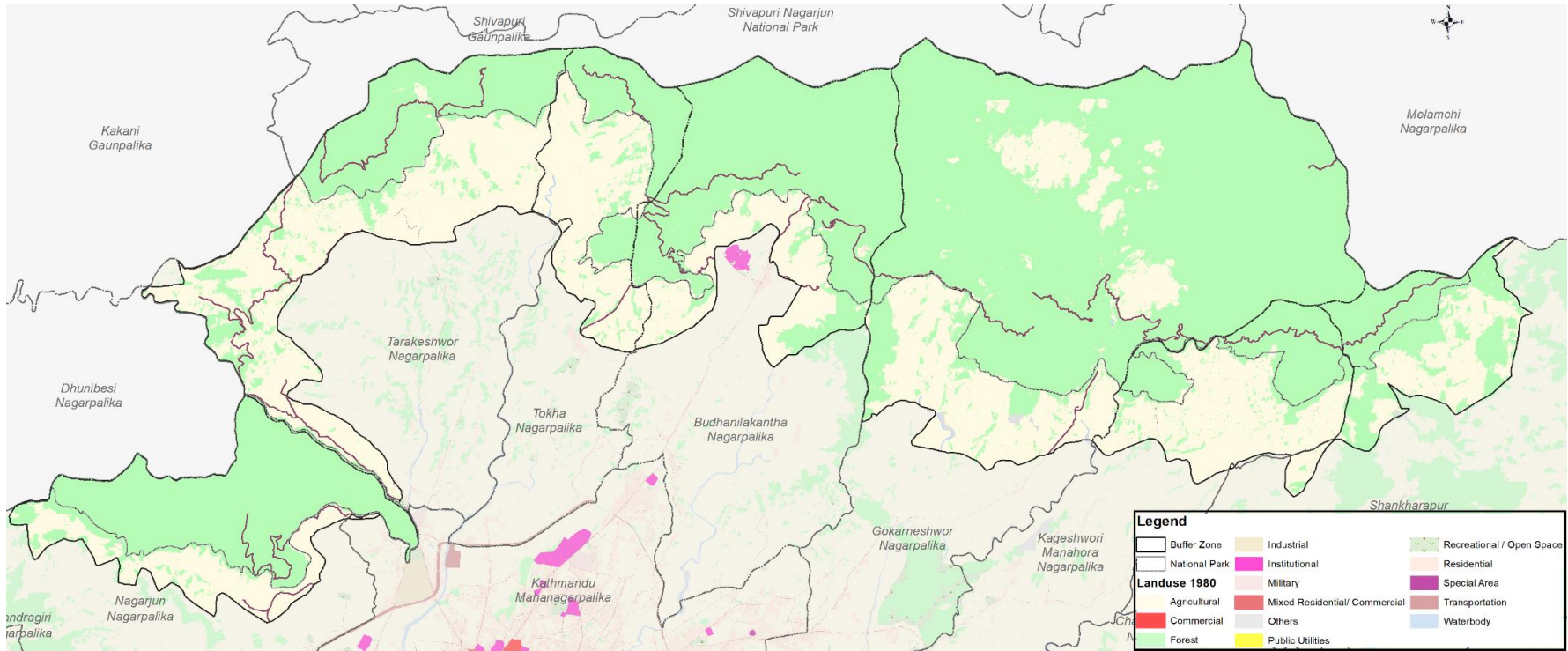


Figure 11: Landuse Map of SNNP (inside KV) 1980

5.2.2 Landuse in 1990

Land use composition of the buffer zone of SNNP inside Kathmandu Valley in the 1990 is quite similar to that of 1980, with the dominant land use being agricultural (77.49%) followed by 21.86% forest area. Similarly, inside the National Park area, forest area is dominant accounting to about 95% of total area. The agricultural area inside the area of National Park accounted to 5.22% which is mostly located in the villages of Okhreni and Mulkharka of the Gokarneshwor municipality.

Table 6: Land use composition in 1990 A.D.

Landuse	Buffer Zone	%	National Park	%
Agricultural	3,660.77	77.49%	379.38	5.22%
Forest	1,032.51	21.86%	6,872.82	94.61%
Industrial			0.01	0.00%
Military			0.47	0.01%
Others	10.29	0.22%	2.30	0.03%
Recreational / Open Space			0.15	0.00%
Residential	2.90	0.06%	0.85	0.01%
Transportation	11.15	0.24%	7.93	0.11%
Waterbody	6.34	0.13%	0.46	0.01%
Grand Total	4,723.98		7,264.36	

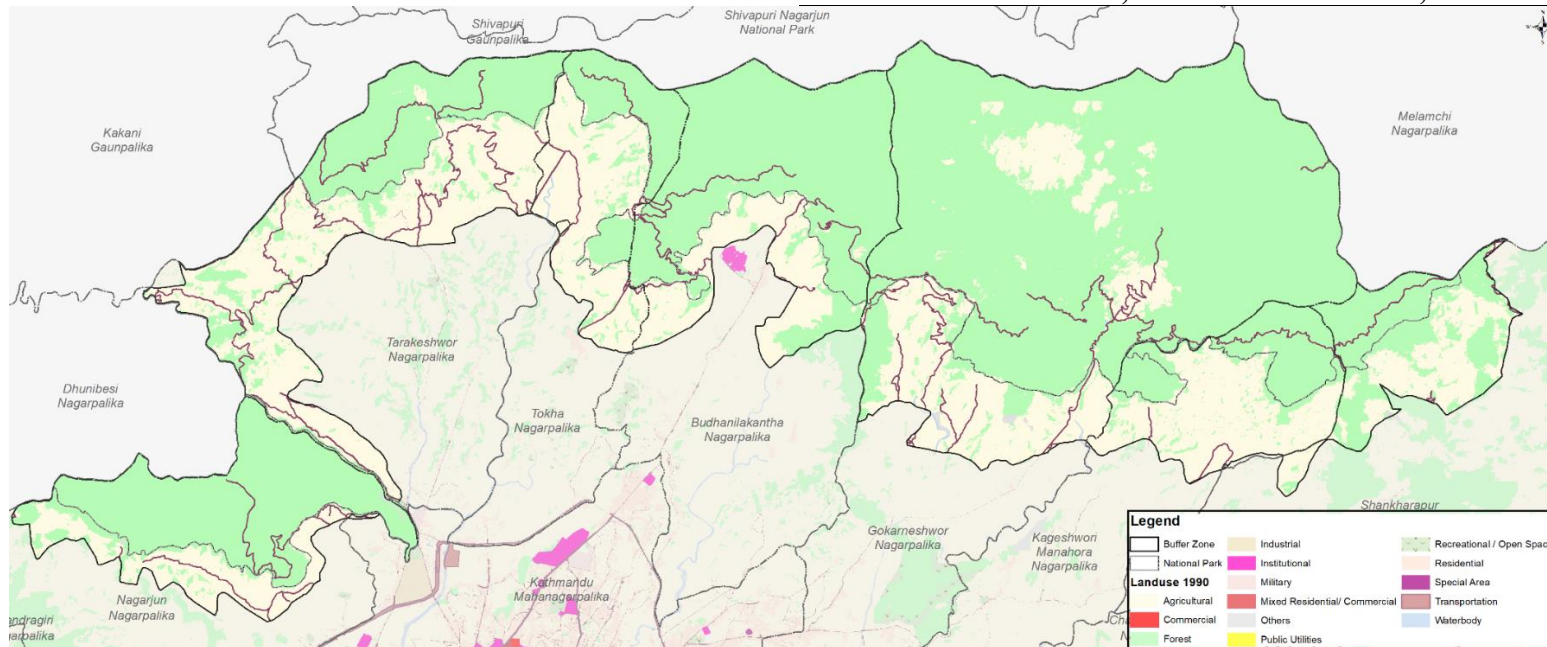


Figure 12: Landuse Map of SNNP (inside KV) 1990

5.2.3 Landuse in 2000

In 2000, the built-up area (excluding agricultural, forest and water bodies) within the SNNP area gradually increased. Even though, prominent land use was agricultural (76.27%), the residential use increased considerably to 0.61 % in all the municipalities within the buffer zone. As compared to the previous decade, development of road has also increased to 1.31%. Thus, the total built up area within the buffer zone accounted to about 2% of the total area in the expense of agricultural and forest area.

Table 7: Landuse Composition in 2000 A.D.

Landuse	Buffer Zone	%	National Park	%
Agricultural	3,602.90	76.27%	369.47	5.09%
Forest	1,019.16	21.57%	6,860.37	94.44%
Industrial		0.00%	0.01	0.00%
Institutional	0.15	0.00%		0.00%
Military		0.00%	1.13	0.02%
Others	6.98	0.15%	5.51	0.08%
Public Utilities		0.00%	0.25	0.00%
Recreational / Open Space		0.00%	0.15	0.00%
Residential	28.74	0.61%	7.81	0.11%
Special Area	0.17	0.00%	0.58	0.01%
Transportation	61.81	1.31%	18.07	0.25%
Waterbody	4.26	0.09%	1.03	0.01%
Grand Total	4,724.17		7,264.38	

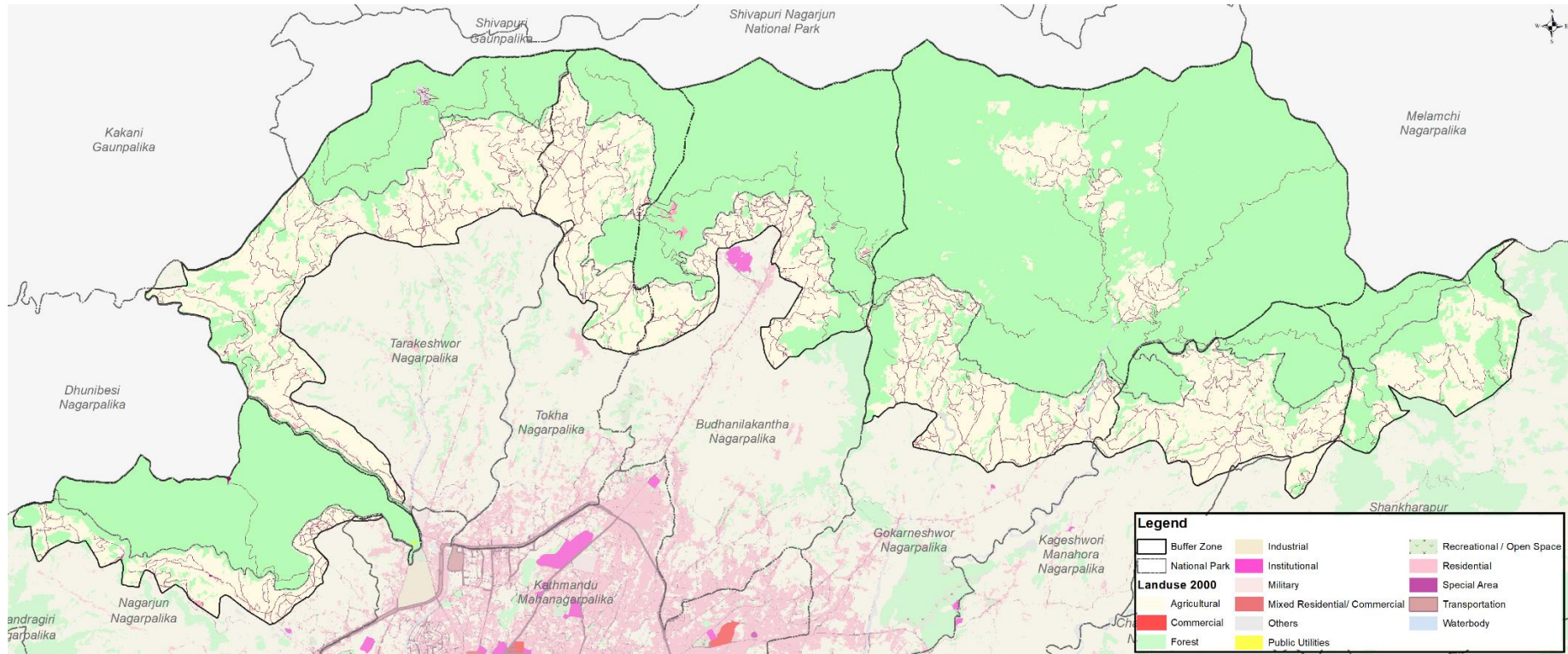


Figure 13: Landuse Map of SNNP (inside KV) 2000

5.2.4 Landuse in 2010

The landuse map of the study area in 2010 shows development of residential settlement along with development of roads. The agricultural use (71.45%) is dominant followed by forest (21.33%) inside the buffer zone. However, in comparison to the landuse map of 2000, agriculture area has depleted by about 5%. The overall built-up area in the buffer zone in 2010 accounts to 7.2%, which was 2.07% in the previous decade.

