

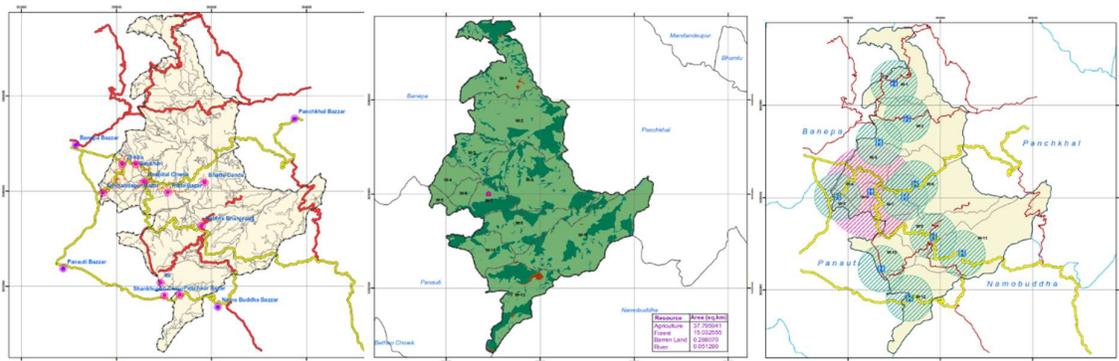


Government of Nepal

Dhulikhel Municipality

INTEGRATED URBAN DEVELOPMENT PLAN OF DHULIKHEL MUNICIPALITY

Volume 2: Physical Development Plan



2019



Submitted By:

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Executive Summary

The Integrated Urban Development Plan (IUDP) for Dhulikhel is a strategic response to the 20-year growth of Dhulikhel Municipality, which brings together infrastructure provision, environmental management, economic growth, disaster preparedness, municipal service delivery and mainstreaming gender equality and social inclusion. This “whole of Council” strategic plan will deliver on the long-term vision of Municipality:

A prosperous, well governed and model town Dhulikhel

based on culture, heritage, tourism and environmentally friendly sustainable development.

Located 30 kilometres east of Kathmandu, Dhulikhel Municipality is blessed with a diverse and vibrant community, high quality environmental assets including clean air and water, spectacular view, rich built and cultural heritage, major institutions with Kathmandu University and Dhulikhel Hospital, agricultural production and a burgeoning tourism industry.

However, the Municipality is facing a number of challenges. This includes: an emerging low density and scattered settlement pattern in the rural wards with poor access to essential social and physical infrastructure; rapid urban development at a rate that is not supported by key infrastructure; fragmented agricultural land which is becoming urbanized; and prioritization of infrastructure. Analysis of physical infrastructure indicate critical problems in water supply management and solid waste management which requires immediate attention.

Observations in the field reveal housing outside, or on the edge of, urban areas being constructed without the provision of constructed roads, drainage, water and sewerage services. This reveals a disconnect between development approvals and infrastructure planning.

It appears that, in many cases, development is not occurring in sequential and planned way and that the provision of infrastructure to support the development is being provided in a reactive way, which is expensive to the community and financially and environmentally unsustainable.

Through research and community engagement, the IUDP includes analysis, strategic policy and practical actions to improve physical infrastructure, social infrastructure, risk sensitive land use, environment management at town level with proposals for capacity building and institutional strengthening of municipal authority. The IUDP also focuses on improving the conditions of women, the poor and the excluded by undertaking a community development program and gender equality and social exclusion (GESI) activities through the Social Development Plan.

The IUDP, presented in 16 volumes, also covers institutional and technical issues. The report provides comprehensive details on: urban management, institutional development; physical development planning, social development planning, economy, environment, institutional and financial planning along with social impacts and poverty; gender and social inclusion; and the subproject resettlement plans and disaster risk reduction. Based on the immediate needs of the municipality, short term plans and long-term plans have been developed which will support Dhulikhel’s growth.

In the preparation of the IUDP project, the most pressing needs of the Dhulikhel Municipality have been identified. Analysis was carried out for physical infrastructure, social infrastructure, economy and disaster management and provide priorities for short, medium and long-term needs of the Municipality.

While generally the spatial distribution of health and education facilities show good coverage, connectivity in rural wards needs to be improved through upgrading existing road networks. Likewise, disaster management is another critical issue demanding a strategic response.

Critically, the IUDP provides a new framework to manage the urbanization of Dhulikhel, while protecting its agricultural, environmental and cultural assets. This will be in the form of new processes for the Municipality, including land use zoning and by-laws, and clear processes to better link land development, community needs and the provision of infrastructure.

The IUDP:

- Sets out the planned urban expansion of Dhulikhel in three key areas to accommodate residential, tourism and commercial growth over the coming 20 years.
- Supports more intensive development around the commercial centres (chowks) that supports existing private and public investment.
- Identifies key road, water and sewerage infrastructure to support the growing community over the next 20 years.
- Identifies key road connections between the Rural wards (in particular Wards 1 and 2) to facilitate access to schools and health services.
- Establishes Land Use Zonings, based on economic, physical attributes and disaster risk management principles, which will support good decisions, guide development in strategically suitable locations and support Dhulikhel's agriculture sector.
- Identifies opportunities to support the growth in tourism and protection of heritage and environmental assets for existing and future generations.
- Identifies priority projects to be undertaken by the Municipality over the coming 5 years to support the delivery of the IUDP, supported by a financial plan.

The IUDP introduces new land use zoning and by-laws which provides for strategically-driven decision making and sustainable development of Dhulikhel into the long term.

Implementation of the actions within the IUDP from all part of the organization is critical to the success of Dhulikhel's future.

The IUDP consists of the following Volumes:

- Volume 1 Background Report
- Volume 2 Physical Development Plan
- Volume 3 Land Use and Zoning Plan
- Volume 4 Social Development Plan
- Volume 5 Economic Development Plan
- Volume 6 Environment Management Plan
- Volume 7 Conservation, Culture and Tourism Plan
- Volume 8 Municipal Transport Management Plan
- Volume 9 Disaster Risk Reduction Plan
- Volume 10 Consolidated Implementation Plan
- Volume 11 Financial and Organisation Plan
- Volume 12 By-Laws
- Volume 13 Municipal profile
- Volume 14 Feasibility Study – Waterfall Construction in Ward 1
- Volume 15 Pre-Feasibility Study – Artificial Lake in Wards 7 and 8
- Volume 16 Feasibility Study – Walking Trail in Wards 7 and 8

Table of Contents

1. Municipal Vision	10
1.1 Long Term Vision	10
2. Sectoral Goals and Objectives	11
3. Physical Development Plan	13
3.1 Objectives	13
3.2 Structure of Physical Development Plan	14
4. Strategies for productive activities and land use	16
4.1 Activity Centres	16
4.1.1 Policies/strategies	17
4.2 Residential - Land Supply and demand for residential land	18
4.2.1 Population estimates and trends	18
4.3 Agriculture	21
4.3.1 Issues	21
4.4 Industry	23
4.4.1 Policies/strategies	23
4.4.2 Proposed	24
5. Linkages	25
5.1 Linkage (Connectivity) of Dhulikhel Municipality	25
5.1.2 Intra-linkage	26
5.1.3 Policies/Strategies	28
6. Physical Infrastructure	30
6.1 Water supply	30
6.1.1 Existing Water Supply	30
6.1.3 Recommended actions	32
6.2 Sanitation and Wastewater	32
6.2.1 Existing situation	32
6.2.2 The solution	33
6.2.3 Policies/Strategies	33
6.3 Irrigation	35
6.3.1 Existing scenario	35
6.3.2 Challenges	35
6.3.3 Strategies/Interventions	35

6.4	Electricity and Communication	36
6.4.1	Electricity	36
6.4.2	Communications	37
7.	Risk Sensitive Land Use Plan	38
7.1	Scattered Development	38
7.2	Accessibility	40
7.3	Natural Hazards/Disaster	40
7.3.1	Earthquake Risk Areas	41
7.3.2	Landslide Susceptible Areas	43
7.3.3	Flood Prone Areas and Flood Plains	44
7.3.4	Industrial area and Environment sensitive areas	45
7.4	Hazard Map Compilation	46
7.5	Implications of Hazards in Land Use Planning	46
7.6	Land use, strategies and policies towards risk reduction:	47
8.	Land Capability of the Municipality	48
9.	Existing Land Use	49
10.	Dhulikhel’s Land Use Plan	51
10.1	Activity Centres	51
10.2	Tourist Development Area	53
10.3	Institutional areas	53
10.4	Residential	54
10.5	Industry	57
10.6	Agriculture	57
11.	Physical Development Plan Implementation Plan	58

LIST OF FIGURES

Figure 1: The Structure of Physical Development Plan	14
Figure 2: Random Urbanization areas	21
Figure 3: Agricultural map	22
Figure 4: Proposed Industrial Scenario	24
Figure 5: Inter-Linkage map	26
Figure 6: Intra-Inter Linkage map	27
Figure 7: Service Road map (I)	28

Figure 8: Service Road map (II).....	29
Figure 9: Possible Coverage Expansion of Water Supply.....	31
Figure 10: Existing/Proposed Wastewater Drainage Networks.....	34
Figure 11: Electricity Map.....	37
Figure 12: Settlement map.....	39
Figure 13: Population Density map.....	40
Figure 14: Earthquake Risk Areas.....	41
Figure 15: Damage Assessment map.....	42
Figure 16: Landslide Prone Areas.....	43
Figure 17: Flood Prone Areas.....	44
Figure 18: Industrial area and Environment Sensitive areas.....	45
Figure 19: Combined Risk Areas.....	46
Figure 20: Land Capability Map of Dhulikhel.....	48
Figure 21: Land Use Map.....	50
Figure 22: Illustration of Activity Centres – blue, pink and red areas (village, local and principle activity centres).....	52
Figure 23: Illustration of Commercial Tourist development area.....	53
Figure 24: Land Re-adjustment area.....	54
Figure 25: Land Re-adjustment Plan.....	55
Figure 26: Illustration of Future residential areas and urban growth boundary.....	56
Figure 27: Dhulikhel Municipality Land Use Plan.....	58
Figure 28: Masterplan Project process for Dhulikhel Municipality Urban and village areas.....	59

LIST OF TABLES

Table 1: Sectoral Goals and Objective.....	12
Table 2: Census population figures 2001 - 2011.....	18
Table 3: Annual construction approvals from 2070/71 to 2074/75.....	19
Table 4: Projected population and households over 20 years.....	19
Table 5: Projected demand for dwellings over 20 years.....	20
Table 6: General forms of Linkages.....	25
Table 7: Physical Intra-Linkages.....	27
Table 8: Existing Land use Areas.....	49
Table 9: Activity centres within Dhulikhel Municipality.....	51
Table 10: Physical Development Plan Actions Summary.....	62

1. Municipal Vision

To reach their desired destination, cities must be aware of where they are starting out. First, they should identify their strengths and weaknesses and after that define the position they want to strive for in the future. By defining the position of the future, they need to be aware of the significant trends and other factors that will influence the direction in which the future unfolds.

To overcome and possibly eliminate the challenges mentioned, Dhulikhel has developed a long-term vision that simplifies the monitoring of long-term goals. The important thing is that development goals are consistent with the city's development vision and strategy, and both must be based on values, wishes, and priorities of the local residents.

1.1 Long Term Vision

The Municipality's vision is a prosperous, well governed and model town of Nepal and its mission is to fulfil basic needs of the residents of the municipality through culture, heritage, tourism and environmental-friendly sustainable development, ultimately leading to a better quality of life.

A prosperous, well governed and model town Dhulikhel

based on culture, heritage, tourism and environmentally friendly sustainable development.

The Municipality will Manage and preserve municipal infrastructure, widen provisions of services, including modern information dissemination systems so locals are better informed, and increase standards of health and social life. In doing so, they are focused on preserving temples and archaeological sites to promote Dhulikhel as a tourist destination, welcoming domestic and foreign tourists to enable economic and social development of the locals.

The main activities include planning local level development projects (social, economic, environment, infrastructure-local roads, rural roads, agro-roads and irrigation projects) to achieve objectives stated above. Provision of basic and secondary education, basic health and sanitation facilities and preparing annual plans and budget and its implementation and monitoring.

In the long term, following lead sectors naturally present themselves as focus area for the development of the region and lead towards fulfilling the long-term vision of Dhulikhel:

- Tourism
- Agriculture
- Health
- Trade and business
- Housing

2. Sectoral Goals and Objectives

Defining clear goals and objectives for different sectors of Urban, Social and Economic Development is a critical step in determining strategies and actions, whether these are about direction-setting strategies, Plans and policies, relatively minor regulatory and governance reforms or large-scale infrastructure investments.

In alignment with the overall development of the municipality following table suggests some sectoral objectives with outputs and the corresponding indicators:

SECTORAL GOALS	Measurement Indicators	Means of Verification	Important Forecasts
ECONOMIC SECTOR			
Municipality will have a positive and qualitative improvement in its economic Status	<ul style="list-style-type: none"> • Increase in Per Capita Income of Dhulikhel municipality. • Significant increase in the development of the industry and the business sector. • Increase in Economically active population. • Increase in average productivity of agricultural production. 	Annual progress review report of municipality.	Increase in help of stakeholders on effective implementation of economic development programs.
SOCIAL SECTOR			
<p>Municipality will have a positive improvement in social life.</p> <p>Social value, recognition and dignity will have a qualitative improvement.</p>	<ul style="list-style-type: none"> • Municipality city's Literacy Rate will increase. • All the children will get mandatory primary education. • Safe drinking water consuming households will be 100 percent. • Toilet using households will be 100 percent • Those who receive service from health institutions will have reached 100 percent. 	Annual progress review report of Municipality.	Increase in the help of stakeholders on effective implementation of economic development programs.
FINANCIAL SECTOR			
Improvement in internal revenue sources which leads the municipality towards Financial self-reliance.	<ul style="list-style-type: none"> • Increase in the income of Dhulikhel municipality 	Annual progress review report of municipality	Support from responsible Stakeholders
ENVIRONMENT SECTOR			
Forest and environment will be properly administered and Dhulikhel will be established as pollution free green city.	<ul style="list-style-type: none"> • Land use policy of sub-metropolitan system will be Prepared and implemented. • Establishment of environmental branch in metropolitan municipality. 	Annual progress review report of Municipality.	Support from responsible Stakeholders
DISASTER RISK REDUCTION SECTOR			
Municipality city will be protected from all kinds of Hazards	<ul style="list-style-type: none"> • Disaster Risk management plan (risk reduction, pre-preparation, rescue and relief and rehabilitation) will be effectively implemented 	Annual progress review report of Municipality.	Support of the stakeholders
INSTITUTIONAL DEVELOPMENT SECTOR			

<p>Development of an influential institutional structure which accounts for a smooth service flow for the people all over the municipality.</p>	<ul style="list-style-type: none"> • Quality Municipal services will be delivered to the people. • Service-related complaints will have decreased significantly. 	<p>Annual progress review report of Municipality.</p>	<p>The cooperation of the concerned sector</p>
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Table 1: Sectoral Goals and Objective

3. Physical Development Plan

The Physical Development Plan (PDP) sets out a 20-year plan to develop the Municipality by addressing challenges with practical and strategically-based solutions and also classifying the land according to its strategic and sustainable use.

The PDP, for Dhulikhel, is intended to deliver the vision for sustainable growth and development of the Dhulikhel Municipality by setting out policies to guide growth and development. The plan provides for the wholistic management of land uses land uses, built form, mobility, community facilities, environmental assets and physical infrastructure.

The PDP is informed by both the physical and socio-economic conditions of the Municipality (as identified in Volume 1 – Background Report) and policies that will develop key economic sectors. It is the spatial response to these conditions and policies.

3.1 Objectives

The Objectives of the Physical Development Plan are to:

- To integrate all aspects of physical planning into the development of Dhulikhel so that the physical development of Dhulikhel is accomplished with the optimal use of all resources, both human and physical.
- To formalize a hierarchy of settlements and bazars/activity centres across the municipality and support these settlements with residential land supply, services, access and infrastructure.
- To provide a spatial framework for the co-ordination and implementation of sectoral programs and development projects.
- To provide guidelines for the development of a transportation network and planning to strengthen the functional links between rural and urban settlements with respect to the movement of people, commodity flows, the delivery of services, and general social economic activities.
- To provide a spatial framework for the provision of physical infrastructure and social services in relation to the distribution of productive activities and population.
- To preserve the best arable lands to secure food supply now, and for future generations.

3.2 Structure of Physical Development Plan

The general framework of how the plan (see **Figure 1**) is to be processed and implemented is shown in the figure below:

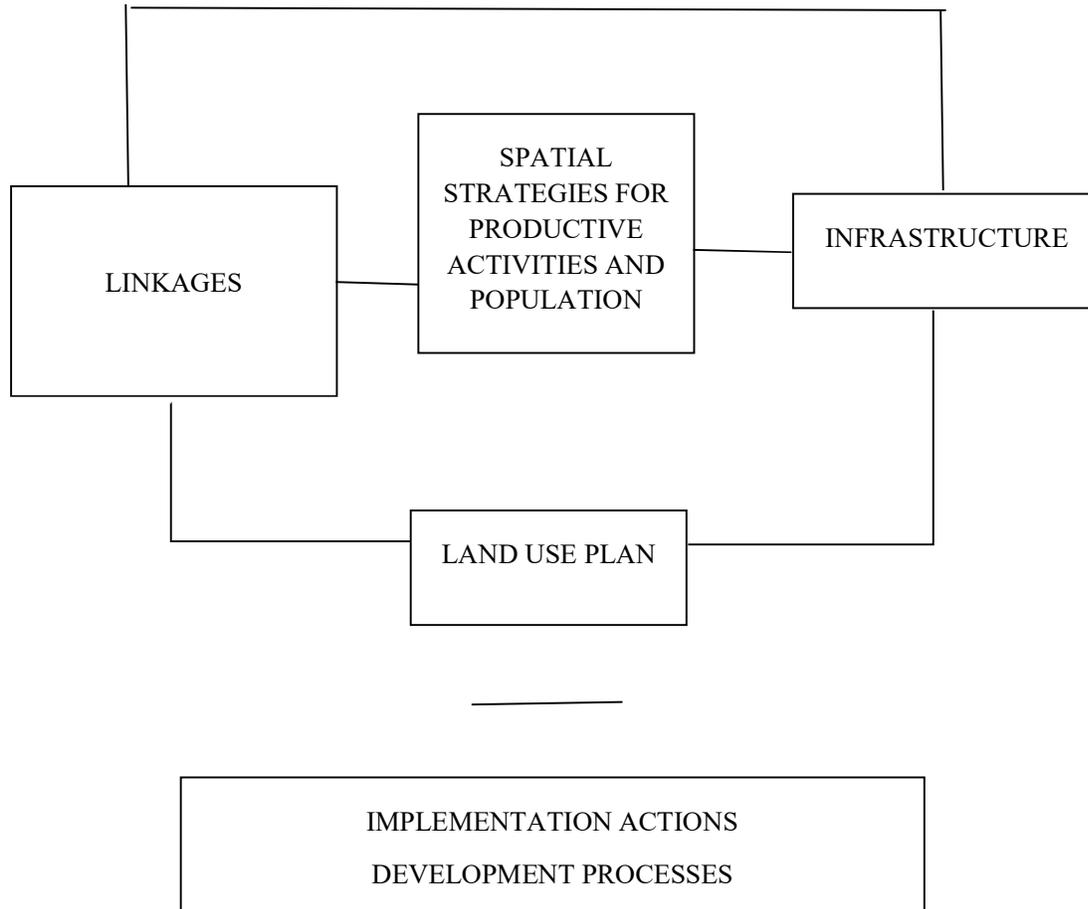


Figure 1: The Structure of Physical Development Plan

The various components are considered in the following sections of the Plan:

Section 1 - Spatial strategies for productive activities:

This section deals with the spatial/locational strategies for productive activities (agriculture, industry and tourism), centres of activities, employment and residential growth. The spatial strategies are directed towards the efficient distribution of productive activities and employment.

