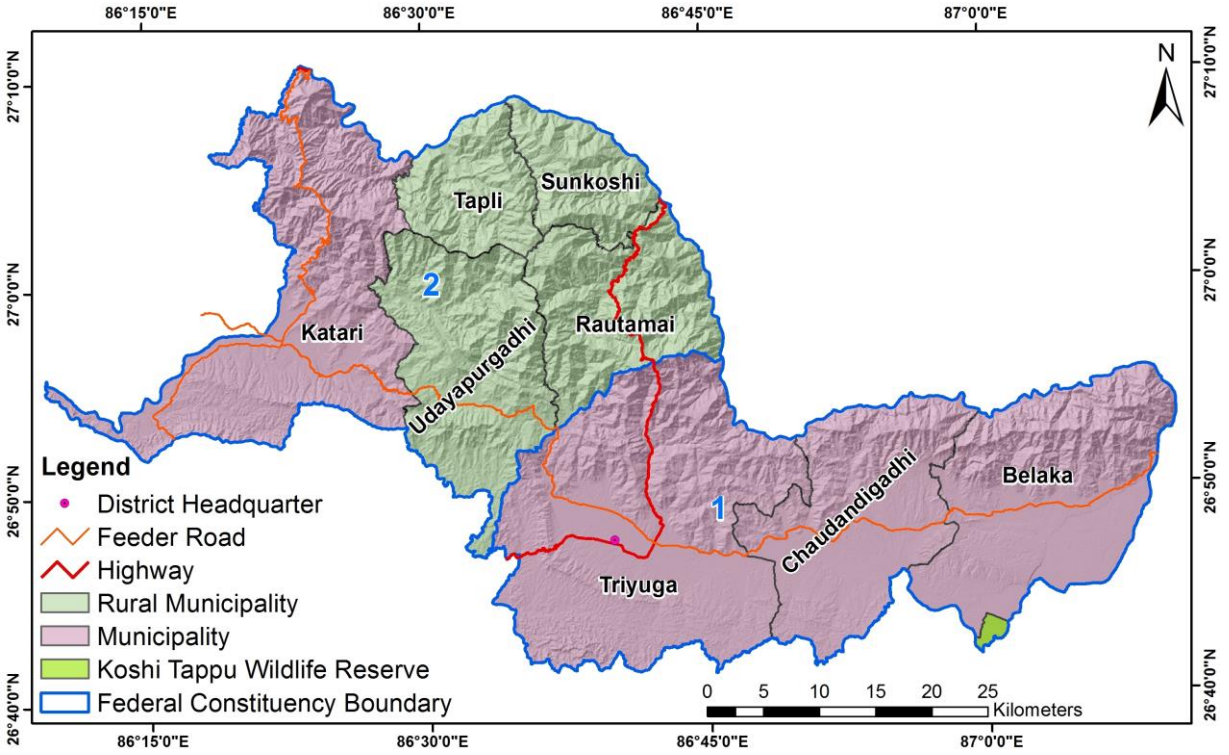
Report on Landslide Inventory of Federal Constituency 1,

Udayapur District, Nepal



Government of Nepal

Ministry of Forests and Environment

Department of Forests and Soil Conservation

Basin Management Center, Koshi

Gaighat, Udayapur, Nepal

2078

FOREWORD

Landslide is one of the main natural disasters in Nepal, responsible for huge social and economic losses for mountain populations. The annual loss of lives and property due to landslides is significantly high in Nepal. Landslide Inventory is an important tool for disaster management, basic data collection and their management. The landslide Inventory provide required knowledge of landslide occurence pattern, condition of certain region, which is useful for the community in planning, mitigating, and avoiding the danger.

Landslides are the results of various causative factors affecting slope instability at a specific location. The first step generally is to map individual landslides and subsequently digitize them for the purpose of a landslide inventory.

In this regard, preparation of the landslide inventory database is utmost desirable component. Further the preparation of landslide hazard mapping with the help of identified landslides is very much helpful to prepare management plan of the affected area. The Landslide hazard analysis and mapping cope to provide useful information for catastrophic loss reduction, and assist in the development of guidelines for sustainable land-use planning.

In this context, the Basin Management center, Koshi under the Department of Forests and Soil Conservation (DoFSC), Babarmahal, Kathmandu has planned to carry out the preparation of landslide inventory at distric level.

Since there is an inadequate documentation on landslides, this Landslide Inventory and Mapping is hoped to be a milestone for further documentation in larger scale in the Basin level. I would like to thank all the concerned local communities, organizations, individuals, and the BMC Koshi team for their tremendous support in preparation of this report. The Suman Multi Consultants is highly appreciated for timely accomplishment of this report.

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ACRONYMS AND ABBREVIATIONS

amsl	:	Average Means Sea Level
BEONC	:	Basic Emergency Obstetric and Neonatal Care
CEONC	:	Comprehensive Emergency Obstetric and Neonatal Care
CBS	:	Central Bureau of Statistics
DEM	:	Digital Elevation Model
DRCN	:	District Road Core Network
EPI	:	Expanded Programme on Immunization
FCHV	:	Female Community Health Volunteer
GIS	:	Geographic Information System
GoN	:	Government of Nepal
GPS	:	Global Positioning System
ha	:	Hectares
ICIMOD	:	International Centre for Integrated Mountain Development
Km	:	Kilometer
Km^2	:	Square Kilometer
LRMP	:	Land Resource Mapping Project
LU/LC	:	Land Use/ Land Cover
m	:	Meter
MSL	:	Mean Sea Level
NTC	:	Nepal Tele Communication
RS	:	Remote Sensing
Sq. Km.	:	Square Kilometer
VRCN	:	Village Road Core Network

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1. INTRODUCTION

1.1 Background

Nepal is a landlocked Himalayan country with an area of 1,47,516 Km^2. The mean width is about 193 Km. In such a short stretch the altitude of place varies from 59 m (Kechanakalan of Jhapa District) to 8,848.86 m (Mt. Everest) MSL, South to North in different geological and geographical set-up. The total population of Nepal is 2,64,94,504 including male 1,29,27,431 and female population is 1,36,93,378 (CBS, 2013).

Nepal is characterized by sources of many small to large size rivers, which flow from North to South. It is stated that there are over 6,000 rivers and their total length exceeds more than 45,000 Km out of which 1,000 are more than 10 Km long; 100 are more than 160 Km. long. Koshi, Gandaki, and Karnali are major river systems of the country.

The water induced disaster event like landslides and floods are common phenomena in Nepal. More than 80% area of Nepal is covered by hills and mountains which are most prone to landslide disasters such as slope failure, debris flow, mass movement and various erosion and sedimentation processes. Nepal's geo-ecological set-up experiences mass wasting, landslide and soil erosion in the hills and mountain areas, and sedimentation in the plain areas. Most of these disaster events occurs during the monsoon season which constantly damages and losses of infrastructure, public property, agriculture land, cattle and livestocks, and taking lives of human being. Unregulated land use practices and human interventions in the upland have further deteriorated the watershed thereby causing floods and sediment deposition along the downstream.

The diverse physiological and fragile geological set-up coupled with ecological, meteorological and demographic factors in this set-up are contributing vulnerability to water induced disasters incluging flood and landslide. Major factors contributing to disasters are rapid population growth, slow economic development, a high degree of environmental degradation, fragility of the land mass and highly elevated mounting slopes.

Floods and landslides are often interrelated in Nepal. Some landslides are triggered by river bank erosion, and some flash floods are aggravated by landslides in the areas adjoining river banks. Both these phenomena occur during the monsoon season. Disastrous flash floods usually occur in Nepal when landslides or debris block a river for several hours and the water is then released suddenly, inundating areas downstream.

Moreover, the Gorkha Earthquake 2015 caused additional occurence of landslides in the country. There are significant number of landslides occur each year. Landslides frequently occur in the monsoon season following an earthquake. Both natural factors (including

steep slopes, undercutting of riverbanks by rivers, weathered, fractured and weak rocks in the mountains, high rainfall and seismic activities) and anthropogenic factors (intensive deforestation, improper agriculture and irrigation practices, overgrazing on the slopes, quarrying for construction materials, and construction of infrastructure beyond the bearing capacities of the hill slopes) contribute to the high incidence of landslides. Thus, the hilly and mountainous regions of Nepal are strongly susceptible to landslides. Thus, the landslide counts as major disaster event of Nepal as country is suffering with enormous losses of life and property and infrastructures and even affecting the national development every year.

In this regard, preparation of the landslide inventory database is utmost desirable component. Further the preparation of landslide hazard mapping with the help of identified landslides is very much helpful to prepare management plan of the affected area. The Landslide hazard analysis and mapping cope to provide useful information for catastrophic loss reduction, and assist in the development of guidelines for sustainable land-use planning.

In this context, the Basin Manageent center, Koshi under the Department of Forests and Soil Conservation (DoFSC), Babarmahal, Kathmandu has planned to carry out the preparation of landslide inventory at distric level. For this reason, BMC, Koshi planned to prepare landslide inventory at Federal Constituency level 1 of Udayapur district, in its annual program of this fiscal year 2077/078.

Landslide inventory maps show the landslide locations with the dimensions and geographical extent of each landslide. These maps are the basis for assessing landslide susceptibility, hazard and risk. They are essential for developing models to predict landslide on the basis of past phenomena. If these are not sufficiently available more emphasis should be given on expert assessment and evaluation. Therefore, we need to know where landslides happened in the past and also the relationship between landslides and the causal factors. Landslide inventories are also used to validate landslide susceptibility/hazard maps and to prepare landslide risk maps.

1.2 Objectives of the study

The main objective of the study was to prepare landslide inventory database of Federal Constituency 1 of Udayapur district. The specific objectives were as follows:

- To extract all landslides from freely available high-resolution images and Google earth images
- To prepare a landslide polygon inventory map

- To prepare geo-database of landslides at Municipality/Rural municipality and ward level
- To prepare geo-database of landslides at different bio-physical feature
- To prepare the final report with respect to landslides descriptions of the study area.

1.3 Scope of the Study

The following were the specific scope of the work:

- Digitization of landslide of the study area on freely available image
- Preparation of the landslide inventory usiging GIS tool with highlighting administrative loction
- Collection of basic spatial layers and prepare inventory of bio-physical features to the study area
- Preparation of the basic thematic layers at study area level
- Development of the landslide relationship with prepared different thematic layer
- Collecion and prepare of socio-economic data of study area district
- Submission of the final report to the BMC, Koshi with enhancing of provided suggestions and comments.

1.4 Limitation of the study

Present study was basically focused on extraction of the landslides from satellite imageries with very limited field verifications. All landslides could not be identified on the images, especially the smaller one.

2. STUDY METHODOLOGY

The following methodology of the proposed work was suggested (Figure 1). The major steps were as below:

- Pre-field Study
- Field verification
- Post-field Activities

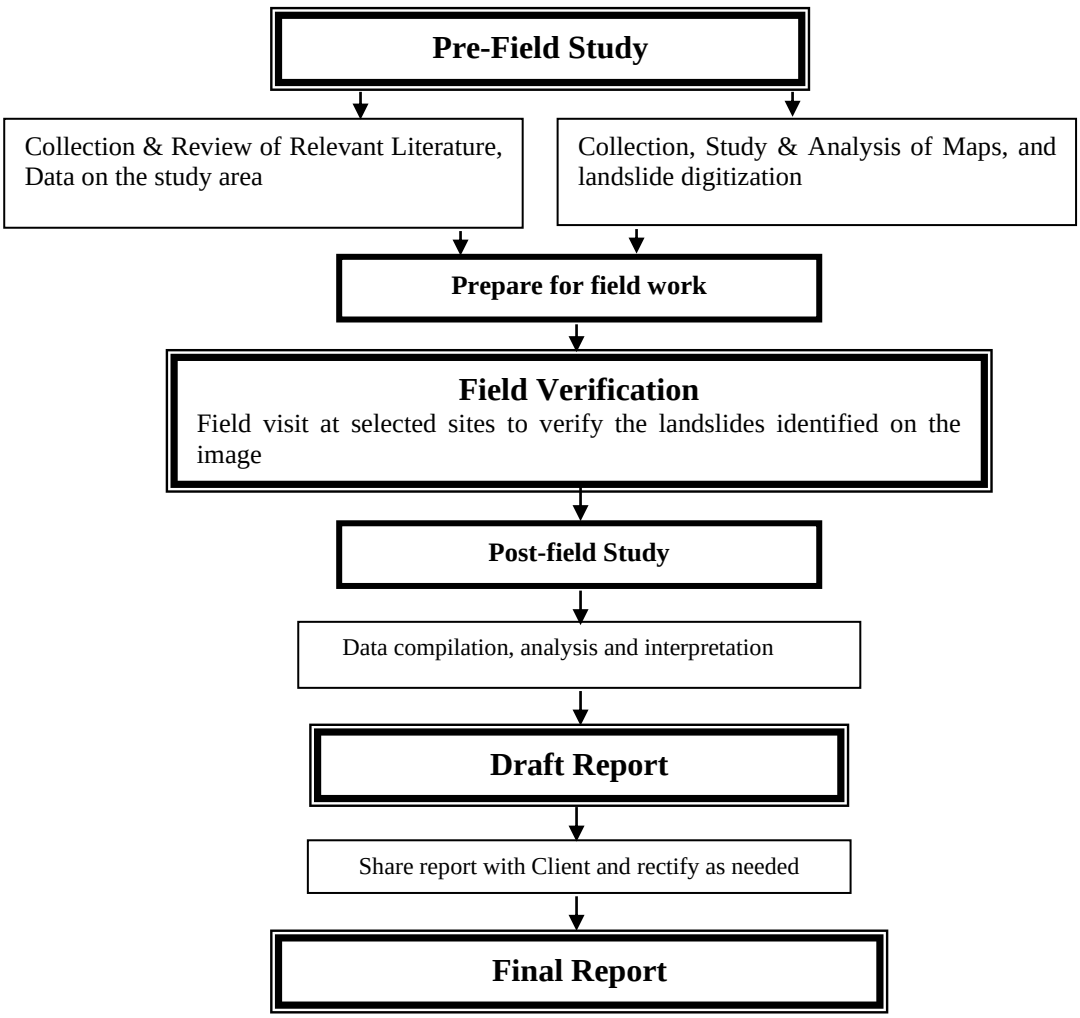

Figure 1: Study methodology

The activities carried out during various stages to lead towards achieving the objectives of the study are briefly summarized below:

2.1 Archive study

The literature review, available topographic maps, satellite imageries, aerial photographs, geological maps, and other relevant maps were studied with reference to the landslide. In addition, the landslide database of MoHA was also considered for past disastrous events.

2.2 Image interpretation

The landslides were identified and digitized on the Google image. Geological map prepared by the Department of Mines and Geology was converted into GIS format, which was useful to relate occurred landslide with the geology of the area. Likewise, land-use map as appeared on the digital topographic map was basis for describing landslide occurrence with respect to the land-use condition in an area. Similarly, it was also attemped to develop landslide relationship with physiographic region, proximity to road, proximity to drainage, slope, and slope aspect.

The relevant data were compiled to develop landslide inventory database in GIS. This was the most important task of the present assignment. The landslide inventory database consists of information of landslides including spatial location, area, district name, local level name, and ward number.

2.3 Categorization

The landslides extracted from Google Earth image was categorized into three classes in terms of area including of < 1 ha, 1-2 ha, and equal to 2 ha and above.

In addition, the landslide distribution in different local level was also analyzed by crossing the landslide inventory thematic layer. This provided information about landslide prone area for prepare of action to control on the occurrence of landslide.

2.4 Monitoring and facilitation

In order to smooth functioning of the project activities leading to successful completion, we proposed BMC, Koshi to designate a focal person (Monitoring Officer) for monitoring and facilitation of the overall works and regularly tracking the progress to provide reporting to the BMC, Koshi.

3. GENERAL FEATURE OF THE STUDY AREA DISTRICT

3.1 Location

Udayapur District is one of the 14 districts of Province No. 1 of Eastern Nepal (Figure 2). The district covers an area of 2,300.34 Km^2. Geographically Udayapur district lies between $26^0$39'0''N to $27^0$1'10''N and $86^0$0'9''E to $87^0$1'0''E with extending from East to West. The Koshi River in the East of the district separates it from Sunsari District, Sunkoshi River in the North draws a borderline which separates it from Bhojpur and Khotang. The district is neighbouring with Saptari and Siraha in the South, and Sindhuli and Dhanusha in the West.

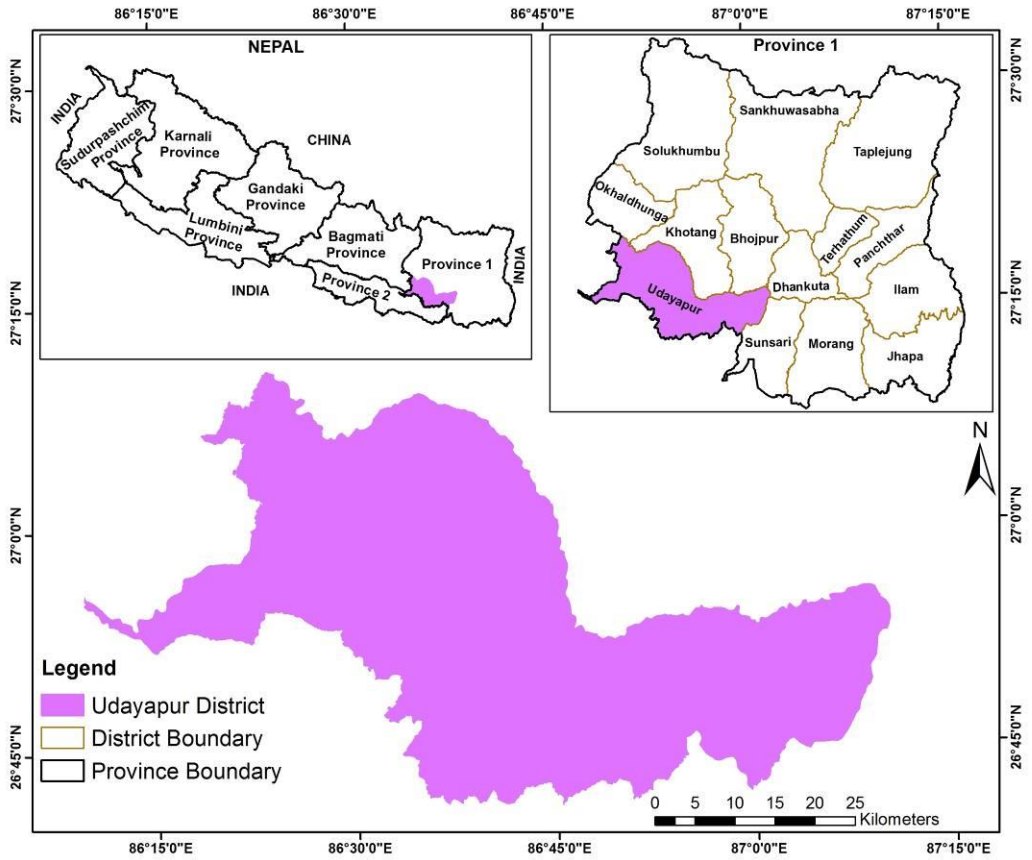

Figure 2: Location map of Udayapur district

3.2 Topography and Physiography

Udayapur district incorporates Middle Mountain, Siwalik and Terai physiography region (Figure 3). It is surrounded by Mahabharat hills from North and Siwalik from South, whereas both hills meet together by West which forms the region a valley Udayapurvalley. In addition, the Triyuga valley in Udayapur district represents the Doon Valley within the Siwalik region. The lower belt of the district lies in the Terai region. About 51% area of

the district is covered by Siwalik region, 39% area is covered by Middle Mountain, and about 10% area is coverd by Terai region. The altitude of the district varies from 88m to 2,343m amsl with average 571m. The upper Northern ridges are more elevated than other part of the district (Figure 4).