Table 8: Landuse Composition in 2010 A.D

Landuse	Buffer Zone	%	National Park	%
Agricultural	3,368.71	71.30%	361.79	4.98%
Forest	1,007.62	21.33%	6,860.76	94.44%
Industrial		0.00%	0.01	0.00%
Institutional	1.05	0.02%	0.04	0.00%
Military	7.19	0.15%	6.28	0.09%
Others	7.93	0.17%	6.20	0.09%
Public Utilities		0.00%	0.25	0.00%
Recreational / Open Space		0.00%	0.16	0.00%
Residential	252.67	5.35%	9.36	0.13%
Special Area	0.11	0.00%	0.51	0.01%
Transportation	77.98	1.65%	19.36	0.27%
Waterbody	1.20	0.03%		0.00%
Grand Total	4,724.45		7,264.72	

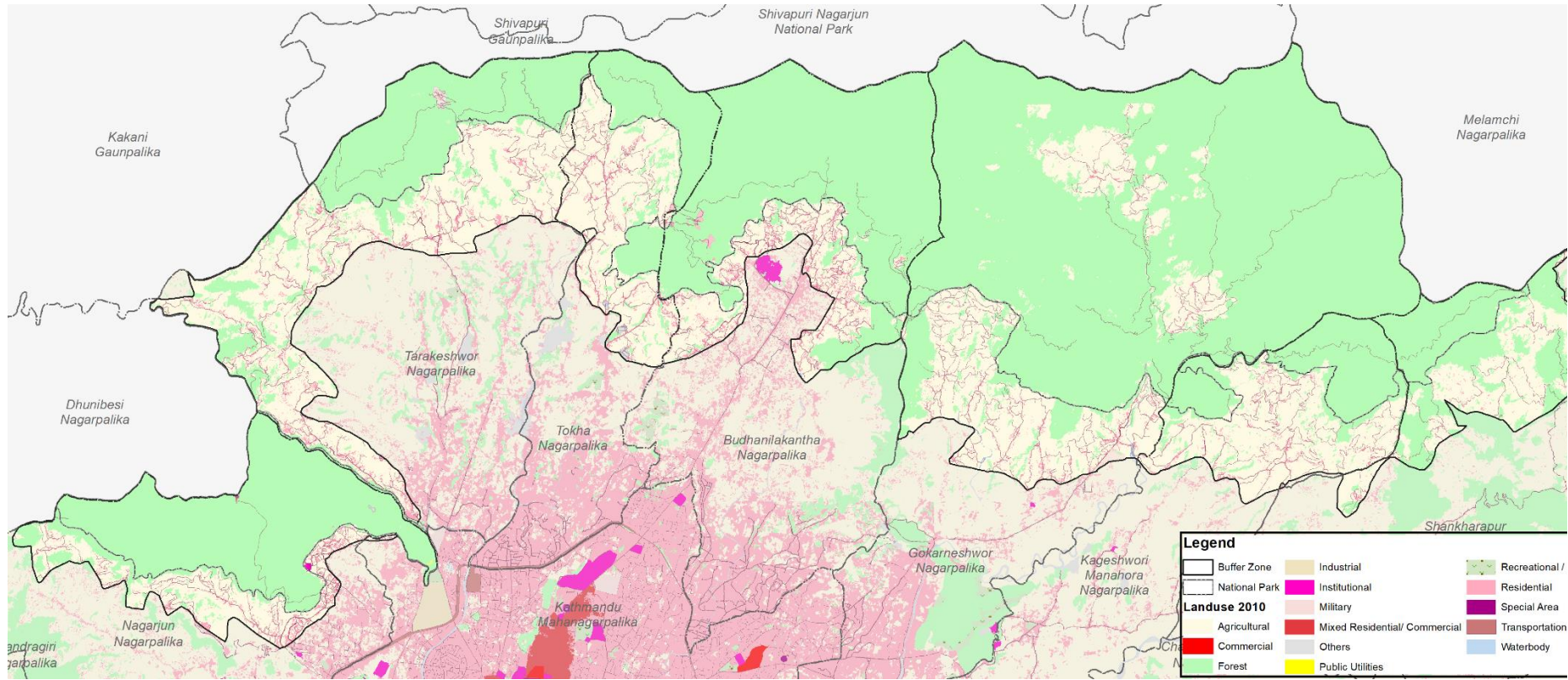


Figure 14: Landuse Map of SNNP (inside KV) 2010

5.2.5 Landuse in 2020

The landuse map of the study area in 2020 shows huge development of residential settlement, roads and other built-up areas. The agricultural use (55.18%) is dominant followed by forest (21.50%) inside the buffer zone. In comparison to the landuse map of 2010, agriculture area has depleted by about 16%. However, the land development activities have been ongoing in great numbers inside the buffer zone as shown in the map below. These land development areas occupy about 176 Ha at present which in near future will increase the built-up area at the expense of agricultural land inside the buffer zone. The overall built-up area in the buffer zone in 2020 accounts to 23.10%, which was 7.2 % in the previous decade.

Table 9: Landuse Composition in 2020 A.D

Landuse	Buffer Zone	%	National Park	%
Agricultural	2,607.47	55.18%	184.44	2.54%
Forest	1,016.07	21.50%	6,948.49	95.64%
Institutional	13.03	0.28%	1.23	0.02%
Military	7.46	0.16%	11.35	0.16%
Mixed Residential/ Commercial	39.77	0.84%	0.05	0.00%
Public Utilities		0.00%	0.27	0.00%
Recreational / Open Space	0.71	0.02%		0.00%
Residential	864.15	18.29%	38.22	0.53%
Special Area	1.00	0.02%	2.32	0.03%
Transportation	165.18	3.50%	61.95	0.85%
Waterbody	10.33	0.22%	16.55	0.23%
Grand Total	4,725.17		7,264.87	

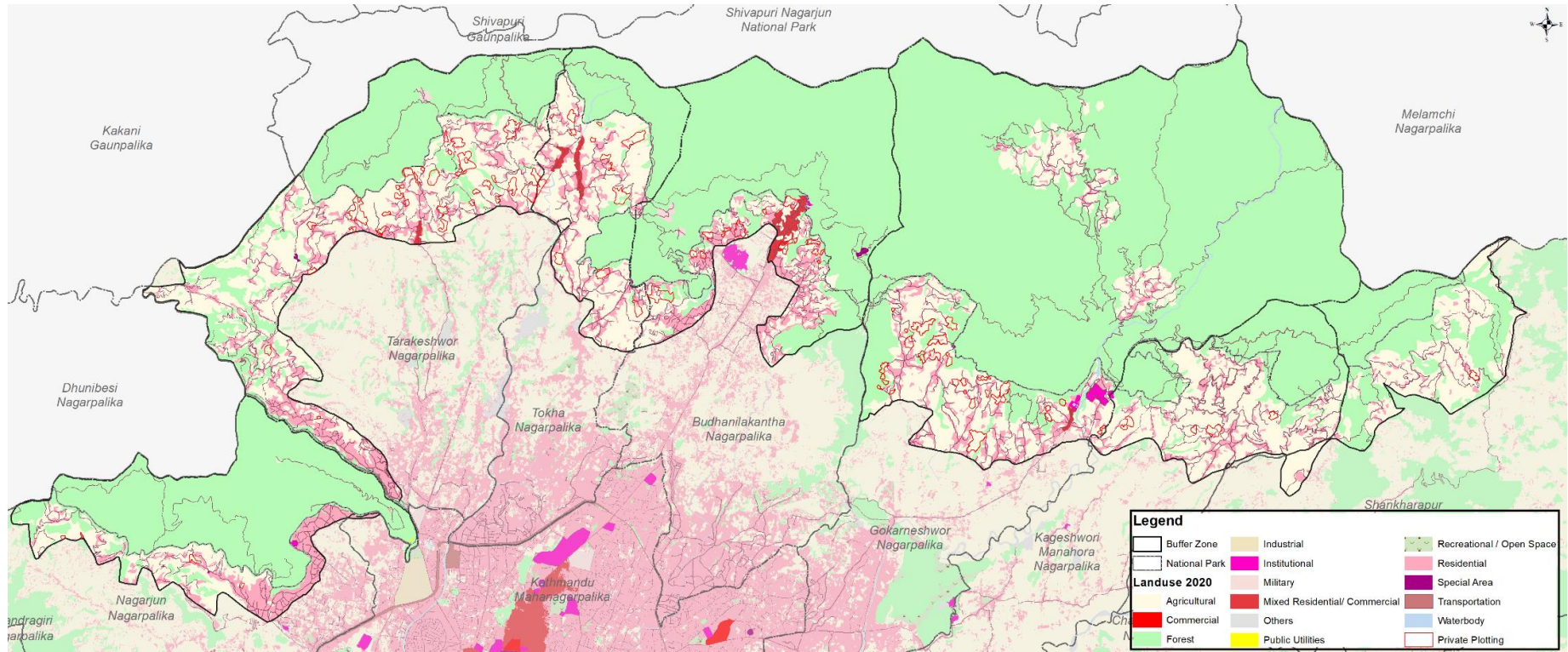


Figure 15: Landuse Map of SNNP (inside KV) 2020

5.3 Scenario of Land use Changes from 1980 to 2020

From the analysis, it has been observed that the built-up area in the buffer zone increased 63 folds from 17.29 Ha in 1980 to 1087.59 Ha in 2020. This massive increase has taken place primarily in the last two decades. The increase in built up area has come at a cost of cultivated land and forest area. Between 1980 to 2020, the cultivable land has decreased by 1049.52 Ha and forest area have decreased by mere 23.57 Ha in the buffer zone. This shows that the attempts made by the government for conservation of forest have had positive result. While, this rapid increase in built up area within the buffer zone provides us a glimpse of the rapid urbanization occurring in the region and further emphasizes on proper land use regulation and integrated development action in this region.