Section 2 - Linkages:

This section is primarily concerned with connecting urban and rural activity centers.

Section 3 - Infrastructure:

This section deals with the following aspects of infrastructure: transportation as it relates to inter-settlement connections; and the provision of clean and hygienic water, irrigation and electricity supplies to support settlements of population and productive activities.

Section 4 - Land Use Plan:

This part of the plan deals with the major competing demands on land for agriculture, forestry, human settlement (residential, commercial, industrial and other uses) and infrastructure. The proposed Land Use Plan balances the requirements of the major land uses and provides a spatial framework for co-coordinating sectoral development. All the objectives of the Plan and existing social and economic development policies have been translated into spatial terms and incorporated into the Land Use Plan.

4. Strategies for productive activities and land use

In setting up objectives for development, and considering the major competitive advantages in the Dhulikhel area, it is necessary to realize that the main economic development drivers for Dhulikhel are in agriculture, culture and nature-based tourism, taking advantage of the natural landscapes and, excellent environmental qualities of Dhulikhel.

The major aim is now to distribute urban activity and development in such a way that supports maximum production of food and fiber in the rural areas and supports the development of connected and well serviced settlements that accommodates an increased population and supports an expanding tourism sector.

Land use, industrial, commercial, residential development and agricultural in rural areas can make maximum use of them. Consumption of locally available products, Differentiation of several types of agricultural land that are in use according to the population densities, provision of quality analysis of different inter-linkages that can be established between the specific regions for the overall development of the area are some primary features that can be implemented. Apart from that, Knowledge and understanding of existing and future population characteristics, size distribution of population, growth trends, internal migration and future population distribution is a must. This helps to synchronize the two issues to the benefit of both rural and urban development.

4.1 Activity Centres

According to Planning Norms and Standards 2013, areas that have at least 50 shops or outlets within 100 metres from the center are categorized as market centers. In the case of Dhulikhel Municipality the main market centres are Banepa, Panauti and Dhulikhel Bazar while others smaller centres are categorized as village centres. Generally, the places within large magnitudes of day to day activities which include all the Economic, Business, Health, Education sectors that are associated with the overall development of the region are called the rural service centres of urban centres. Settlements in Dhulikhel Municipality need public and private services. These services are fulfilled by the inter-linkage (physical connections) to these market centres.

The more effectively these linkages function, the more efficiently and successfully the socio-economic system will work. It becomes part of a spatial system with functional linkages among sectors, farmers, traders, producers, consumers, etc.

For instance, the public health standard can only be raised to a desired standard if people have access to the necessary medical facilities. Equally, farmers can enter into the cash economy only if they can sell their product i.e., if marketing and storage facilities are available. Communication among people, both in their social and in their economic roles, takes place only if postal facilities, telephone, broadcasting services, distribution of newspapers, bus services, etc., exist and are accessible to all.

It is an accepted practice for the services and functions to be grouped together in centers rather than scattered in isolated places over the country. In this way users of one facility can take the opportunity to use another available facility at the center during the same trip. Considerable travel costs and time can be saved by the users. Importantly,

this approach also supports existing private and public investment in activity centres and provides critical mass to attract future investment, thus continual improvement in services and offer to the community.

4.1.1 Policies/strategies

Key strategies which provide for retail and commercial services:

1. Recognise the Activity Centre hierarchy within the Dhulikhel Municipality, which includes Primary Activity Centre, local centre and a series of village centres in the rural wards.
2. Encourage retail, office, community services, entertainment and housing within existing and planned activity centres.
3. Strongly discourage 'out of centre' retail development.
4. Discourage unplanned ribbon commercial development along the highway.
5. Apply "Commercial" or Mixed Used zones to the activity centres.

4.2 Residential - Land Supply and demand for residential land

In preparing the Plan it is necessary to consider projected population, and land supply/demand in order to ensure that the Plan is capable of accommodating growth or demand for land for various facilities, services and general uses.

As it is expected there will be little growth in the most rural wards (refer to Volume 1, Background Report), the PDP concentrates on the further development the urban areas, at the same time noting the important role of agriculture and rural settlements.

4.2.1 Population estimates and trends

	Total Pop'n (Old 9 wards)	Total Pop'n (New 12 wards)	Households (Old 9 wards)	Households (New 12 wards)	Average Household size (Old 9 Wards)	Average Household size (Old 12 Wards)
2001	9,812	28,826	1624	N/A	N/A	N/A
2011	14,283	32,162	3279	7061	4.36	N/A
Annual Growth rate	4.57%	1.16%				

Table 2: Census population figures 2001 - 2011

The population growth rate of Dhulikhel Municipality (which includes both rural and urban areas) is very low compared to urban annual population growth rates in some urban centres in Nepal of up to 7 percent (World Bank, 2013). Under a ‘Business As Usual’ scenario, and uninterrupted by any external factors, the population of the entire Municipality is expected to be around 40,560 in 2031.

It is expected that in the rural parts of the municipality, the 1.16% annual rate will remain or in some cases may reduce due to migration/attraction to urban areas for employment or resettlement from areas of high risk of disaster.

On the other hand, it is expected that the growth rate of the existing urban areas (4,5,6 and 7) will continue to increase, at least based on the past average of 4.57%. In this context, it is expected by 2038 (in 20 years) in the pre-restructure wards alone, the population will be 49,057 (refer to Table 4). The Dhulikhel Bazar area is a centre for different commercial activities, different types of health, governmental as well as other social institutions are located in Dhulikhel. This has attracted populations from the regions around Dhulikhel resulting in a reasonably rapid increase in population.

This is consistent with other scenarios throughout urban Nepal. Should significant interventions such as the introduction of new mass transport modes or new industries be proposed, which could lead to accelerated population growth, a review of the growth rate will be required.

Alternative growth scenarios can be difficult to predict and can be dependent on international, federal or local political or investment decisions or circumstances entirely out of control of government and the private sector, such as natural disasters. Externalities including the installation of rail from Kathmandu to Dhulikhel, thus promoting Dhulikhel as a ‘commuter city’ of Kathmandu, could be a ‘game changer’ for the Municipality. This could accelerate the economic activities of Dhulikhel when coupled with industries and tourism attracting people from hinterlands. Similarly, the

potential determination of the headquarters for the Province 3 in Dhulikhel, leading to relocation government institutions is another scenario.

Therefore, it is suggested for annual land supply audit and overall IUDP to be reviewed every 3 years. This will take into account changing conditions leading to changing population scenarios and allow flexibility in the strategy

4.2.2 Housing trends

Construction approvals for dwellings over past 5 years:

Fiscal year	Houses
2070/2071	106
2071/2072	70
2072/2073	105
2073/2074	378
2074/2075	1011

Table 3: Annual construction approvals from 2070/71 to 2074/75

As per the data provided by the Dhulikhel Municipality the number of construction for the year 2074/2075 accounts for 1,011 which is comparatively significantly higher than the previous years. According to Municipality, the greatest proportion of construction is in Ward No. 4 (178 houses). Also the “3 lakhs incentive” introduced in 2074/2075 accounts for over 200 builds and a substantial increase in the number of recent builds.

Year	Projected population	Number of households	Average households per house	Average household size	Dwelling units
2011	14283	3279	1.52	4.36	2157
2018(0)	19668	4552			2994
2023(5)	24717	5721			3763
2028(10)	31062	7190			4730
2038(20)	49057	11355			7470

Table 4: Projected population and households over 20 years

4.2.3 Estimating Housing Demand and Land Requirements

In 2018, Dhulikhel is projected to have an estimated population of 19,668. The average persons per household the Municipality in 2011 were 4.36. Thus, the number of households in Municipality for the year 2018 is found by dividing the population by average household size 4.36 which is 4,552. According to Census data of 2001, average household per housing unit for an urban area was 1.52. This value was used to calculate the number of dwelling units of the year 2018. Number of existing dwelling units for 2018 was calculated to be 2,994 based on the

minimum lot size requirements of 2 Ana 2 paisa in the zoning by-law corresponding area for the projected dwellings is calculated.

Corresponding housing demand for the next 5, 10 and 20 years are calculated in the table below:

Demand					Time frame (Years)	
	Additional dwellings	Total dwellings	Additional dwellings	Total dwellings	Additional dwellings	Total dwellings
	5 years	5 years	10 years	10 years	20 years	20 years
Total Demand of additional Dwelling units	769	3763	967	4730	2740	7470
Area	394,800 .4 Sq.ft.		891, 253.0256 sq.ft.		2,297,954. 23 Sq.ft.	

Table 5: Projected demand for dwellings over 20 years

From the above table it is clear that **Dhulikhel needs additional 2,740 dwelling units in next 20 years.**

Considering the Minimum lot size requirement of 2 anna 2 paisa, an additional demand for residential land is 21.77 hectares. In addition, for serviced residential development, up to 25 to 30 per cent of the land being subdivided is required for public use including roads, drainage reserves, water and sewerage infrastructure and public open space. Therefore, an additional 6.6 hectares of land is required to provide land for these services. **In total 28.37 hectares of additional land is required to accommodate residential supply over the coming 20 years.**

It is recommended that 28.37 hectares be zoned for additional land

The location of future residential land is specified in the Land Zoning map in Land Use section of the report.

Policies/Strategies for Residential Land Use

- Ensure a 20-year supply of zoned residential land
- Ensure residential land is located close to activity centres and serviced with road, sewerage, electricity, communications and water supply.
- Ensure residential areas are safe and have high amenity, including good noise, air and water quality.

4.3 Agriculture

Agriculture is the major source of the economy of Dhulikhel. Most of the people depend on agriculture for livelihood. Almost all the of the farmers in the rural areas are small holder farmers. Small-holders sell to private traders at the farm, local village markets, and the markets in urban areas.

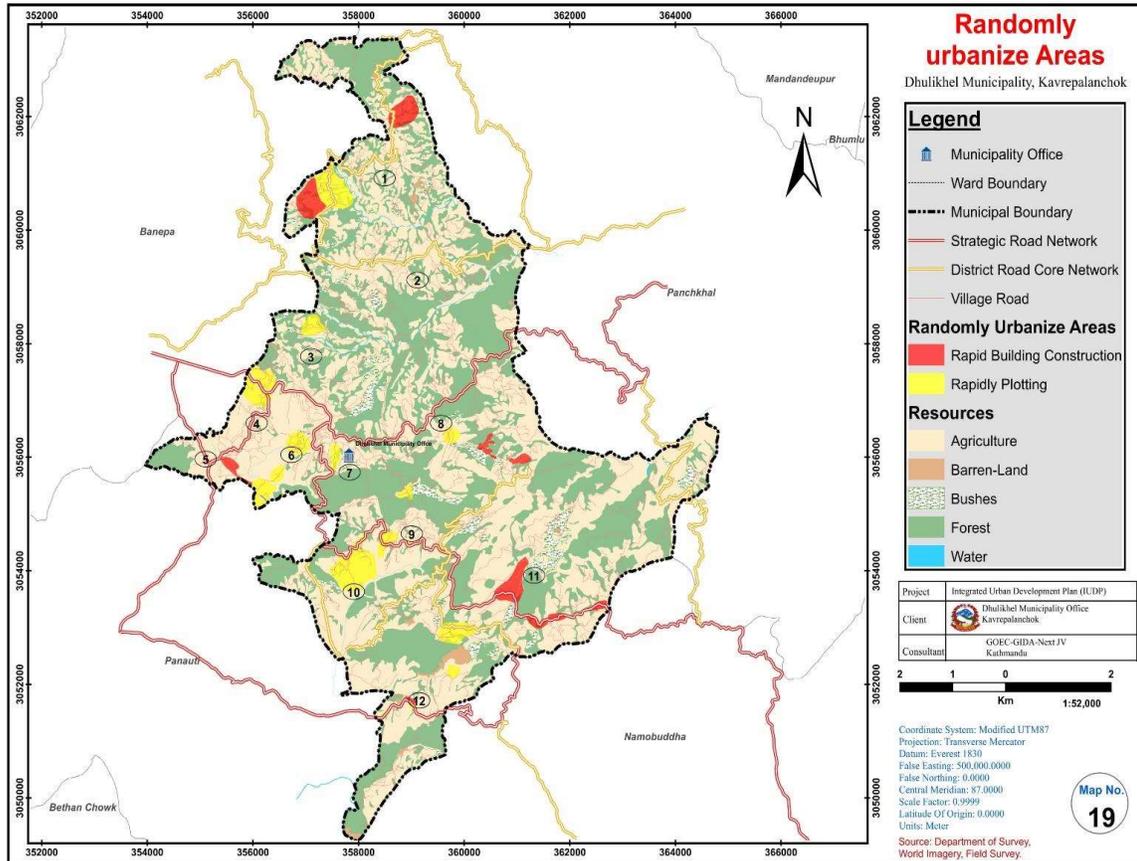


Figure 2: Random Urbanization areas

4.3.1 Issues

The major agricultural issues which are of significance to the Plan are:

1. Scattered and isolated farmland: considering the fact that, driven by cultural inheritance traditions, there is a widespread fragmentation of the agricultural land, this has impact on the agricultural productivity.
2. There is a practice of subsistence farming where households are relying on produce to feed their families.
3. There is a need to protect agricultural areas that are essential for food security including the prime agricultural lands, command areas of irrigation projects, and lands that are essential for livelihood of rural population.
4. Due to the attraction of Dhulikhel for its clean air, water and landscape, farm plots are being sold for development of dwellings for the “lifestyle”.
5. It is important to control development in rural areas to protect agriculture and the natural resource base. In terms of settlement planning there are two threats to agricultural land. One is the sporadic development of

individual dwellings on farm land, which incrementally removes agricultural land. The second threat is trend of rapid acquisition of agricultural land and its transformation into residential areas (see Figure 2).

4.3.2 Policies/strategies

Policies to reasonably mitigate the above issues relating the agricultural land use, population distribution and development are addressed below:

1. To promote rural agricultural development in order to generate employment, which helps to minimize the rural urban migration, and support the development of rural and urban service centres. To enhance connectivity of rural areas with Dhulikhel Bazar.
2. Adopting the concept of land pooling for consolidation of agricultural land, and acquisition of land for infrastructure.
3. Promote consolidation of plots in agricultural areas to increase productivity and “economies of scale” of agricultural production.
4. Discourage haphazard fragmentation of land which provides for fixing limit of land miniaturization for different land uses.
5. Encourage further development in existing settlements and discourage isolated small lots in rural zones.
6. Apply Agricultural Zone that restricts subdivision and residential development that is not associated with agriculture

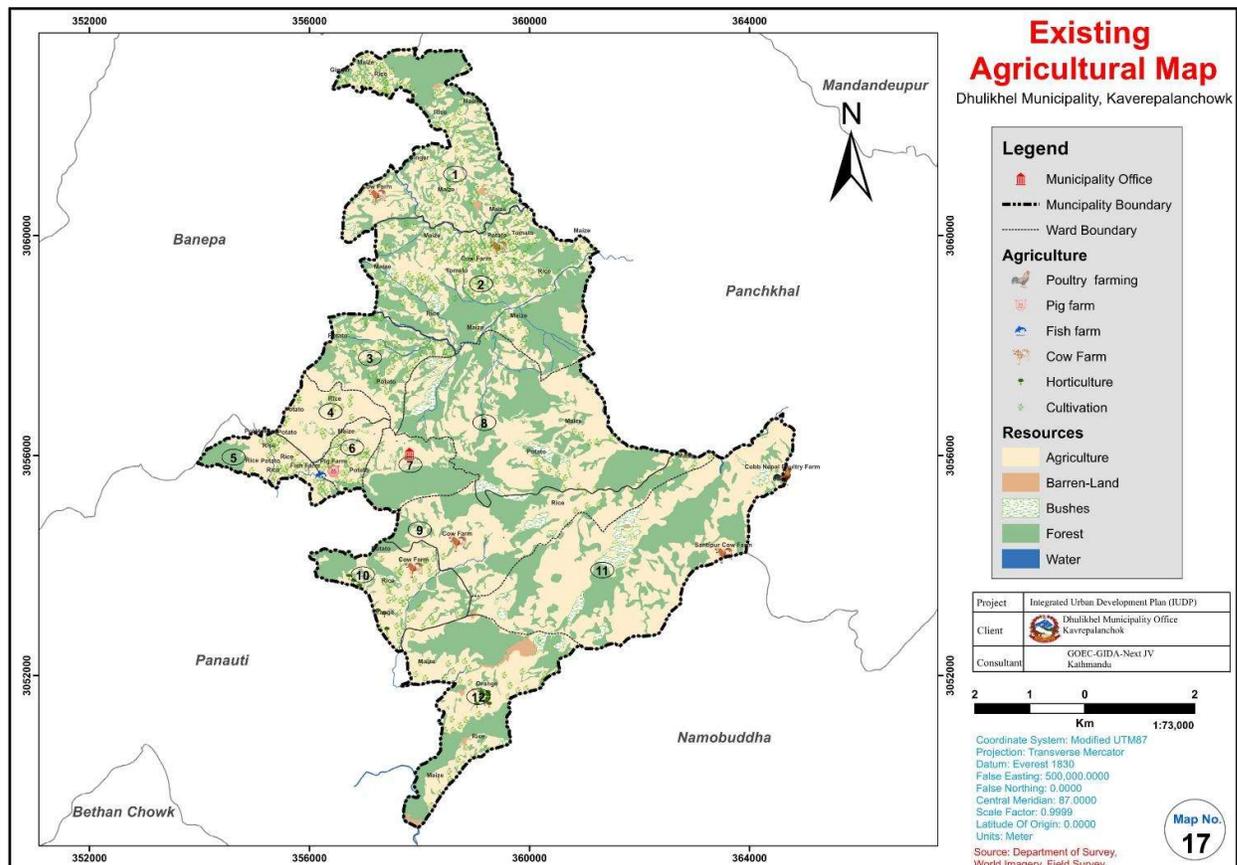


Figure 3: Agricultural map

4.4 Industry

Industry, namely manufacturing for local demand, transforms local agricultural, livestock, forest into finished goods for private consumption or construction. Examples including bakeries, dairies, rice mill, carpentry, motor mechanics and the like. Rural areas are characterized by a great diversity of economic activities, including processing and marketing of agricultural products, tourism, mining and services. In addition, industry is located along highways and on the edge of the towns.

