VIEW FROM BULBULE TAAL, BIRENDRANAGAR
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TAYAR NEPAL – IMPROVED DISASTER RISK MANAGEMENT PROJECT

DEVELOPMENT OF RISK SENSITIVE LAND USE PLANNING FOR FOUR MUNICIPALITIES

Planning Report Summary- Birendranagar Municipality

April 2022

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MULTI HAZARD, VULNERABILITY AND RISK PROFILE – BIRENDRANAGAR MUNICIPALITY

Planning Report Summary- Birendranagar Municipality

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1. MUNICIPAL PROFILE

Birendranagar Municipality is located in Surkhet district of Karnali Province of Nepal. It covers an area of 245.06 sq. km. The municipality's coverage was recently consolidated merging three VDCs - Gadi, Ratu, Garpan VDCs and into the existing Birendranagar Municipality. The municipality has altogether 16 wards.

Geographically it extends from 81°32'57.3" to 81°46'41.4" east longitude and from 28°30'19.94" to 28°41'31.68" north latitude in the Siwalik physiographic (Chure) region of Nepal. The municipality has altogether 16 wards with total area of 25345.84 (Ha). It lies in the Western Nepal Himalaya that covers Siwalik, Intermontane basin of Surkhet Valley and Lesser Himalaya. The municipality comprises entire intermontane basin of Surkhet, which is physiographically called as Dun Valley. This intermontane basin was formed due to tectonic activities during the upliftment of Siwaliks.

According to Land Use Policy 2072, the land use pattern in this Municipality has been classified as agriculture land (5602.33 ha), commercial area (238.30 ha), forest (13758.17 ha), residential (561.36 ha), public service (497.89 ha), riverine and lake (403.57 ha), cultural and archaeological (13.57 ha), industrial (12.11 ha) and other area (4257.73 ha). The Bheri River is a major tributary to Karnali River. The drainage area of Bheri River up to the hydrological station at Samaijighat is 12200 square km (DHM).

The metrology data derived from the station index number 506. The 30 years' rainfall analysis shows the average annual precipitation is around 1500 mm. The maximum monthly average rainfall is 460 mm and minimum monthly average rainfall is 5 mm in November and December. The highest temperature measured is 34 degrees and the lowest temperature measured is 5 degrees (Celsius) in January. The Municipality has 6,973 (92.91%) private parcels, 232(0.31%) forest parcels and 5,087 (6.78%) parcels are government.

Map 1 Landuse Map

Total population of Birendranagar in 2075 was 115,451. Average population growth trend is 4.57% from 2001 to 2011, which is more in comparison to the national growth rate 1.35%. It is expected that the municipality population will be 155,984; 252,045; 421,933 and 728,887 in the year 2021, 2031, 2041 and 2051 respectively.

The main economies of Birendranagar Municipality are business, services, agriculture, forest, retail business, animal farming, and tourism. A large quantity of limestone is likely to be available in the Chure

Mountains of this municipality if it can be excavated by assessing the environmental and environmental impact. According to the municipality's profile 2075, ballast, sand and stone mines are in operation at Girighat, Bheri, Dobhan and Bagar in Ward No. 2 and Bhutchowk Jhupra Powerhouse in Ward No. 13. A sand and stone quarry is in operation at Jhupra Bheri Dobhan in Ward No. 11. As the municipality has various invaluable herbs like Amla, Chutro, Sugandhawal, Sajiwan, Cinnamon, Rajvriksha, Harro, Barro, Kurilo, it is possible to strengthen the economy of the municipality by investing in small scale industries using such natural resources and available raw materials. A total length of 469.41 km road has been constructed in Birendranagar Municipality out of which 145 km is black topped, 248 km is graveled, and 76 km is track.