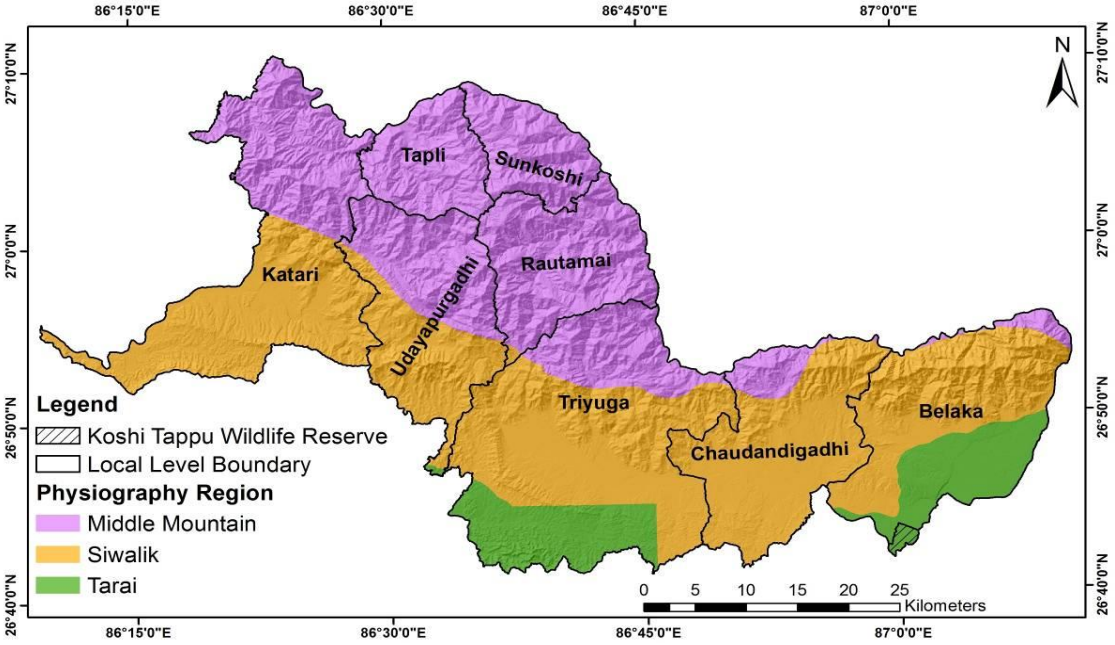

Figure 3: Physiography region within Udayapur district

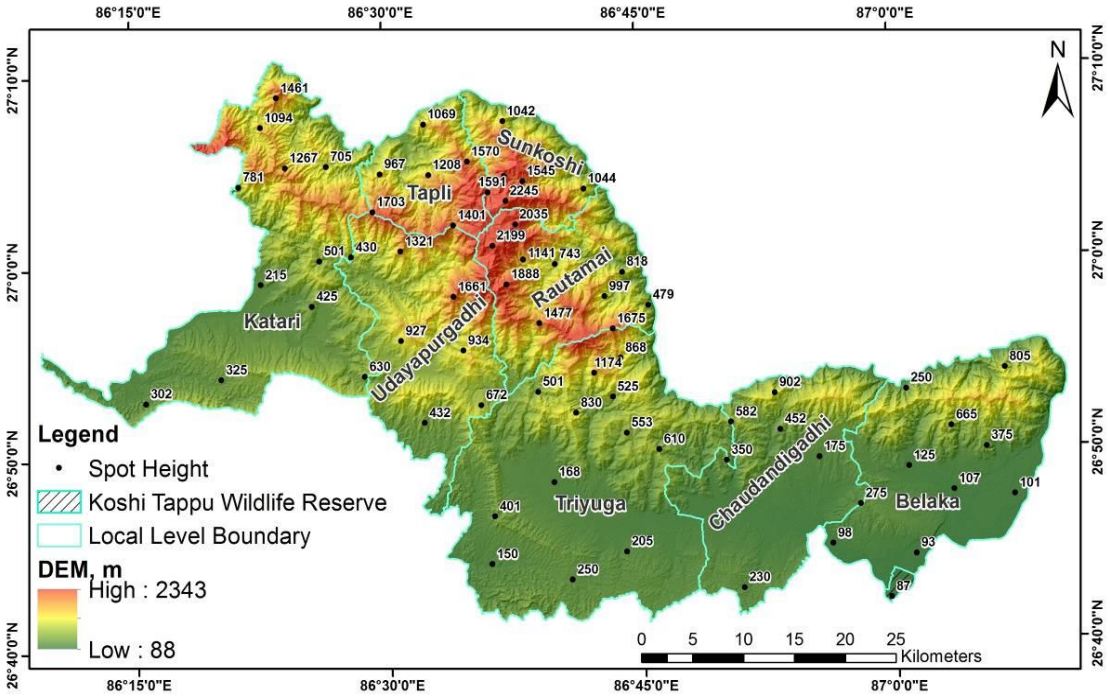

Figure 4: DEM of Udayapur district

3.3 Elevation

The aerial coverage by the various elevation classes has been analyzed and it was observed that only 0.51% of the total district area is covered by high elevation class (2000-2383m) while the maximum area (55.63%) is covered by the elevation class of 88-500m followed by elevation class of 500-1000m(27.33%), elevation class 1000-1500m (12.21%), and elevation class 1500-2000m (4.32%) (Figure 5, Table 1). The upper North-East ridges of Rautamai Rural Municipality, Southern ridges of Sunkoshi Rural Municipality, middle and lower South-West region of Tapli Rural Municipality, and Upper North-West area of Udayapurgadhi Rual Municipality are found to be highly elevated than other parts of the district.

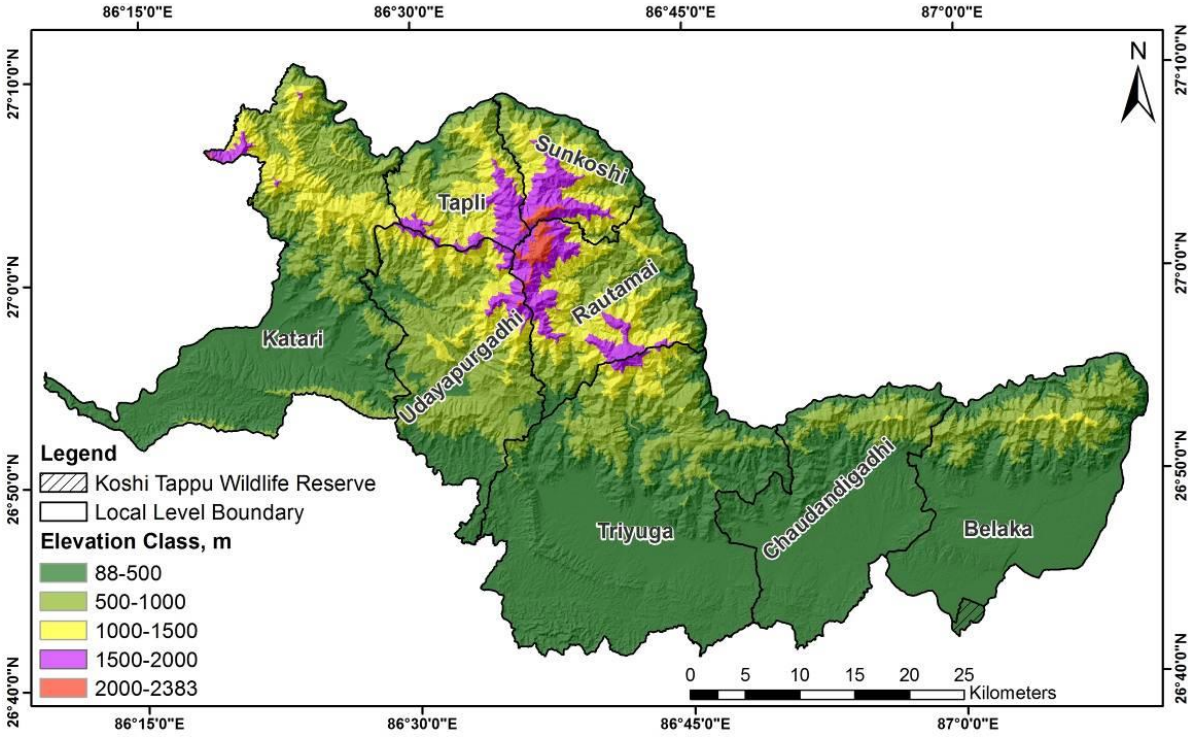

Figure 5: Distribution of differtent elevation classes within Udayapur district

Table 1: coverage by different elevation classes within Udayapur district

Elevation Class (m)	Area (Km^2)	Area (%)
88-500	1279.67	55.63
500-1000	628.65	27.33
1000-1500	280.84	12.21
1500-2000	99.46	4.32
2000-2383	11.72	0.51

3.4 Slope and Slope Aspect

The topography of Udayapur district is dominantly steep terrain. Most of the upper regions are found to be steepness slope (Figure 6). The aerial coverage of various classes of the slope was analyzed and found that about 31.41% area is covered by steep slope, around 23.48% area is covered by gently sloping, 18.79% area is coverd by moderately steep slope, 17.46% area is covered by very steep slope and 8.86 % area of the district is covered by level/nearly level slope (Table 2).

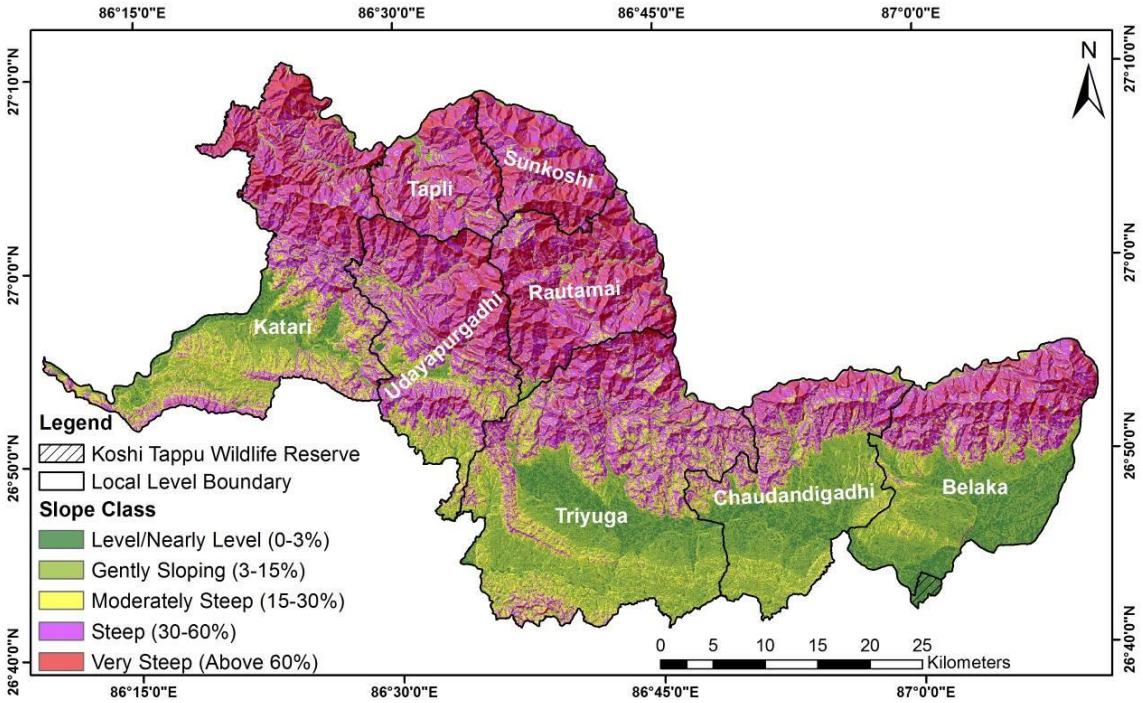

Figure 6: Aerial coverage of slope within Udayapur district

Table 2: Aerial coverage of different slope classes within Udayapur district

Slope Class	Slope (%)	Area (%)
Level/Nearly Level	0-3	8.86
Gently Sloping	3-15,	23.48
Moderately Steep	15-30	18.79
Steep	30-60	31.41
Very Steep	Above 60	17.46

The slope aspect of the district is more or less equal in all direction. However, the majority of middle part of the district area is mostly South facing (Figure 7). There is an exit of flat area (1.43%) which is found in many parts of the district. Around 25.99% area of the district is North facing slope flowed by East facing slope (24.35%), West facing slope (27%), South facing slope (24.30%), and around 23.93% West facing slope aspect (Table 3).

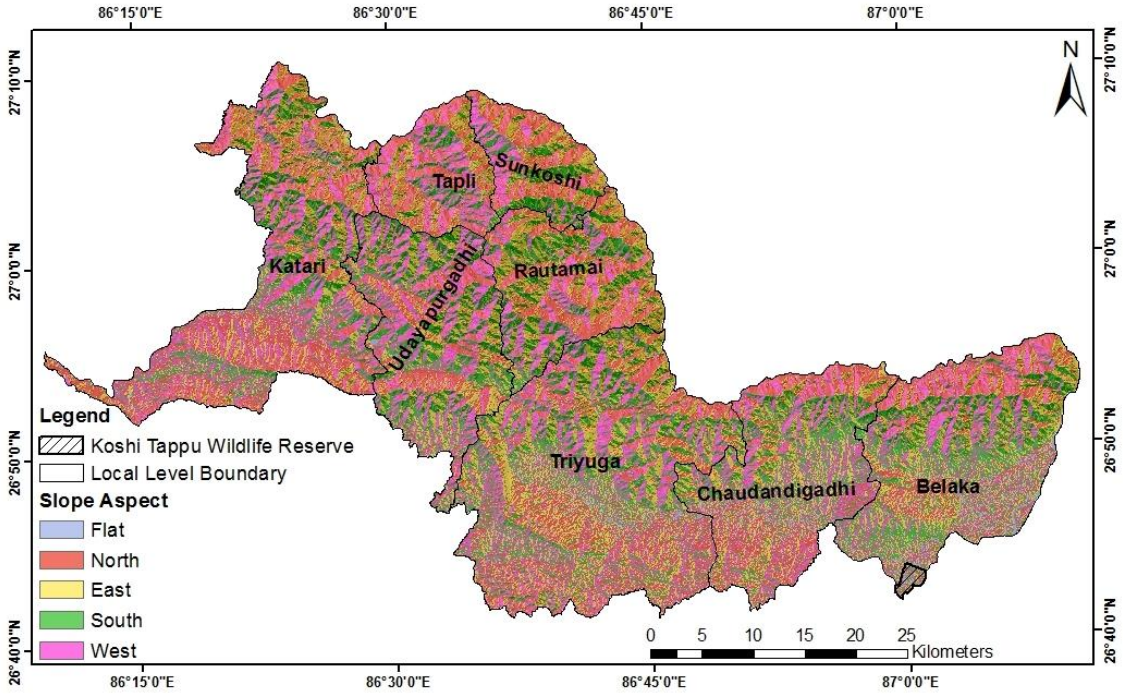

Figure 7: Slope aspect within Udayapur district

Table 3: Slope aspect within Udayapur district

Slope Aspect	**Area (%)**
Flat	1.43
North	25.99
East	24.35
South	24.30
West	23.93

3.5 Drainage Network

Udayapur district drains with enormous river and streams. The major river within the district is Sunkhoshi River which flows through the Northern border of the district from West to East, Kamala River which flows through the South-West border of the district from North to South, Saptakoshi River which flows through the North-East border of the district form North to South, Triyuga River, Tawa Khola, Baidyanath Khola, Kakur Khola, Bahadur Khola, Surung Khola, Yari Khola, Rasuwa Khola, Rakuli Khoal, and Adheri Khola. The Sunkoshi River and the Triyuga River are the river system of Saptakoshi River. Likewise, Bahadur Khola, Sorung Khola, Yari Khola, Rasuwa Khola, Rakuli Khola, and Adheri Khoa are the river system of Sunkhoshi River. Similarly, Kukur Khola, and Baidhyanath Khola are river system of Tawa Khola, and Tawa Khola is river system of Kamala River (Figure 8). Apart from these River systems, there are numbers of minor river/streams that flow from the Southern region of the district.