Industry is a significant contributor to the economic and employment well-being of the community. At the same time, it is essential that industrial uses are located in appropriate places and managed so that they do not degrade the amenity of the area where there are sensitive land uses nearby, such as schools, hospitals and residential areas. In addition, they should be managed in a way that minimizes their impact on the environment, including water and air pollution or visual pollution.

4.4.1 Policies/strategies

Key strategies which provide the convenience for the locally available products to be consumed and processed in a larger scale:

1. To promote decentralized balanced industrial development (in particular in the rural wards) in order to spread the benefits of employment throughout the municipality, help minimize rural- urban migration, and support the development of rural and urban service centres.
2. Necessity of an agro-based cottage industry that provides a significant employment opportunity which helps to upgrade or uplift the overall agricultural production as well as consumption.
3. Protect residential areas and other sensitive uses such as hospitals and schools by applying a buffer between industrial uses and sensitive uses.
4. Apply zoning and effective by-laws that requires industrial uses to operate to minimise impact on water and air quality and upon the amenity of the area.
5. Ensure that the sites where Industrial uses are located are well-presented and do not negatively impact upon the landscape or character of Dhulikhel.

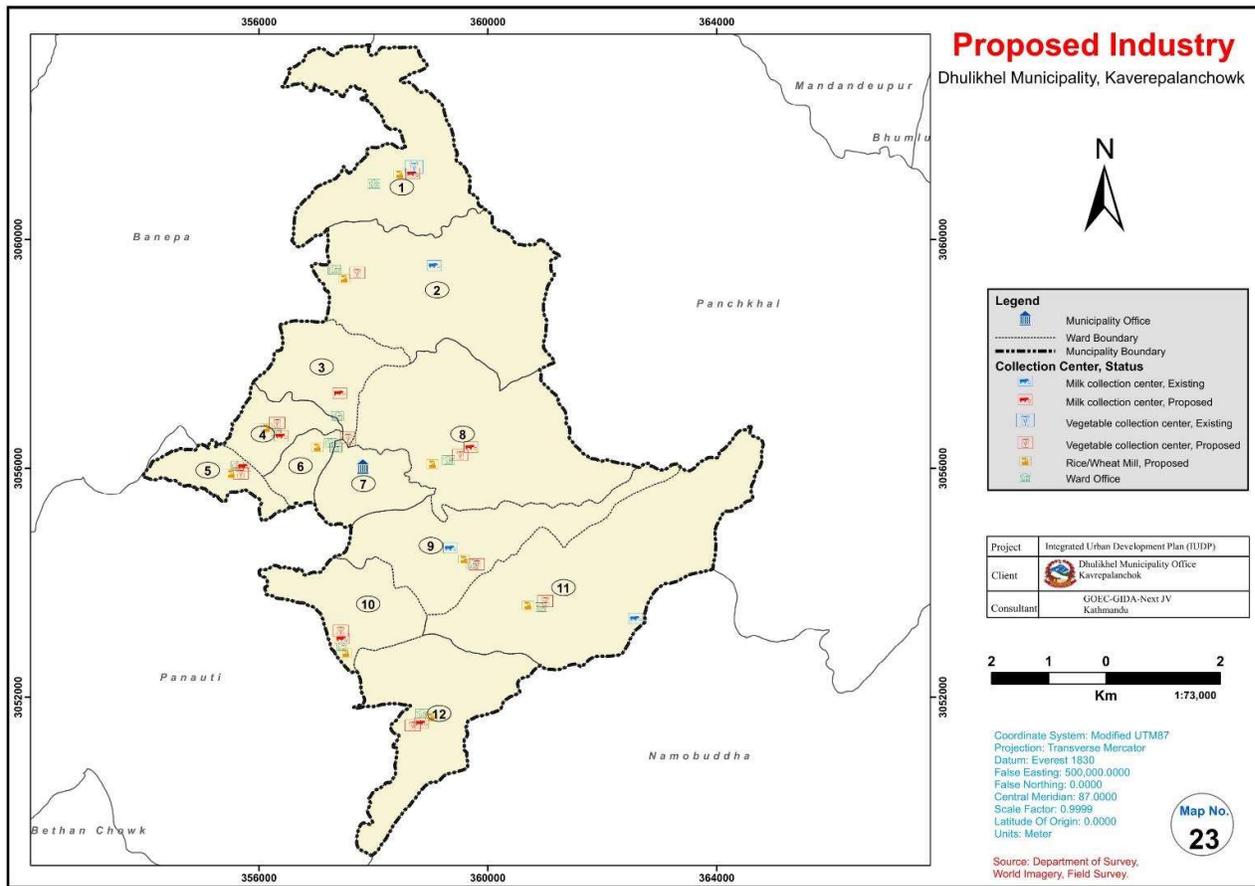


Figure 4: Proposed Industrial Scenario

4.4.2 Proposed

Agro-based cottage industries based on raw materials that are locally available are proposed in strategic locations (Village centers). The proposed industrial map above shows different collection centres including Vegetable Preservation Centres, Fruit preservation centres, Milk collection centres, Rice mill, Flour mill for different types of locally available products.

The above distribution of agricultural products according to the specific area of interest helps to enhance production and create equal opportunities for the farmers of various regions who might have been deprived of such facilities till the present time.

By-Laws have been prepared to facilitate Industrial uses in appropriate locations.

5. Linkages

5.1 Linkage (Connectivity) of Dhulikhel Municipality

Dhulikhel, being one of the places with great economic as well as socio-cultural value, is interlinked with a number of major highways as physical linkage like the Araniko highway which is one of the oldest highways of Nepal connecting Nepal and China, BP highway which possess a great value for connecting hills with terai and has significant economic features as well. Linkages can be of different varieties connecting and affecting the several features of a region or area. An overview table of different types of Linkages is presented below. (See Table 6)

Types of Linkages	Elements	Facilities
Physical linkages	Transport by-Road	Networks, Intra and Inter-system Connections (Nodal Points) ;e.g. Interlink between Primary, Secondary and Tertiary Roads; Stations, etc.
Economic Linkages	<ul style="list-style-type: none"> ○ Goods Distribution ○ Production ○ Production Linkages ○ Forward and Backward ○ Linkages ○ Capital Flows 	<ul style="list-style-type: none"> ○ Commercial Centres ○ Producer and Consumer Goods Markets ○ Input Delivery (Raw Materials, intermediate Goods, Machinery, Tools) ○ Export Outlets ○ import Agencies ○ Banking
Technological Linkages	Diffusion of Technology: Skills, Machinery, Tools	<ul style="list-style-type: none"> ○ Production Input Delivery (see also Economic Linkages) ○ Vocational Training (see also Service Delivery Linkages) ○ Extension Services (Agriculture. Crafts)
Service Delivery Linkages	<ul style="list-style-type: none"> ○ Social Services ○ Communication Services ○ Technical Services 	<ul style="list-style-type: none"> ○ Health Facilities ○ Educational Facilities (General Education, Vocational Training) ○ Postal Services ○ Telecommunication Facilities Mass Media (Newspaper, Radio) ○ Transportation Services (Public and Private Transportation of Passengers and Goods) ○ Accommodation Facilities ○ Maintenance/ Repair Workshops ○ Extension Services (Agriculture. Crafts, Industry, Trading) ○ Energy Supply ○ Water Supply, Public Utilities

Table 6: General forms of Linkages

5.1.1 Inter-linkages

Inter-linkages are those features which deal with the open system among the group. In case of Dhulikhel municipality, a generalized Inter-linkage descriptive map showing different classes of highways or physical inter-linkage from Dhulikhel along with a brief description which helps in categorizing the various areas present along the periphery of Dhulikhel municipality is presented below.

Physical Inter-linkage:

1. Panchkhal ----Dhulikhel (ward 1, 2) ----Banepa through **DRCN12 AND DRCN9**
2. Kathmandu----Dhulikhel (major market clusters) ----China-Araniko highway.
3. Kathmandu----Dhulikhel----Bardibas-**BP highway**
4. Panauti----Dhulikhel (ward no 12) ----Namobuddha-**F72**

This linkage proves that major service centers (market centers) for the Dhulikhel Municipality are Dhulikhel bazar, Banepa Bazar and Panauti Bazar. Some important physical inter-linkages as described in the above segment is presented as a visual re-conformation in the form of a map. (See Figure 5)

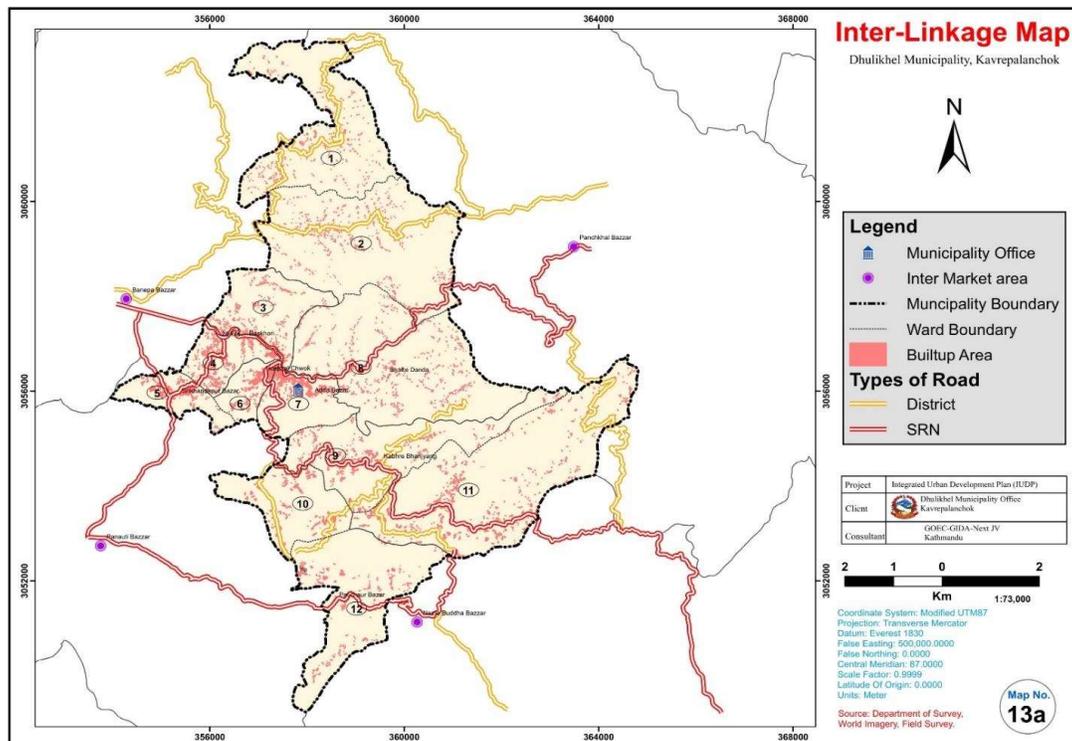


Figure 5: Inter-Linkage map

5.1.2 Intra-linkage

‘Intra’ is a prefix used to form words that mean on the inside, within. Therefore, Intra-linkage can be defined as the closed system of linkages within an area i.e., in this case Dhulikhel municipality. A specific example of physical intra-linkage can be a highway system or road system only within the borders of Dhulikhel municipality. A map

(see Figure 6) presenting different inter as well as intra-linkages of Dhulikhel municipality is given below. It shows all these possible physical inter and intra-linkages prevailing in Dhulikhel municipality.

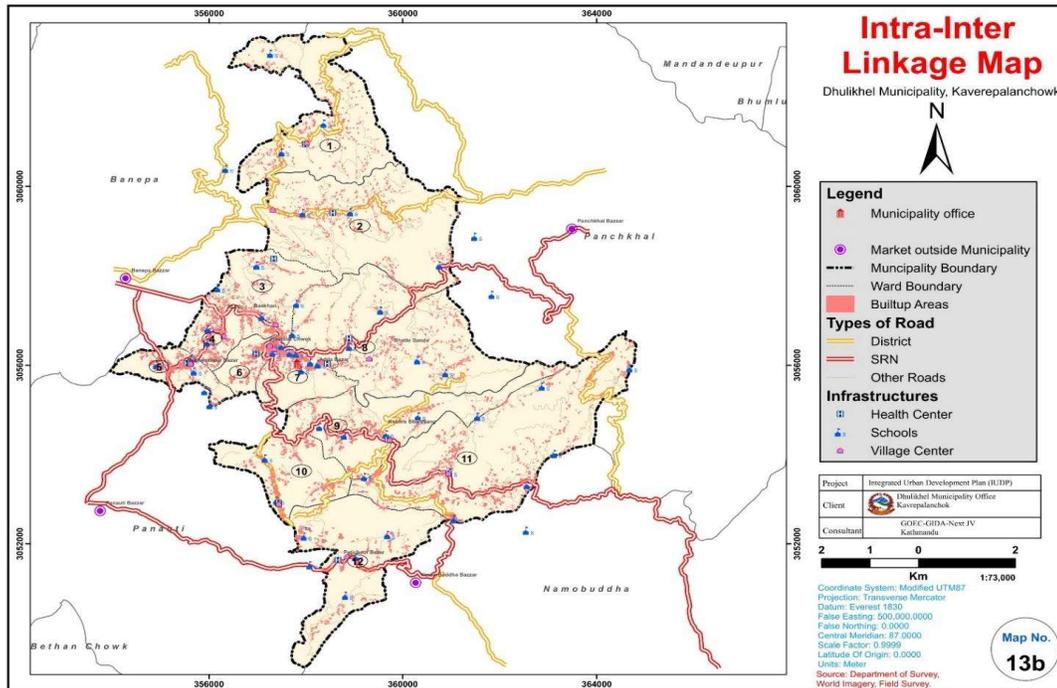


Figure 6: Intra-Inter Linkage map

It is necessary to improve links between village centres and market centres. This ensures the proper distribution of resources available locally and boosts the capability of the region both economically and institutionally. Some of the physical inter-linkages (highway and road systems) are proposed in the form of a table. (See Table 7).

Ward no. Village centres	SERVICE ROADS (FRINGE SETTLEMENTS-VILLAGE CENTRE/HIGHWAYS/DISTRICT ROADS)
1(Midinichhap)	Thing khola- Kashi Bhanjyang, Milanchowk –Bhadaure Danda - Anaikot
2.(Dudamukh)	Rabi-Deurali-Chamare, Chisapani –Sakhin Chaur, Chaplati - Ward No 1, Sisne Khola–Thini Gaun
3.(Dhulikhel bazaar)	Dhulikhel-Devitar, Panchakanya - Kutal – Rabi, Panchakanya - Chankubesi
4.(Ratmate)	Chukunepati – Bashghari, Dhulikhel - DMI – Shreekhandapur
5.Shreekhandapur Bazar	Punyamata Khola Corridor, GandivChok – Chaukot,
8(Bhattedanda)	Khawa - Sikharkatarito – Kalche, Khawa - Swarsatima – Kavre bhyanjang, Thakle– Chapaladevi, Pipalbot – Kavre bhyanjang,
9(Kavrebhanjyang)	Ghat Khola- Thulachaur, Hulaki Pati-Panitanki, DevasthanKavrebhanjyang, Kavreybhyanjang – Thatithok, Majuwa Khola - Kavreybhyanjang
10(Batase)	Bhairabghat – Thakurichhap, Phaskot - KrisnaMandir, MathilloPipalbot - Dhungeban
11(Kharka)	SunarTole – Tiniple, Maskate - Thulitar – Pipalthumki, Jukepokheri - Dobane
12(Shankhupatichaur)	Sankheswari – Tallo Eklekhet, Eklekhet – Fending, Ite – Piple, Lamichane – Kukel thumka

Table 7: Physical Intra-Linkages

5.1.3 Policies/Strategies

The following strategies are based on:

- The analysis of the existing system of human settlements and hierarchy of service centers;
- Disparities in the geographical distribution of service and facilities;
- Inter-settlement functional linkages;
- The distance factor in the accessibility of service centers;
- The Background Study Report (Volume 1).

1. Ensure reasonable and safe access for the entire population, to service centres;

All-weather standard road network should be improved especially in the case of access to centres of Dhulikhel and Banepa. As Rural Market centres contain or are to provide a substantial number of facilities serving basic need road access to these centres should be given emphasis in road development programs.

Land in the road reserve adjacent to Arankio and BP Highways (that land within Municipality jurisdiction) should include “active transport” corridors - pedestrian and cycling paths.

For the detailed road development programs refer to the Municipal Transport Management Plan Volume in the IUDP.

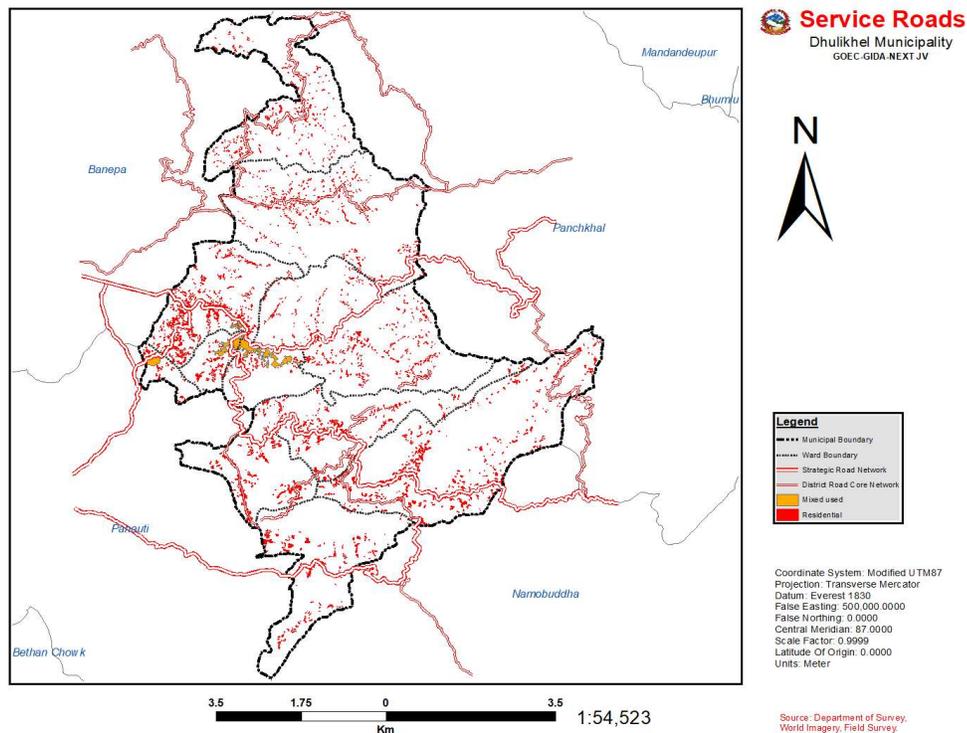


Figure 7: Service Road map (I)

Upgrading Service Roads mentioned above (see Figure 38) connecting market centres and village centres. Improvements in public transportation and increasing the frequency of public transport for **wards 2, 8, 10, 11 and 12**.