The new urban development is characterized as spatially dispersed frequently rising over the prime agricultural lands and linear development along the Highway, Ringroad and other major road networks. There are altogether 251 settlements spreading across the municipality covering around 6% of the total municipal area as built-up. There are altogether 32596 buildings with different typologies. Buildings are predominantly residential type with 86.6% while mixed type cover around 8.2%. Remaining proportion of buildings are used for other purpose. Around 62% of buildings are concentrated in core area of ward 3,4,5,6,7,8,9 and10 which is directly connected to Ratna Highway. The highway connects the municipality to east west highway at Kohalpur of Banke district. Karnali highway is the other highway that connects the municipality with other districts: Dailekh, Kalikot, Jumla and Mugu of the Karnali Province.

There is one district hospital, one province hospital, one Ayurveda hospital and nine health posts providing basic health facilities to the urban and rural people. There are altogether 64 community school and 76 private schools providing Basic and Secondary level education (MoUD, 2020). Also there are 176 Child development centers among which 99 are Community and 77 are under Private management. Besides, there are 2 Government College and 4 Private colleges along with 2 Madrasa. Government services such as Regional administrative office, District administrative office, Tax service office, District court, Mid-western road division office, etc. are located in the main bazar area of the municipality. The municipality is served by 30 banking and financial institutions including 253 saving and credit cooperatives and multipurpose cooperatives. There are altogether 164 open spaces in Birendranagar Municipality including public parks, school ground and institutional grounds.

2. RISK AND HAZARD PROFILE

2.1 VS30

The Vs30 value has been estimated by measuring shear wave velocity at selected locations. The locations were selected based on type of geology, topography, slope aspect, soil type, size of settlement and potential for future extension of settlements, relative importance of the area etc. Multichannel Analysis of Surface Wave (MASW) and Downhole seismic methods has been applied to measure VS30 at selected locations. The Global Vs30 map based on slope prepared by USGS has been incorporated with measured Vs30 value in the site. Distribution of VS30 within whole area has been estimated by Geostatistical methods. Vs30 value varied from 250 to 780 m/s. The southern part has low shear wave velocity than northern part, which could be due to thick boulder deposited at the northern part.

2.2 PEAK GROUND ACCELERATION

Peak Ground Acceleration (PGA) value for a station has been estimated by considering scenario earthquakes, fault model, distance from the fault to study area, potential magnitude of the earthquake

etc. based on equation proposed by Boore et al 1997. PGA from three different scenario earthquakes Main Himalayan Thrust (MHT) (Mw 9.0), Main Boundary Thrust (MBT) (Mw 8.5), and Local Thrust (Mw 6.5) has been considered. PGA for MHT has a very narrow range of 400 to 600 gal, while PGA for MBT also has small range of 400 to 500 gal. PGA for Local Back Thrust ranges from 150 to 180 gal.

2.3 LIQUEFACTION

Birendranagar Municipality lies in the dun valley, drained and deposited by local rivers and lakes, therefore there are thick sandy soil in the study area. Geotechnical properties of soil shows, the properties of the soil is highly liquefiable during shaking. Presence of soil with low SPT value, low shear wave velocity and sandy soil proves the soil is highly liquefiable. The central part of the city is highly liquefiable than the peripheral part. Around 1,724.12 ha (6.80%) of total area is under high liquefaction hazard zone, while 3,623.92 ha (14.30%) and 19,997.97 ha (78.90%) is under medium and low hazard zone respectively.

2.4 MODIFIED MERCALLI INTENSITY

As a tool to define the intensity levels, it is recommended that the Modified Mercalli Intensity (MMI) scale be used. This defines twelve intensity degrees from intensity I to intensity XII. Intensity I is not felt except by a few under especially favorable conditions, while in intensity XII, there is total damage. Waves are seen transmitted at ground surface. Topography changes, and objects are thrown into air. Analysis shows (MMI) X for MHT, IX for MBT and VIII for Local Thrust.

2.5 RAINFALL INDUCED LANDSLIDE

Rainfall-induced landslide shows the probability of landslide occurrence due to severe rainfall in the municipality. The analysis was performed using statistical approach adopting Bayesian probability model, in which the probability of occurrence of landslide is based on topographic, geologic, hydrologic, and anthropogenic factors. These factors are also called as causative parameters of landslide occurrence. The weightage for each causative parameter was computed through analytical hierarchical process (AHP) approach. Analysis shows that around 5,038.73 ha (19.88%) of total area is under high rainfall-induced landslide hazard zone, while 10,471.72 ha (41.32%) and 9,830.16 ha (38.78%) is under medium and low hazard zone respectively.