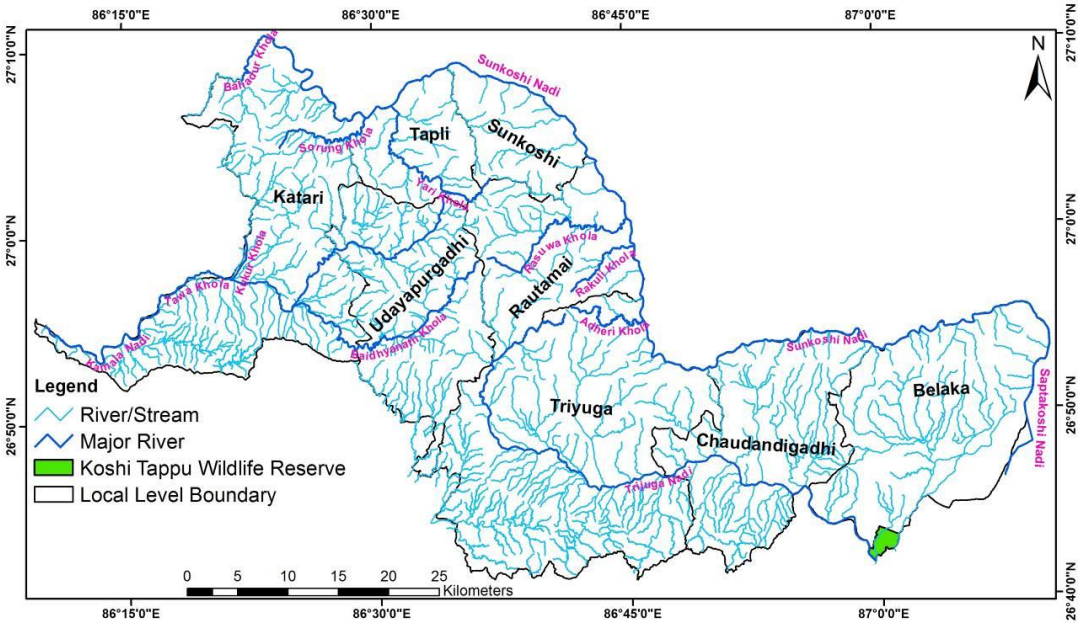

Figure 8: Drainage network within Udayapur district

3.6 Watershed

Udayapur district has mainly four watersheds i.e., Triyuga-Koshi, Balan-Khando, Kamala, and Lower Sunkoshi (Figure 9). Triyuga-Koshi is largest watershed within the district which covers about 43.06% area followed by Lower Sunkoshi watershed (28.57%), Kamala watershed (21.64%), and Balan-Khando watershed which covers about 6.73% area of the district (Table 4).

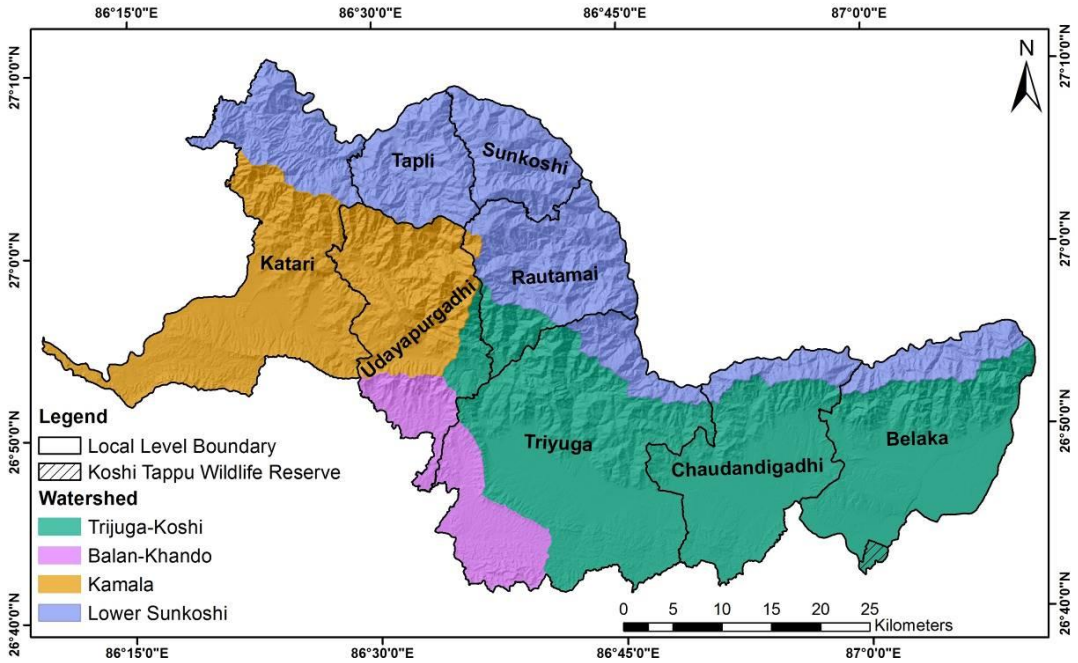

Figure: Watershed within Udayapur district

Table 4: Watershed within Udayapur district

Watershed	Basin	Area (Km^2)	Area (%)
Triyuga-Koshi	Koshi	990.31	43.06
Balan-Khando	Chure-Terai	154.78	6.73
Kamala	Independent	497.68	21.64
Lower Sunkhoshi	Koshi	657.10	28.57

3.7 Land Use

The land cover map of the province shows that forest and agriculture area are the major land use class within the district where forest area occupies about 68.57% area and agriculture area occupies about 24.39% of the total area of the district. Besides there exist grass land, shrub land, barren land, built-up, and water body where grass land covers around 2.78%, barren land 2.21%, shrub land 1.14%, and water body and built-up area are less than 1% coverage of the total area of the ditrict (*Table 5*, *Figure 10)*.

Table 5: Coverage of different land use classes within Udayapur district

Land Use Class	Area (Km2)	Area (%)
Agriculture Area	561.15	24.39
Forest	1577.33	68.57
Shrub Land	26.14	1.14
Grass Land	63.99	2.78
Barren Land	50.94	2.21
Built-up	4.93	0.21
Water Body	15.86	0.69

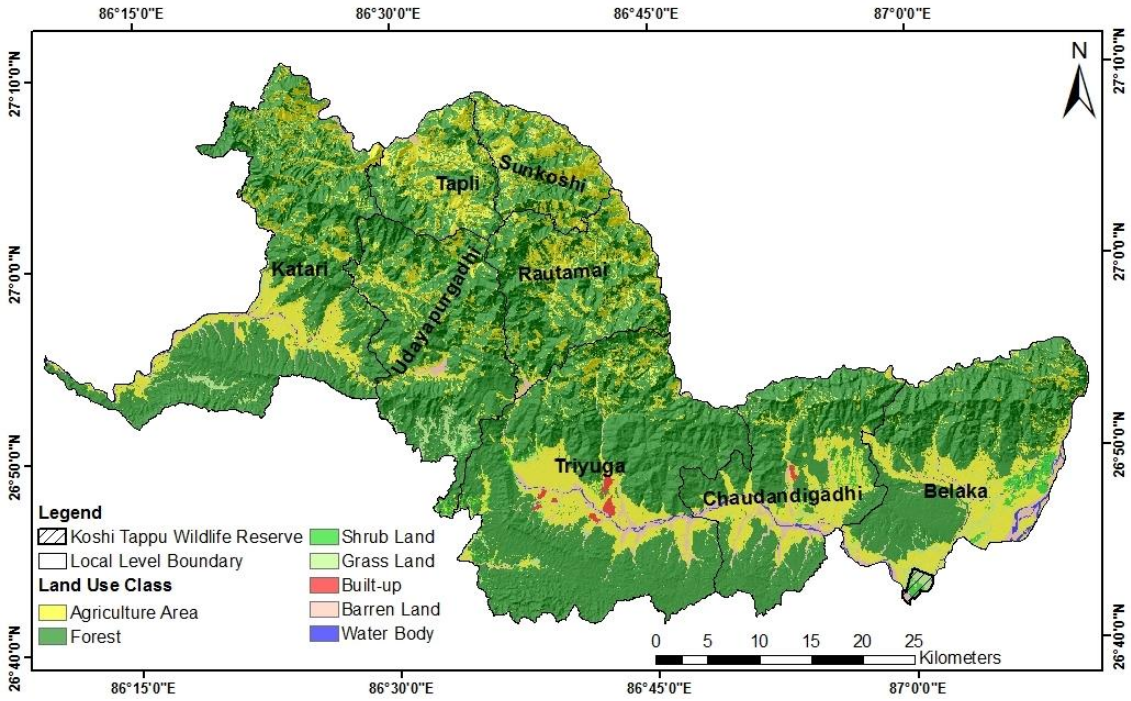

Figure 9: Land-use map of Udayapur district

3.8 Road Network

The district has good accessibility of road as many settlements are connected with motorable roads. Gaighat, the district headqurter is connected with Sagarmatha Highway, which connects Udayapur with East-West Highway at Kadmaha and also connects to Khotang district however the road is not paved. The district has coverage of total 782.47 Km road network including strategic road (highway and fedder road) network 243.36 Km, district road core network 397.98Km, and 141.13 Km village road. As of defined types of roads within the district, about 90.77 Km black top road, 119.42 Km graveled road, and 572.28 Km earthen road. In the district, about 210.19 Km road are all weather types while 572.28 Km roads are fair weather types (*Table 6*, *Figure 11)*

. *Table 6: Road network within Udayapur district*

Road Class	Unit	Total Length	Black Top	Gravel	Earthen	All Weather	Fair Weather	New Construction
Strategic Road Network	Km	243.36	89.96	44.4	109	134.36	109	-
District Road Core Network	Km	397.98	-	58.22	339.76	58.22	339.76	83.54
Village Road	Km	141.13	0.81	16.8	123.52	17.61	123.52	-
Total	**Km**	**782.47**	**90.77**	**119.42**	**572.28**	**210.19**	**572.28**	**83.54**

(Source: DoLIDAR, 2016)

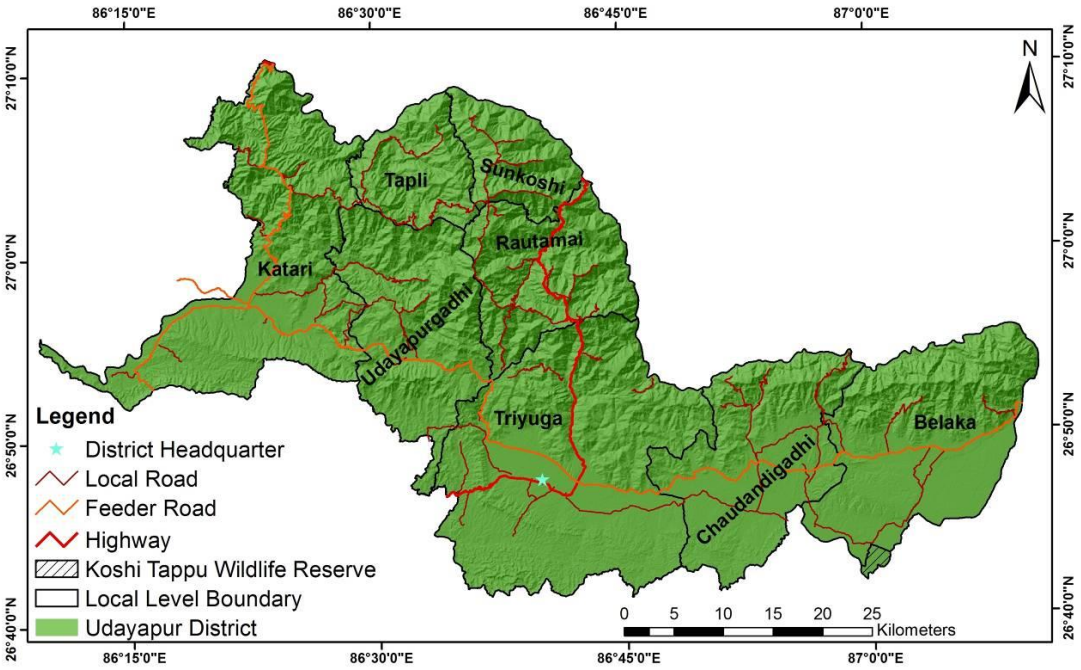

Figure 10: Road network within the Udayapru district

3.9 Forest Resource

Forest is one of the natural resources of Udayapur district as around most of the area of the district is covered by forest. Due to diverse physiographic and climatic condition, district incorporates mosaics of different forest types and habitats for different wildlife. The

community forest covers an area of 77,661.36ha. The distict incorporates small part of Koshi Tappu Wildlife Reserve (5.39 Km^2) which lies in the Terai region. It comprises extensive mudflats, reed beds, and freshwater marshes in the floodplain of the Saptakoshi River which was designated as a Ramsar site in December 1987. It hosts Nepal's last remaining herd of the wild water buffalo (*Bubalus bubalis*)

3.10 Water Resource

Small and large river and ponds are the main source of water within the district however Udayapur district does not possess larger lakes. Sunkoshi River and Saptakoshi River, Triyuga River and Kamala River are the major governing river sources within the district. Other major river soruces are Tawa Khola, Baidhyanath Khola, Bahadur Khola, Sorung Khola, Yari Khola, Adheri Khola, Rasuwa Khola, Rakuli Khola, Kukur Khola, Baruwa Khola, Kanga River, and Dwar Khola. Besides, there are numbers of ponds including Rauta Pokhari, Suke Pokhari, Tapli Pokhari, Jogidaha Chure Forest Pond, Then Pokhari, and Jhilke Pokhari which are key water resources for the the district. All these rivers and ponds have been providing irrigation facilities for agriculture land as well as help to create different micro-climatic condition to support biological diversity.

3.11 Geology

The Uadayapur district has formed with various geological units. The Siwaliks including of Upper Siwalik, Middle Siwalik, and Lower Siwalik are the most covered geological unit in the district which falls in the middle and majority part of the lower Southern belt (Figure 12). The detail of geological unit and coverage within the district is given in (Table 7)

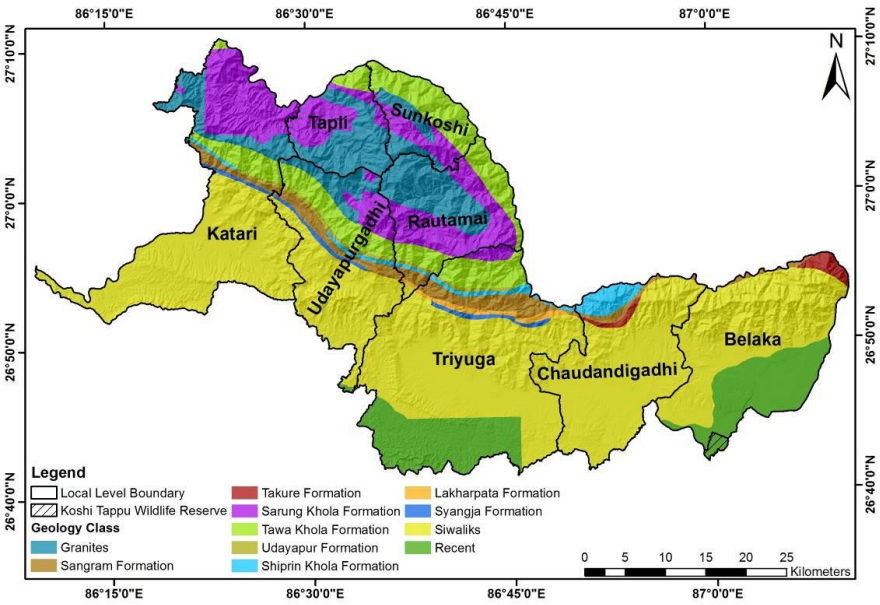

Figure 11: Geological condition within the Udayapru district

Table 7: Distribution of different geology class within Udayapur district

Geology Class	Area (Km^2)	Area (%)
Granites	234.05	10.17
Sangram Formation	81.50	3.54
Takure Formation	16.20	0.70
Sarung Khola Formation	260.11	11.31
Tawa Khola Formation	223.42	9.71
Udayapur Formation	15.37	0.67
Shiprin Khola Formation	37.19	1.62
Lakharpata Formation	12.28	0.53
Syangja Formation	17.67	0.77
Siwalik	1279.24	55.61
Recent	123.30	5.36

3.12 Socio-economic Setting

3.12.1 Local Level and Population

Udayapur district comprises of two federal constituencies with incorporating of eight local levels. The federal constituency 1 consists of three local levels including of Triyuga Municipality, Chaudandigadhi Municipality and Belaka Municipality, and federal constituency 2 covers five local levels including of four Rural Municipality (Udayapurgadhi, Tapli, Sunkoshi, and Rautamai) and one Municipality (Katari) *(Figure 13)*

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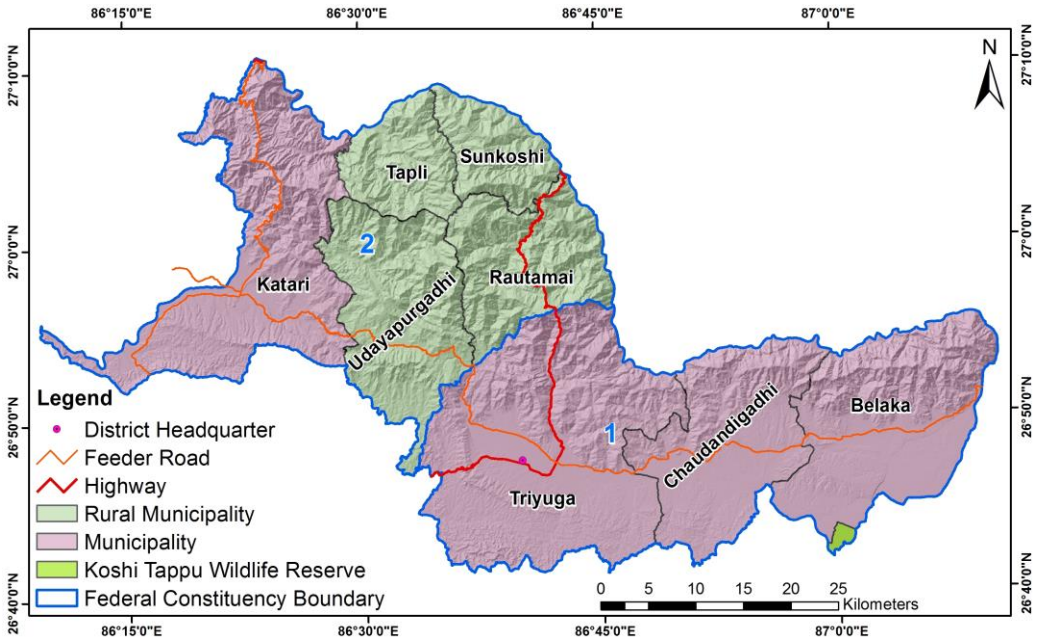


Figure 12: Federal Constituency and local level within the Udayapru district

The total population of the district is 3,15,429 with male population 1,47,761 and female population 1,67,668. Out of the total area of the district, local levels cover an area of 2,294.954 Km2 and about 5.39 Km2 is covered by Koshi Tappu Wildlife Reserve. Triyuga

Municipality is rather dense population with population of 87557 while Sunkoshi Rural Municipality is having less population compared to other local levels (*Table 8)*

Table 8: Local level and population distribution within Udayapur district

Local Level	Federal Constituency	Total Area (Km2)	Total Population	Male	Female
Belka Muncipality	1	339.34	42386	19605	22781
Chaudandigadhi Muncipality	1	283.78	48574	22082	26492
Triyuga Muncipality	1	547.44	87557	41221	46336
Udayapurgadhi Rural Muncipality	2	269.51	30731	14501	16230
Katari Muncipality	2	424.89	56146	26582	29564
Tapli Rural Muncipality	2	119.11	14562	6929	7633
Sunkoshi Rural Muncipality	2	106.80	11992	5662	6330
Rautamai Rural Muncipality	2	204.08	23481	11179	12302
Koshi Tappu Wildlife Reserve		5.39			
Total		**2300.34**	**315429**	**147761**	**167668**

(Source: Statistics Office, Udayapur, 2074)

3.12.2 Cast/Ethnicity and Religion

Different cast and ethnic groups are residing within the district. Chhetri (21.50%), Rai (17.30%), and Magar (13.90%) are the major cast and ethnic groups living in the district. Besides, there are Tharu, Tamang, Brahamin-hill, Kami, Newaar, Danuwar, and others ethinic groups also residing within the district. Majority of the population belongs to Hindu religion (72.60%) followed by Buddhism (12.10%), Kirat (9.90%). Besides, Christian, Prakriti, Islam, and other religion also exist in the district.