2. Ensure accessibility from fringe areas to centres

For the proper and most reasonable accessibility from the rural areas to the village centre, all of the existing service roads presented in the map (see Figure 8) below are to be upgraded in order to provide maximum efficiency.

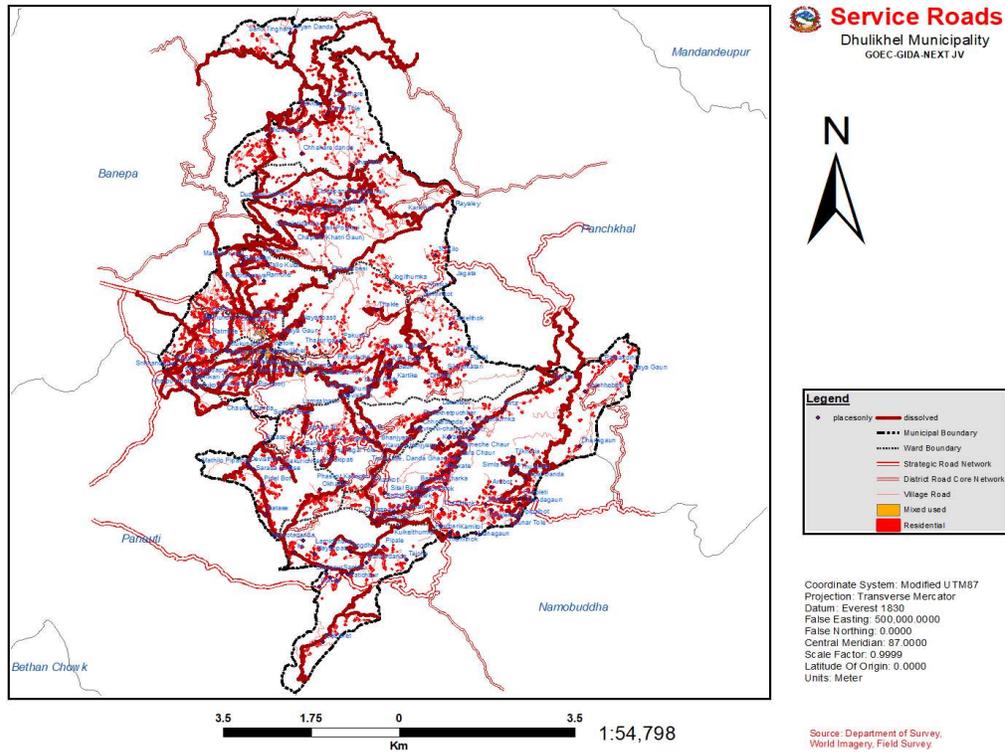


Figure 8: Service Road map (II)

3. Achieve the greatest impact in the provision of services and facilities;

Services should be grouped in the selected centres in accordance with the Guidelines for the Location of Services and Facilities rather than scattered in isolated places over the Dhulikhel Municipality. In this way user of one facility can benefit from other available facilities at a center during the same travel or trip and considerable travel time and cost can be saved by the relevant users.

6. Physical Infrastructure

Infrastructure is the term used for the underlying foundation or basic framework of a business or nation. Transportation, communication, sewage, water-supply and electric systems are some basic examples of infrastructure. Other examples of social infrastructure include hospitals, education, open space and security posts. These systems tend to be high-cost investments and are vital to a Municipality's economic and social development, livability and prosperity. In case of Dhulikhel, a number of infrastructures are yet to be fully developed and require planning and investment and delivery.

6.1 Water supply

6.1.1 Existing Water Supply

The major Drinking water supply system in Dhulikhel is operated by Dhulikhel Water Supply User Committee (DWSUC) which is located at Dhulikhel Municipality, Kavre in Nepal.

Major features of Dhulikhel drinking water supply project are:

- Design population: 14,387
- Population covered by project: 23,650
- No. of taps: 2200 household and 27 public taps
- Coverage area: Ward number 2, 3, 4, 5 (whole area covered) and 1, 6, 7 (partial area covered), Extension going on in wards number 8 and 9.

Supply of drinking water in the Bazar area is covered by the Dhulikhel Drinking Water Supply Project (DDWSP). There has been rapid increase in demand of water especially in the bazaar areas of Dhulikhel because of rapid urbanization with expansion of tourism businesses, new houses, and public and private institutions. Furthermore, the majority of households in rural wards and newly added rural wards rely on open streams and underground water which are susceptible to contamination. In some of the remote areas, there are few available untapped sources of drinking water and the management of those sources is poor. **Figure 9** illustrates the existing water supply infrastructure.

The current water supply distribution system is functioning on its limit. According to urban planning norms and standard 100 LPCD of water is required for the urban population and 60 LPCD for the rural population. Considering the projected population for 2031(40,036) the drinking water supply required is 4MLD (Millions liters per day). Current supply amount of drinking water by DDWSUC is 1.2 MLD. Which suggests there is deficit of approx. 2MLD of water in entire Municipality. Such a big deficit of drinking water suggests, a big project to fulfill the long term demand of the municipality is required. Considering current scenario of water deficit, a short term and long-term plan is proposed.

6.1.2 Future Water Supply

The "Kavre Valley Drinking Water Supply Project", currently being undertaken by Government of Nepal (GON) with financial assistance of Asian Development Bank (ADB), will deliver a long-term solution to augment water supply to the three towns in Kavre Valley, namely, Dhulikhel, Banepa and Panauti. The Government of Nepal (GoN) with

financial assistance of Asian Development Bank (ADB) is implementing Kavre Valley Integrated Water Supply Project with an objective to improve water supply system in the three cities Banepa, Panauti and Dhulikhel municipalities.

As a combined water supply scheme for Banepa, Dhulikhel and Panauti municipalities, the scheme is considering to extract water from Roshi Khola and its tributaries such as Khar Khola, Gudgude Khola, Bairamahadev Kholsi, and Shishakhani Kholsi. After implementation of this, the supply of water in all three municipalities will be regular and sufficient enough to meet the need of the present population.

As a part of shorter-term solution, the existing water supply system can be augmented with the help of available probable water sources, also new water supply projects can be developed within wards with the help of those available sources of water. A Water supply map (see Figure 9) showing probable water sources along with proposed projects in the Municipality is presented below.

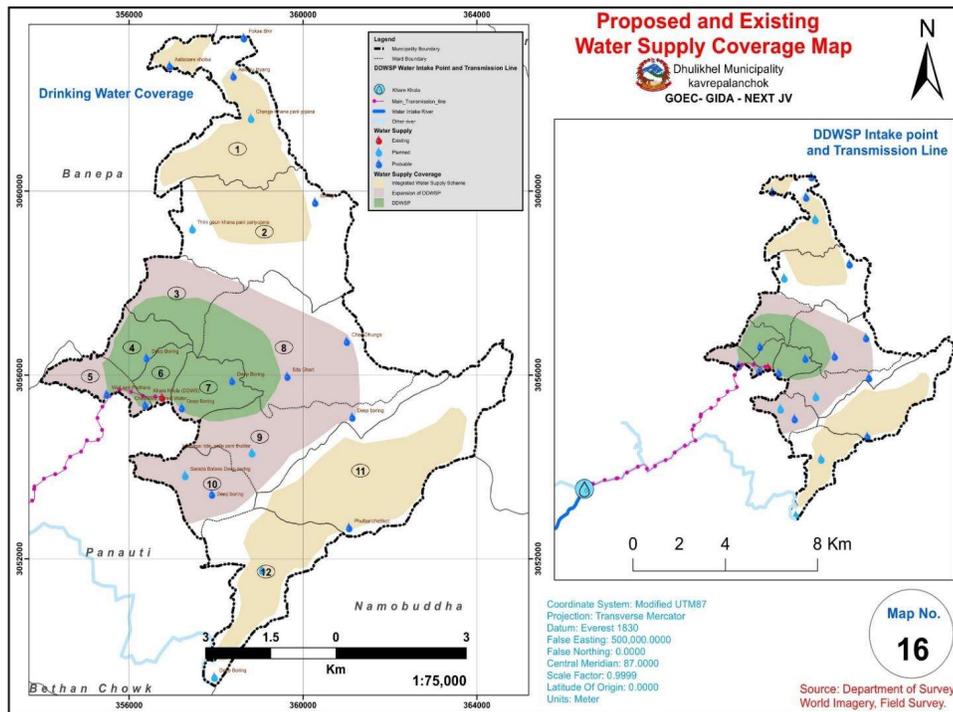


Figure 9: Possible Coverage Expansion of Water Supply

As discussed earlier, the probable sources can be used along with the present water supply system to expand the coverage areas in other wards of the municipality. There are 3 probable sources currently available jointly in ward No. 1 and 2. These sources could be added to create an integrated water supply scheme to serve households of ward 1 and ward 2 (including with a treatment plant and reservoir) as shown in the figure. Likewise, an integrated water supply scheme is required to serve newly added wards 8, 9, 10, 11.

Another major concern in Dhulikhel Municipality is the sustainability of drinking water resources. In order to address concern of declining groundwater table, DDWUC officials are collaborating with Dhulikhel Municipality and South

Asia Institute of Advanced Studies to recharge groundwater with rainwater by building a series of recharge ponds within forest areas.

In addition, harvesting rainwater should be investigated. This is particularly important in more isolated, rural areas which are not prioritised for urban development and difficult to service with reticulated water. This technology could also be effective in urbanized areas to provide water supply for gardens, toilets and washing, and to water open space areas.

6.1.3 Recommended actions

1. Design and establish Integrated water supply scheme to serve wards 1 and 2 within short term
2. Design and establish Integrated water supply scheme to serve wards 8, 9, 10 and 11
3. Support the implementation Kavre Valley Drinking Water Supply projects to serve the towns of Banepa, Dhulikhel and Panauti.
4. Undertake a trial of rainwater harvesting technology using Municipality buildings as test cases.

6.2 Sanitation and Wastewater

Sanitation and wastewater management, circulation and disposal is one of the key factors that has an adverse effect on the overall health and hygiene of the population of the Municipality.

A reticulated sewerage system refers to the system of pipes, sewers and drains used to move sewerage from a property to a sewerage treatment plant. Maintenance of pipes and the treatment plant is the responsibility of the Municipality.

Septic tank and soakage pits-soakage pits are used to soak septic tank effluent in to the surrounding soil. Landowners are responsible to maintain their systems.

6.2.1 Existing situation

Very few wards in Dhulikhel municipality have pipe system for sewerage. 95% of households within ward 5 are serviced with pipe drainage system. However presently no piped sewerage system service the other wards of the Municipality. The majority of premises in the denser areas of these wards are serviced by septic tanks with soak pits.

There is no municipal service offered for removing septage (septic sludge) from the septic tanks when they become full. Usually, households will contact a local contractor who will arrange to empty the tank manually.

Presently, where pipe sewerage is not available, new development is required to install a septic system. However, there is no assessment about the capacity of the land to be able to manage the sewerage and waste-water on-site. Factors to determine capacity include size of plot, soil characteristics, slope and number of occupants and bathrooms/kitchens. This issue is becoming more critical as areas are developed more densely and houses are now much larger, containing more bathrooms and a significantly higher number of occupants.

6.2.2 The solution

The existing problems of wastewater treatment in Dhulikhel can be solved using appropriate and viable technologies commensurate with the density and projected rate of development. In the case of Dhulikhel there are three characteristics of settlement:

- Urban with high and conventional density.
- Peri-urban and
- Rural

Suitability for wastewater management solutions depends on:

- The physical characteristics of the soil and topography
- The density of existing development
- The projected development; and
- The ability of the system to be managed and maintained.

In response to the existing scenario of Dhulikhel Municipality following interventions and strategies are required:

6.2.3 Policies/Strategies

Detailed Waste Water Management Design

1. A detailed study is required to determine the appropriate solution to improve the poor wastewater management within the municipality, as follows:
 - a) Identify areas where wastewater disposal or septic tanks are problematic, i.e. where septic tanks are overflowing onto land or into surface water drainage: e.g. due to
 - i) High water table;
 - ii) Impervious ground;
 - iii) No space for soak-pit;
 - iv) No space for septic tank;
 - v) Density of development; and/or
 - vi) Prolonged seasonal flooding.
 - b) Where areas are identified in the PDP and Land Use Plan for conventional residential development, infill areas or new growth areas, plan for strategic provision of sewerage infrastructure, considering:
 - i) On-site septic tanks with soak-pit;
 - ii) Septic tanks with overflow to small bore sewerage;
 - iii) Conventional sewerage.

The above work is to be undertaken when Urban Development Masterplans are developed for these areas. It is recommended that the dense urban settlements require piped sewerage system. Where possible, growth areas should be designed to be serviced by a gravity-fed sewerage system, rather than a pumped system.

Potential approach

For management of drainage in the Municipality, a detailed assessment of drainage especially in the bazar areas is required. When designing the future drainage system for the bazar areas, present drainage system and treatment plant in ward number 5 could be utilized. There exists possibility of upgrading existing treatment plant at Shrikhandapur for the benefit of surrounding urban areas. Other urban areas where there is no possibility of expanding the drainage system to the existing treatment plant requires another site-specific solution. It is anticipated that the most economical solution might be the installation of small-bore sewerage for the main commercial and high-density residential areas. This system would collect the overflow from septic tanks which would be connected to a decentralized effluent treatment (DEWATS) plant. A proposed wastewater drainage network map (see fig 10) is presented below.

When preparing Septage sludge treatment plant in Dhulikhel, anaerobic digestion technology can be considered as it is the most socially and environmentally acceptable option based on past experiences from the municipalities of Nepal. Even if biogas is not utilized fully, at least a quality compost product would be produced. This could be included as part of a bio-degradable component for solid waste management improvements. Operation of the Septage treatment plant could be assisted by the sale of compost fertilizer and utilization of biogas in agricultural zones of the municipality.

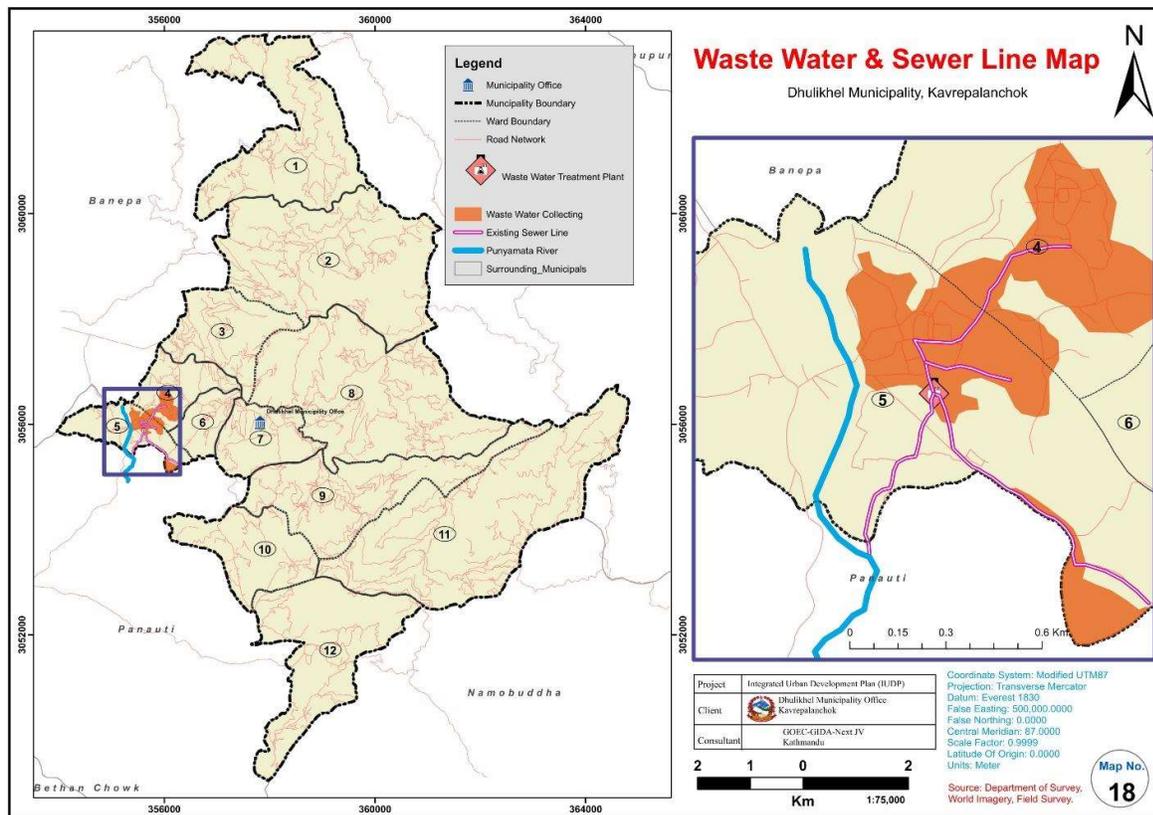


Figure 10: Existing/Proposed Wastewater Drainage Networks

Development Referrals

All applications for development must be referred to the Municipality Infrastructure Department, Water Department and other service agencies to determine infrastructure sequencing and responsibilities required by the applicant and the Municipality.

6.3 Irrigation

Dhulikhel is known for its Agriculture which demands for irrigation system. Dhulikhel municipality includes a number a small to medium irrigation projects. The current irrigation scenario is discussed below.

6.3.1 Existing scenario

Agriculture continues to be an important source of livelihood and can contribute to food security. Most of the area in Dhulikhel Municipality is occupied by rural wards and is used for agricultural purposes. The population is entirely dependent on agriculture for living. Milk production, vegetables, potato, maize and fruits like oranges are the major agricultural product within the Municipality.

More than 18 irrigation projects have been identified in the entire Municipality. Kendra Kulo is one of the oldest canals constructed by the Government of Nepal in ward 1, likewise Sungure jammte lama irrigation project (Hill/Rehab) is under construction. Most of the others irrigation system present in the Ward are managed by farmers. Sikhar kateri sichai yojana in ward number 2 is another government constructed project servicing an area of 100 hectares. Other irrigation systems present in the Municipality are farmer managed irrigation system.