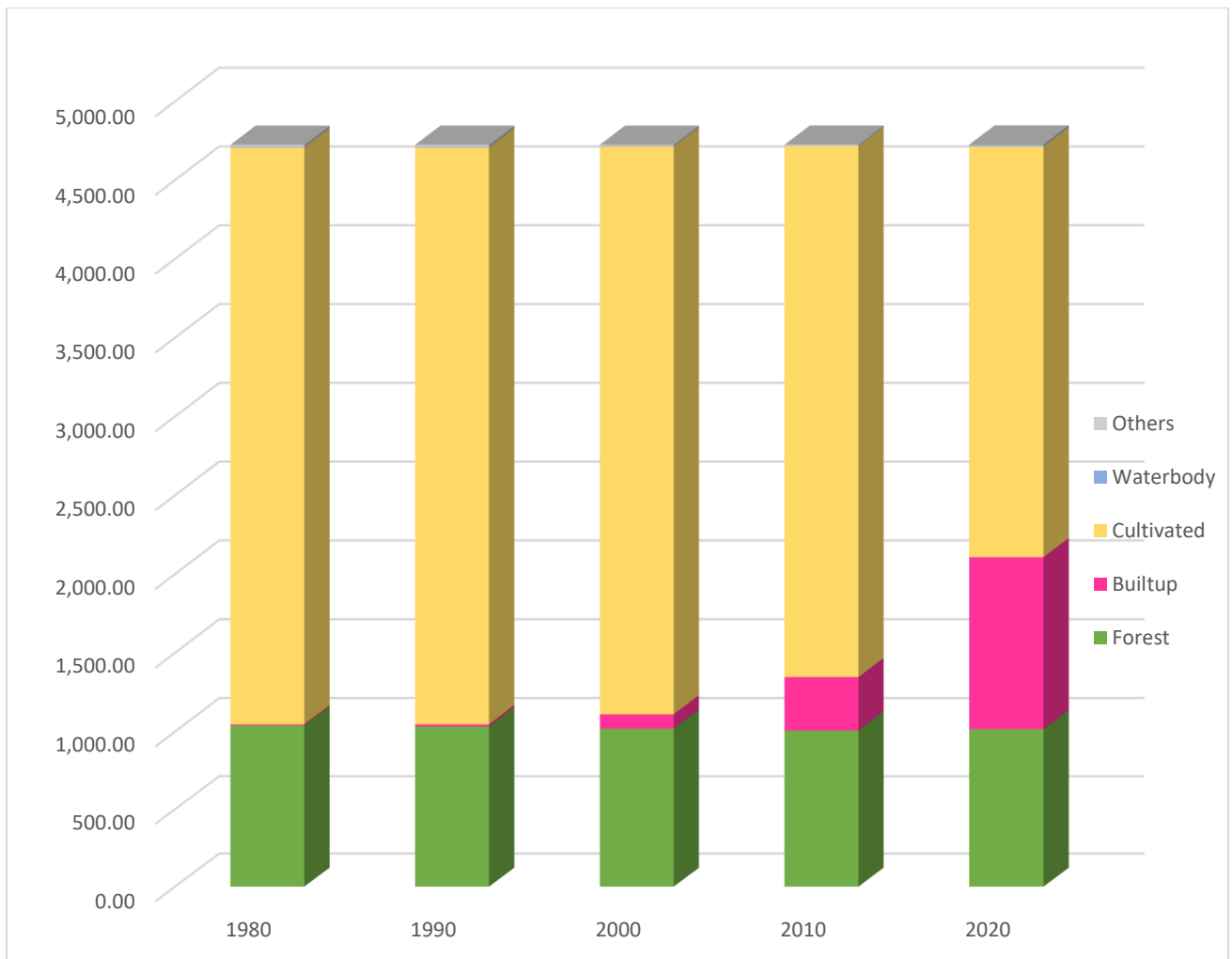


Figure 16: Temporal Change of Landuse (Area in Ha)

5.3.1 Landuse Changes in Different Municipalities within the Buffer Zone

The temporal land use composition inside the buffer zone is analyzed as per the municipalities inside the buffer zone to ascertain the urbanization trend. Figure 13 shows the temporal change in built-up and non-built-up areas inside the buffer zone. Hence, similar charts have been prepared for areas of buffer zone in each municipality to compare the urbanization rate among the municipalities.

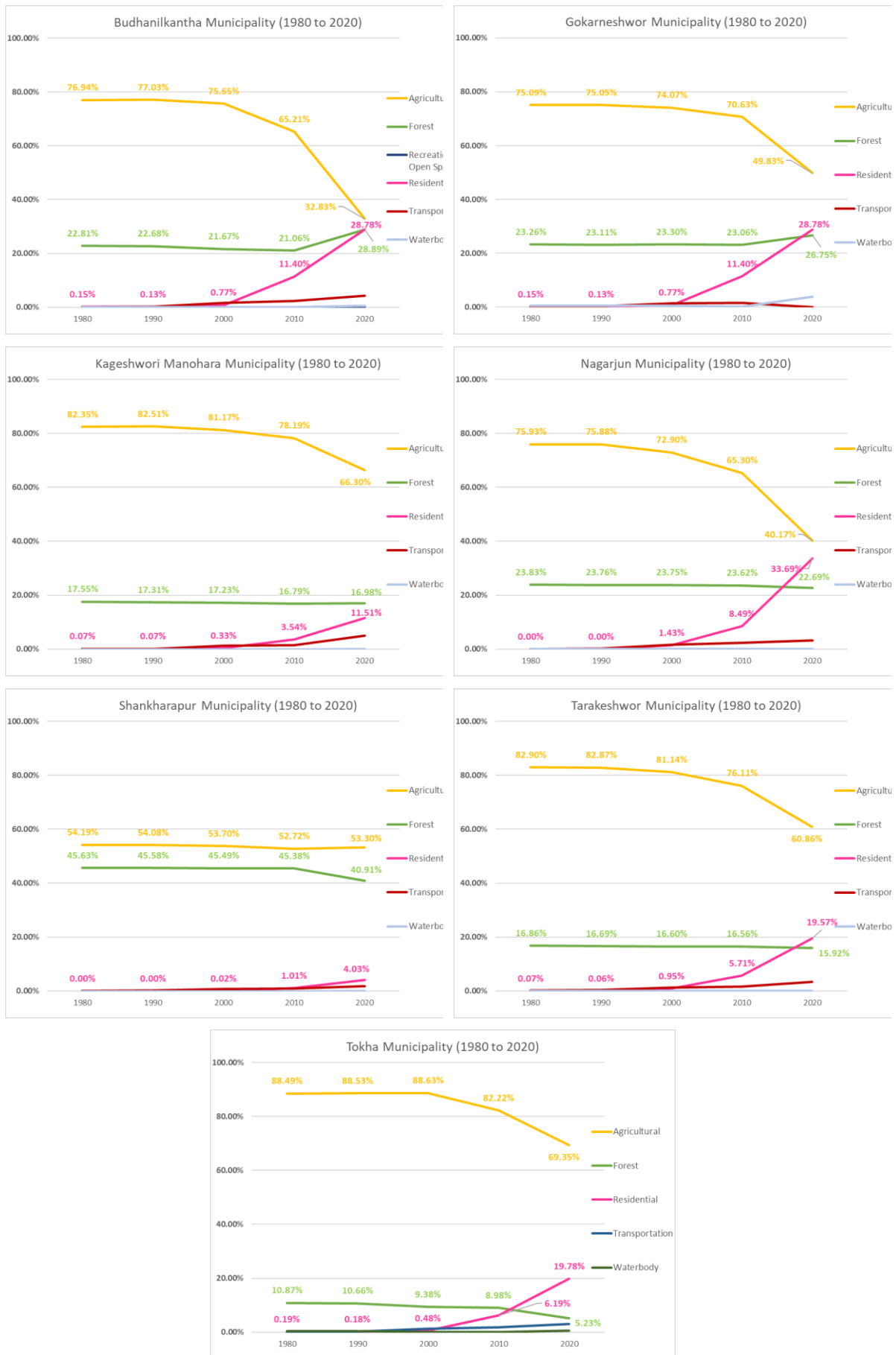


Figure 17: Land use change in the municipalities inside buffer zone of SNNP

The figure above shows the decadal change in landuse in the municipalities inside the buffer zone. Upon ranking the areas of municipalities in the buffer zone as per the decrease in agriculture use and increase in residential use, Nagarjun and Budhanilkantha municipalities seem to be the most urbanized among others and Shankharapur along with Tarakeshwor municipalities still have rural characters. Upon analyzing the charts above, the three municipalities Budhanilkantha (urbanized), Tarakeshwor (rural context) Municipality were selected for further detail study on the drivers of changes. However, those two municipalities represented the land use change scenario in extremes. So, Gokarneshwor municipality was also selected for further study as the municipality area inside the buffer zone is in urbanizing state i.e., in between the two extremes. The area of the municipalities inside the buffer zones are divided into different users' committees viz; area of Budhanilkantha municipality lies in Bishnu Chapali Users' Committee, area of Gokarneshwor municipality lies in Sundarijal Shivapuri Users' Committee and there are 2 users' committee in Tarakeshwor Municipality. For the further study, the area under Goldhunga Jitpur Users' Committee was preferred.

5.3.2 Landuse Changes in the Survey Area

For efficient management of the buffer zone of the national park, it is divided into 11 units of Users' Committee (UC) as per the Buffer Zone Management Regulation 2052 BS and Shivapuri Nagarjun National Park Buffer Zone Management Guideline 2073 BS. Each Users' Committee is further divided in several Users' Group (UG). The number of users' group in a users' committee depends on the population and geography area. UCs are responsible for preparing their operation plan of 5 years for implementing conservation programs in their area.

Table 10: Users' Committee of SNNP Buffer Zone

No.	Name of Users' Committee	Number of Users' Group	Population Covered	Current Municipality
1	Sundarijal - Shivapuri	42	4,869	Gokarneshwor Municipality
2	Chisapani – Shivapuri	20	5,680	Shivapuri Rural Municipality
3	Ichangu Narayan	33	4,737	Nagarjun Municipality
4	Kakani - Okharpauwa	27	5,032	Kakani Rural Municipality
5	Bishnu - Chapali	7	2,552	Budhanilkantha Municipality
6	Gurje - Bhanjyang	25	5,726	Shivapuri Rural Municipality
7	Ramkot - Bhimdhunga, Chattri Deurali	16	3,330	Dhunibesi Municipality
8	Manichud - Kageshwori	36	6,795	Kageshwori Manohara Municipality
9	Goldhunga - Jitpur	40	6,680	Tarakeshwor Municipality
10	Sindhu – Shivapuri	18	4,545	Melamchi Municipality
11	Boudeshwar Mahadev	32	6,510	Tarakeshwor and Tokha Municipality
	Total	296	56,636	

a) Bishnu Chapali Users' Committee

It occupies areas of Budhanilkantha Municipality (former Budhanilkantha VDC and Chapali Bhadrakali VDC). The landuse maps and composition of the area under this users committee is shown below:

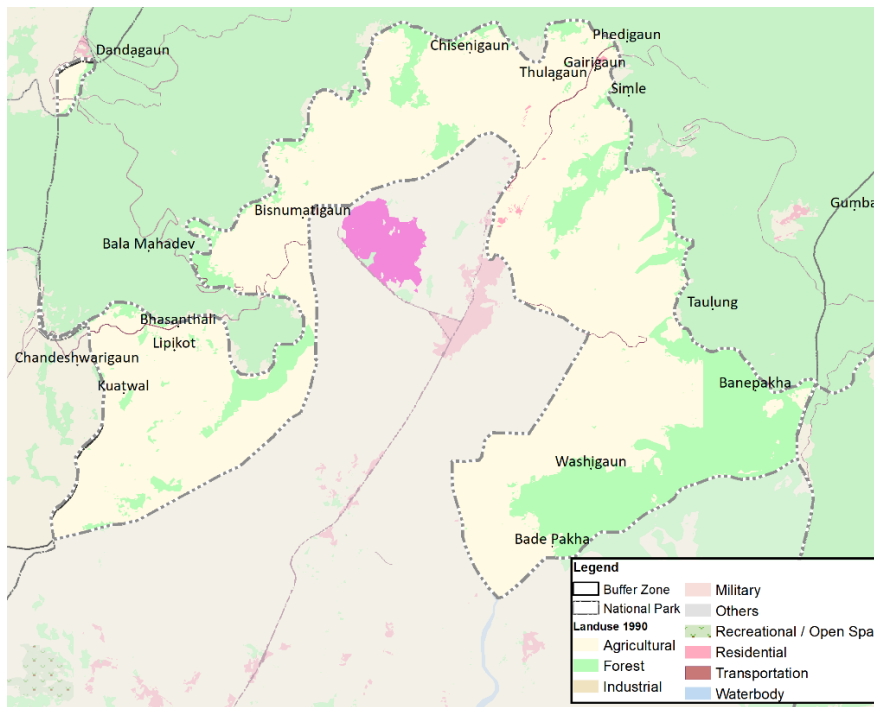


Figure 18: Land use Map of Bishnu Chapali UC, 1990

The map alongside shows some small patches of settlement in the buffer zone. Outside of the buffer zone has significantly large settlement patch near the Budhanilkantha Temple. The dominant landuse is agricultural (77%) followed by forest (22.68%). Built up (0.28%) is negligible consisting road and residential patches.