3.12.3 Settlement distribution and Household Pattern

The district incorporates total of 66,514 househlds residing in more than 1,486 settlements. The settlement pattern shows that Triyuga Municipality is densely inhabited in comparison to the other local levels of the district, however, there are growing trend of settlements in other local levels too (Figure 13). This trend indicates availability of the profound infrastructure and other facilities leading to high economic zone. According to Statistics Office, Udayapur (2074), out of the total house, about 23.9% houses outer wall are built with mud and brick/stone, some 15.8% houses walls are built with cement bonded bricks/stone, 14.2% houses wall are built with wood/planks, 44.6% houses walls are built with bamboo, 0.1% houses wall are built with unbaked brick, and some 1.50% houses walls are built with other materials. Likewise, about 28.4% houses roof are covered with galvanized iron, 26.4% houses roofing are with tile/slate, 5.7% houses roofing are RCC designed, 0.3% houses roof are built with wood/planks, 37.9% houses roofing are with

thatch/straw, and remaining 1.3% houses roof are built with mud and other materials (Figure 14).

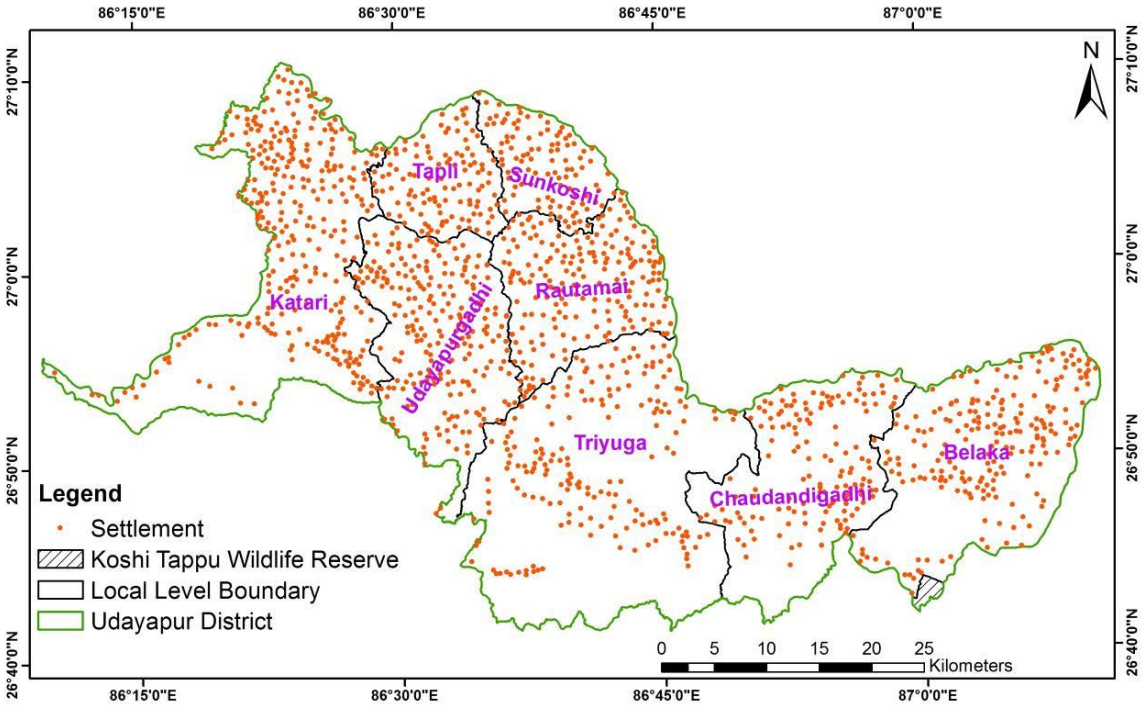


Figure 13: Settlement distribution within Udayapur district.

3.12.4 Literacy

The district has good progress in education. According to CBS, 2017, the literacy rate of the district is around 68.82% in which male literacy is about 77.18% and female literacy is about 61.47%. With this regard, the female literacy is much lower than that of male literacy.

Table 9: Local level wise litertacy within Udayapur district

Local Level	Literacy (%)	Male Literacy (%)	Female Literacy (%)
Belka Muncipality	67	74.90	60.30
Chaudandigadhi Muncipality	70.50	78.80	63.60
Katari Muncipality	66.20	75.00	58.30
Rautamai Rural Muncipality	67.70	76.00	60.20
Sunkoshi Rural Muncipality	63.50	71.50	56.50
Tapil Rural Muncipality	61.50	70.80	53.20
Triyuga Muncipality	74.00	82.20	66.50
Udayaurgadhi Rural Muncipality	64.70	72.90	57.50

There are number of community and institutional schools have been established within the district in which Triyuga Municipality have highest number of schools while Sunkoshi Rural Municipality have loWest number schools (Table 10)

Table 10: Distribution of schools within Udayapur district

Local Level	Number of School		
	Community	**Institutional**	**Total**
UdayapurgadhiRural Municipality	61	1	62
Katari Municipality	84	18	102
Chaudandigadhi Municipality	49	22	71
Tapli Rural Municipality	37	3	40
Triyuga Muncipality	76	44	120
Rautamai Rural Muncipality	60	0	60
Belaka Municipality	52	14	66
Sunkoshi Rural Municipality	32	0	32
Total	**451**	**102**	**553**

3.12.5 Energy Source

Wood/firewood is the predominant energy source of cooking in Udayapur district. About 91.14% household usage firewood for cooking, followed by Liquefied Petroleum Gas (LPG). Besides, household also usage bio-gas, kerosene, electricity, cow dunk, other sources for cooking purpose. The detail of energy source accoriding to local level is given in (Table 11).

Table 11: Fuel used for cooking within Udayapur district

Local Level	Type of fuel used for Cooking (%)							
	Wood/ Firewood	**Kerosene**	**LP Gas**	**Cow dung**	**Bio Gas**	**Electricity**	**Others**	**Not Stated**
Belka Municipality	96.69	0.81	0.95	0.39	0.93	0.01	0	0.22
Chaudandigadhi Municipality	94.73	0.46	2.24	0.21	2.23	0.01	0.02	0.1
Katari Municipality	91.49	0.38	6.26	0.36	0.82	0.06	0.09	0.53
Rautamai Rural Municipality	97.73	0.34	0.88	0.43	0.02	-	0.04	0.56
Sunkoshi Rural Municipality	99.18	0.26	-	0.3	0.04	-		0.22
Tapli Rural Municipality	98.93	0.26	-	0.07	0.04	-	-	0.7
Triyuga Municipality	81.21	0.42	13.97	0.18	2.34	1.34	0.26	0.29
Udayapurgadhi Rural Municipality	96.28	0.79	0.36	2.23	0.18	0.03	-	0.13
Total (%)	**91.14**	**0.49**	**5.77**	**0.45**	**1.33**	**0.41**	**0.10**	**0.31**

3.12.6 Lighting Source

The district is having moderate electricity facility in which only about 51.29% household usage electricity as major source for lighting. Apart from electricity, kerosene and solar is also another major source for the household for lighting purpose in Udayapur district.

Besides, household also use bio-gas and other soruces for lighting purpose. The detail of the source for lighting at local level is given in Table 12.

Table 12: Fuel used for lighting within Udayapur district

Local Level	Type of fuel used for Lighting (%)					
	Electricity	**Kerosene**	**Bio Gas**	**Solar**	**Others**	**Not Stated**
Udayapurgadhi Rural Municipality	4.14	32.19	0.29	57.87	5.37	0.13
Tapli Rural Municipality	0.11	36.07	0.11	41.73	21.38	0.59
Sunkoshi Rural Municipality	1.51	32.94	0.43	36.96	27.94	0.22
Rautamai Rural Municipality	30.67	30.37	0.15	22.48	15.77	0.56
Belka Municipality	18.62	37.14	0.37	36.92	6.73	0.21
Chaudandigadhi Municipality	72.55	22.91	0.29	3.44	0.71	0.1
Triyuga Municipality	85.37	9.95	0.19	2.36	1.83	0.31
Katari Municipality	55.13	18.27	0.21	20.41	5.45	0.53
Total (%)	**51.29**	**22.48**	**0.25**	**19.72**	**5.95**	**0.31**

3.12.7 Drinking Water and Sanitation

Drinking water condition is good in the district as most of the houses have tap/piped water and tube well/hand pump for the drinking water. Uncovered well/kuwa is also another source for drinking water within the district. Apart from these sources, household uses river/stream, covered well/kuwa, spout water, and other soruces for drinking water purpose (Table 13).

Table 13: Source for drinking water within Udayapur district

Local Level	Type of fuel used for drinking water							
	Tape/ Piped Water	**Tube well/ Hand pump**	**Covered well/ Kuwa**	**Uncovered well/Kuwa**	**Spout Water**	**River/ Stream**	**Others**	**Not Stated**
Udayapurgadhi Rural Municipality	59.96	5.08	1.89	22.4	1.83	8.5	0.19	0.15
Tapli Rural Municipality	83.46	0.11	3.03	9.84	2.84	0.02	-	0.7
Sunkoshi Rural Municipality	86.74	-	0.09	9.37	3.07	0.39	0.13	0.22
Rautamai Rural Municipality	77.43	5.44	1.03	11.17	2.42	1.8	0.17	0.54
Belka Municipality	34.39	42.15	0.28	18.62	1.49	2.23	0.63	0.21
Chaudandigadhi Municipality	30.01	40.99	3.45	22.72	0.37	0.63	1.74	0.09
Triyuga Municipality	27.18	58.87	0.57	9.19	1.42	1.45	1.02	0.3
Katari Municipality	49.39	24.12	1.37	20.63	1.14	1.92	0.91	0.53
Total	**43.44**	**34.49**	**1.37**	**16.01**	**1.32**	**2.21**	**0.85**	**0.31**

The district has moderate statistics in sanitation and drainage system. According to Statistics Office, Udaypaur (2074), about only 51.33% household have own toilet facility while about 48.35% houses do not have toilet facility (Table 14).

Table 14: household by toilet facility within Udayapur district

Local Level	Without Toilet	Flush Toilet	Ordinary Toilet	Not Stated
Udayapurgadhi Rural Municipality	4,021	1,281	868	9
Tapli Rural Municipality	998	462	1,224	19
Sunkoshi Rural Municipality	1,464	27	820	5
Rautamai Rural Municipality.	2,757	979	904	26
Belka Municipality	5,422	1,624	1,864	20
Chaudandigadhi Municipality	4,263	3,842	2,403	10
Triyuga Municipality	7,632	8,045	3,748	59
Katari Municipality	5,604	3,372	2,681	60
Total	**32,161**	**19,632**	**14,512**	**208**

3.12.8 Health Facility and Services

The district health service institutions are providing various health related facilities. The district is in progress in the sector of health facility and services. There are different types of health facilities and services which are providing better health care to the residents of Udayapur district. The detail of the health facility is given in the Table 15.

Table 15: Health facility and services within Udayapur district

S. N	Health Facilities	No of Facilities
1	Government Hospital	2
2	Health post	44
3	Community Health Unit	2
4	PHC	1
5	Urban Health Center	6
6	EPI Clinic	211
7	FCHV (Urban)	90
8	FCHV (Rural)	360
9	Private Health Facilities	3
10	BEONC	2
11	CEONC	1
12	Birthing Centers	29
13	PHC/ORCs	156

(Source: Statistics Office, Udayapur, 2072)

3.12.9 Financial Institution

The district has different types of financial institutions for providing banking, and financing services. There are 17 commercial banks, 2 development banks, and 1 finance company within the district. Besides, there are numbers of different types of cooperatives exit within the district including saving and loan cooperatives, multipurpose cooperatives, agriculture cooperatives, dairy cooperatives, consumer cooperatives, vegetables and fruits cooperatives, Tea and Coffee cooperatives, herbs cooperative, communication cooperative, and others cooperatives and these cooperatives are offering many facilities and services in the respective feilds (Table 16).

Table 16: Different types of cooperatives within Udayapur district

S.N.	Types of Cooperatives	Total
1	Saving and Loan Cooperatives	89
2	Multipurpose Cooperatives	50
3	Agriculture Cooperatives	133
4	Dairy Cooperatives	2
5	Consumer Cooperatives	15
6	Vegetables and Fruits Cooperatives	2
7	Tea and Coffee Cooperatives	3
8	Herbal Cooperatives	2
9	Communication Cooperatives	1
10	Others Cooperatives	5

(Source: Department of Cooperative, 2017)

4. LANDSLIDE INVENTORY OF FEDERAL CONSTITUENCY 1

Udayapur district constitutes of two federal constituencies. The federal constituency 1 (Study Area) consists of Eastern part incorporating of three local levels; Belaka Municipality, Chaudandigadhi Municipality, and Triyuga Municipality (Figure 15). The study area covers an area of 1,175.95 Km^2 including small part of Koshi Tappu Wildlife Reserve (5.39 Km^2) with extending from East to West.

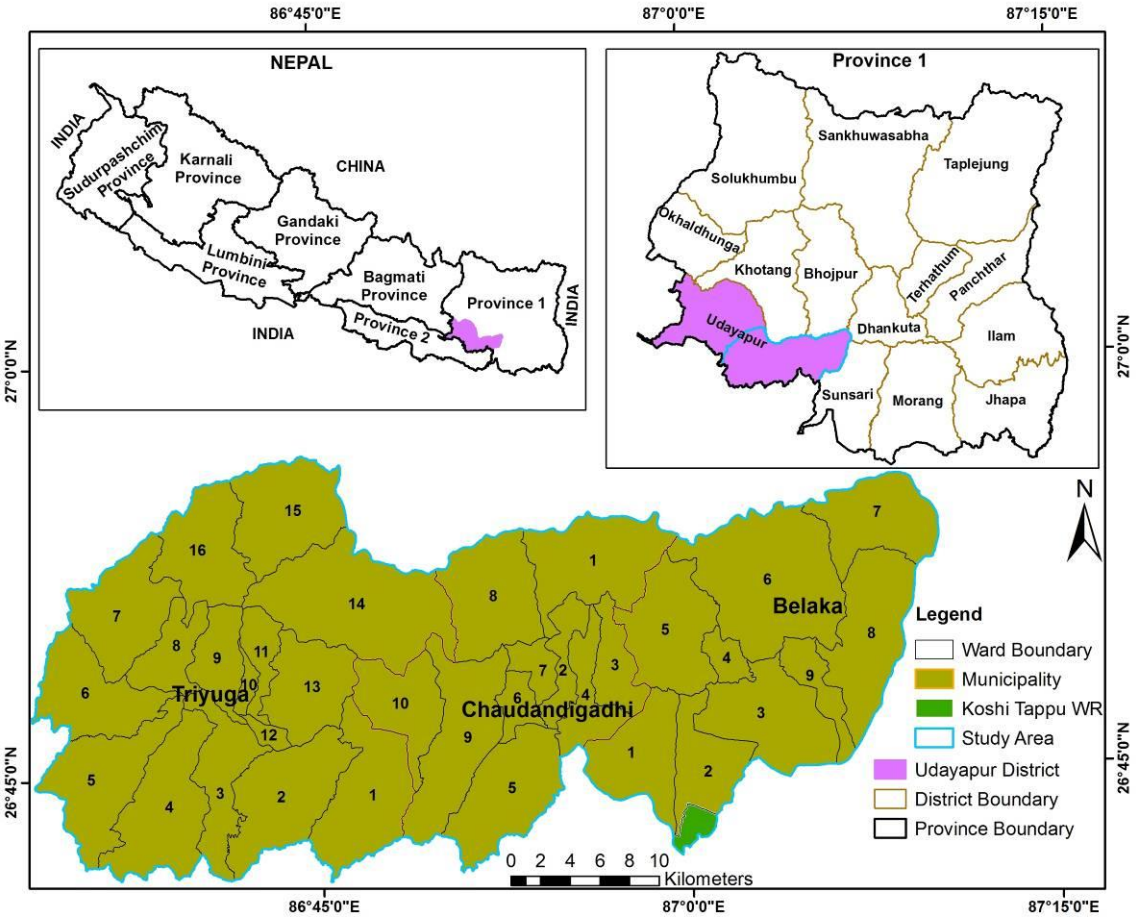


Figure 14: Location map of federal constituency 1 of Udayapur district

4.1 Landslide Inventory

4.1.1 Landslide distribution in different local level

Total of 164 landslides have been identified within the studya area (Figure 16). These landslides are extracted through digitization on Google Earth. The total area of the landslide is 102.40 ha (1.02 Km^2). The largest landslide is 12.86 ha (0.13 Km^2) which lies

in the Belakha Municipality-6 and smallest landslide is 0.012 ha (123.52 m^2) which lies in Belakha Municipality-5. The detail of the landslides is given in Annex 1.