6.3.2 Challenges

Some of the key challenges that categorize irrigation development in Dhulikhel are:

- 1) Depleting source discharge, decreasing ground water table, increasing competition for water, declining interest of young generation in farming have emerged as new challenges in irrigation of agricultural land in Dhulikhel Municipality.
- 2) Most of the irrigation systems are fed by medium or small rivers, which almost entirely depend on the rainfall.
- 3) Land use change from agriculture to urban uses.
- 4) Continuation of subsistence agriculture practices in command area etc.
- 5) Institutional resource challenges include few technical personnel and those that do exist lack the capacity to meet the emerging constraints and challenges.
- 6) Poor performance of irrigation systems
- 7) Problems of river management
- 8) Strengthening the Water User Associations (WUAs)

6.3.3 Strategies/Interventions

1. According to the study conducted by ADB (Meagher, 2013), on irrigation and poverty showed that the incidence of poverty in irrigated areas is half that in rain-fed areas and that access to irrigation water mitigates poverty.
2. Small irrigation systems are more effective than medium-sized or large systems in helping poor communities (Meagher, 2013). Therefore, the policy should be targeting smallholder farmers and influencing their land and water management offers the greatest opportunity for reducing poverty quickly.
3. Modernization of the irrigation systems improving its intake structures, canal lining, and cross drainage structures.

4. Strengthening relationship between agriculture and irrigation by integrating irrigation planning and management with agricultural development.
5. Improve management of existing irrigation systems.
6. Improve planning and implementation of new irrigation systems.
7. Strengthen local capacity for planning, implementation and management of irrigation.
8. Encourage consolidation of land to promote irrigation/agricultural efficiency.
9. Improve groundwater development and management.

6.4 Electricity and Communication

To safeguard the economic and social prosperity of the Municipality, reliable access to electricity and communication networks critical.

The Municipality issues permits for the connection to electricity. While it is acknowledged that the actual delivery and maintenance of electricity and communications infrastructure is not the jurisdiction of the Municipality, this is critical infrastructure that the Municipality needs to advocate for. The present condition of Dhulikhel district's electricity and communication networks and access are discussed below.

6.4.1 Electricity

According to Planning Norms & Standards 2013, power access for any Municipality should be such that it has 100% coverage over the city.

As per the data collected; almost 100% households in all wards have access to reticulated electricity supply except for Ward 9 (95%). While most households have access to power supply, reliability and service management is very poor. Almost all wards have electricity facility but the service management is very poor. Although transformers are there in all wards, the voltage is deficient. Unstable electric poles are found across the Municipality. The distribution of power infrastructure is included in Figure 11.

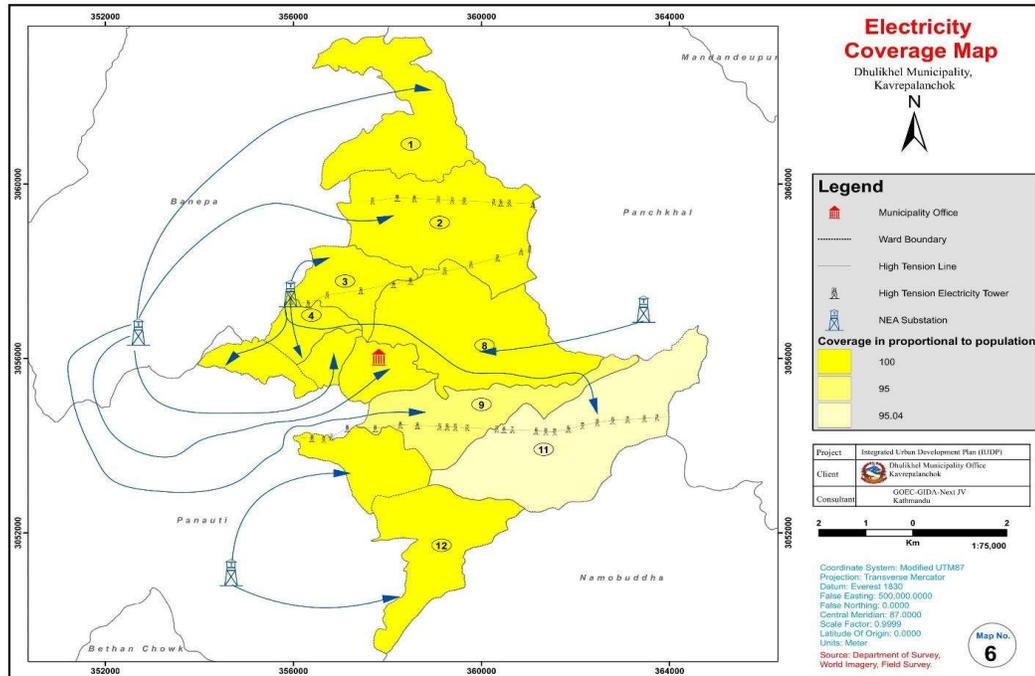


Figure 11: Electricity Map

6.4.2 Communications

According to Planning Norms & Standards 2013, landline/mobile should cover 100% of the Municipality and one public/community Telephone booth (TB) (standard booth) should allocated 2 per neighborhoods. According to data collected, Mobile service (2G & 3G) has reached to all wards and working well. Wards 1,2,8,9 and 12 lacks landline service.

7. Risk Sensitive Land Use Plan

Risk-sensitive land use planning recognizes that land use and disaster/risk are related elements whose interactions are needed to be considered to determine the most appropriate and safest strategies for development. Uncontrolled urbanization is the major issue in Dhulikhel Municipality. The lack of land use has led to developments of settlements at the cost of loss of prime agricultural land, forest and impact on rivers.

As settlements have grown there has been a lack consideration for environmental hazards such as landslide susceptibility and flood prone areas.

Lack of control mechanisms has caused scattered settlements and fragmentation of agricultural land. Scattered unplanned settlements has made it difficult to lay infrastructures and efficiently provide municipal services and facilities. In addition, the fragmentation of agricultural land has posed similar problems in the production of agricultural goods, which is eventually going to challenge the food security in the Municipality.

A strategic and long-term land use plan for Dhulikhel is required which identifies the potential risks in different areas of the municipality, suitable areas for settlement development, also identifies the other zones like agriculture, forest, river etc and proposes policies for their protection. Further, Through Risk sensitive land use planning disaster related factors are addressed to decrease vulnerability, increase resilience and mitigate potential damages and losses in the Municipality.

In recent years, a number of land use issues has been encountered in the Municipality, such as conversion of agricultural land, haphazard development of the scattered settlements, fragmentation of agricultural land Scattered, natural hazards like soil erosion, earthquakes and even political issues related to land use decisions are Made. Some of the major land use issues are discussed below.

7.1 Scattered Development

Study of land use and settlements through primary data collected at ward level and GIS Mapping indicates that rural population engaged in subsistence farming, have no proper support system of markets, roads and service centres because they are isolated and scattered at very low densities. A map showing settlements scattered throughout the Municipality (see Figure 12) is presented below:

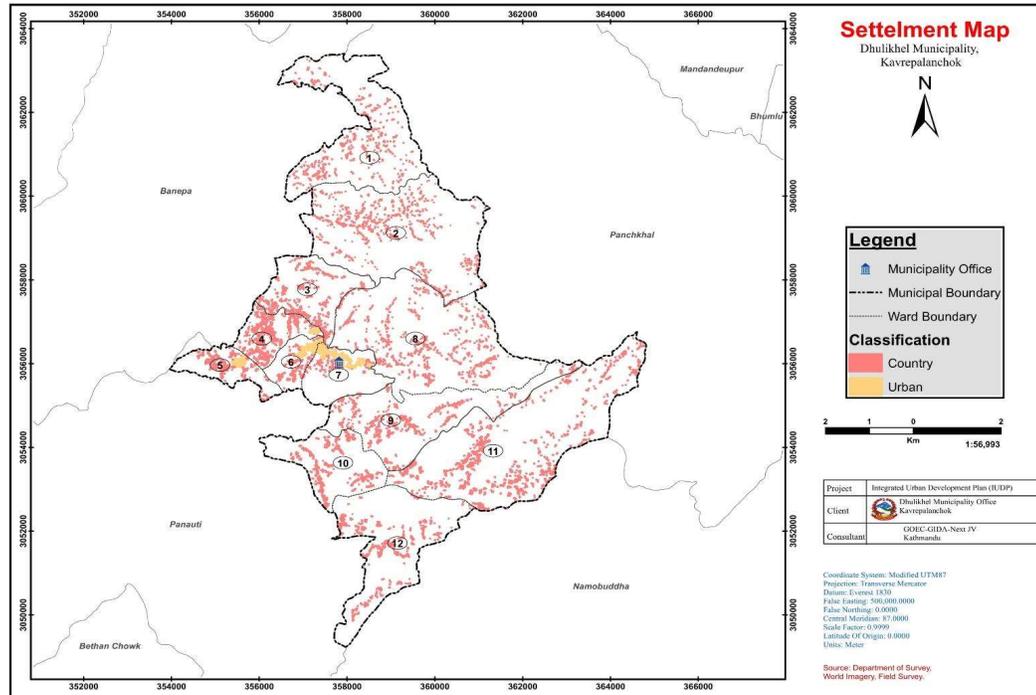


Figure 12: Settlement map

The following problems related to such sporadic land settlement should be considered as some of the major constraints to agricultural and rural development in the municipality:

- The very low density of human settlements (except Bazar area: ward no. 4,5,6,7) makes it very difficult - almost impossible - to provide access roads and other facilities, given the limited financial resources available.
- As subsistence farms are remote and isolated far from the urban centres. Ward number 1,2,9,10,11,12 have weak linkage with the centres. Farmers in these wards neither cannot sell their surplus food crops easily nor can farm inputs and agricultural extension services be provided without the farmers walking very long distances.
- There is a lack of threshold population in these wards considered adequate to justify the provision of facilities such as schools and health clinics.
- In the absence of an organized village in the rural wards mentioned above, there is neither a social support system nor a sense of community. It is a most inefficient form 'of land settlement and land use as thousands of unutilized pockets of vacant customary land lie between cultivated patches and between settlements.

7.2 Accessibility

It is almost impossible to provide access roads and other facilities to most of the settlements in low population density wards (9,10,11,12). Establishing major infrastructures in the settlement of these wards where population density is very low is not feasible in many ways. Here the financial, social, environmental constraints have to be considered in a sustainable way. Such low dense areas in the municipality does not seems to be sustainable in laying out the infrastructures when compared with these sustainability constraints. A population density map is presented in Figure 13.

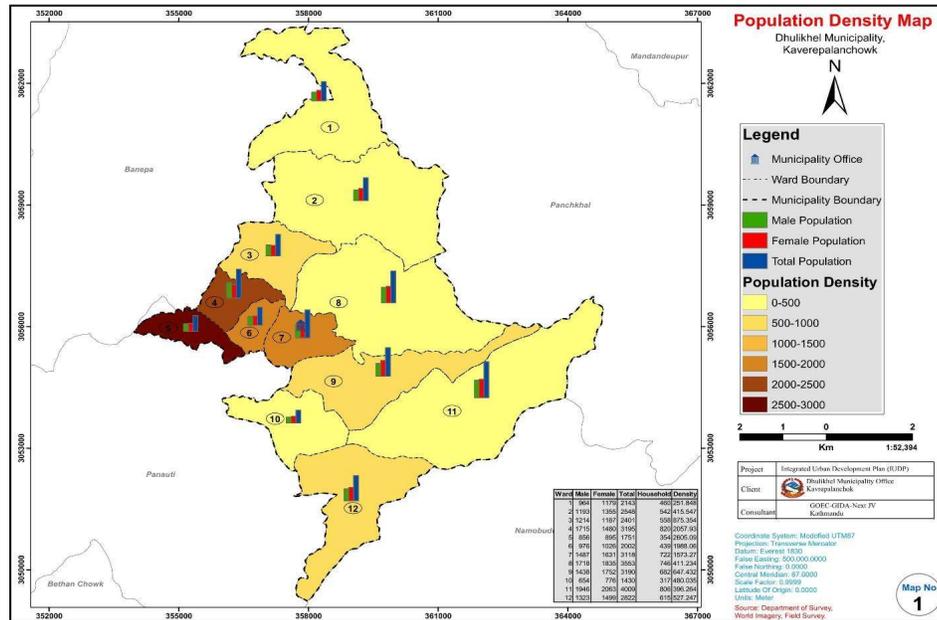


Figure 13: Population Density map

7.3 Natural Hazards/Disaster

Natural disasters occurring in the municipality have a serious impact on society and the economy, resulting in a significant human loss. Dhulikhel encountered a serious loss of life and property in the last earthquake in 2015. Areas of Dhulikhel are also susceptible to landslides which are triggered through earth tremors, monsoonal rains and loss of vegetation.

Development activities in these areas are subjected to a significant to mitigate these risks to future development, land use policy and building by-laws need to respond to the risks and ensure that future development is not compromised.

Likewise, there are many environmentally sensitive areas in the Municipality.

Plan should be developed for appropriate risk reduction phenomenon. Identifying the vulnerable zones in Dhulikhel to safeguard. Hazard mapping has been prepared to identify the possible disaster-prone zone areas to inform how land should have used, therefore proving maximum safeguards to life and property. Various types of hazard maps for Dhulikhel Municipality along with their description is given below:

7.3.1 Earthquake Risk Areas

Earthquake risk areas inside the Dhulikhel municipality are presented in the Seismic Hazard Map (see Figure 14) below. From the map we can conclude that all the Wards inside the municipality are vulnerable to earthquake.

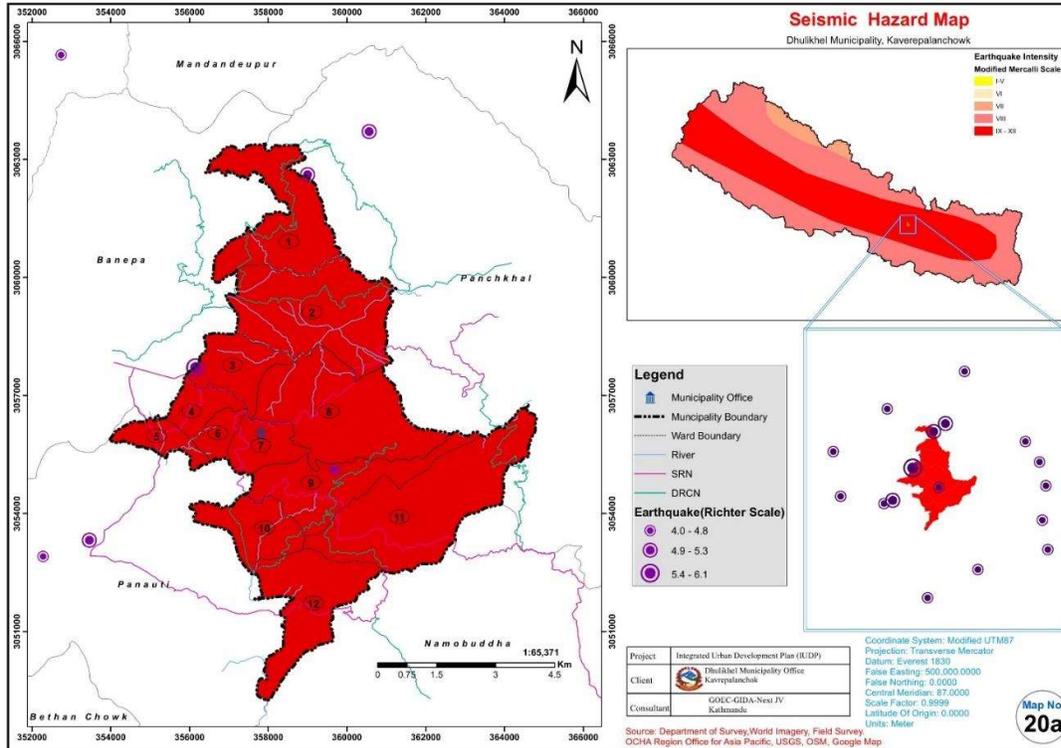


Figure 14: Earthquake Risk Areas

The Earthquake 2015 Damages Map (see Figure 14) below confirmed the vulnerability of Dhulikhel Municipality to the earthquakes. The red dots scattered in the Map indicate significant damage caused by the earthquakes 2015. This factor must be considered while preparing the Land Use Plan and Building By-Laws of the Municipality.

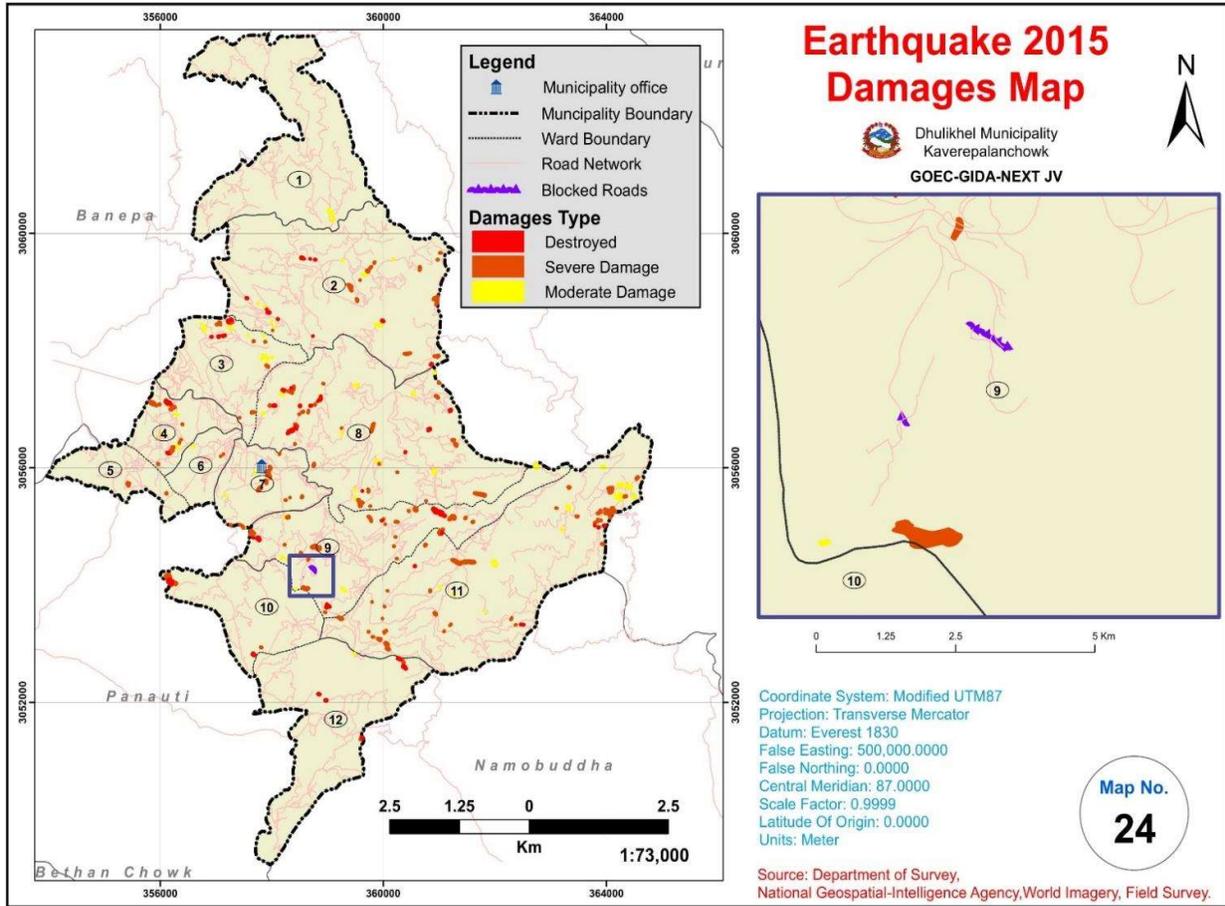


Figure 15: Damage Assessment map

7.3.2 Landslide Susceptible Areas

Through the analysis of the data through GIS, including slope and soil type a Landslide prone area map has been prepared. The map (see Figure 16) shows almost all the Wards in Dhulikhel are composed of steep sloped areas with a high degree of earthquake susceptibility. The Map shows the possibility of high landslide risk in the Devitar area of Ward 1. It also indicates that Wards 4,5,6, and 7 are the least susceptible to landslide and therefore are more suitable for urban development activities.