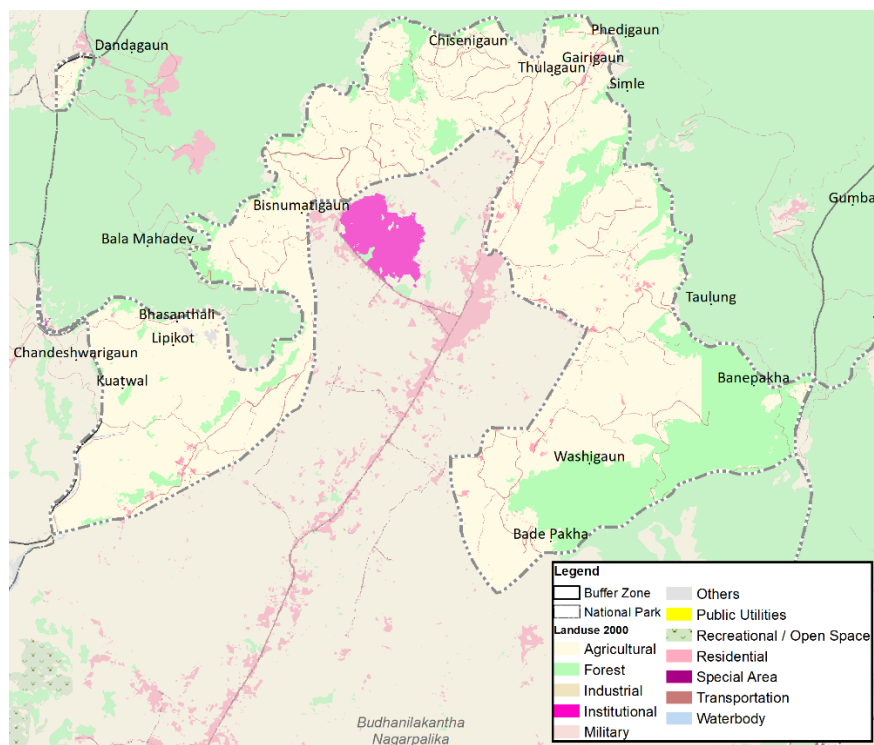


Figure 19: Landuse Map of Bishnu Chapali UC, 2000

In the next decade of 2000's, agriculture (75.65%) and forest (21.67%) dominate the land use composition. Linear patches of roads and numerous polygonal patches of residential areas have increased altogether contributing to 2.62% of built up area.

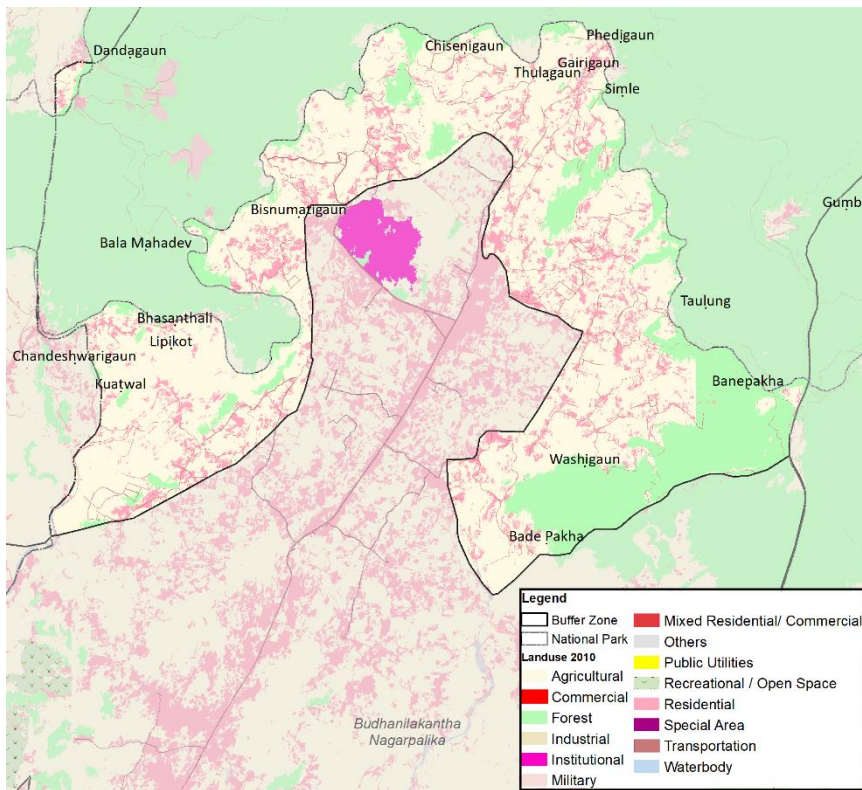


Figure 20: Landuse Map of Bishnu Chapali UC, 2010

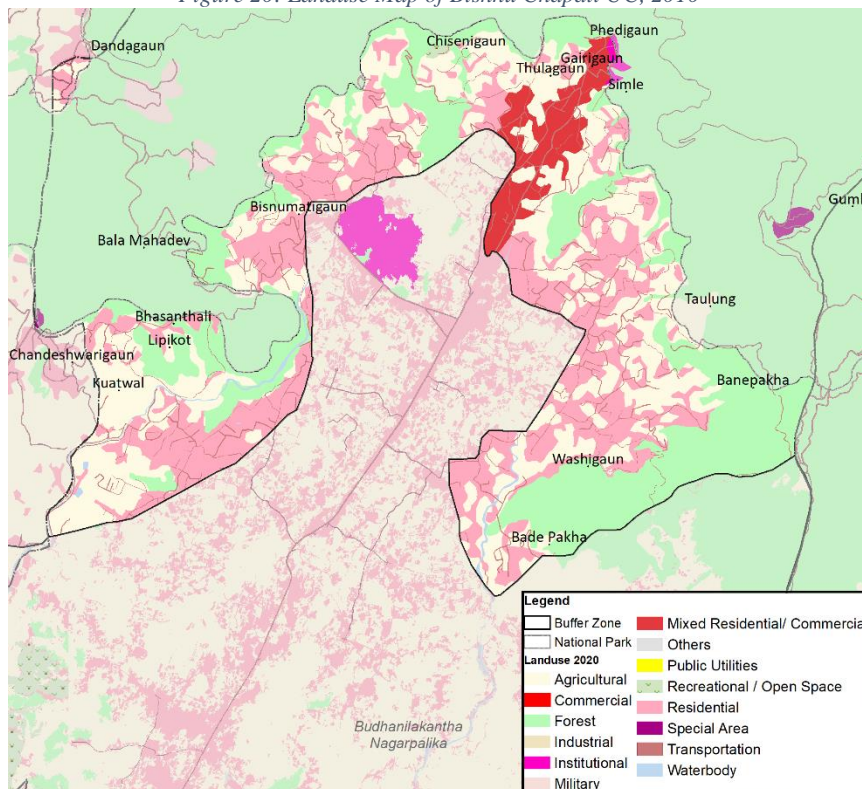


Figure 21: Landuse Map of Bishnu Chapali UC, 2020

The landuse map of 2010 shows that the agricultural area has decreased to 65.21% and increase in residential (11.4%) and transportation (2.28%) landuse. Between 2000 and 2010, settlement was developed along the road. The agricultural land converted to settlement with the development of road network.

Between the decade of 2010 and 2020, infill development took place in the study area to a great extent. The decline in agriculture land continued to 32.83% there by increasing the built-up area to 37.65% comprising transportation (4.22%) and residential (28.78%) uses.

b) Shivapuri Sundarijal Users' Committee

It occupies areas of Gokarneshwor Municipality (former Gokarneshwor VDC, Baluwa VDC, Nayapati VDC and Sundarijal VDC). The landuse maps and composition of the area under this users committee is shown below:

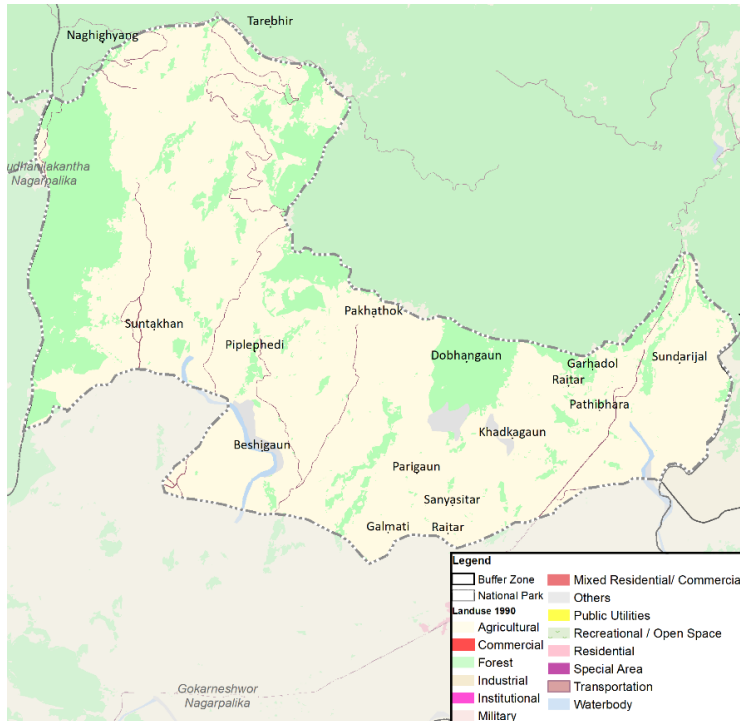


Figure 22: Land use Map of Shivapuri Sundarijal UC, 1990

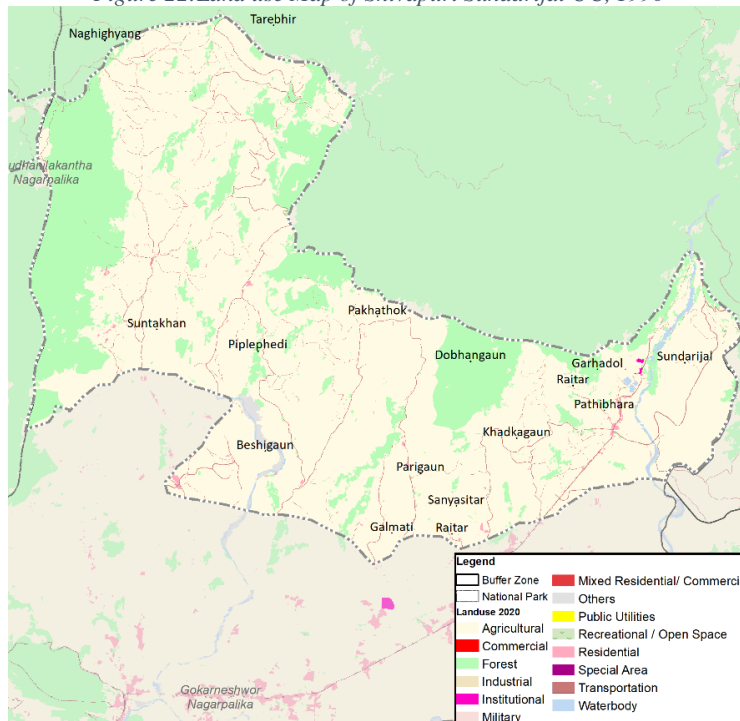


Figure 23: Landuse Map of Shivapuri Sundarijal UC, 2000

The map alongside shows some small patches of settlement in the buffer zone. Outside of the buffer zone small patches of settlement can be seen. The dominant landuse is agricultural (75%) followed by forest (23.26%). Built up (0.26%) is negligible consisting road and residential patches.