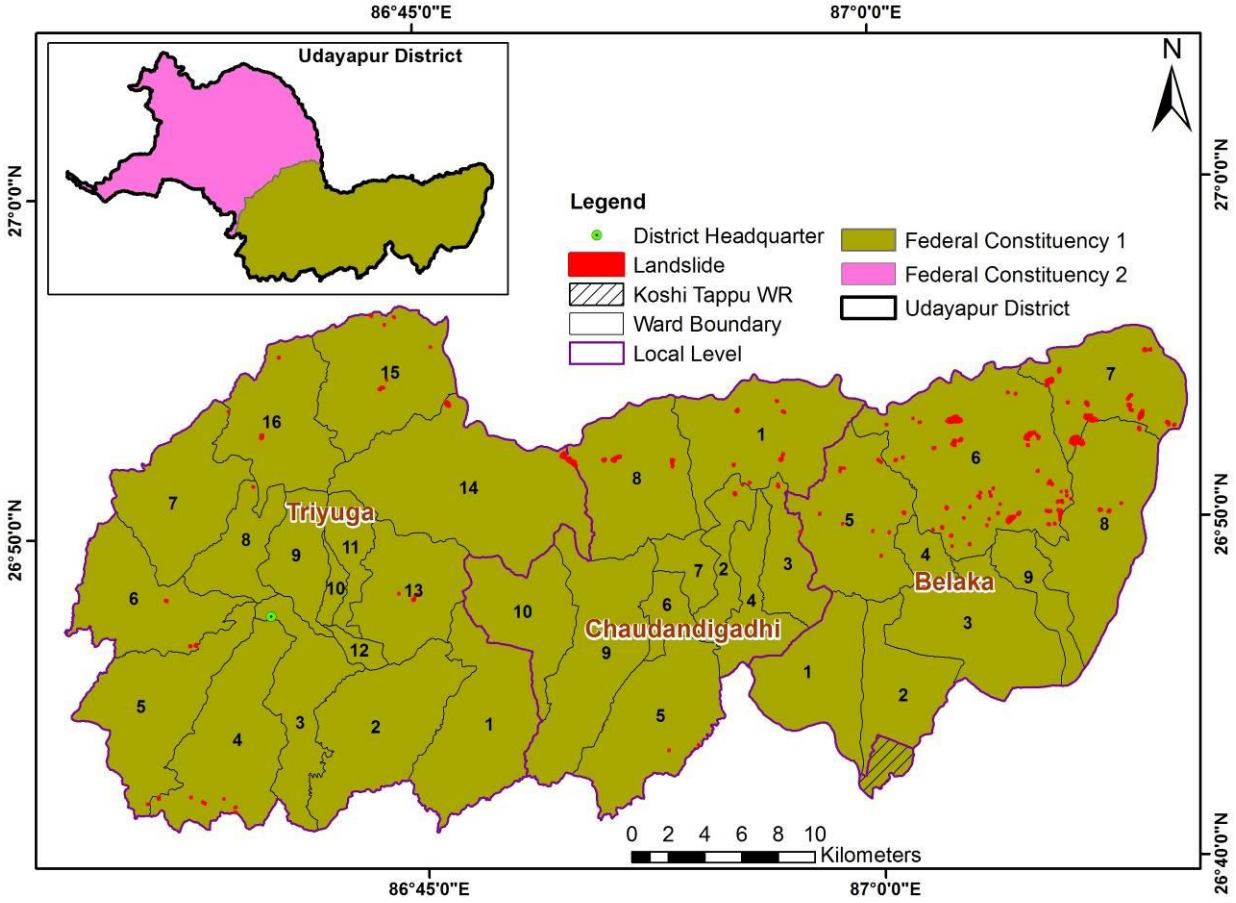


Figure 15: Landslide distribution within local level of federal constituency 1 of Udayapur district

As of distribution of landslides, it was found that majority of thte landslides were in Belaka Municipality with about 67.07% in various locations, 17.68% landslides were in Triyuga Municipality, and about 15.24% landslides were in the Chaudandigadhi Municipality of the total landsliedes (Table 17, Figure 17).

Table 17: Distribution of landslides in Local level under federal constituency 1 of Udayapur district

Local Level	No of landslide	% of Landslide
Belakha Municipality	110	67.07
Triyuga Municipality	29	17.68
Chaudandigadhi Municipality	25	15.24

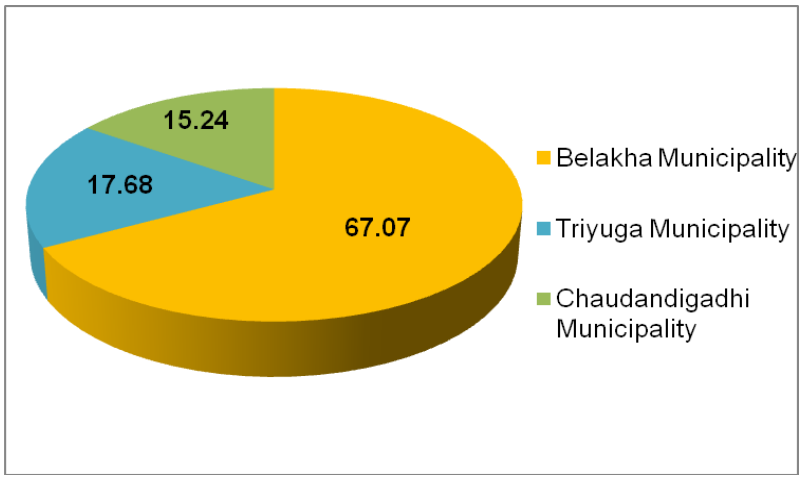


Figure 16: Landslide distribution (%) within local level of federal constituency 1

4.1.2 Landslide distribution in watershed

The study area covers three watersheds i.e. Sunkoshi, Triyuga, and Balan-Khando. It was observed that out of the total landslide occurence, 125 (76.22%) landslides occurred in Triyuga-Koshi watershed, 31 (18.90%) in Lower Sunkoshi, and 8 (4.88%) landslides in Balan-Khando watershed (Table 18, Figure 18).

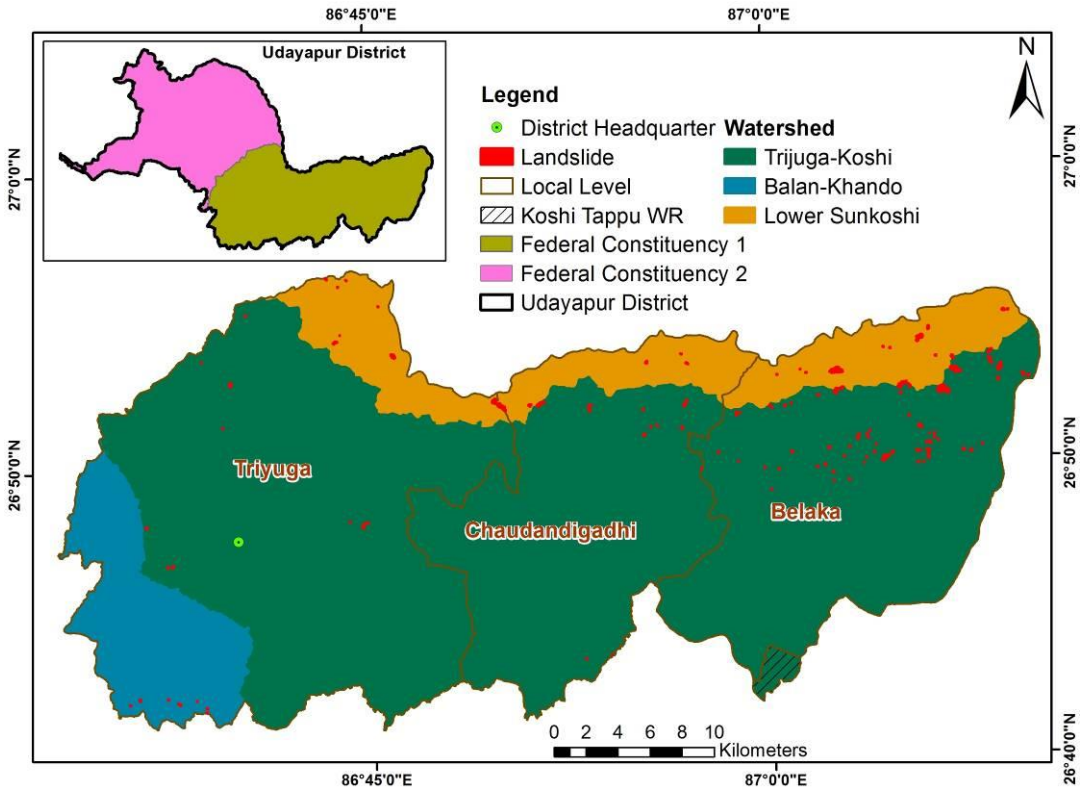


Figure 17: Landslide distribution within watersheds of federal constitiuency 1

Table 18: Landslide occurence within watersheds of federal constituency 1

Watershed	No of landslide	% Of Landslide
Triyuga-Koshi	125	76.22
Lower Sunkoshi	31	18.90
Balan-Khando	8	4.88

4.1.3 Distribution of Larger Landslide

The landslide 2 ha or above has been considered as larger landslide. It was found that 12 larger landslides within the federal constituency 1 with total area of 61.32 ha (Figure 18). Belaka Municipality has highest number of larger landslide (66.66%), Triyuga Municipality (16.67%), and Chaudandigadhi Municipality (16.67%) (Table 19, Figure 19).

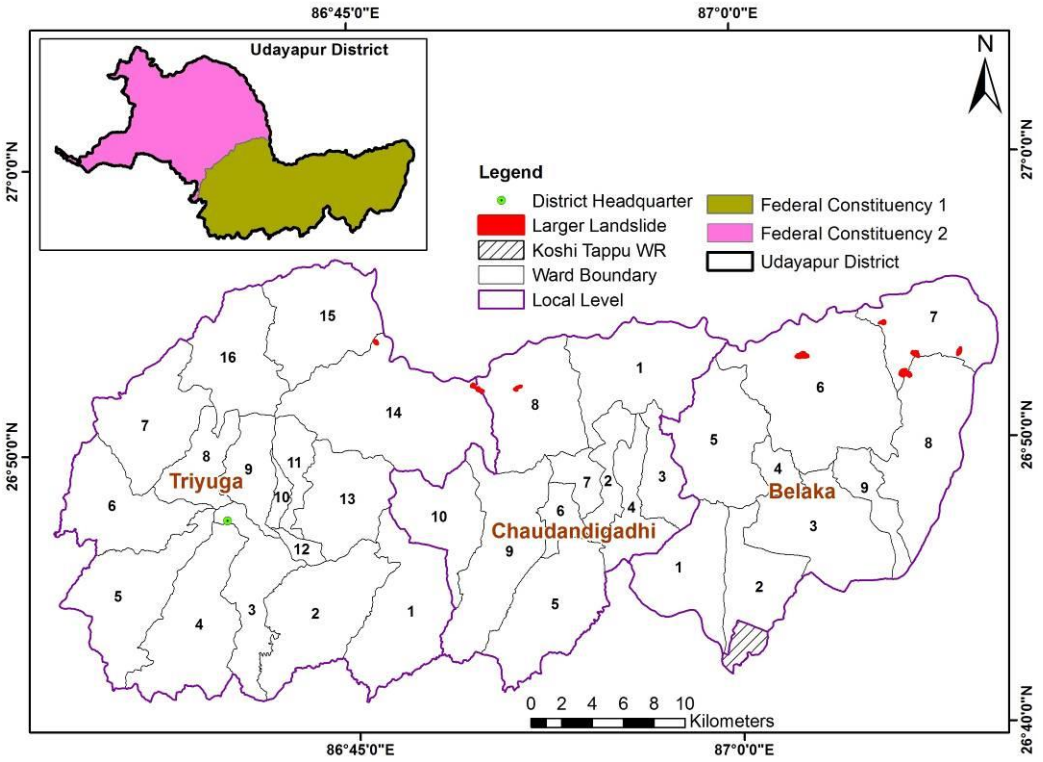


Figure 18: Distribution of larger landslide within federal constituency 1

Table 19: Distribution of larger landslide at local level of federal constituency 1

Local Level	No of landslide	% of Landslide
Belakha Municipality	8	66.66
Triyuga Municipality	2	16.67
Chaudandigadhi Municipality	2	16.67

4.1.4 Landslide distribution in different elevation class

Landslides were overlaid on the elevation classes in order to analyze their occurrence with respect to elevation (Figure 20).

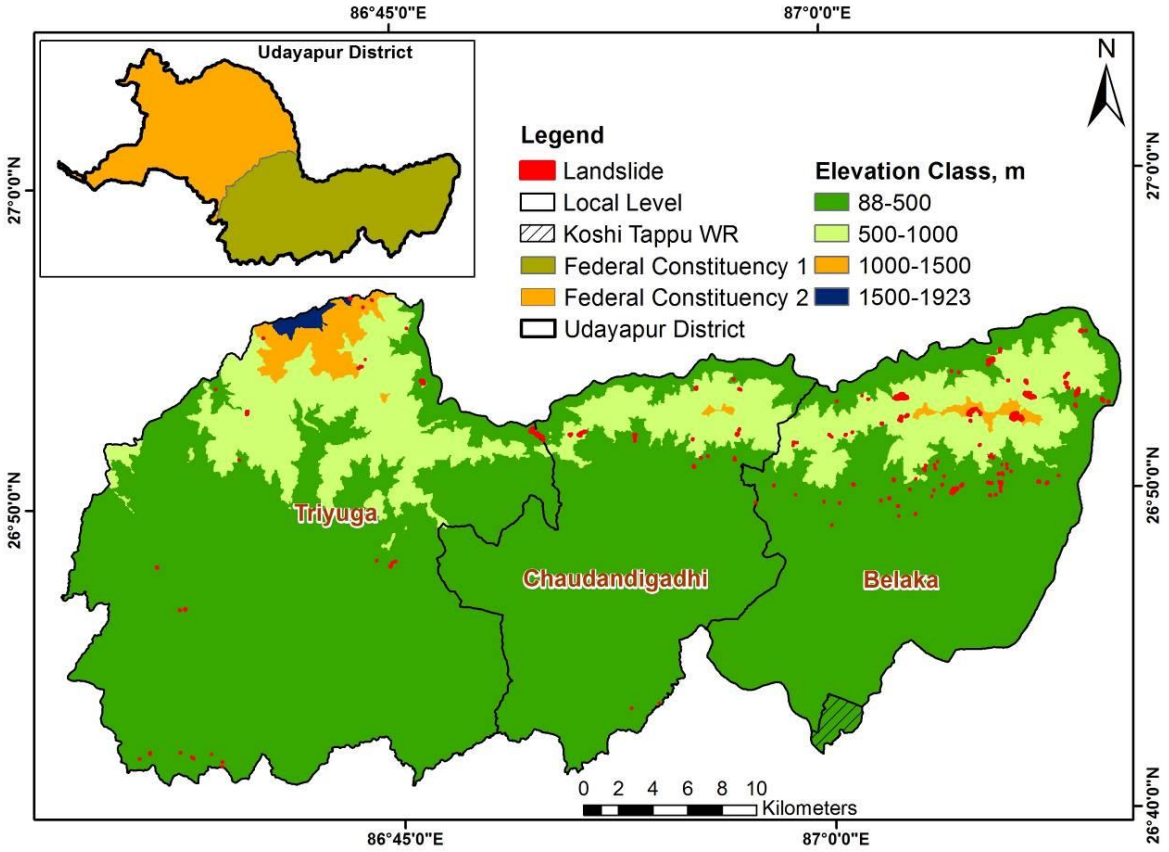


Figure 19: Distribution of landslide in different elevation classes within federal constituency 1

It was observed that 51.40% landslide has occurred in elevation class between 500-1000 m, 38.68% in elevation class between 88-500 m, 9.75% in elevation class between 1000-1500m, and 0.17% landslide has occurred in elevation class between 1500-1923m (Table 20, Figure 21).