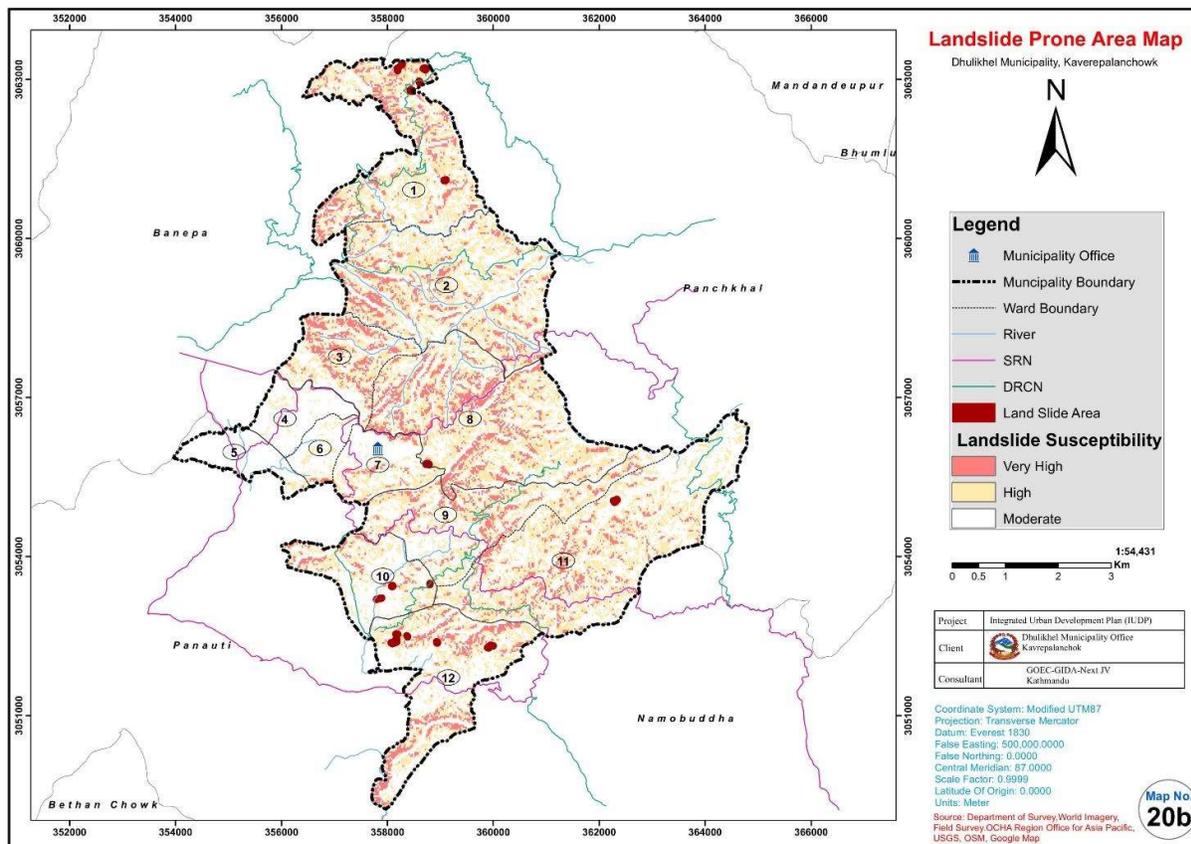


Figure 16: Landslide Prone Areas

7.3.3 Flood Prone Areas and Flood Plains

Flood prone areas have been identified based on the data collected from the field informed by local knowledge and past hydrological records. The areas where previously occurred flood has created a considerable damage are categorized into the potential flood areas. Figure 17 shows the potential flood prone areas inside Dhulikhel municipality, where wards 1 and 10 are identified as flood prone areas.

More research is needed to identify areas affected by overland flow. This will identify flood levels and heights that floor levels should be to the building being flooded.

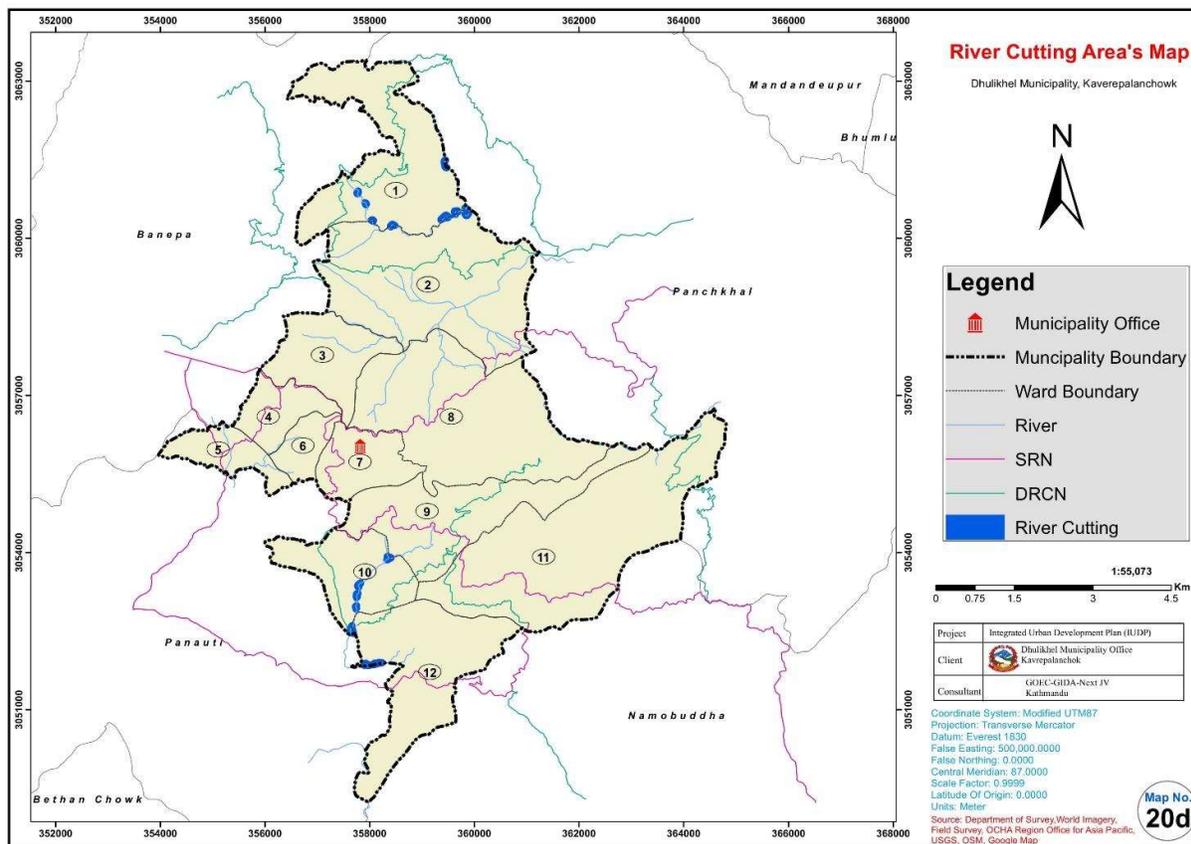


Figure 17: Flood Prone Areas

7.3.4 Industrial area and Environment sensitive areas

It is also necessary to identify environmental risks area in the Municipality such as industries like Brick kiln, Fire Sensitive zones in the traditional settlement at the core area of the municipality, Petrol pumps near to the settlements that pose threat to human settlement. For Dhulikhel municipality, environment sensitive areas are shown in the figure.

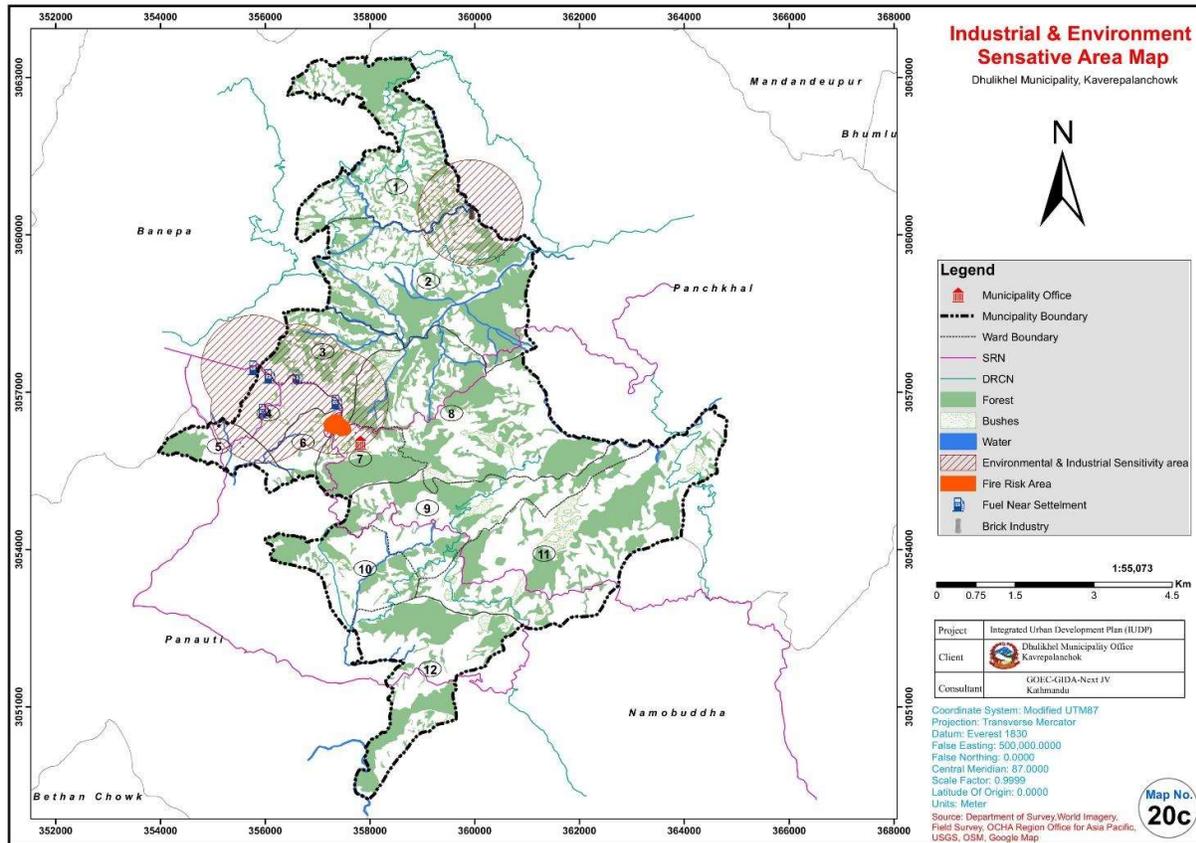


Figure 18: Industrial area and Environment Sensitive areas

7.4 Hazard Map Compilation

Considering all the above-mentioned risks; earthquake risks, flood risks, other environmental sensitive areas, landslide risk area, a Hazard Compilation Map (Figure 19: Combined Risk Areas) has been prepared which represents all the risk features. The Hazard Compilation Map will inform decisions around the strategic use of land as documented in the Land Use Map and building by-laws. Most of the areas of Wards 4,5,6 and 7 and some areas of 9,10,11 and 12 are free from all the above-mentioned risks. These areas are suitable for new development activities.

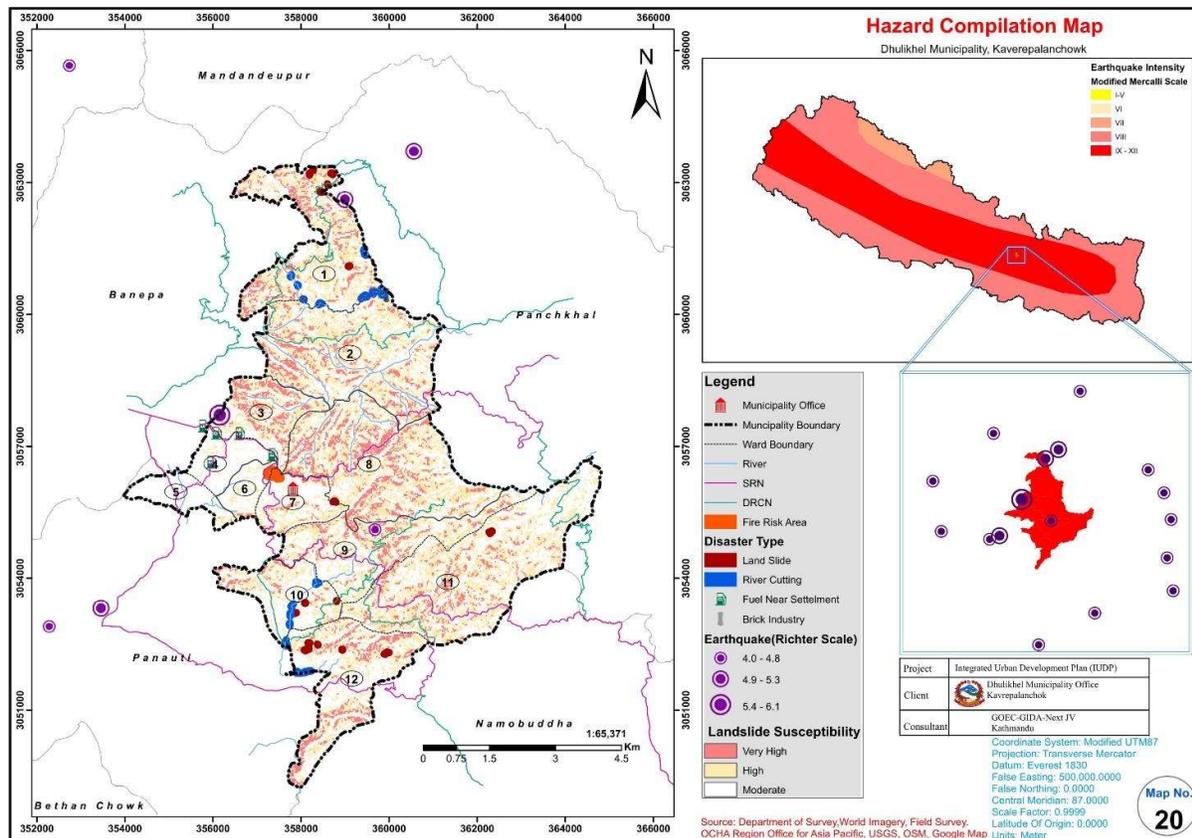


Figure 19: Combined Risk Areas

7.5 Implications of Hazards in Land Use Planning

Identifying areas at risk of hazards will be the greater important for land use regulation and planning new developmental activities. It is very much important to understand these **hazards and its potential consequences in urban centers**, which may have socio-economic damage. The hazard mapping will assist in a scientific based proactive strategic approach to pro-active to planning as well as developing appropriate mitigation, preparedness and emergency response plans for these urban areas.

Land use planning techniques are most appropriate for generally the undeveloped land. Another common approach to earthquake loss mitigation is to apply earthquake-responsive **building codes and practices/ standards** for new and existing construction. Given the extent of earthquake prone land, it is recommended this apply to all existing and new development, regardless of its location. The adaptation of land use regulations and the implementing the Disaster Risk

Reduction Plan will increase the capacity of the community and local officials to quickly respond for the emergency situation.

7.6 Land use, strategies and policies towards risk reduction:

Hazard Policies that are to be considered in Land Use Plan and Building By-Laws of the Municipality

1. Mitigation of risk to an acceptable level in development permission based on the geological study and Multi Hazard Risk Map.
2. Updating of the Building Code in order to respond to the earthquake, flooding and other disasters.
3. Promotion of awareness and caution among residents regarding earthquake.
4. The development of a Disaster Risk Reduction Plan.

Earthquake Polices

1. Require all new buildings be designed and constructed to resist stresses produced by earthquakes.
2. Foster the rehabilitation or elimination of structures susceptible to collapse or failure in an earthquake.
3. Only approve new development in areas of identified seismic hazard if such hazard can be appropriately mitigated.
4. In the by-laws, continue to require geotechnical studies for development proposals; such studies should determine the actual stability of special structural requirements, and the feasibility and desirability of a prop extent of seismic hazards, optimum location for structures, and the advised facility in a specified location.
5. Vital public utilities, including communication and transportation facilities should be located and constructed in a way that maximizes their potential to remain functional during and after an earthquake.