In the next decade of 2000's, agriculture (74.07%) and forest (23.30%) dominate the land use composition. Linear patches of roads and numerous polygonal patches of residential areas have increased altogether contributing to 2.11% of built-up area.

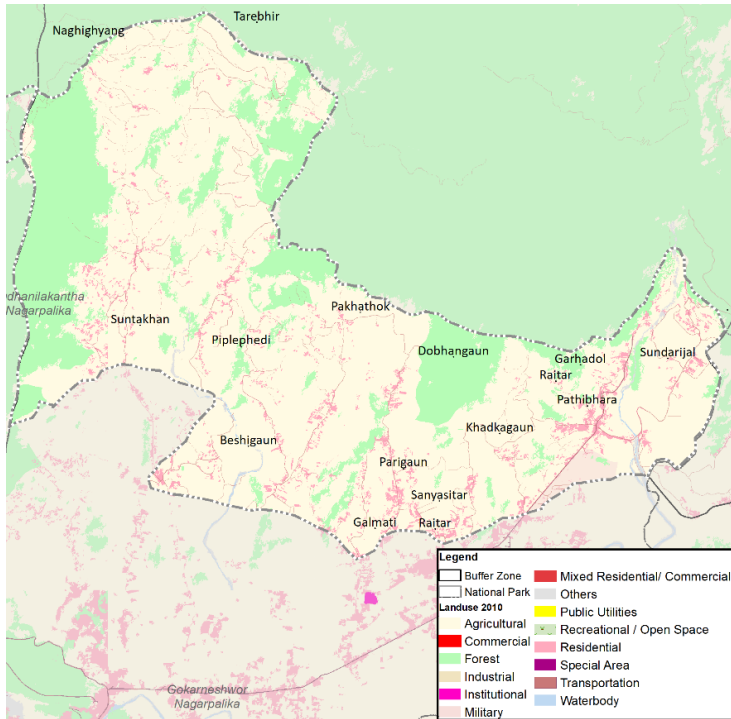


Figure 24: Landuse Map of Shivapuri Sundarrijal UC, 2010

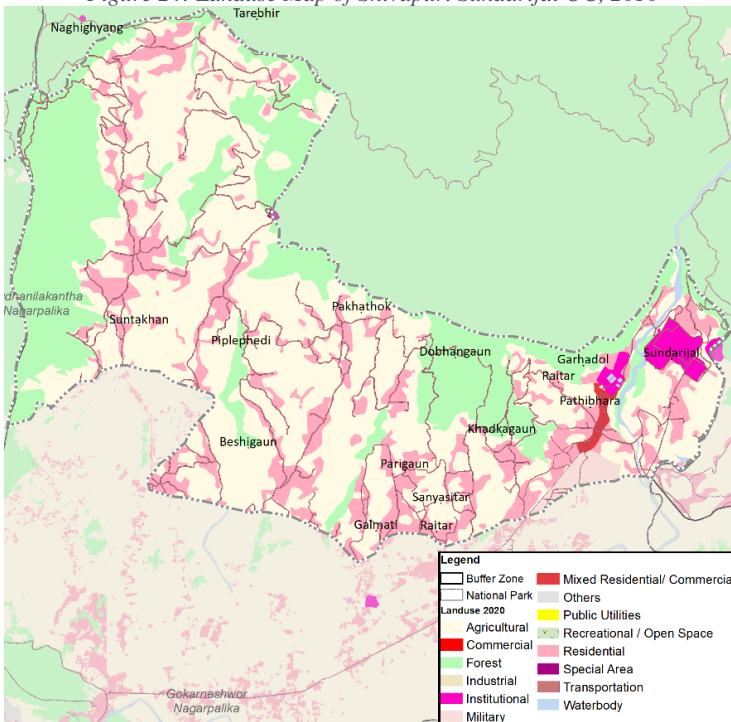


Figure 25: Landuse Map of Shivapuri Sundarrijal UC, 2020

The landuse map of 2010 shows that the agricultural area has decreased to 70.63% and there is increase in residential (3.32%) and transportation (1.6%) landuse. Between 2000 and 2010, settlement was developed along the road. The agricultural land converted to settlement with the development of road network.

Between the decade of 2010 and 2020, settlement expansion along the road took place in the study area to a great extent. The decline in agriculture land continued to 49.83% there by increasing the built-up area to 22.41% comprising transportation (3.83%) and residential (16.40%) uses.

c) Jitpur Goldhunga Users' Committee

It occupies areas of Tarakeshwor Municipality (former Jitpur and Goldhunga VDC). The landuse maps and composition of the area under this users committee is shown below:

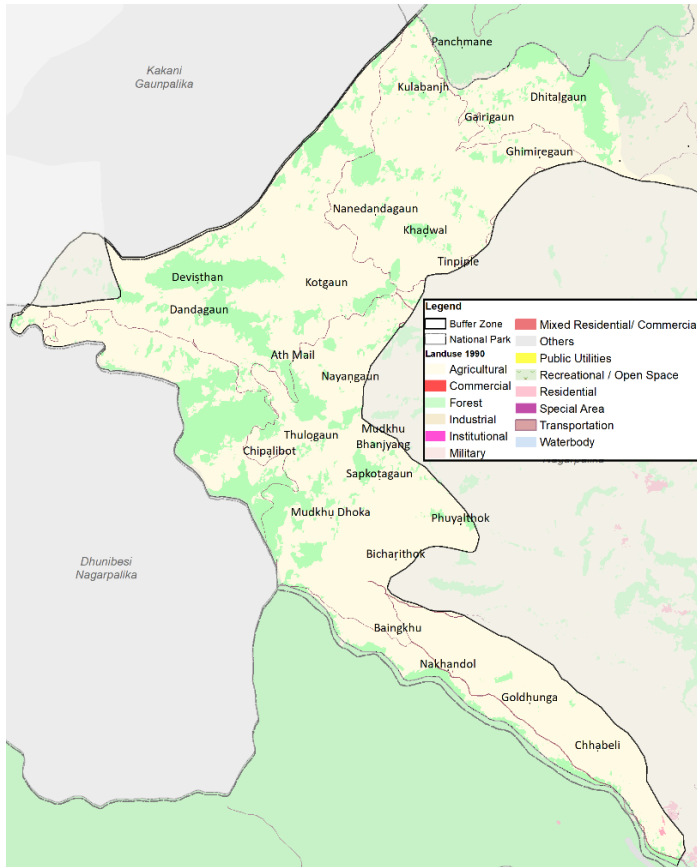


Figure 26: Land use Map of Jitpur Goldhunga UC, 1990

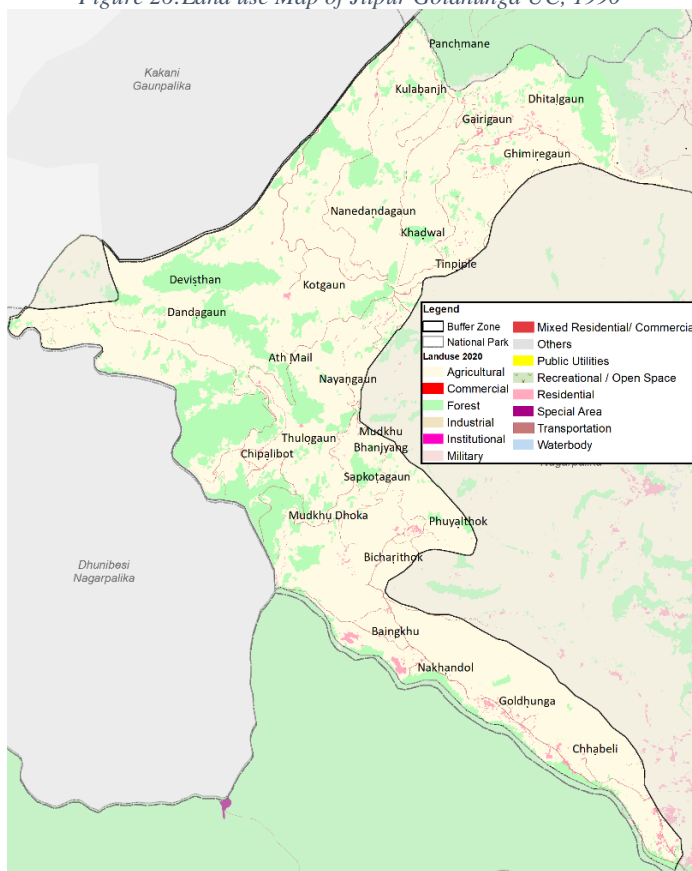


Figure 27: Landuse Map of Jitpur Goldhunga UC, 2000

The map alongside shows some small patches of settlement in the buffer zone. Outside of the buffer zone has traces of settlement patch can be seen. The dominant landuse is agricultural (79.5%) followed by forest (20.09%). Built up (0.41%) is negligible consisting road and residential patches.

In the next decade of 2000's, agriculture (77.78%) and forest (19.97%) dominate the land use composition. Linear patches of roads and numerous polygonal patches of residential areas have increased altogether contributing to 2.25% of built-up area.