2.6 EARTHQUAKE INDUCED LANDSLIDE

Earthquake-induced landslide hazard shows the probable places of landslide occurrence due to strong shaking of earthquake. The earthquake-induced landslide hazard map has been modelled by calculating stability index of sloping terrain, which is based on the lithological (rock and soil) characteristics, terrain (slope) parameters, and seismic behavior (peak ground acceleration) experienced by the terrain during an earthquake. Analysis shows that around 2,311.08 ha (9.12%) of total area is under high earthquake-induced landslide hazard zone, while 12,378.12 ha (48.78%) and 10,641.68 ha (41.99%) is under medium and low hazard zone respectively.

2.7 ROCKFALL

Rock fall hazard describes the scenario of one of the major geo-hazards in the mountainous and hilly terrain. The susceptibility index of rock falls and rockslides is based on the lithological characteristics as well as the terrain parameters. The slope gradient and internal relief of terrain are essential topographical parameters to determine the possibility of rock fall and rockslide. Analysis shows that

around 1,837.33 ha (7.25%) of total area is under high rock fall hazard zone, while 8,147.20 ha (32.14%) and 15,356.31 ha (60.59%) is under medium and low hazard zone respectively.

2.8 FLOOD

Flood hazard assessment of Bheri River and its tributaries of Birendranagar Municipality was completed using hydraulic modelling using one dimensional HEC-RAS and HEC GEORAS tool. The main data used are hydro-meteorological data, DEM, Image of project area, surveyed cross sections. The flow data required for flood modeling is estimated with probability distribution function and different empirical methods developed by Water and Energy Commission Secretariat (WECS) used for Nepal. The settlements built near to the Khorke, Itram khola, Neware Khola are at risk of flooding. There is a high possibility of inundation of large area of land at the confluence of those all small rivers downstream at inlet to the Nikashe Khola. Analysis shows that around 410.59 ha (1.78%) of total area is under high flood hazard zone, while 126.97 ha (0.55%) and 128.56 ha (0.56%) is under medium and low hazard zone respectively.

2.9 VAPOUR CLOUD EXPLOSION

In the municipality, there are petrol pumps that can cause explosion and fire in case of accidental release and ignition. Multi-Energy Model was used for VCE modeling. Analysis showed that side on peak over pressure had inverse relation with distance. The overpressure was significantly high within 5-15m of the source of petrol pumps, depending on the quantity of fuel, which then sharply declined till 100 m. From 100 m onward, overpressure declined slowly with increasing distance. Around 6.27 ha was categorized as high hazard zone, while 38.46 ha and 1259.63 ha were categorized as medium and low hazard zone respectively.

2.10 URBAN FIRE SUSCEPTIBILITY

Urban fire susceptibility assessment was done using multi-criteria evaluation (MCE). For this, seven different factors were identified based on available data, literatures and in consultation with relevant experts. Analytical Hierarchy Process (AHP) method, introduced by (Saaty, 1987), was used to determine the weights of each factor and check the consistency of the weight. Based on MCE, around 4.69 ha of the municipality was highly susceptible to urban fire, while 1034.15 ha was moderately susceptible to urban fire

2.11 FOREST FIRE

Historical fire incident data recorded by moderate resolution imaging spectroradiometer (MODIS) obtained from NASA was used to map forest fire incidents. Hotspot analysis was done to identify the areas where forest fire is concentrated using Getis-Ord. From 2010 to 2021, a total of 175 forest fire incidents were recorded by MODIS. Highest forest fire was recorded in 2016 and 2021. Hotspot analysis showed that the forest fire hotspots present in the Southern parts of the municipality.