8. Land Capability of the Municipality

The Department of Land Use in Nepal uses the Land Capability Classification System to assess, classify and map land according to its ability to support a range of crops on a long-term sustainable basis. Land is evaluated on the basis of the range of potential crops, productivity, ease of management and risk of degradation. The Land Capability Map for Dhulikhel has been extracted from the Nepal Government Department of Land Use, which shows classes in Dhulikhel Municipality. Map shows three classes of land (I, II and III) in Dhulikhel. Class I indicate most suitable and highly productive while Class II also indicates productive agricultural land. While some land in Class III is suitable for some agricultural use, much of this land is compromised due to slope and is considered either 'Barren land', forest or urban land. Land capability is an important base for the classification of Land Use zone

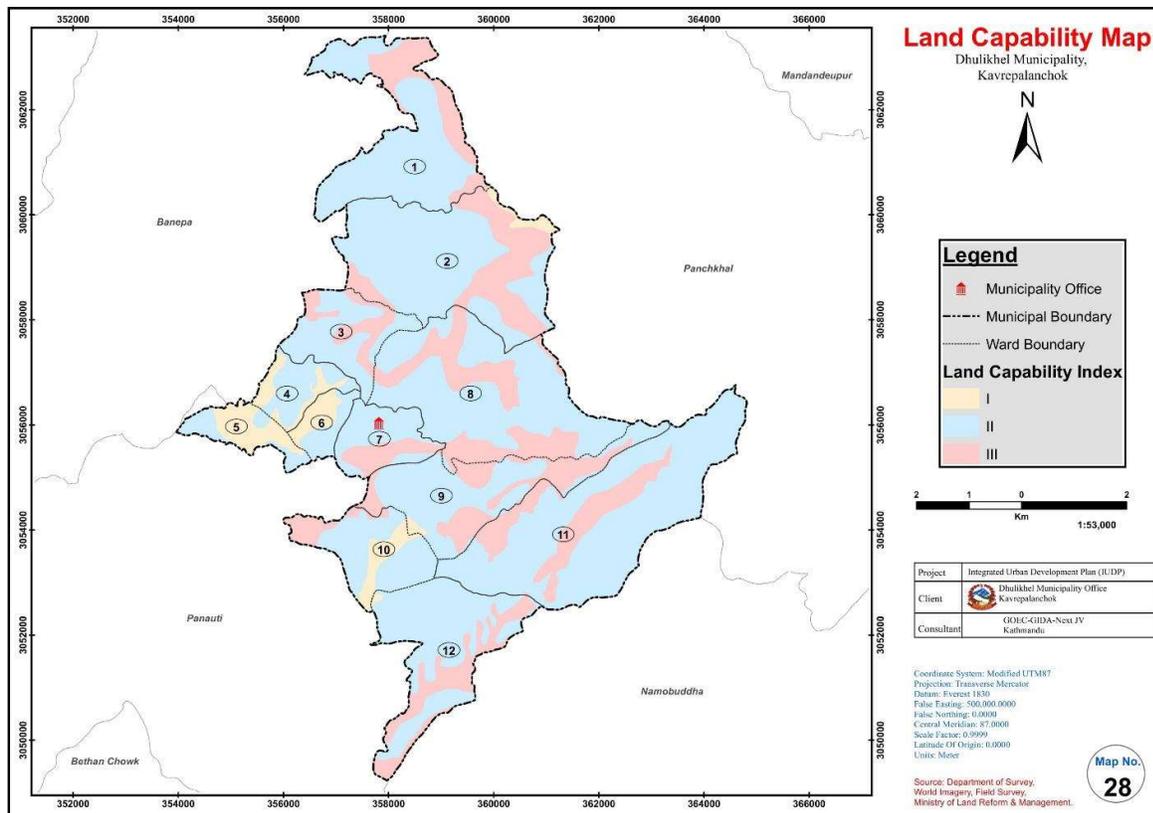


Figure 20: Land Capability Map of Dhulikhel

9. Existing Land Use

Inputs for the preparation of the Land Use Plan is analysis of the existing land use. As Dhulikhel is famous for its agriculture-based products, the greatest proportion of the land is used for agricultural purposes, although due to scattered development, some agricultural land has become peri-urban in nature, while other agricultural lands are less compromised and have a greater production output. Forest areas also account for a major portion of land and as intensive urban settlement accounts for a relatively small percentage of overall land use. That said, due to scattered low density urban development, there is a portion of land that could be considered either marginal agricultural or peri-urban. Table 8: Existing Land use Areas with areas of different existing land use types and map representing all these features are presented below.

Land Use Feature	Area Occupied(km ²)	Percentage (%)
Barren Land	0.286257	0.524083
Built Up	1.397133	2.557887
Bushes	1.674094	3.064949
Cultivation	28.965145	53.029693
Forest	38.212468	38.212468
Water Resources	0.186891	0.342163
Road	1.239209	2.268757

Table 8: Existing Land use Areas

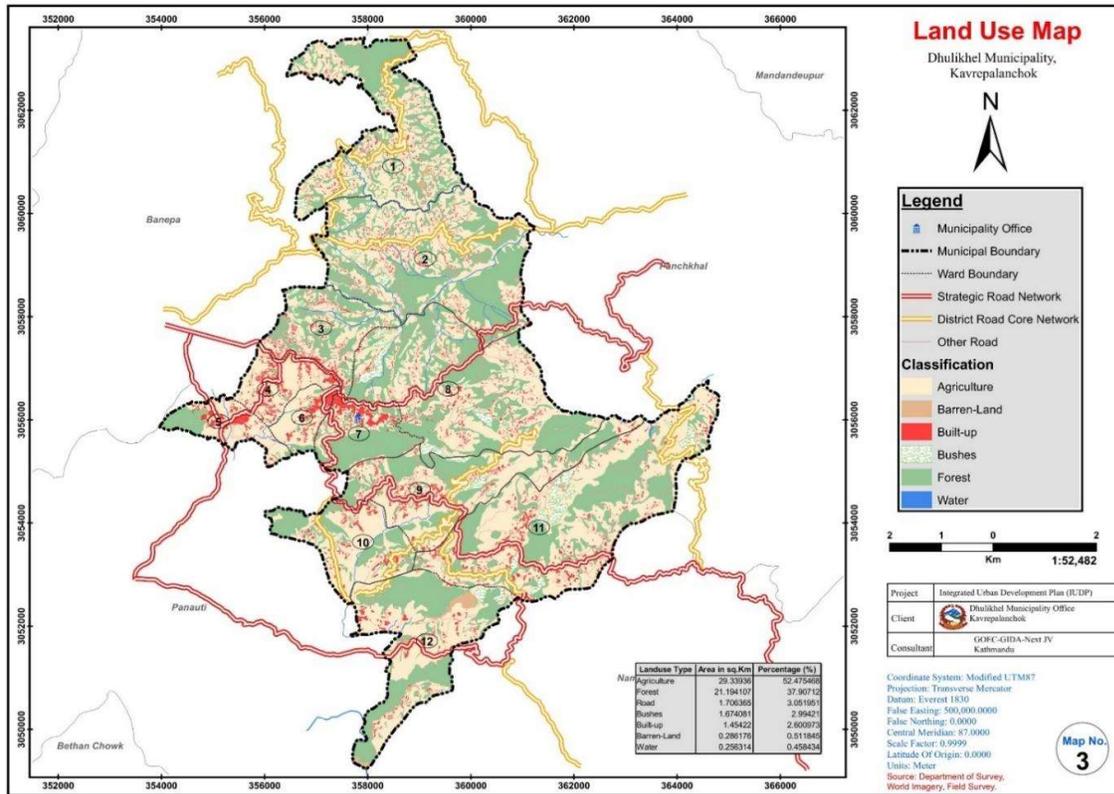


Figure 21: Land Use Map

Existing Land Use Map shows larger settlements are concentrated in central areas covering the wards within 1 to 2 kilometers along the major highway transportation corridor. Specifically, major built up areas and settlement areas are concentrated in Wards 4, 5, 6 and 7 where commercial, residential and social activities are located and some residential development in a 'ribbon' form along the roads connecting the main bazar area and highways. In addition, scattered settlements are found in widely divergent areas of the Municipality except in wards 4, 5, 6 and 7 where more intense development is located. Likewise, physical and natural constraints to development in Dhulikhel municipality are combined with landslides and river cuttings.

10. Dhulikhel’s Land Use Plan

The strategic Land Use Plan for Dhulikhel encompasses the location of principle, local and village activity centres, future urban growth areas, residential areas, an urban growth boundary indicating the area where development will be supported by infrastructure, locations of forest and environmental areas and location of agricultural land. It considers the Hazard mapping and Land capability mapping in the preceding chapters.

A key mechanism of the IUDP, the Land Use Plan translates and integrates policies and strategies from all of the Plans that make up the IUDP into a physical settlement framework.

10.1 Activity Centres

The following strategies determine the location of activity centres:

- Recognise the Activity Centre hierarchy within the Dhulikhel Municipality, which includes Primary Activity Centre, local centre and a series of village centres in the rural wards.
- Encourage retail, office, community services, entertainment and housing within existing and planned activity centres.
- Strongly discourage ‘out of centre’ retail development.
- Discourage unplanned ribbon commercial development along the highway.
- Apply “Commercial” or Mixed Used zones to the activity centres.

Activity centres include:

Ward no. (Market centres /activity centres)	Linked Market Centres	Major Link Roads
1(Midinichhap)	Banepa Bazar	DR012
2.(Dudamukh)	Banepa Bazar	DR009
5.Shreekhandapur Bazar	Banepa/Panauti	F73
3/4/6/7(DhulikhelBazar)		
8 (Bhattedanda)	Banepa Bazar	Saraswoti Bazar- Adda Bazar
9(Kavrebhanjyang)	Banepa Bazar	BP Highway
10 (Batase)	Dhulikhel Bazar/Panauti	BP HW - Sarada Batase – Ite
11(Kharka)	Dhulikhel	H06
12(Shankhupaticchau)	Panauti	F72

Table 9: Activity centres within Dhulikhel Municipality

- Around Dhulikhel Chowk (at the junction of Araniko Highway and BP Highway), (Wards. 6 and 7)
- The Bashghari Area (Araniko Highway), 28Kilo to KU Bus stand (Araniko Highway) (Ward no.4).
- BP Rajmarga- From Jaran Danda Ghanti tole chowk to Dhulikhel Hospital

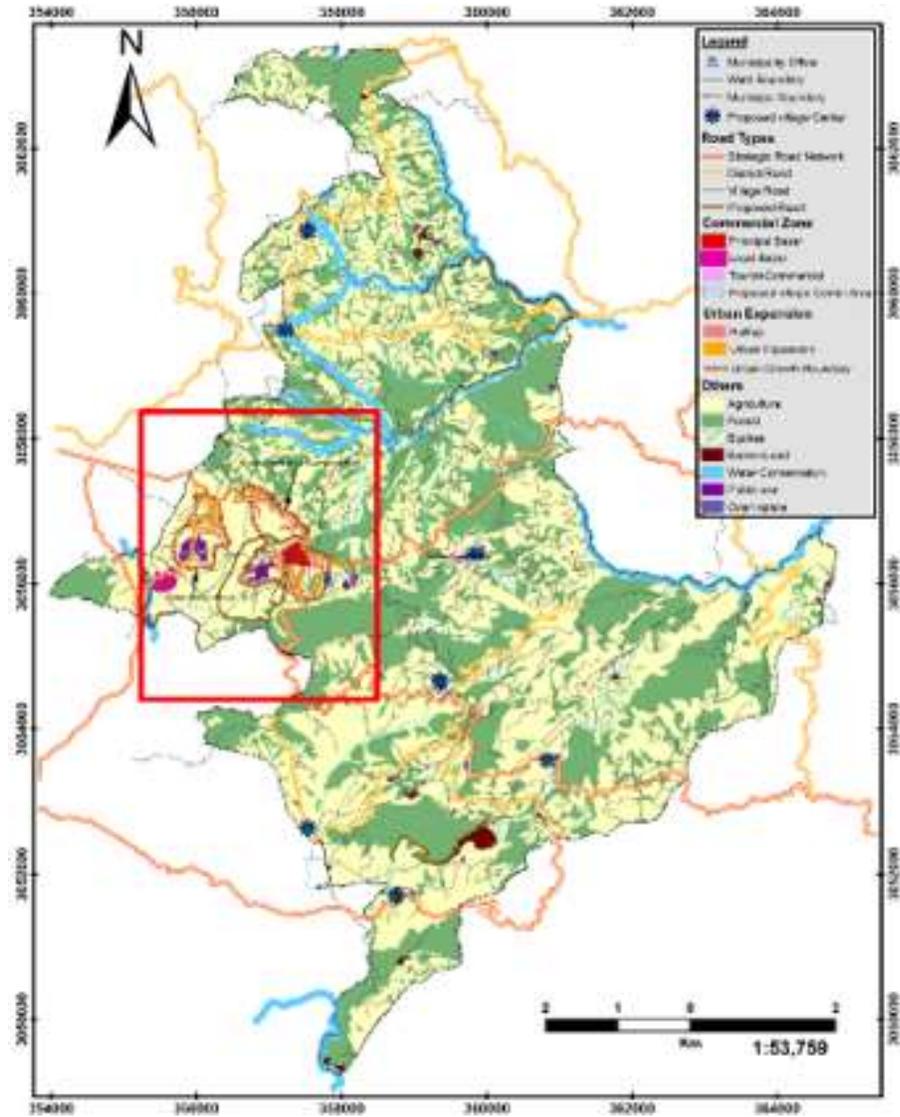


Figure 22: Illustration of Activity Centres – blue, pink and red areas (village, local and principle activity centres)

10.2 Tourist Development Area

Bhutte Danda is one of the major tourist attractions of the Municipality. Road from Gokhureswor to Bhutte Danda has developed itself as a very important commercial corridor. The corridor is also within a dense forest area and this factor needs to be considered and balanced when considering new development. Many Resorts and Hotels are developed along the road because of tourism. This stretch of road is a focus for further tourism development.

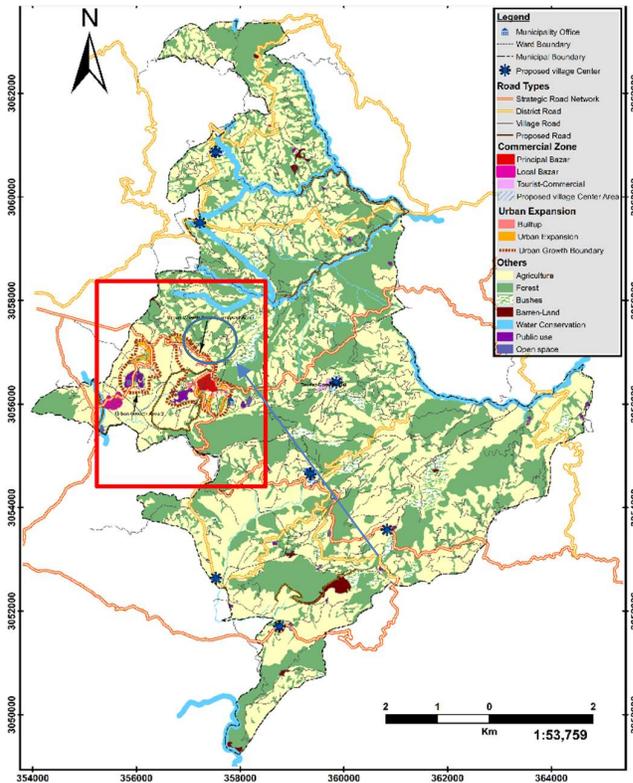


Figure 23: Illustration of Commercial Tourist development area

10.3 Institutional areas

Land belonging to various government and semi-organizations are indicated as institutional areas. They provide services to the community, employment and should be located within or immediately next to activity centres. The following key institutional areas are:

Ward 4

Kathmandu university area and Institutional area between F73 and Dhulikhel-DMI-Shreekhandapur road

Ward 6

DMI area (Institutional area between Lakhanamai-Suwaltole road and Gitamarga-hospital chowk road)

Ward 7

Institutional area along the Saraswati- Adda Bazar road

10.4 Residential

Residential land needs to be identified to accommodate the additional population over a 20-year period. It includes existing residential and strategically located land that is year to be developed but requires planning and infrastructure to accommodate future growth.

Based on population, land supply and demand analysis in this report, an additional 28 hectares of land is required for residential use (and associated infrastructure) to accommodate the population over the next 20 years. Strategies to consider the location of residential land include:

- Ensure a 20-year supply of zoned residential land
- Ensure residential land is located close to activity centres and serviced with road, sewerage, electricity, communications and water supply.
- Undertake Masterplans for residential growth areas.
- Ensure residential areas are safe and have high amenity, including good noise, air and water quality.

Dhulikhel Municipality has already started a Land pooling project in ward no 4. In wards 4,5,6 and 7 there is a pattern of fragmentation of land parcels into irregular shapes and sizes, functional open spaces are becoming rare with each building constructed with each new building constructed with no harmony with the existing buildings and infrastructures in the neighbourhood. To solve this problem National Urban Development Strategy 2015 has aimed to get the new residential areas developed by land readjustment by 2031. Dhulikhel Municipality has initiated this land readjustment project in ward 6 along the Araniko Highway. The Existing and planned Land pooling area is illustrated below:

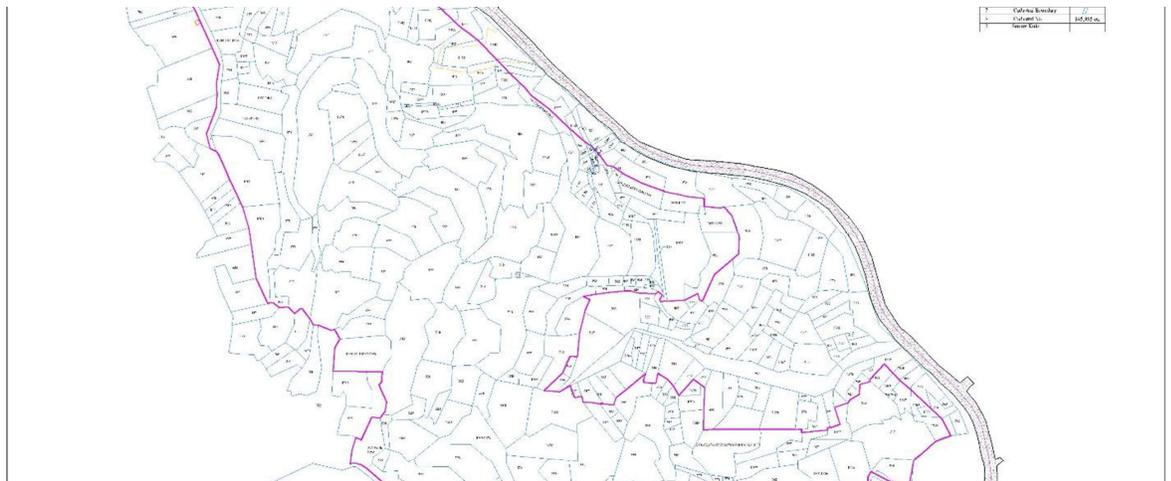


Figure 24: Land Re-adjustment area



Figure 25: Land Re-adjustment Plan

Wards 4, 5, 6 and 7 are the low disaster risks zones and are appropriate for new development activities. Furthermore, Expansion areas are selected based on the principle of giving neighbourhood compact form. Also, the ability to efficiently sequence road, water and sewerage infrastructure has also been considered.

Existing residential uses lie within Wards 4, 5, 6 and 7 and urban expansion is best located immediately adjoining these existing residential areas to maximise the use of existing infrastructure. Furthermore, land fragmentation and building activity is high on wards 4, 5, 6, 7 and therefore these areas are identified as potential area for urban expansion. The existing settlement pattern in these wards is dense along and around highways and more on the northern part of highway. Therefore, the major portion of residential zone is proposed on these areas of the ward.

An Urban Growth Boundary is proposed around the major urban area as a policy tool to clearly show where intensive residential development and subdivision is encouraged.