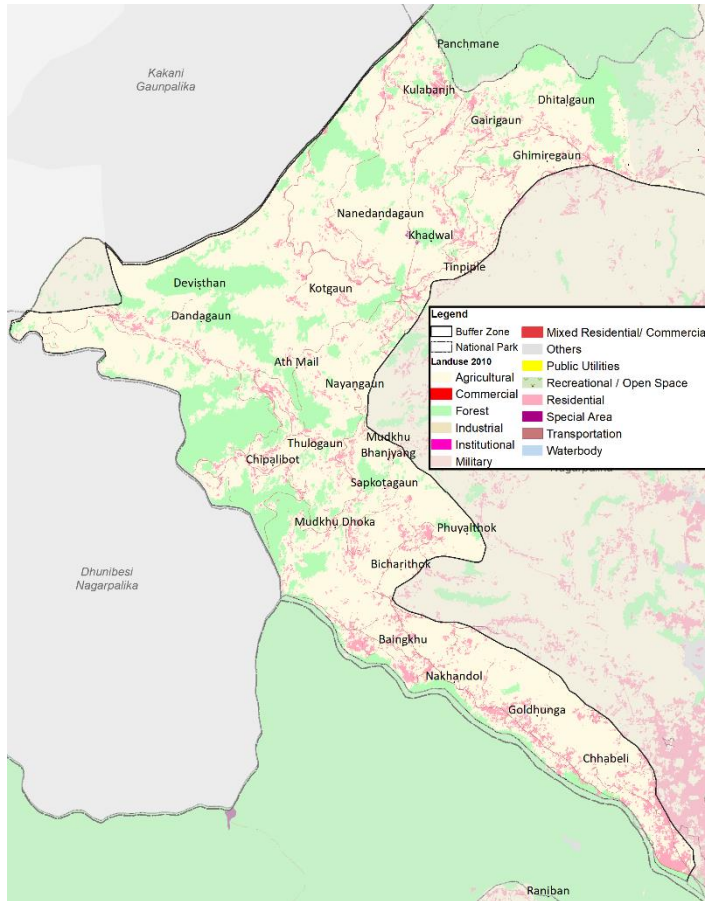


Figure 28: Landuse Map of Jitpur Goldhunga UC, 2010

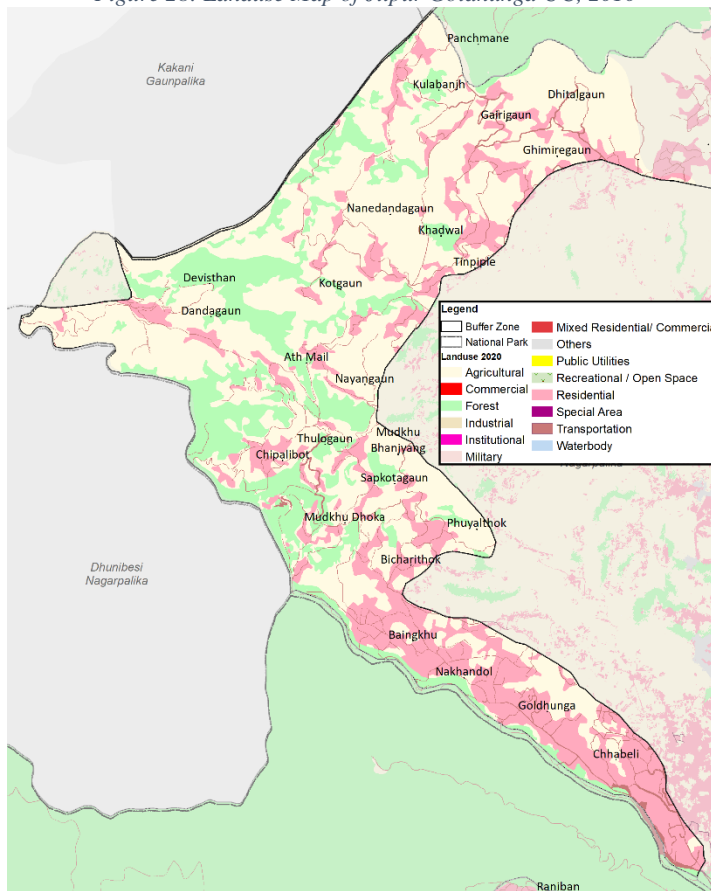


Figure 29: Landuse Map of Jitpur Goldhunga UC, 2020

The landuse map of 2010 shows that the agricultural area has decreased to 72.02% and increase in residential (6.39%) and transportation (1.67%) landuse. Between 2000 and 2010, settlement was developed along the road. The agricultural land converted to settlement with the development of road network.

Between the decade of 2010 and 2020, settlement expansion along the road took place in the study area to a great extent. The decline in agriculture land continued to 56.50% there by increasing the built-up area to 24.62% comprising transportation (3.36%) and residential (21.17%) uses.

5.4 Sample Household Survey

Out of the samples of the household survey, there were 72.35 % males and 27.65% females. Similarly, the most surveyed age group were 35-44. The total responses were calculated and the mean response of each question was calculated. The response higher than the mean response higher than the mean response were considered as the driver of land use change. The house hold survey was conducted in three different areas as per the users' committee of the buffer zone; Bishnu Chapali Users' Committee of Budhanilkantha Municipality, Sundarijal Shivapuri Users' Committee of Gokarneshowr Municipality and Goldhunga Jitpur Users' Committee of Tarakeshwor Municipality.

5.4.1 Family Size of Sampled Household

The average family size in the surveyed households were found to be 5.82, 5.62 and 5.73 in Bishnu Chapali UC, Sundarijal Shivapuri UC and Goldhunga Jitpur UC respectively. The chart below shows the distribution of family size in the sampled households.

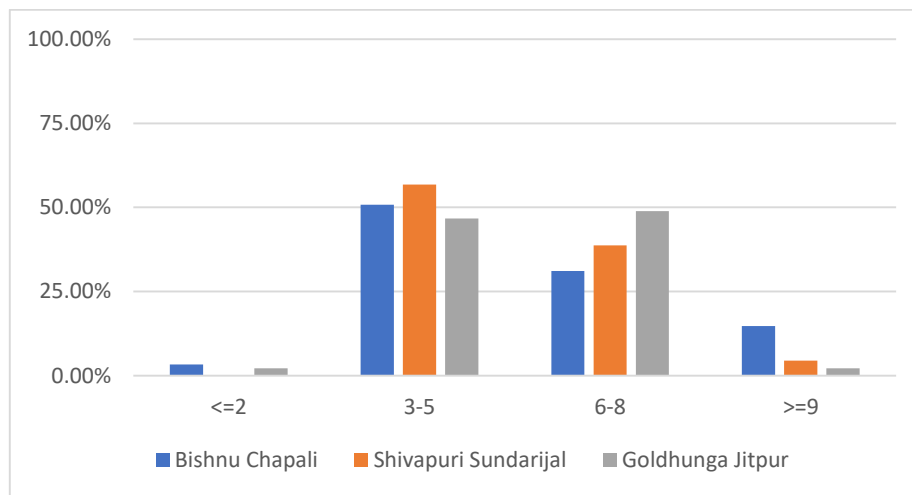


Figure 30: Family Size in Sampled Households

5.4.2 Period of Residence

The respondents were asked about the period of their residence in that location. Based on the sample survey, majority of the households were found to be residing for more than 20 years in all the survey areas. The data shows that the number of people residing for more than 20 years is highest in Goldhunga Jitpur area among others.

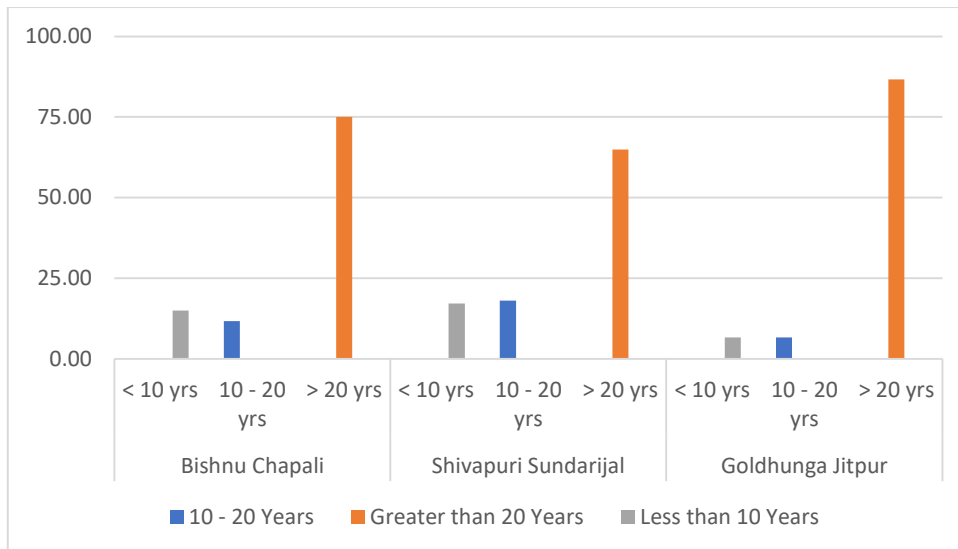


Figure 31: Period of Residence

5.4.3 Major Occupation

According to the sample household survey, most of the household in the study area are engaged in business followed by farming and private job. In Bishnu Chapali, Goldhunga Jitpur and Shivapuri Sundarijal area, about 32 %, 20% and 37% of sample household have business as major occupation. Among others, most of the respondents were housewives and some of them were unemployed.

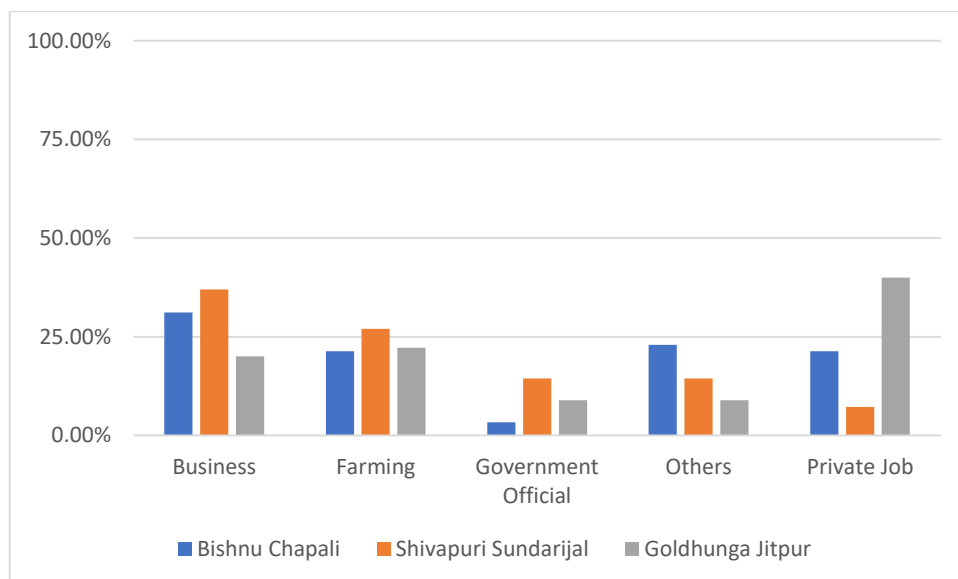


Figure 32: Major Occupation of the Household

5.4.4 Monthly Income

According to the sample household survey, most of the household (56.72%) in the study area have income of 25,000 or less followed by income between 25 and 50 thousand (32.34%) and least household (1.49%) have income greater than 100,000. In terms of monthly income, the economic condition of the two-survey areas is quite similar.

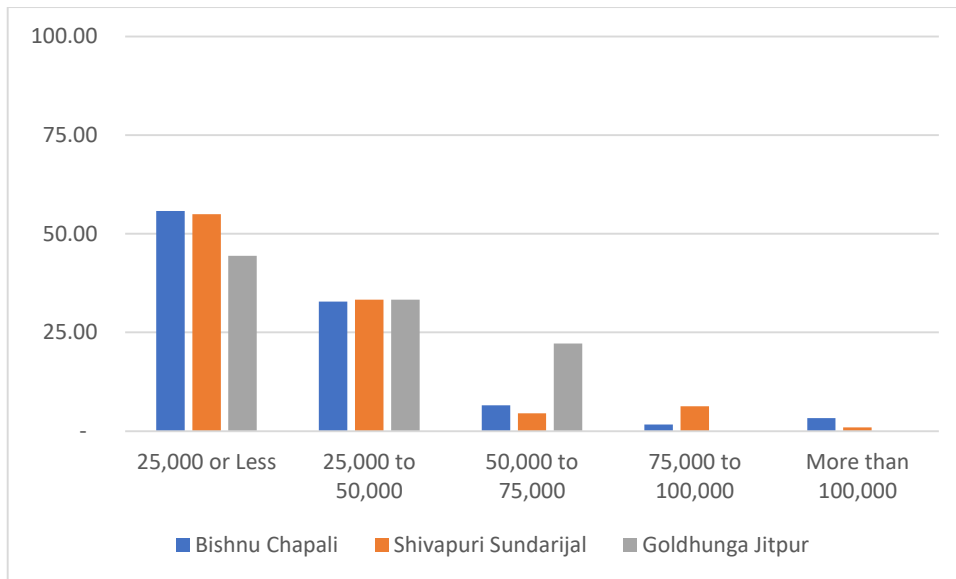


Figure 33: Monthly Income of Sample Households

5.4.5 Physical Reason to choose the Location

According to the sample household survey, it was observed that the physical reason to choose the location was found to be availability of road and availability water sources in all the surveyed areas.