2.12 LIGHTENING

Focus group discussion was used to map the lightening incidents. Few incidents of lightening have occurred in the municipality. Focus group discussion showed that past incidents occurred in wards- 15 and 16 - in 2019, while DRR portal showed that 3 incidents occurred in wards 14, 15 and 16 in 2019 (1 event each in 2011, 2013 and 2015).

2.13 HUMAN WILDLIFE CONFLICT

Every year, incidents of conflicts between people and wildlife, especially deer, have been occurring in Birendranagar municipality resulting in loss of crops. These animals influx from the forests of Kakrebihar. Kurit, Kakre Bihar, Nayangaun and Purano Ghusra are some of the settlements affected by wildlife.

2.14 CLIMATE CHANGE

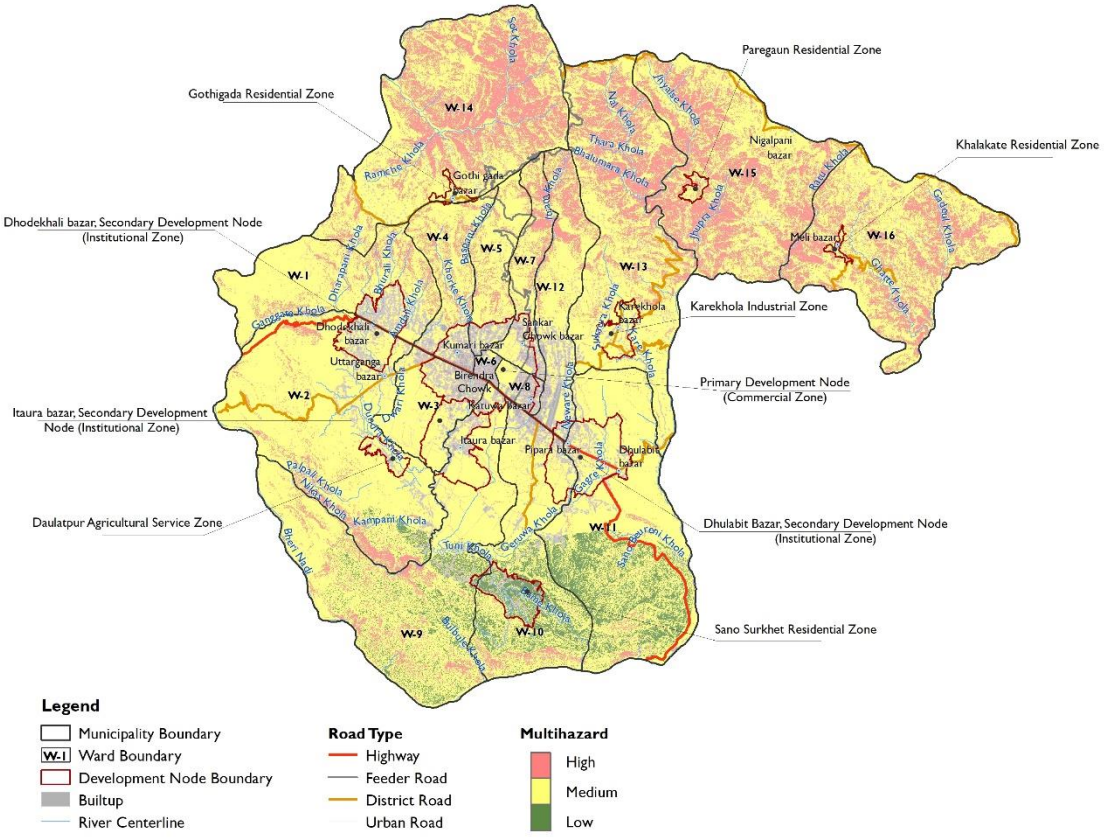
Heatwave is global temperature phenomena and occurs when the ocean temperature rises normally high and moves toward the atmosphere in the land area. T temperature acts to lead and traps a hot air usually rising coming from the sea and continues for few weeks and is called heat wave. These rising temperature of dry wind parameters characteristics are different in different countries. Mostly when the dry wind rises temperature in several country. They have a self-right to make decisions about the heat wave conditions in their respective country. Mostly any day appeared this rising temperature of 400C above they announce as heat wave, if five days continuously rising more than above given temperature, they called intense heat wave. But in our country from Government of Nepal such criteria are still not fixed. In the Birendranagar the 95 % percentile of total 535 days (36.60C) and in the 90 % percentile the total 1088 days (34.90C) of heatwave has been found from observed data (1990 to 2020) of 10950- days (30-years). Whereas the HWD trend of 0.110 per days and the total contributed of HWF 0.601 per days are increasing from 1990 to 2020. Similarly, HWN 0.11°C per annual and average temperature across all HWM -0.08°C per annual are increasing. Similarly, the hottest day of the HWA -0.14°C per annual is also increasing. Overall trends of this heatwave are increasing but the extreme peak of individual heatwave is found in (1998, 2005, 2012, 2016) years from the observed data.