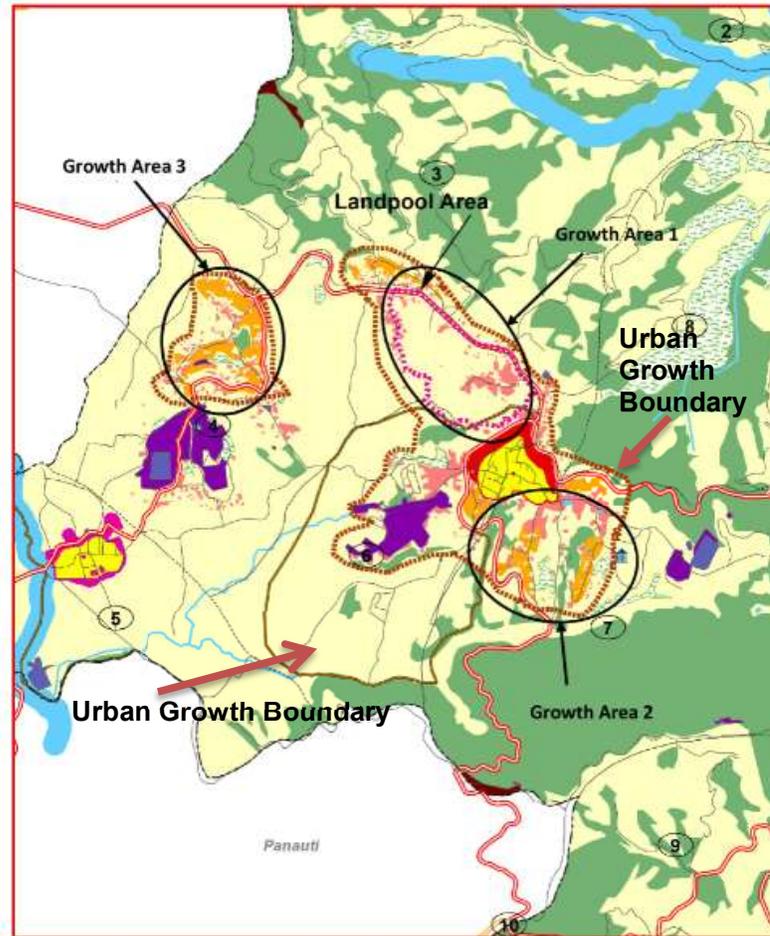


Figure 26: Illustration of Future residential areas and urban growth boundary

Areas identified as urban expansion areas to accommodate future development is illustrated in the map above.

Urban Growth Area 1

The settlement below Araniko Highway in Ward 4, the existing landpool area (approximately 17 hectares)

Urban Growth Area 2

Area south east of Main Bazar-Saraswati Bazar-Adda Bazar to BP Highway (approximately 6 hectares)

Urban Growth Area 3

Land around KU Road to be consolidated and can be used for urban expansion in the future (approximately 5 hectares)

Policy statements:

- **Urban Development** such as Residential and commercial development and subdivision is **strongly encouraged** on land **within** the Urban Growth Boundary. These activities are **strongly discouraged** on land **outside** the Urban Growth Boundary.
- **Existing residential areas** should be **consolidated with in-fill development** to achieve a **compact settlement** form and maximise the efficient use of infrastructure.

10.5 Industry

Dhulikhel's economy is predominantly driven by agriculture, tourism and trade. Light industrial uses such as mechanics, carpentry, welding etc serves the immediate population. Agriculture and tourism rely on the preservation of a 'clean green' environment. Therefore, large intensive 'heavy' industrial uses are not encouraged.

The following strategies should be applied:

- To promote decentralized balanced clean industrial development (in particular in the rural wards) in order to spread the benefits of employment throughout the municipality, help minimize rural-urban migration, and support the development of rural and urban service centres.
- Encourage agriculture-based industry such as value-adding enterprises.
- Necessity of an agro-based cottage industry that provides a significant employment opportunity which helps to upgrade or uplift the overall agricultural production as well as consumption.
- Protect residential areas and other sensitive uses such as hospitals and schools by applying a buffer between industrial uses and sensitive uses.
- Apply zoning and effective by-laws that requires industrial uses to operate to minimise impact on water and air quality and upon the amenity of the area.
- Ensure that the sites where Industrial uses are located are well-presented and do not negatively impact upon the landscape or character of Dhulikhel.

10.6 Agriculture

Agriculture is the main land use within the Municipality, a major contributor to the economic wealth of its people and the means to secure food sources. Given the rapid development of agricultural land for scattered urban development, it is essential that this land is protected for agricultural use into the next generations.

The following strategies apply:

- To promote rural agricultural development in order to generate employment, which helps to minimize the rural urban migration, and support the development of rural and urban service centres. To enhance connectivity of rural areas with Dhulikhel Bazar.
- Promote consolidation of plots in agricultural areas to increase productivity and "economies of scale" of agricultural production.
- Discourage haphazard fragmentation of land which provides for fixing limit of land miniaturization for different land uses.
- Encourage further development in existing settlements and discourage isolated small lots in rural zones.
- Apply Agricultural Zone that restricts subdivision and residential development that is not associated with agriculture.

11. Physical Development Plan Implementation Plan

Pulling together all of the Land Uses, the Dhulikhel Land Use Plan is illustrated below:

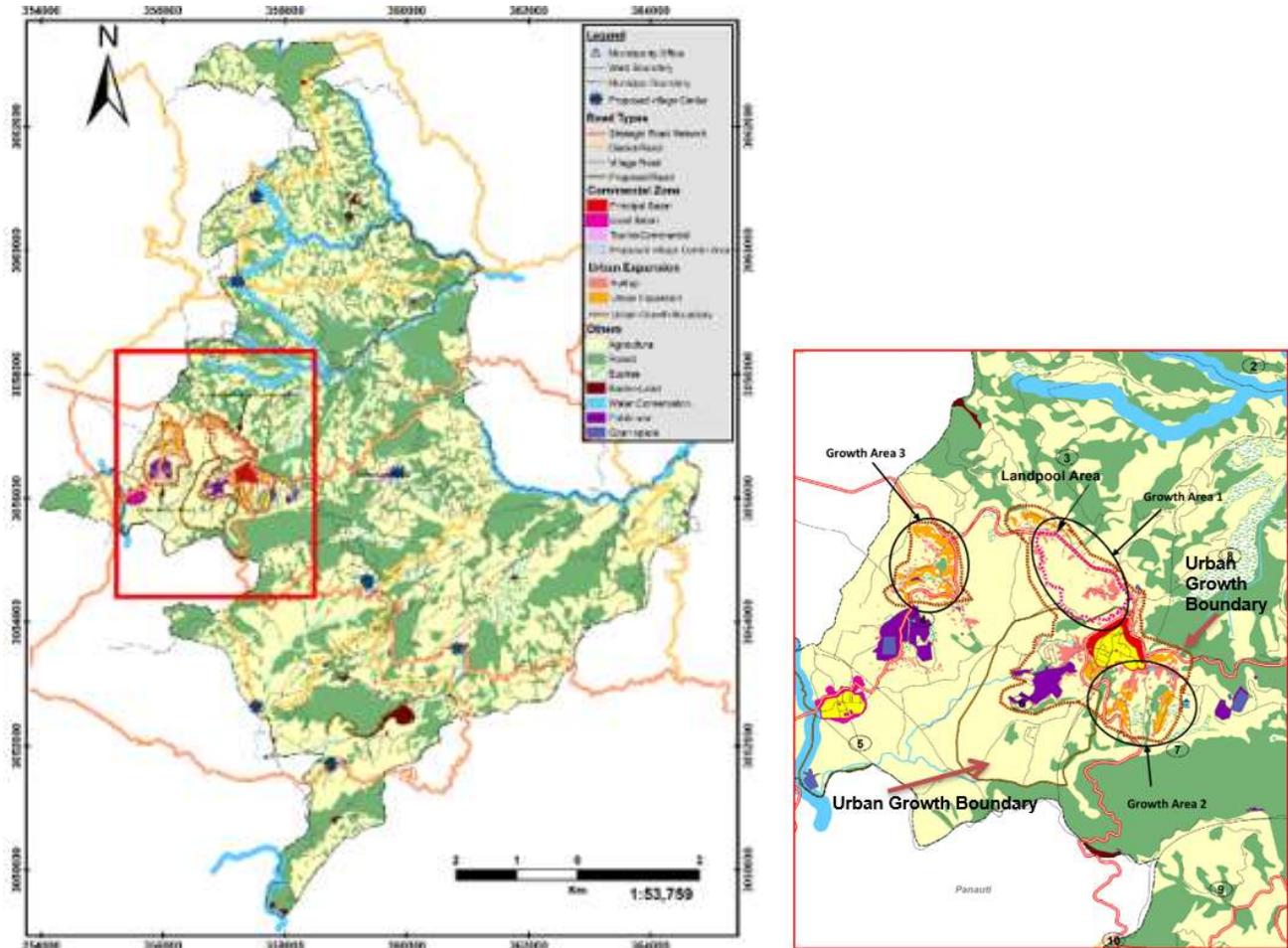


Figure 27: Dhulikhel Municipality Land Use Plan

It is critical that the **next phase** of planning is to develop a **detailed Masterplan of the Dhulikhel Urban Area (within the urban growth boundary)** and the rural settlement villages.

While the IUDP is a “high level” plan for the whole municipality, the Masterplan for each urban area is a much more detailed plan for each settlement. The Masterplan identifies the land pooling areas/urban growth areas, areas where infill development is encouraged, the transport network including roads and active transport links, location and type of infrastructure including drainage and reticulated water and sewerage, public open space, communal carparking areas, bus interchange. The Masterplan will also include an Urban Design Framework which focusses on design specifications/design palette for the installation of municipal infrastructure such as footpaths, signage and street furniture. The Masterplan may recommend changes to by-laws based on more in-depth analysis of the urban area, including potential height controls, etc.

The project process is illustrated below:

Masterplan project process

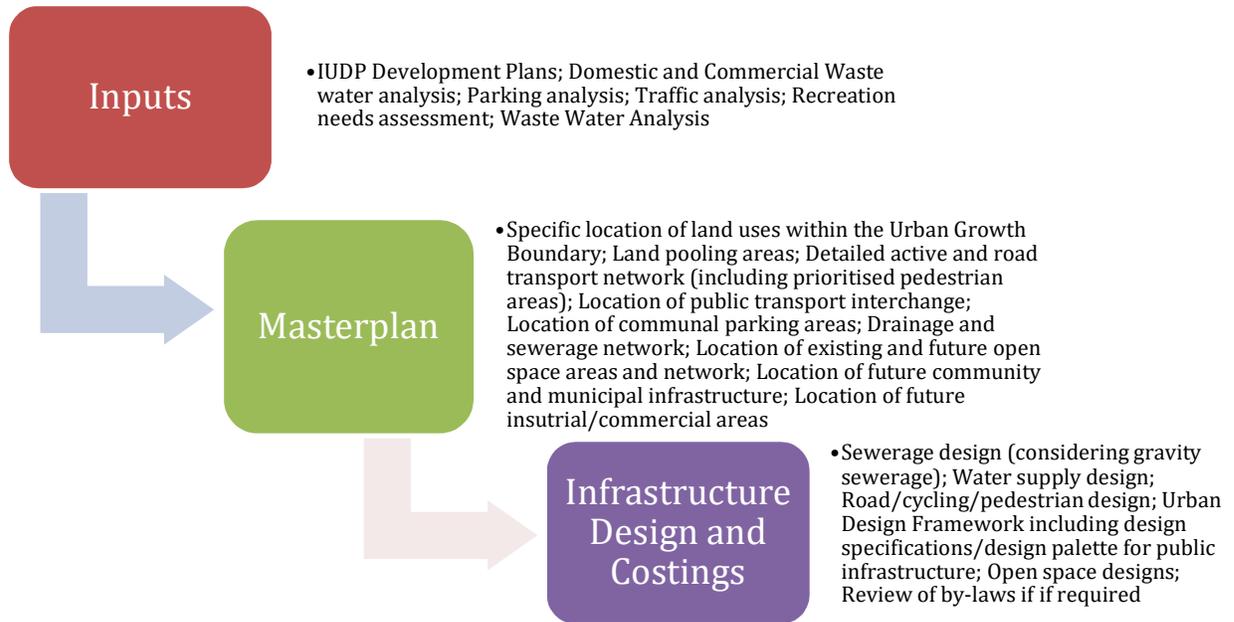


Figure 28: Masterplan Project process for Dhulikhel Municipality Urban and village areas

Physical Development Plan Implementation:

MAIN PLANS AND PROGRAMS		RESPONSIBILITY	SUCCESS INDICATOR
Land Use Plan			
Implementation of Land use plan, will have introduced planned urban development in the Municipality.	Translate the Land Use Plan into Land Use Zoning maps and by-laws	Planning <i>(IUDP Link: IUDP Zoning Maps)</i> Support from the Department of Road Department of Urban Development and Building Construction and Department of Survey	Zoning maps are created
Establishment of land pooling/consolidation mechanism in the Municipality	Identify areas for land pooling and consolidation in order to relocate the scattered, risk prone houses and to improve the agricultural production	Planning Building approvals Support from the sectoral agencies and the residents of the Municipality. <i>(IUDP Links: Land Use Plan, Social Development Plan)</i>	

Masterplans for Urban Dhulikhel and small settlements – village	Undertake an Urban Masterplan for urban Dhulikhel and each Village Centre in each Ward: Include detailed location of land pooling areas, road network and active transport links, location of water and sewerage infrastructure, public open space and recreation infrastructure, communal carparking areas, bus stops and interchange Detailed costings and implementation schedule are required	Planning Engineering <i>(IUDP Links: Social Development Plan, Conservation Culture and Tourism Development Plan, Environment Management Plan, Municipal Transport Management Plan)</i>	
Drainage	Drainage design and construction - Areas where the population density is high i.e. 4, 5, 6, 7 (as part of Masterplan process)	Engineering <i>(IUDP Links: Environment Management Plan)</i>	
Water supply	Expansion of the capacity of Dhulikhel water supply users Committee. Feasibility study for combined water supply scheme in wards 1 and 2 Feasibility study for combined water supply scheme in ward 9,10,11 Provision of other urban areas as per the Masterplans	Engineering Water Department Water Committees Support of Drinking Water and Sewerage Departments will be received <i>(IUDP Links: Environment Management Plan)</i>	City will have increased drinking water and sanitation facilities. 100% of households have clean and hygienic drinking water consumption
Water supply	Undertake a trial of rainwater harvesting technology using Municipality buildings as test cases.	Water Department <i>(IUDP Links: Environment Management Plan)</i>	Test site operational
Waste water and Sanitation planning and service extension	Pipe Sewerage design and construction - Areas where the population density is high i.e. 4, 5, 6, 7 (as per future Masterplans)	Engineering Sewerage Department <i>(IUDP Links: Environment Management Plan)</i>	100% of households using Toilet
Improvement in the linkage of rural centres of the Municipality with the urban centers like Dhulikhel Bazar	Design and construct the following roads – considering all modes of transport including active transport): Thing khola- Kashi Bhanjyang, Milanchowk –Bhadaure Danda – Anaikot Rabi-Deurali-Chamare, Chisapani –Sakhin Chaur, Chaplati - Ward No 1, Sisne Khola– Thini Gaun Dhulikhel-Devitar, Panchakanya - Kutal – Rabi, Panchakanya – Chankubesi Chukunepati – Bashghari, Dhulikhel - DMI – Shreekhandapur Punyamata Khola Corridor, GandivChok – Chaukot,	Engineering <i>(IUDP Links: Municipal Transport Management Plan, Social Development, Economic Development Plan)</i>	Major identified link roads will be upgraded and the transportation system for all modes will be improved

	<p>Khawa - Sikharkatarito – Kalche, Khawa - Swarsatima – Kavre bhyanjang, Thakle– Chapaladevi, Pipalbot – Kavre bhyanjang,</p> <p>Ghat Khola- Thulachaur, HulakiPati- Panitanki, Devasthan Kavrebhanjyang, Kavreybhyanjang – Thatithok, Majuwa Khola – Kavreybhyanjang</p> <p>Bhairabghat – Thakurichhap, Phaskot – Krisna Mandir, Mathillo Pipalbot - Dhungeban</p> <p>SunarTole – Tinpiple, Maskate - Thulitar – Pipalthumki, Jukepokheri - Dobane</p> <p>Sankheswari – Talloeklekhet, Eklekhet – Fending, Ite – Piple, Lamichane – Kukulthumka</p> <p>Land in the road reserve adjacent to Arankio and BP Highways (that land within Municipality jurisdiction) should include “active transport” corridors - pedestrian and cycling paths</p> <p>In the design and development of the roads, consider all modes of transport, where practical.</p>		
<p>Creation of the employment by promoting the decentralised balanced industrial development</p>	<p>Support the Establishment of small-scale industries related to the agriculture.</p> <p>Establishment of vegetable, milk collection centres, Rice mill, Flour mill</p>	<p>Economic Development Unit</p> <p>Support from the sectoral agencies, private sector and the residents of the Municipality.</p> <p><i>(IUDP Links: Economic Development Plan)</i></p>	
<p>Development of Municipal facilities related Infrastructure.</p>	<p>City House (1)</p> <p>New Buspark (1)</p> <p>Public Toilets in Main bazaar areas, Primary tourist areas, Cultural areas.</p> <p>Central Vegetable Market (1)</p> <p>Slaughter House (1)</p> <p>Security Posts</p> <p>School in Ward 2</p> <p>Health posts</p> <p>Recreation facilities in Public Open Space</p> <p>Cycling tracks</p> <p>Trekking tracks</p> <p>Sanitary Landfill site</p> <p>(include within Masterplans)</p>	<p>TBC</p> <p><i>(IUDP Link: Social Development Plan, Municipal Transport Management Plan, Economic Development Plan, Environment Management Plan, Tourism Development Plan)</i></p>	

<p>Co-ordinated and Integrated Development approvals</p>	<p>Establish a new integrated permit system of development approvals and infrastructure provision to ensure that new communities/dwellings that are serviced with critical infrastructure and that new developments do not compromise infrastructure</p>	<p>Engineering Planning Building approvals (IUDP Link: Physical Development Plan,</p>	<p>Process developed</p>
	<p>Development Referrals to Environmental Health – As part of the by-laws process, all development applications for the construction of dwellings or commercial premises that propose to use a septic tank be referred to Environmental Health Department. The Environmental Health department will determine whether the land has the capacity to deal with the waste water.</p>	<p>Planning Building approvals Environmental Health <i>(IUDP Link: Environment Management Plan, Land Use Plan)</i></p>	<p>Applications referred</p>
	<p>Development Referrals to Engineering Water Department and Power Service providers – As part of the by-laws process, all development applications for the construction of dwellings or commercial premises that require the construction of a road, footpaths, stormwater drainage, water supply and electricity supply be referred. These departments will determine if, when and how the infrastructure can be provided and responsibilities of the applicant.</p>	<p>Planning Building approvals Engineering <i>(IUDP Link: Physical Development Plan, Land Use Plan)</i></p>	<p>Applications referred</p>

Table 10: Physical Development Plan Actions Summary