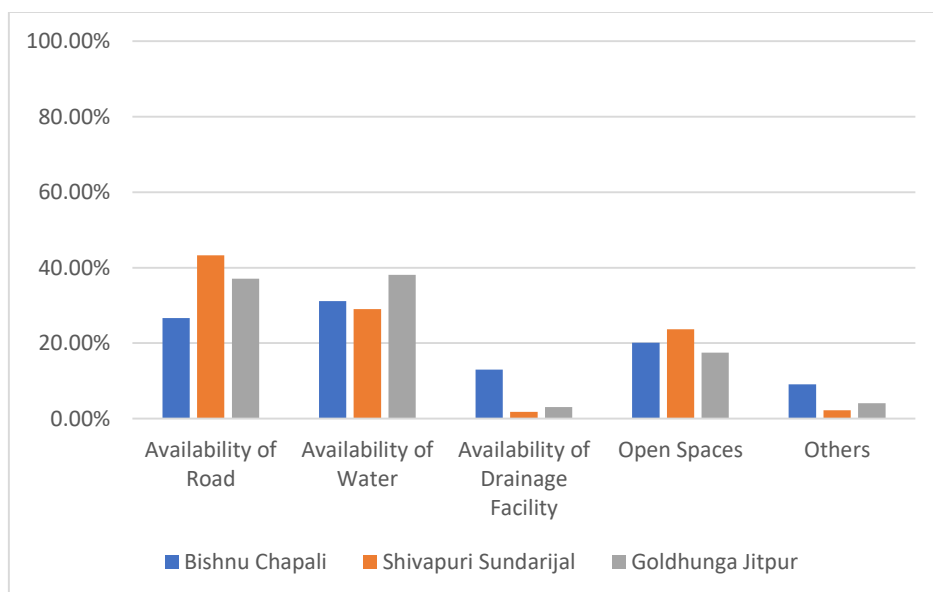


Figure 34: Physical Reasons to choose the Location

5.4.6 Economic Reason to choose the Location

According to the sample household survey, it was observed that the economic reason to choose the location was found to be economic opportunities and proximity to workplace in all the survey areas in totality. As for Goldhunga Jitpur area, the economic reasons to choose the location for residence is due to relatively low land price and affordability.

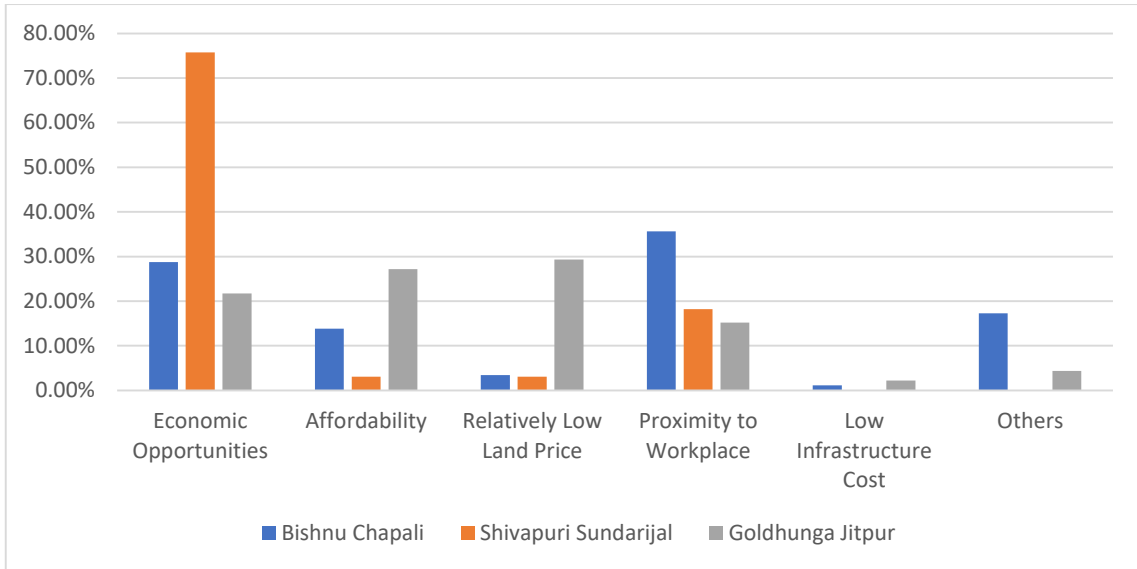


Figure 35: Economic Reasons to choose the Location

5.4.7 Social Reason to choose the Location

According to the sample household survey, it was observed that the social reason to choose the location was found to be availability of safety and security in both Bishnu Chapali Area and Shivapuri Sundarijal Area. Similarly, the social reason to choose the location for residence was presence of relatives and proximity health and education facilities in Goldhunga Jitpur area.

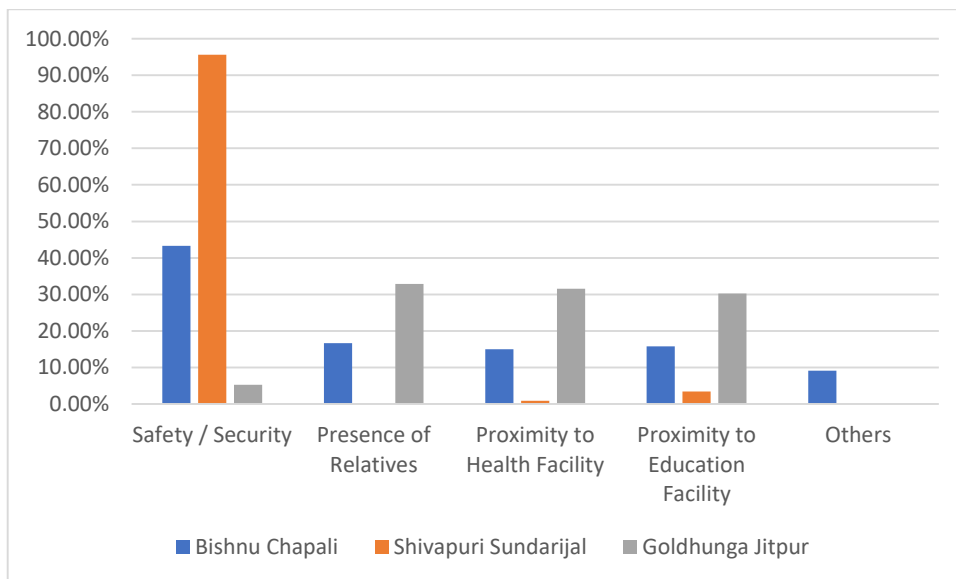


Figure 36: Social Reason to choose the Location

Table 11: Drivers of Landuse Change from HH Survey

	Reasons	Bishnu Chapali UC	Mean Responses	Shivapuri Sundarijal UC	Mean Responses	Goldhunga Jitpur UC	Mean Responses
Physical	Availability of Road	41	30.80	97	44.80	36	19.40
	Availability of Water	48		65		37	
	Availability of Drainage Facility	20		4		3	
	Open Spaces	31		53		17	
	Physical Others	14		5		4	
Economic	Economic Opportunities	25	14.5	100	22	20	15.33
	Affordability	12		4		25	
	Relatively Low Land Price	3		4		27	
	Proximity to Workplace	31		24		14	
	Low Infrastructure Cost	1		0		2	
	Economic Others	15		0		4	
Social	Safety / Security	52	24	110	23	4	15.20
	Presence of Relatives	20		0		25	
	Proximity to Health Facility	18		1		24	
	Proximity to Education Facility	19		4		23	
	Social Others	11		0		0	

From the table above, the response with greater frequency than the mean responses were identified as the drivers of land use change in that area. Hence, in all the survey area the physical drivers responsible for land use changes are availability of road, water supply and open spaces. Similarly, the economic drivers in Budhanilkantha (Bishnu Chapali UC) and Gokarneshwor (Shivapuri Sundarijal UC) municipality are proximity to work place and economic opportunities while that in Tarakeshwor municipality (Goldhunga Jitpur UC) are affordability and economic opportunities. Likewise, the social drivers of land use change are safety and security in Budhanilkantha (Bishnu Chapali UC) and Gokarneshwor (Shivapuri Sundarijal UC) and presence of relatives and proximity to health and education facilities in Tarakeshwor municipality (Goldhunga Jitpur UC).

5.5 Knowledge about Buffer Zone Management

5.5.1 Association to any Forest Users' Group /Committee

The respondents were asked about their association to any of the forest users' group or users' committee of the buffer zone to get idea about their awareness towards buffer zone in all the survey areas. The result showed that very few (15.67 %) were aware of the buffer zone community forest users' group or

committees. This shows that most of the respondents living in the buffer zone do not have knowledge about the buffer zone. This also reflects that there is huge communication gap between the SNNP office and the local residents. Also, provision of every household inside the buffer zone being the member of users' group (as per the management guideline of the buffer zone of SNNP) has also not fulfilled. However, more numbers of households of Goldhunga Jitpur area were aware of the provision of Users' Group/ Committee among others.

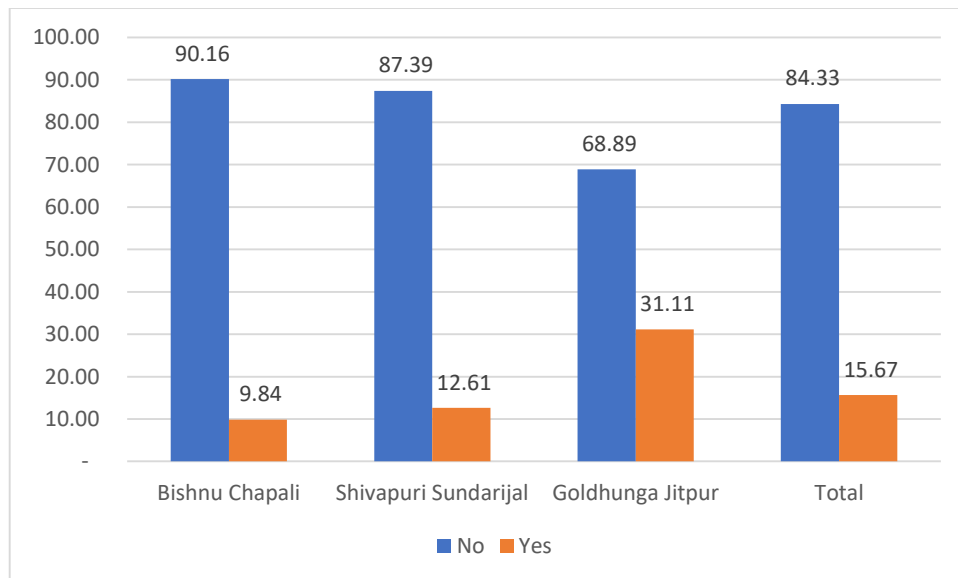


Figure 37: Knowledge about association to any Users' Group/ Committee

5.5.2 Advantages/ Disadvantages of being in the Buffer Zone

The respondents were asked if they had faced any benefits or difficulty to carry out any activities inside the buffer zone. Even though most of the respondents were unaware about their association to any buffer zone users' group or committees, about 50% of the respondents in the survey area responded that they face hinderance to use/extract the resources from their private land. Many of the respondents residing in the immediate boundary of national park told that they were not allowed to cut down tree of their own land. Some of the respondents said that they had to leave their agriculture fields (*bari*) vacant as the planted crops would be destroyed or consumed by the animals from the National Park before harvesting. Those who were aware of the legislations of buffer zone said that even for small works they need to visit the Park Head office at Panimuhan. They were not satisfied with the time-consuming administrative procedure. Some respondents revealed that they need not go very far to fetch grass, fodder and firewood.

5.5.3 Physical Changes on Land in the Past

The respondents when enquired about activities performed in the past 10 or 20 years that have caused physical changes on land, majority of respondents of Shivapuri Sundarijal area (79.28%) and Goldhunga Jitpur area (62.22%) have developed their land and constructed building in the past 10 years. Very few respondents in Goldhunga Jitpur area (16.67%) have constructed agriculture farm in their

lands. While in Bishnu Chapali, only 18.33% of the respondents have constructed building in the past 10 years.