Table 20: Distribution of landslides in different elevation classes of federal constituency 1

Elevation Class (m)	Occurrence of Landslide	No of landslide (%)
88-500	456	38.68
500-1000	606	51.40
1000-1500	115	9.75
1500-1923	2	0.17

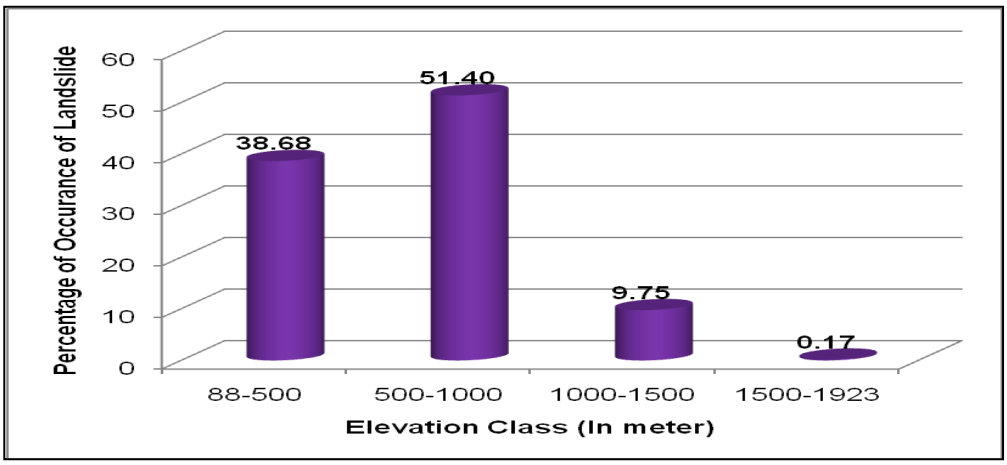


Figure 20: Occurrence of landslide (%) in different elevation classes within federal constituency 1

4.1.5 Landslide distribution in different slope class

Landslides in different slope class were also analyzed *(Figure 22)*. It was found that 57.93% landslide has occurred in very steep slope followed by steep slope, moderately steep slope, and gently sloping slope class *(Figure 23)*

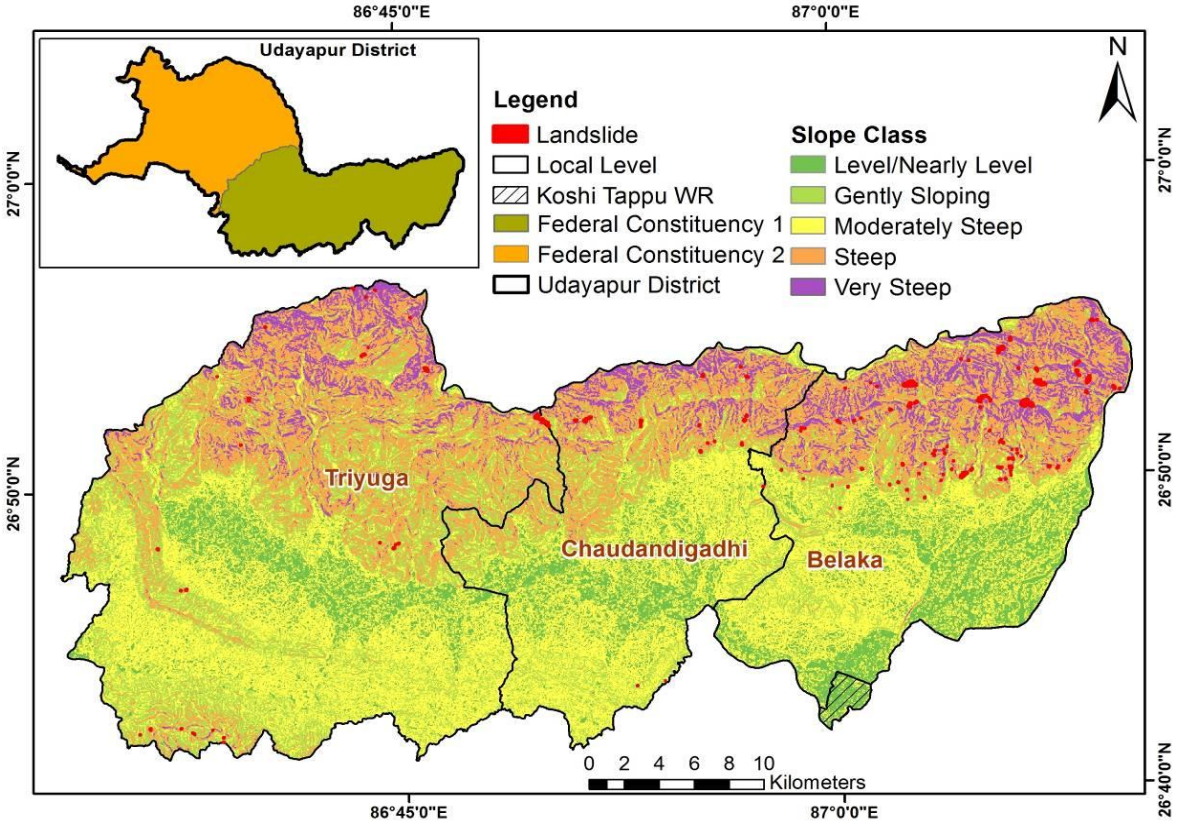


Figure 21: Distribution of landslide in different slope classes within federal constituency 1

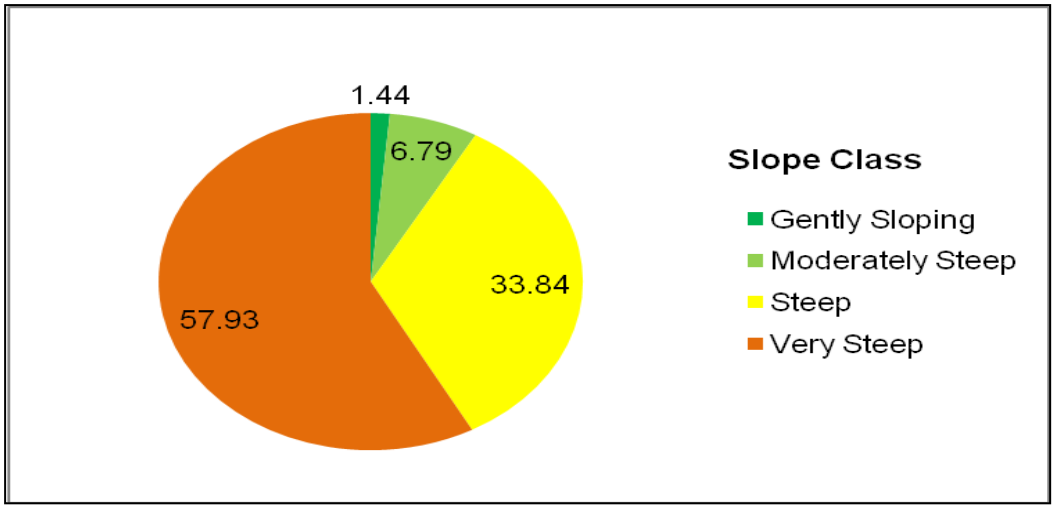


Figure 22: Occurrence of landslide (%) in different slope classes within federal constituency 1

4.1.6 Landslide distribution in different slope aspect class

Landslide in different slope aspects class were analyzed (Figure 24). It was found that South facing slope are more porne to landslide. It was observed that about 52.76% landslides occured in South facing slope, 21.97% in East facing slope, 19.42% in West facing slope and about 5.85% in North facing slope (Figure 25).

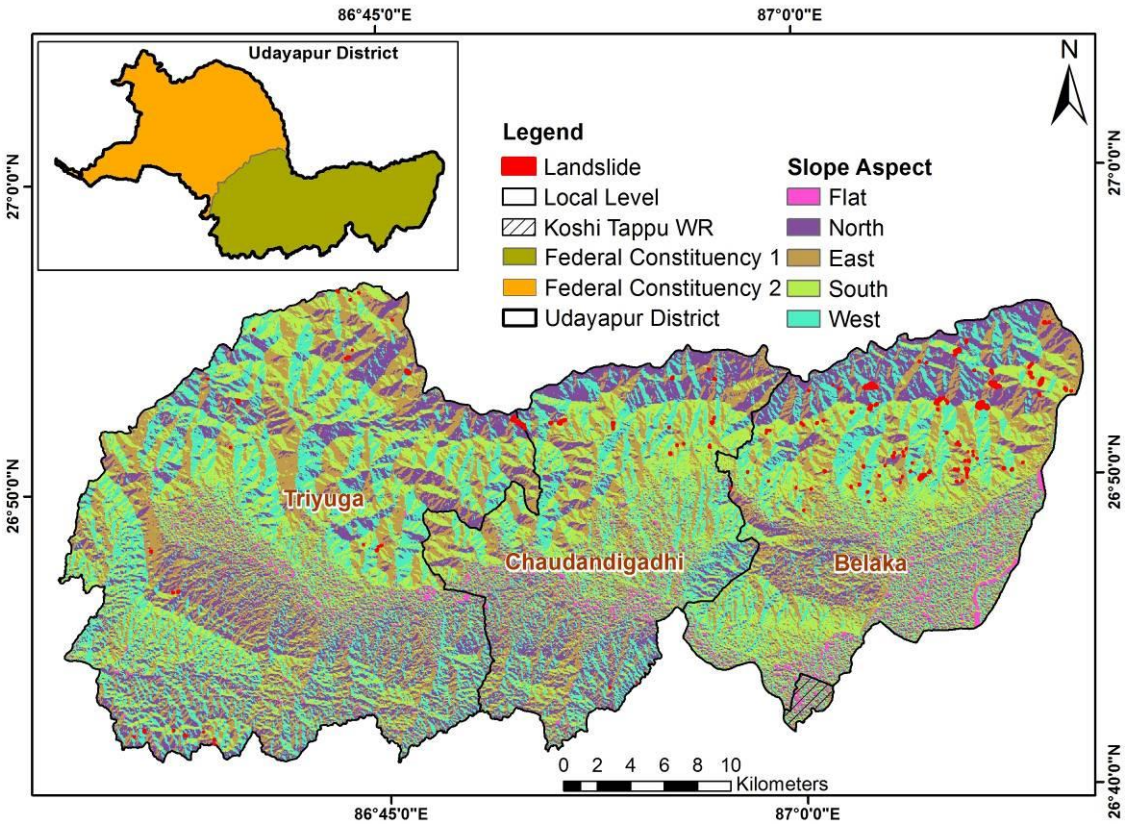


Figure 23: Distribution of landslide in different slope aspet within federal constituency 1

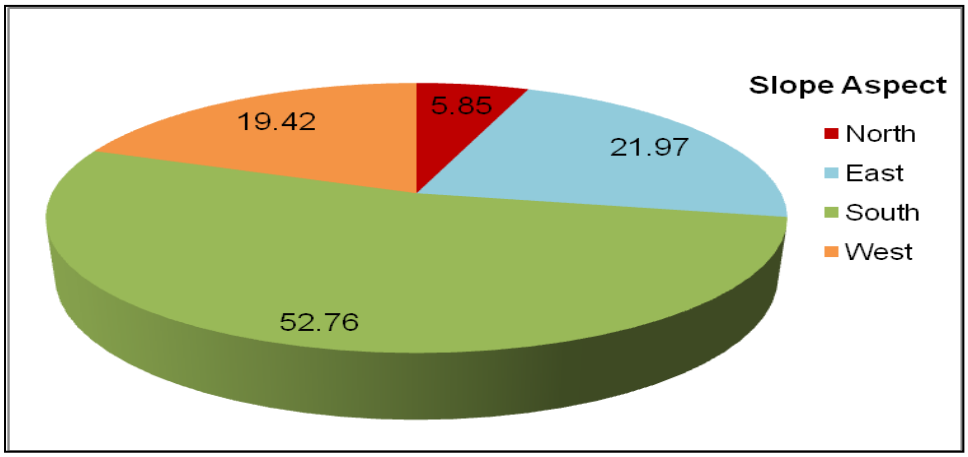
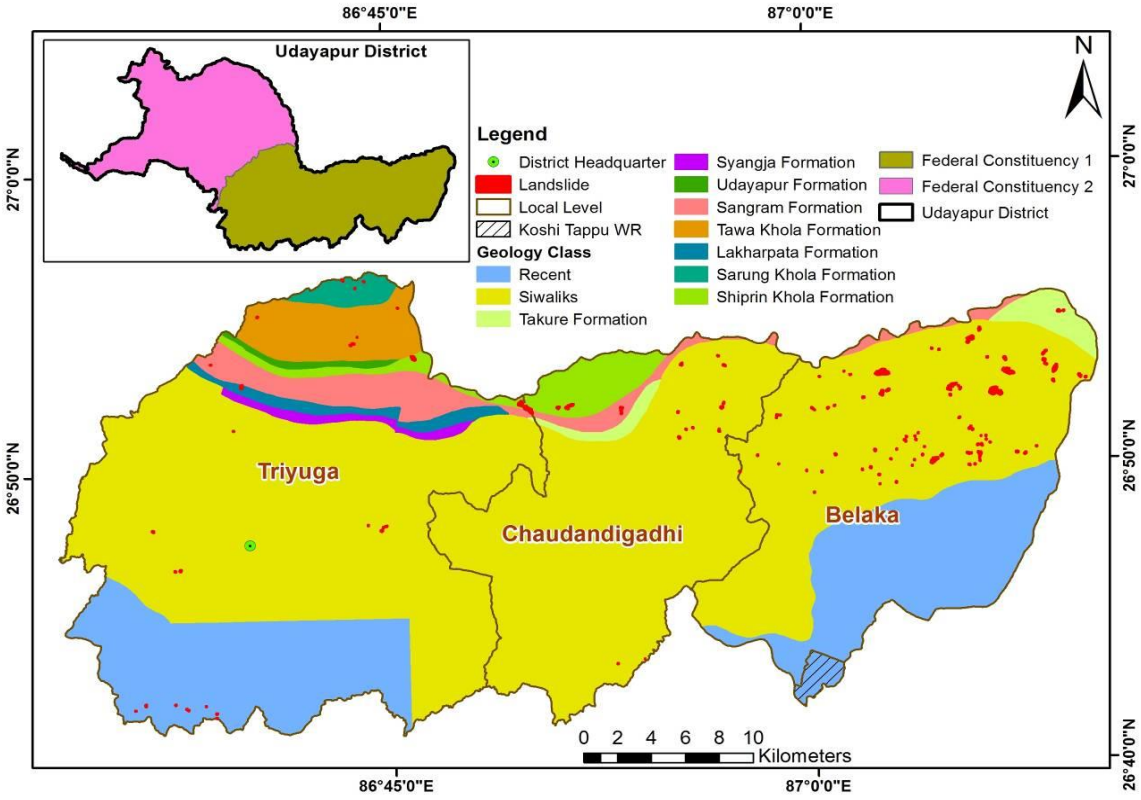


Figure 24: Occurrence of landslide (%) in different slope aspect within federal constituency 1

4.1.7 Landslide distribution in different geology class

The relationship between geology and landslide occurrence were observed (Figure 26). It was found that majority of landslides were in Siwalik region (79.05%). The analysis also showed that Shiprin Khola Foramation is another geological unit for contributing landslides within the federal constituency 1. Besides, about 1.61% landslide each occurred in Lakharpata Formation and Sangram Formation, 1.10% landslide occurred in Takure Formation, and less than 1% landslide has occurred in other geological groups including of Tawa Khola Formation, Recent, and Sarung Khola Formation geological units (Figure 27).



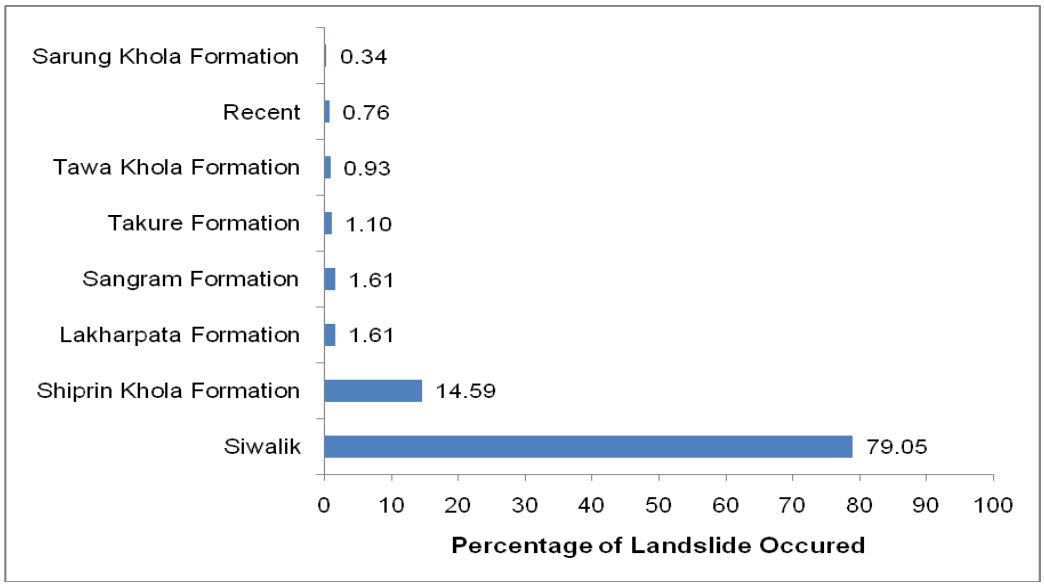


Figure 25: Occurrence of landslide (%) in different geology classes within federal constituency 1

4.1.8 Landslide distribution in different physiography region

The landslide occurrence in different physiographic region were analysed (Figure 26). The analysis showed that more than two third landslides are found in Siwalik region, 15.24% landslides in Middle Mountain region, and 4.88% landslides in Terai physiographic region *(Figure 29).*

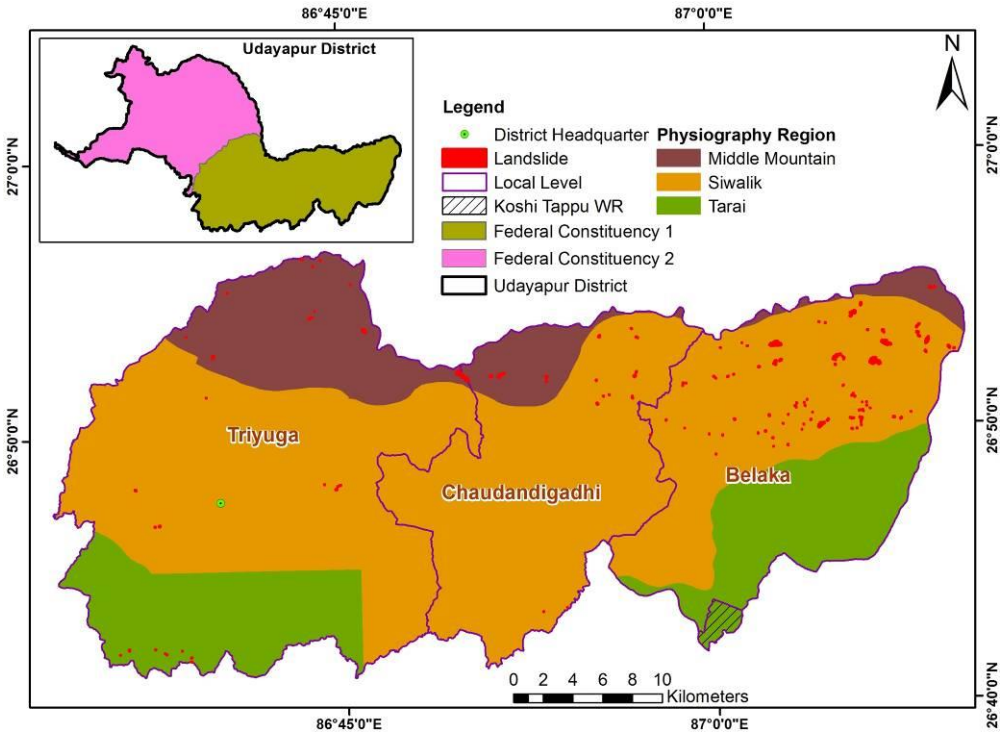


Figure 26: Landslide distribution in different physiography regions within federal constituency 1

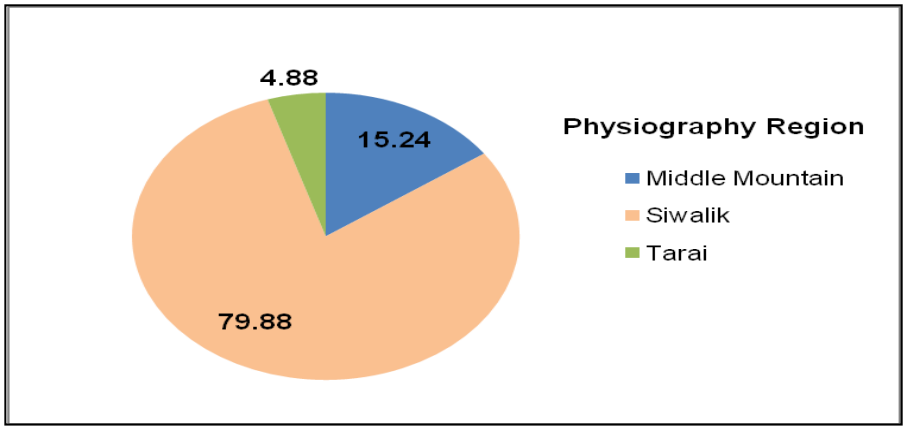


Figure 27: Occurrence of landslide (%) in different physiography regions within federal constituency 1

4.1.9 Landslide distribution in different land use class

The relationship between land use and occurrence of landslide were also analysed *(Figure 30)*. It was found that 47.20% has occurred in agriculture land, followed by 40.86% in forest land, barren land (6.32%), grass land (3.12%), and about 2.67% landslide has occurred in shrub land *(Figure 31)*.