The respondents were also asked if they encountered any hindrances from any organizations such as municipality office, National Park office etc. while making any physical changes on their land. Most of the respondents (approx. 90%) had not any encountered interferences of any sorts by any organizations. Remaining 10% of the respondents said that they had to take permissions from the National Park first before making any physical changes on their land as their land was bounded by government or unclaimed land (*Parti*). Some of the respondents needed to take permission from the Users' Committee to cut down tree in their own land.

5.5.4 Perception towards Buffer Zone delineation

The respondents were required to give their view on the inclusion of their respective area under buffer zone of the National Park. Among three survey areas, most of the people (78.69%) in Bishnu Chapali UC area were unhappy with the delineation of Buffer Zone in their area. However, in the other two i.e., Sundarijal Shivapuri and Goldhunga Jitpur UC area, almost 100% of the respondents were positive about their inclusion in the buffer zone.

On being asked about the reasons for their response, almost every dissatisfied respondent had faced problem in extracting resources from their private land. Some had the complaints about the administrative procedures for getting permission to make changes in their land, compensation against damaged house, shed, crops. However, the positive respondents were aware of the ecological and economic benefits of National Parks and shed its importance to the people, wildlife and environment itself. Being in the buffer zone of National Park, has enhanced the tourism potential of the area and has generated economic opportunities to the residents.

CHAPTER 6 FINDINGS AND CONCLUSIONS

Based on the study and review of the prevailing legislations, analysis of temporal land use of the buffer zone and house hold survey, the study has drawn the following conclusions:

- The acts, policies, guidelines and directives prepared by the government for management of buffer zones have the major objective of conservation of forest area and thereby conserving biodiversity. From analysis of decadal land use change in the buffer zone it has been found that the area of forest in the buffer zone has not depleted in a great deal. The forest area had 22.01% coverage in 1980, 21.86% in 1990, 21.57% in 2000, 21.33% in 2010 and 21.50% in 2020 in the buffer zone. The small decrement in the forest area must be due to development of road network to provide accessibility to the park. Hence, the legislations have been effective in fulfilling their objectives.
- The buffer zone has been affected by the urbanization of Kathmandu Valley; the built-up area has increased rapidly from 7.2% in 2010 to 23.02% in 2020 in the buffer zone with decrease of agricultural land by 16% during the last decade. During the same period Kathmandu Valley also observed increase in built up area from 14.37% to 28.31% in the expense of decrease of cultivable land from 46.54% in 2010 to 26.66% in 2020 (Thapa & Joshi, 2021). The spatial growth trend of built-up area is sprawling pattern in the buffer zone.
- One of the physical drivers of land use change were found to be the availability of road in the buffer zone from the sample house hold survey. This can be validated by analyzing the trend of development of road network and residential development in the buffer zone. The land use composition shows that acreage of road network increased to 3.5% in 2020 from 1.31% in 2000. In the same duration the, acreage of residential area increased to 19.14% in 2020 from 0.61% in 2000.
- Regarding the drivers of land use change, availability of roads and water supply, proximity to workplace, education and health facilities have been identified in the study area from sample household survey. The responses do not reflect the dependence on forest products of the park unlike found in similar studies conducted previously in Chitwan, Bardiya and Sagarmatha National Park. Being close to the core city of Kathmandu, the residents in the surveyed area have abandoned the traditional way of life. In the past, the residents used to extract firewood, timber and fodder for cattle from the nearby forest. However, in recent times petroleum gas has replaced firewood as cooking fuel and raising cattle in individual houses has been abandoned
- The sample household survey has revealed that very few (15.67%) are aware of the buffer zone and its provisions. This shows that the users' committee and users' group of the buffer zone have not been engaged in raising awareness among the residents and the process of formation of users' group of the buffer zone has not been participatory. However, as per the buffer zone regulation every household inside the buffer zone must be the member of any one users' group.

- The residents of the surveyed area have responded that buffer zone has more disadvantages than advantages. The major concern of the residents is that they have too many restrictions to use resources inside the buffer zone even in their private land. The act has clearly mentioned that the property rights of the residents inside the buffer zone will not be hampered. Respondents also had discontent due to destruction of crops by the wildlife from the National Park. Even though there are provisions for compensation against damage caused by wildlife in the legislations, there were complaints on the administrative procedures and time consumed to receive the compensation.
- There is no coordination among the SNNP office and municipality office for restricting developments in the buffer zone of the park. According to Mr. Manjit Bista, Planning Officer of SNNP office, there is no close coordination among the municipality office and the SNNP office. He also told that SNNP office has received less support from the local residents enforcing buffer zone regulations. He added that the leadership of municipality have shown less interest in conservation of National Parks.

CHAPTER 7 RECOMMENDATIONS

Based on the findings of the study report, the following are the recommendations for the study area:

- The buffer zone of the National Park has been heavily affected by the urbanization of Kathmandu Valley. The development pattern of settlements in the buffer zone is sprawling. Hence, there is an urgent need to prepare land use plan of Kathmandu Valley in coordination with the individual municipalities and its enforcement. The plan should be prepared with special provisions for the buffer zone. Land use that are compatible to wildlife conservation such as ecotourism, conservation agriculture, Watershed management for water quality and soil conservation. Such plans have been prepared in the past, but were not implemented. Enforcement of land use plan of KV with provisions of planned development reduces the development pressure in the areas adjacent to the National Park and Buffer Zone. Also, to ensure coordination among the governing bodies their involvement in formulation of the plans is necessary.
- The municipalities lying in the buffer zone have not prepared building bye laws. There is an utter need to prepare building bye laws in coherence to the land use plan. The provisions of restricting construction high rise buildings in the buffer zone, minimizing ground coverage to 25 to 30% should be included in the building bye laws. Promotion of green buildings should be provisioned in the buffer zone.
- The delineation of buffer zone should be based on scientific studies about the type of threat posed to the ecology and biodiversity by the external environment. As previously mentioned in Biosphere Reserve Model of buffer zone planning, the core area of the park should be protected by outer layers of restrictive uses. The level of restriction should be in decreasing order with increasing distance from the core area. Such method has been previously adopted in planning of buffer zone in Germany, Austria, Canada, Sweden and Switzerland (Ruoss, 2013).
- In the longer term, a policy should be formulated to acquire land in the buffer zone. The land lying in the immediate boundary of the National Park which has still not been converted to builtup area should be prioritized for acquiring. Compensation to the land owners should be provisioned while acquiring land.

Alongside the above, enforcement of regulations to control informal land developments in the steep slopes of the buffer zone should be strengthened to minimize the threat of disasters. The use of conservation easements could also be fundamental for protecting land from incompatible developments.

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ANNEX 1- HOUSEHOLD SURVEY QUESTIONNAIRE

TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

DEPARTMENT OF ARCHITECTURE

PULCHOWK CAMPUS, LALITPUR

HOUSE HOLD SURVEY QUESTIONNAIRE

Study of Landuse Change in the Buffer Zones of Protected Area; Case of Shivapuri

Nagarjun National Park, Kathmandu Valley

NOTE: The information that you will give here will be used strictly for academic purposes and will be treated with high confidentiality. Your assistance will be greatly appreciated.

Name of surveyor:

Name and Address of Respondent:

1. Age of Respondent: 18-24 25-34 35-44 45-54
 55-64 65 or older
2. Gender of Respondent: Male Female Others
3. Household size:
4. How long have you been staying in this location?
 <10 years 11 -20 years >20 years Owner Occupier
5. Occupation:
 Business Private Job Government Official Farming
 Others
If others, please specify:
6. Income:
 25000 or less 25001-50000 50001-75000 75001-100000
 More than 100000
7. What are the physical reasons to choose this location?
 Availability of Road Availability of Water
 Availability of Drainage Open space Others
If others, specify:
8. What are the economic reasons to choose this location?
 Affordability Relatively low Land Value Economic opportunities
 Proximity to job Low infrastructure development cost
 Others

If others, specify:

9. What are the social reasons to choose this location?

- Safety/ Security Presence of relatives Proximity to education facility
- Proximity to health Other facilities

If others, specify:

10. Are you associated with any of the Users' Group and Users' Committee of Buffer Zone Community Forest? (If yes, please specify)

.....

11. What provisions of the Buffer Zone legislation have you utilized?

.....

.....

.....

.....

12. What physical changes have you made in your land? (E.g., Land Development, Building Construction, Forest Clearance and so on)

Last 10 Years	Last 20 Years

13. Did you encounter any problems in making any changes in this piece of land from any organization?

.....

.....

.....

.....

14. Do you think this area should be in the buffer zone? Why?

.....

.....

.....

ANNEX 2-KEY INFORMANT INTERROGATION QUESTIONNAIRE

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
DEPARTMENT OF ARCHITECTURE
PULCHOWK CAMPUS, LALITPUR

KEY INFORMANT INTERROGATION QUESTIONNAIRE

**Study of Landuse Change in the Buffer Zones of Protected Area; Case of Shivapuri
Nagarjun National Park, Kathmandu Valley**

NOTE: The information that you will give here will be used strictly for academic purposes and will be treated with high confidentiality. Your assistance will be greatly appreciated.

Department of National Park and Wildlife Conservation

Name of Respondent	Contact no
.....
Job position	Professional background
.....

1. How have you conceptualized a Buffer Zone in the National Park?

2. What are the parameters for declaring an area as Buffer Zone? How are they quantified?

3. Are the intended objectives of the Buffer Zone achieved?

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PULCHOWK CAMPUS, LALITPUR

KEY INFORMANT INTERROGATION QUESTIONNAIRE

**Study of Landuse Change in the Buffer Zones of Protected Area; Case of Shivapuri
Nagarjun National Park, Kathmandu Valley**

NOTE: The information that you will give here will be used strictly for academic purposes and will be treated with high confidentiality. Your assistance will be greatly appreciated.

Shivapuri Nagarjun National Park, Head Office

Name of Respondent

Contact no

.....

Job position

Professional background

.....

1. What are the roles of SNNP office in brief?

2. Which land use activities have been/are being carried out in the Buffer Zone and what are their causes?

3. What urban related problems have/are being experienced while promoting conservation in the area?

4. Who has been responsible for the uncontrolled development in the area?

5. Do you have consultations with this authority concerning the developments? If yes, what have been the achievements of these consultations towards enhancing conservation?

6. What is your organization doing in the area towards solving the conservation challenges posed by the changing land uses in the area?

7. What difficulties are being experienced by the organization in addressing these challenges?

8. What can you suggest as the better policy intervention towards managing these challenges posed by urban population growth and land use changes?

9. Which department/organization should be responsible for this to succeed?

10. What roles should these departments play in the new set up?

11. Can the area of buffer zones be sub divided into different bands? If yes, have we differentiated in SNNP? If not why?

12. What differentiates SNNP from other National Parks in terms of its management guidelines and directives?

13. How does the SNNP communicate with the Users' Group/ Users' Committees?

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KEY INFORMANT INTERROGATION QUESTIONNAIRE

**Study of Landuse Change in the Buffer Zones of Protected Area; Case of Shivapuri
Nagarjun National Park, Kathmandu Valley**

NOTE: The information that you will give here will be used strictly for academic purposes and will be treated with high confidentiality. Your assistance will be greatly appreciated.

Buffer Zone Community Forest Users' Committee

Name of Respondent	Contact no
.....
Job position	Professional background
.....

1. When was the Users' Committee formed?

2. What are its roles and responsibilities?

3. Have you felt any advantage/limitations being in the buffer zone?

4. What urban related problems have/are being experienced while promoting conservation in the area?

5. What major activities on landuse changes have you observed since the formation of Users' Committee? Were they intended as per the buffer zone management guidelines and working plan of the Users' Committee?

ANNEX 3-SITE PHOTOGRAPHS