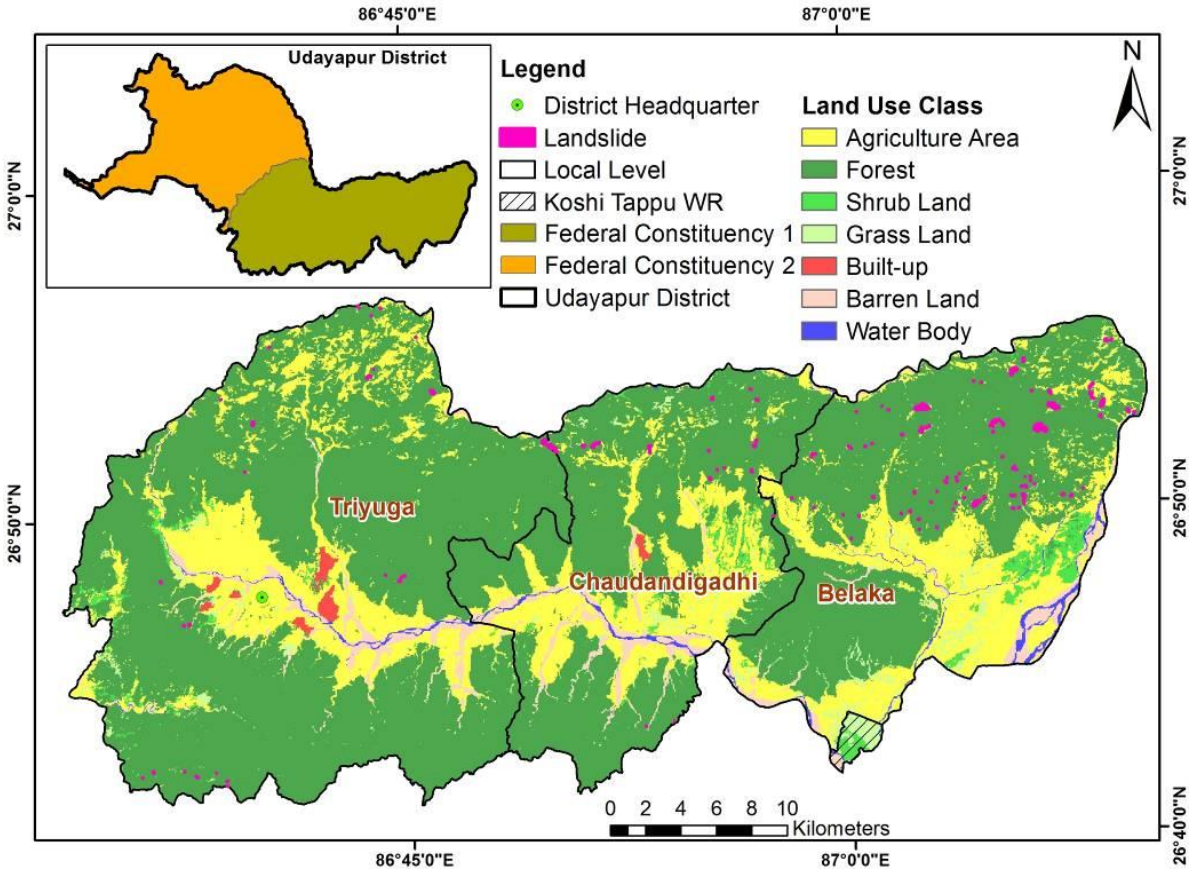


Figure 28: Distribution of landslide in different land use classes within federal constituency 1

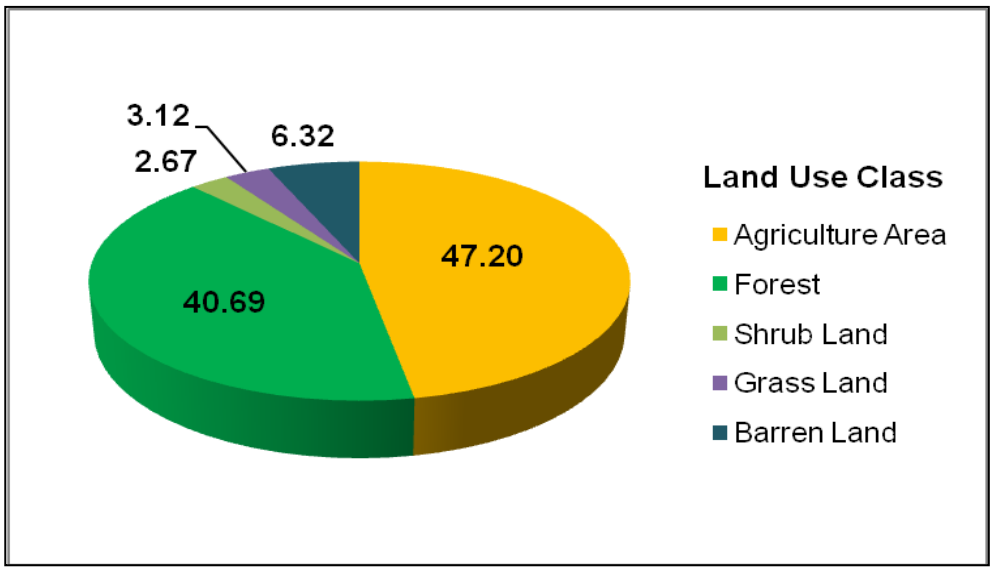


Figure 29: Occurrence of landslide (%) in different land use classes within federal constituency 1

4.1.10 Landslide distribution at proximity to river/stream

The relationship between proximity to drainage and landslide were analyzed (Figure 33). The proximity to drainage has been classified into four categories: 100 m, 100-200 m, 200-500 m, and above 500 m using the proximity tools in Arc GIS environment and explored the occurrence of landslide in each proximity to drainage classes. It was found that 36.22% landslide has occurred in proximity to drainage between 200-500m, 29.94% above 500m, 19.68% in proximity to drainage 100m, and 14.16% landslide has occured in proximity to drainage between 100-200m (Figure 32).

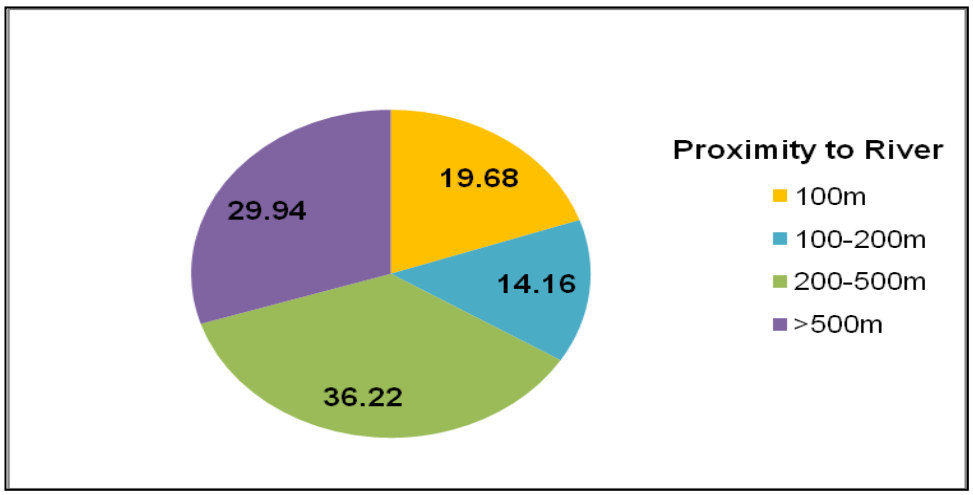


Figure 30: Occurrence of landslide (%) in different proximity to drainage within federal constituency 1

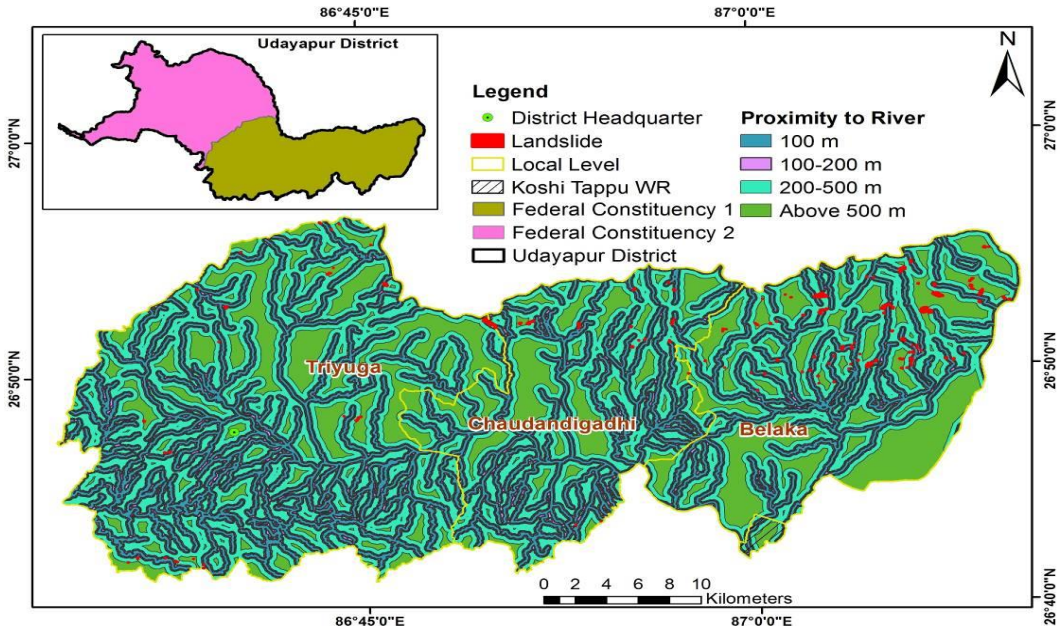


Figure 31: Distribution of landslide in different proximity to drainage classes within federal constituency 1

4.1.11 Landslide distribution at proximity to road

The relationship between proximity to drainage and landslide were analyzed. The proximity to road were classified into into four categories: 100 m, 100-200 m, 200-500 m, and above 500 m using the proximity tools in Arc GIS environment and explored the occurrence of landslide in each proximity to road classes. It was found that 95.76% landslide has occurred in proximity to road above 500m, 2.80% landslide in proximit to road between 200-500m, and 1.44% landslide has occurred in proximity to road between 100-200m *(Figure 34, Figure 35).*

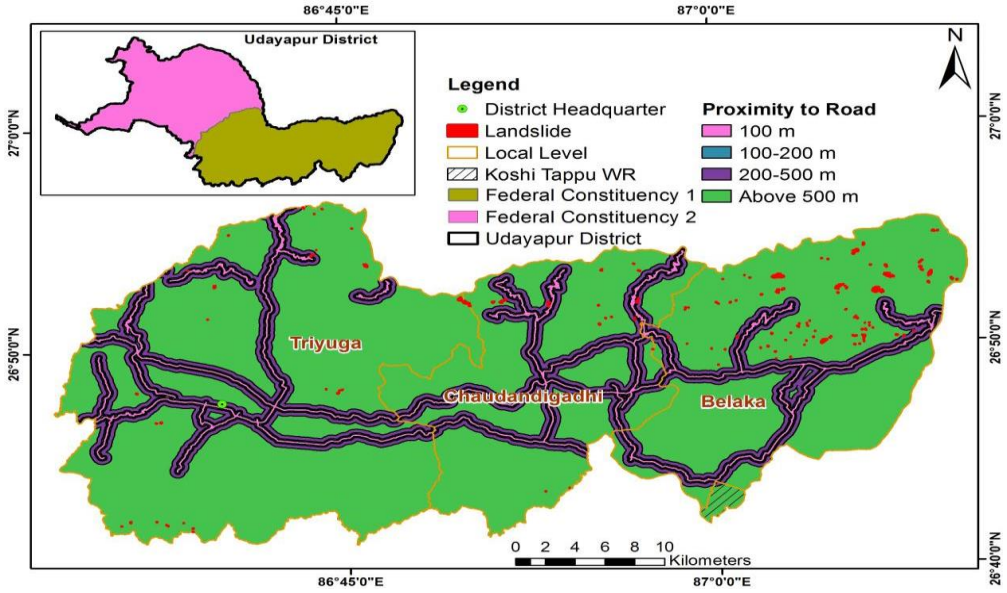


Figure 32: Distribution of landslide in different proximity to road classes within federal constituency 1

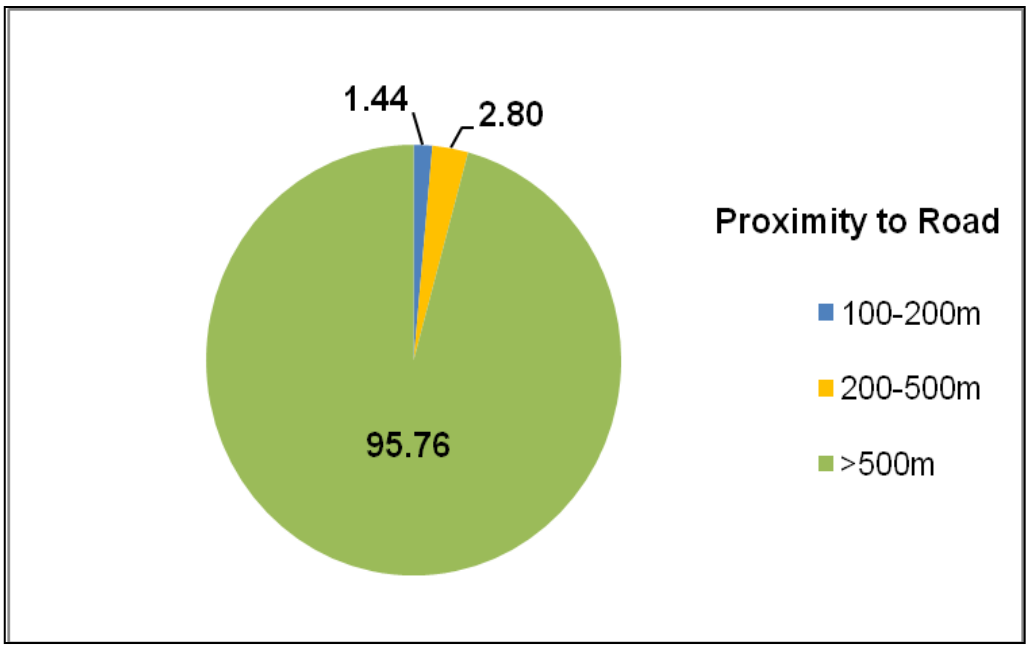


Figure 33: Occurrence of landslide (%) in different proximity to road classes within federal constituency 1

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The landslide inventory of the Federal Constituency 1 of Udaypur district has been carried out through the study of satellite imageries, and topographic map of the Department of Survey. Total of 164 landslides have been identified including 12 larger landslides (2 ha and above). The landslide has covered an area of 102.40 ha including of the total area of 12.86 ha of larger landslide. Belaka Municipality has highest number (110) of landslides. Likewise, Triyuga-Koshi watershed has highest number of landslide (221) occurence among the other watersheds within Federal Constituency 1 of Udayapur district. Similarly, most of the landslides have occurred in elevation class between 500 and 1000m (51.40%) and elevation class between 88 and 500 m (38.68%). Slope classes very steep and steep have comprised most landslides occurrence. With respect to geology, majority of landslides have occurred in Siwalik region. South facing slope is having of more than 50% landslide occurence. Moreover, landslides are generally occurring on the agriculture and forest area. Majority of the landslides have occurred at the drainage proximity of up to 500 m.

5.2 Recommendation

A comprehensive landslide database has been prepared and the relevant analysis has been done. However, landslide is a dynamic process and hence the database needs to be frequently updated. As the watershed management perspective, the landslide in the study area should be dealt with watershed wise so that the landslide disster mitigation activities would be more effective. The larger and vulnerable landslides should be identified and prioritized for mitigation measures. The landslides should be studied in detail with respect to geological condition, engineering geological condition. Further with the geophysical, civil engineering and topographical survey, mitigation measures should be proposed and implemented.

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ANNEX

ANNEX 1: LANDSLIDE DATABASE

Province	District	Federal Conatituency	LS_ID	Latitude	Longitude	Local Level	Ward No.	Area (m^2)	Area (ha)
1	Udayapur	1	1	2972602.93805051	795029.25127994	Belaka Municipality	5	1592.77	0.16
1	Udayapur	1	2	2975104.00340735	796153.18687481	Belaka Municipality	5	388.75	0.04
1	Udayapur	1	3	2972069.54282760	796267.72734366	Belaka Municipality	5	125.34	0.01
1	Udayapur	1	4	2971654.59780874	797923.36267274	Belaka Municipality	5	761.81	0.08
1	Udayapur	1	5	2970313.02819548	798378.54038243	Belaka Municipality	5	1157.72	0.12
1	Udayapur	1	6	2971590.71127328	798827.36181566	Belaka Municipality	5	1549.84	0.15
1	Udayapur	1	7	2972659.82579380	799610.67757787	Belaka Municipality	5	1998.26	0.20
1	Udayapur	1	8	2975528.66231409	799173.54579065	Belaka Municipality	6	3005.53	0.30
1	Udayapur	1	9	2976372.98994546	802321.83283510	Belaka Municipality	6	6538.00	0.65
1	Udayapur	1	10	2976556.57511781	802379.27320286	Belaka Municipality	6	13366.47	1.34
1	Udayapur	1	11	2973133.59515009	804859.87582533	Belaka Municipality	6	433.44	0.04
1	Udayapur	1	12	2976693.33325563	806326.02879062	Belaka Municipality	6	6279.26	0.63
1	Udayapur	1	13	2976490.29377131	809306.47943687	Belaka Municipality	8	36216.21	3.62
1	Udayapur	1	14	2972782.98073180	810840.57838023	Belaka Municipality	8	3185.31	0.32
1	Udayapur	1	15	2973185.97970374	811485.23181406	Belaka Municipality	8	835.78	0.08
1	Udayapur	1	16	2977255.01285981	812462.85831647	Belaka Municipality	8	6204.97	0.62
1	Udayapur	1	17	2977886.71805991	809686.28007918	Belaka Municipality	7	58053.34	5.81
1	Udayapur	1	18	2977735.93426738	810063.90578986	Belaka Municipality	7	11508.40	1.15
1	Udayapur	1	19	2978614.70234812	809602.71721501	Belaka Municipality	7	11171.21	1.12
1	Udayapur	1	20	2978272.01922865	812012.08268907	Belaka Municipality	7	5009.17	0.50
1	Udayapur	1	21	2978006.27610936	812572.57253788	Belaka Municipality	7	52725.45	5.27
1	Udayapur	1	22	2977553.08487310	814032.11204337	Belaka Municipality	7	9245.79	0.92
1	Udayapur	1	23	2980428.30041327	808103.81018835	Belaka Municipality	7	11071.56	1.11
1	Udayapur	1	24	2979879.82405218	807589.03205735	Belaka Municipality	7	42957.79	4.30
1	Udayapur	1	25	2979625.53676002	807428.79721113	Belaka Municipality	7	8028.03	0.80
1	Udayapur	1	26	2977744.62307487	802441.88500050	Belaka Municipality	6	128618.32	12.86

Province	District	Federal Conatituency	LS_ID	Latitude	Longitude	Local Level	Ward No.	Area (m^2)	Area (ha)
1	Udayapur	1	27	2976640.11691192	802710.69247279	Belaka Municipality	6	9826.27	0.98
1	Udayapur	1	28	2977685.50965889	802050.15330179	Belaka Municipality	6	20435.35	2.04
1	Udayapur	1	29	2973758.97415368	803806.65568172	Belaka Municipality	6	422.23	0.04
1	Udayapur	1	30	2972381.86109883	802891.99544832	Belaka Municipality	6	822.05	0.08
1	Udayapur	1	31	2970953.69925091	803215.10768636	Belaka Municipality	6	1824.75	0.18
1	Udayapur	1	32	2972779.40463422	807407.22471703	Belaka Municipality	6	1558.02	0.16
1	Udayapur	1	33	2972742.03843457	807507.58519666	Belaka Municipality	6	1402.85	0.14
1	Udayapur	1	34	2972752.14092700	807643.71632881	Belaka Municipality	6	256.40	0.03
1	Udayapur	1	35	2972775.48177717	808185.86795526	Belaka Municipality	6	4002.19	0.40
1	Udayapur	1	36	2973246.22692515	808261.43962814	Belaka Municipality	6	1730.13	0.17
1	Udayapur	1	37	2973413.51500934	808738.01210921	Belaka Municipality	6	633.83	0.06
1	Udayapur	1	38	2972468.43479368	808132.11661948	Belaka Municipality	6	391.45	0.04
1	Udayapur	1	39	2972820.99271344	808043.30755529	Belaka Municipality	6	982.94	0.10
1	Udayapur	1	40	2972076.67917630	807852.79306137	Belaka Municipality	6	935.27	0.09
1	Udayapur	1	41	2974297.87671523	807530.23029382	Belaka Municipality	6	3314.89	0.33
1	Udayapur	1	42	2974942.66631607	806921.93127082	Belaka Municipality	6	1341.63	0.13
1	Udayapur	1	43	2976753.62981377	806979.70346595	Belaka Municipality	6	3372.02	0.34
1	Udayapur	1	44	2976894.69314172	806873.02293689	Belaka Municipality	6	348.14	0.03
1	Udayapur	1	45	2976348.43724103	806384.63083877	Belaka Municipality	6	1975.16	0.20
1	Udayapur	1	46	2972578.76625665	805852.42842016	Belaka Municipality	6	1133.76	0.11
1	Udayapur	1	47	2972264.66479284	805384.04527725	Belaka Municipality	6	17965.40	1.80
1	Udayapur	1	48	2972645.86434103	804762.40896129	Belaka Municipality	6	1517.82	0.15
1	Udayapur	1	49	2972326.73169036	804280.48745441	Belaka Municipality	6	349.57	0.03
1	Udayapur	1	50	2971982.90794478	804153.94389309	Belaka Municipality	6	445.05	0.04
1	Udayapur	1	51	2973987.73162731	804499.93036573	Belaka Municipality	6	580.82	0.06
1	Udayapur	1	52	2973787.80610362	804309.92530927	Belaka Municipality	6	587.68	0.06

Province	District	Federal Conatituency	LS_ID	Latitude	Longitude	Local Level	Ward No.	Area (m^2)	Area (ha)
1	Udayapur	1	53	2973483.76367571	803761.88971527	Belaka Municipality	6	750.05	0.08
1	Udayapur	1	54	2970843.31961817	802248.19689293	Belaka Municipality	6	691.74	0.07
1	Udayapur	1	55	2971417.72888180	802201.25415931	Belaka Municipality	6	2677.65	0.27
1	Udayapur	1	56	2971864.89333432	801703.86350562	Belaka Municipality	6	3251.55	0.33
1	Udayapur	1	57	2971735.10882029	801204.36737603	Belaka Municipality	6	801.60	0.08
1	Udayapur	1	58	2972929.43510878	801956.12569866	Belaka Municipality	6	4717.57	0.47
1	Udayapur	1	59	2975679.10560770	799560.05436038	Belaka Municipality	6	990.53	0.10
1	Udayapur	1	60	2977469.11088420	798667.68721356	Belaka Municipality	6	468.56	0.05
1	Udayapur	1	61	2977586.05834007	800488.07364074	Belaka Municipality	6	1044.40	0.10
1	Udayapur	1	62	2977793.02036423	800116.96116975	Belaka Municipality	6	306.25	0.03
1	Udayapur	1	63	2976188.63610787	801263.87199280	Belaka Municipality	6	3921.62	0.39
1	Udayapur	1	64	2972979.62683001	803232.45776400	Belaka Municipality	6	468.25	0.05
1	Udayapur	1	65	2979142.30530501	805719.73375731	Belaka Municipality	6	1066.05	0.11
1	Udayapur	1	66	2979212.48277222	805288.56978454	Belaka Municipality	6	1174.13	0.12
1	Udayapur	1	67	2975489.42112262	798289.45449735	Belaka Municipality	5	4861.45	0.49
1	Udayapur	1	68	2981544.09952167	812779.72602734	Belaka Municipality	7	9633.05	0.96
1	Udayapur	1	69	2978681.87714982	808571.92989587	Belaka Municipality	7	2213.81	0.22
1	Udayapur	1	70	2981555.17892729	813068.22154172	Belaka Municipality	7	2669.80	0.27
1	Udayapur	1	71	2972837.10681209	810338.36404863	Belaka Municipality	8	5603.55	0.56
1	Udayapur	1	72	2972034.29988393	807527.35551024	Belaka Municipality	6	2181.48	0.22
1	Udayapur	1	73	2972154.63271630	805306.67802789	Belaka Municipality	6	2917.30	0.29
1	Udayapur	1	74	2972425.96705610	805502.59048426	Belaka Municipality	6	1856.02	0.19
1	Udayapur	1	75	2972447.86639998	805553.89417762	Belaka Municipality	6	2303.97	0.23
1	Udayapur	1	76	2972440.79607908	805614.62578625	Belaka Municipality	6	1911.93	0.19
1	Udayapur	1	77	2972331.26593813	805537.22892940	Belaka Municipality	6	897.00	0.09
1	Udayapur	1	78	2972437.43023653	805387.69592824	Belaka Municipality	6	620.24	0.06

Province	District	Federal Conatituency	LS_ID	Latitude	Longitude	Local Level	Ward No.	Area (m^2)	Area (ha)
1	Udayapur	1	79	2972405.52979137	805431.08887507	Belaka Municipality	6	1717.70	0.17
1	Udayapur	1	80	2972444.17446505	805451.95941903	Belaka Municipality	6	453.35	0.05
1	Udayapur	1	81	2972404.78312343	805667.91634734	Belaka Municipality	6	454.30	0.05
1	Udayapur	1	82	2972666.48352986	805930.40046608	Belaka Municipality	6	1820.23	0.18
1	Udayapur	1	83	2974214.23946461	807701.95449344	Belaka Municipality	6	2124.78	0.21
1	Udayapur	1	84	2974398.36480629	807609.42551422	Belaka Municipality	6	668.07	0.07
1	Udayapur	1	85	2972603.68185603	808159.84370111	Belaka Municipality	6	1936.72	0.19
1	Udayapur	1	86	2972283.54651668	808146.43064902	Belaka Municipality	6	734.42	0.07
1	Udayapur	1	87	2973277.42553831	808030.24966143	Belaka Municipality	6	1873.05	0.19
1	Udayapur	1	88	2973594.70497535	808507.51710215	Belaka Municipality	6	772.65	0.08
1	Udayapur	1	89	2973833.74853942	808495.16985458	Belaka Municipality	6	562.81	0.06
1	Udayapur	1	90	2973811.19062315	808199.99948475	Belaka Municipality	6	280.82	0.03
1	Udayapur	1	91	2973312.47688614	808234.31015909	Belaka Municipality	6	704.85	0.07
1	Udayapur	1	92	2972724.90401131	808093.79348621	Belaka Municipality	6	755.15	0.08
1	Udayapur	1	93	2973566.72243878	803669.75045747	Belaka Municipality	6	311.15	0.03
1	Udayapur	1	94	2973599.84799993	803740.47086064	Belaka Municipality	6	286.11	0.03
1	Udayapur	1	95	2973580.63799146	804374.55614814	Belaka Municipality	6	1124.97	0.11
1	Udayapur	1	96	2977456.00586689	814375.04224556	Belaka Municipality	7	2810.64	0.28
1	Udayapur	1	97	2978517.26811818	811924.59657872	Belaka Municipality	7	11644.16	1.16
1	Udayapur	1	98	2979059.83863853	811999.42186436	Belaka Municipality	7	4268.51	0.43
1	Udayapur	1	99	2978910.85776917	811878.93621491	Belaka Municipality	7	4257.38	0.43
1	Udayapur	1	100	2977733.26384171	809833.29022123	Belaka Municipality	7	21525.06	2.15
1	Udayapur	1	101	2972718.64482421	810781.81447042	Belaka Municipality	8	480.95	0.05
1	Udayapur	1	102	2976606.27363410	808922.09876112	Belaka Municipality	7	105078.03	10.51
1	Udayapur	1	103	2976867.48164106	806373.52980364	Belaka Municipality	6	12860.44	1.29
1	Udayapur	1	104	2976957.04594875	806509.30385001	Belaka Municipality	6	7563.84	0.76

Province	District	Federal Conatituency	LS_ID	Latitude	Longitude	Local Level	Ward No.	Area (m^2)	Area (ha)
1	Udayapur	1	105	2977012.58554801	806658.83370812	Belaka Municipality	6	7572.23	0.76
1	Udayapur	1	106	2972654.26566199	799654.70825290	Belaka Municipality	5	929.35	0.09
1	Udayapur	1	107	2975076.81995305	796169.47278001	Belaka Municipality	5	771.27	0.08
1	Udayapur	1	108	2975082.63002916	796358.40657365	Belaka Municipality	5	206.76	0.02
1	Udayapur	1	109	2975097.20995287	796304.44064343	Belaka Municipality	5	123.51	0.01
1	Udayapur	1	110	2974915.13402443	796143.62549045	Belaka Municipality	5	383.41	0.04
1	Udayapur	1	111	2971616.64568434	793979.39424584	Chaudandigadhi Municipality	3	866.41	0.09
1	Udayapur	1	112	2975556.01228395	792909.82133651	Chaudandigadhi Municipality	1	8518.53	0.85
1	Udayapur	1	113	2974298.09760897	791199.18320184	Chaudandigadhi Municipality	1	1478.87	0.15
1	Udayapur	1	114	2973733.92553164	790375.33306033	Chaudandigadhi Municipality	2	1253.87	0.13
1	Udayapur	1	115	2975538.29767233	786987.35540715	Chaudandigadhi Municipality	8	4681.71	0.47
1	Udayapur	1	116	2975212.07518621	786983.14177223	Chaudandigadhi Municipality	8	1399.96	0.14
1	Udayapur	1	117	2975608.60422850	783912.86486248	Chaudandigadhi Municipality	8	35966.37	3.60
1	Udayapur	1	118	2975268.34407575	790326.31989429	Chaudandigadhi Municipality	1	2083.20	0.21
1	Udayapur	1	119	2978166.52435085	793049.31308445	Chaudandigadhi Municipality	1	2656.25	0.27
1	Udayapur	1	120	2975521.24471172	783233.89149887	Chaudandigadhi Municipality	8	5732.59	0.57
1	Udayapur	1	121	2975578.24239305	783292.17255670	Chaudandigadhi Municipality	8	1940.14	0.19
1	Udayapur	1	122	2975497.74726087	781450.04595984	Chaudandigadhi Municipality	8	49223.34	4.92
1	Udayapur	1	123	2978742.11022012	792692.37987571	Chaudandigadhi Municipality	1	1454.88	0.15

Province	District	Federal Conatituency	LS_ID	Latitude	Longitude	Local Level	Ward No.	Area (m^2)	Area (ha)
1	Udayapur	1	124	2974140.17937637	792758.43850397	Chaudandigadhi Municipality	3	6580.88	0.66
1	Udayapur	1	125	2978231.44083233	790524.35293038	Chaudandigadhi Municipality	1	9156.20	0.92
1	Udayapur	1	126	2960022.84020508	788393.73985192	Chaudandigadhi Municipality	5	153.64	0.02
1	Udayapur	1	127	2959734.91865642	786797.97689336	Chaudandigadhi Municipality	5	613.77	0.06
1	Udayapur	1	128	2975245.11919131	781659.72805153	Chaudandigadhi Municipality	8	1664.48	0.17
1	Udayapur	1	129	2975221.24744154	781722.44536211	Chaudandigadhi Municipality	8	1572.80	0.16
1	Udayapur	1	130	2975171.25918087	786981.94513635	Chaudandigadhi Municipality	8	364.72	0.04
1	Udayapur	1	131	2975394.25319430	786968.79392487	Chaudandigadhi Municipality	8	1830.55	0.18
1	Udayapur	1	132	2974201.34311011	790802.91183754	Chaudandigadhi Municipality	2	1385.46	0.14
1	Udayapur	1	133	2973673.53959424	790418.25760136	Chaudandigadhi Municipality	2	2047.43	0.20
1	Udayapur	1	134	2975808.17669070	793007.79903136	Chaudandigadhi Municipality	1	1252.23	0.13
1	Udayapur	1	135	2975865.91105581	793037.01891052	Chaudandigadhi Municipality	1	533.46	0.05
1	Udayapur	1	136	2981110.69119424	765509.03805444	Triyuga Municipality	16	1255.84	0.13
1	Udayapur	1	137	2976807.18970127	764572.56527202	Triyuga Municipality	16	15188.18	1.52
1	Udayapur	1	138	2978160.55782195	762747.84007265	Triyuga Municipality	7	522.04	0.05
1	Udayapur	1	139	2974070.39177533	764110.87105390	Triyuga Municipality	8	617.07	0.06
1	Udayapur	1	140	2978585.85867833	774703.12064452	Triyuga Municipality	14	34218.59	3.42
1	Udayapur	1	141	2979474.29309400	771155.97220496	Triyuga Municipality	15	4233.20	0.42
1	Udayapur	1	142	2979882.90525980	771392.25923393	Triyuga Municipality	15	136.99	0.01
1	Udayapur	1	143	2983388.50907721	770529.90365792	Triyuga Municipality	15	1768.62	0.18

Province	District	Federal Conatituency	LS_ID	Latitude	Longitude	Local Level	Ward No.	Area (m^2)	Area (ha)
1	Udayapur	1	144	2982889.84577055	771256.12934282	Triyuga Municipality	15	227.18	0.02
1	Udayapur	1	145	2981683.04062432	773772.93567409	Triyuga Municipality	15	866.17	0.09
1	Udayapur	1	146	2983316.37163690	771775.21618117	Triyuga Municipality	15	280.16	0.03
1	Udayapur	1	147	2968252.74081053	772070.71071431	Triyuga Municipality	13	704.33	0.07
1	Udayapur	1	148	2975772.48451649	781031.37160662	Triyuga Municipality	14	28204.95	2.82
1	Udayapur	1	149	2956617.92348960	763140.34901408	Triyuga Municipality	4	1272.91	0.13
1	Udayapur	1	150	2956348.94420366	763138.68682837	Triyuga Municipality	4	1340.07	0.13
1	Udayapur	1	151	2957075.08281314	762507.86879415	Triyuga Municipality	4	466.47	0.05
1	Udayapur	1	152	2956830.38122971	761468.92103909	Triyuga Municipality	4	841.68	0.08
1	Udayapur	1	153	2957158.54264068	760707.21508064	Triyuga Municipality	4	1543.89	0.15
1	Udayapur	1	154	2957117.45349105	758962.07039959	Triyuga Municipality	4	4537.21	0.45
1	Udayapur	1	155	2965394.81689520	760677.60793805	Triyuga Municipality	6	1852.50	0.19
1	Udayapur	1	156	2965445.97432138	760988.82602931	Triyuga Municipality	6	4773.92	0.48
1	Udayapur	1	157	2967857.70326892	759363.68820060	Triyuga Municipality	6	5372.97	0.54
1	Udayapur	1	158	2956799.98948144	758347.97168902	Triyuga Municipality	5	590.20	0.06
1	Udayapur	1	159	2956899.33127222	761358.19089737	Triyuga Municipality	4	1234.48	0.12
1	Udayapur	1	160	2975918.07577816	781088.56402454	Triyuga Municipality	14	1002.92	0.10
1	Udayapur	1	161	2967930.01054585	772856.64753865	Triyuga Municipality	13	4465.03	0.45
1	Udayapur	1	162	2968202.78163269	773127.84398598	Triyuga Municipality	13	2103.95	0.21
1	Udayapur	1	163	2968139.19491578	772958.50027145	Triyuga Municipality	13	759.18	0.08
1	Udayapur	1	164	2979372.84585074	771009.57288168	Triyuga Municipality	15	1918.20	0.19