Coldwave is a cold snap of weather phenomenon, distinguish by cooling of the air and rapid temperature going to minimum falls within 24 hours. It is decadent with geographic region and time of year. A cold wave is also declared differently for different values and according to Indian Meteorological Department (IMD) the minimum temperature is 100C or below and is 4.5 notches less than normal. A "severe" cold wave is when the minimum temperature dips to 20C or the departure from normal is more than 6.40C. But Government of Nepal has not fixed the above types of criteria. The study of coldwave in Birendranagar results are found, the trend of annual event contribute cold waves (CWF) are 0.20 per year increasing, the number of individuals cold waves (CWN) trend are increasing 0.00 annual /day and length of the longest cold wave (CWD) is also increasing 0.20 annual/ day 1990 to 2020.

Similarly, the projected CMIP6 data heatwave (HWF) is more procurance in the mid future from three scenario (ACCESS-CM2, ACCESS-ESM1-5 and CanESM5) and the individual peak (HWF) found be too hot from mid future to far future up to the 2100 century. The number of days contribute to 'cold waves' of ECF_HWN (CWF) are found to be decreasing trend after the mid future 2055. It is very essential to make decisions from our government about the heatwave and coldwave.

2.15 MULTIHAZARD

Multi hazard map was prepared using AHP using different hazards and weights were assigned to each hazard in consultation with experts. Based on multi-hazard assessment, around 4.90% (1241.77 ha) of total area was categorized as low hazard zone, while 75.38% (7063.74 ha) and 19.67% (1034.15 ha) of total area were categorized as moderate and high hazard zone respectively.



Map 2 Multi Hazard Map

2.16 CLIMATE CHANGE

Heatwave is global temperature phenomena and occurs when the ocean temperature rises normally high and moves toward the atmosphere in the land area. T temperature acts to lead and traps a hot air usually rising coming from the sea and continues for few weeks and is called heat wave. These rising temperature of dry wind parameters characteristics are different in different countries. Mostly when the dry wind rises temperature in several country. They have a self-right to make decisions about the heat wave conditions in their respective country. Mostly any day appeared this rising temperature of 400C above they announce as heat wave, if five days continuously rising more than above given temperature, they called intense heat wave. But in our country from Government of Nepal such criteria are still not fixed. In the Birendranagar the 95 % percentile of total 535 days and in the 90 % percentile the total 1088 days of heatwave has been found from observed data (1990 to 2020) of 10950- days (30-years). Whereas the 0.56 per days and the total contributed of HWF 0.22 per days are increasing from 1990 to 2020. Similarly, the heatwave of HWM is found to be decreasing trend of -0.08°C per year, the heatwave of HWA is found to be decreasing trend of -0.14°C per, year, the heatwave of HWN is found to be increasing trend of 0.113°C per year, the heatwave of HWD is found to be increasing trend of 0.01 per day and the heatwave of HWD is found to be increasing trend of 0.60 per day.

Coldwave is a cold snap of weather phenomenon, distinguish by cooling of the air and rapid temperature going to minimum falls within 24 hours. It is decadent with geographic region and time of year. A cold wave is also declared differently for different values and according to Indian Meteorological

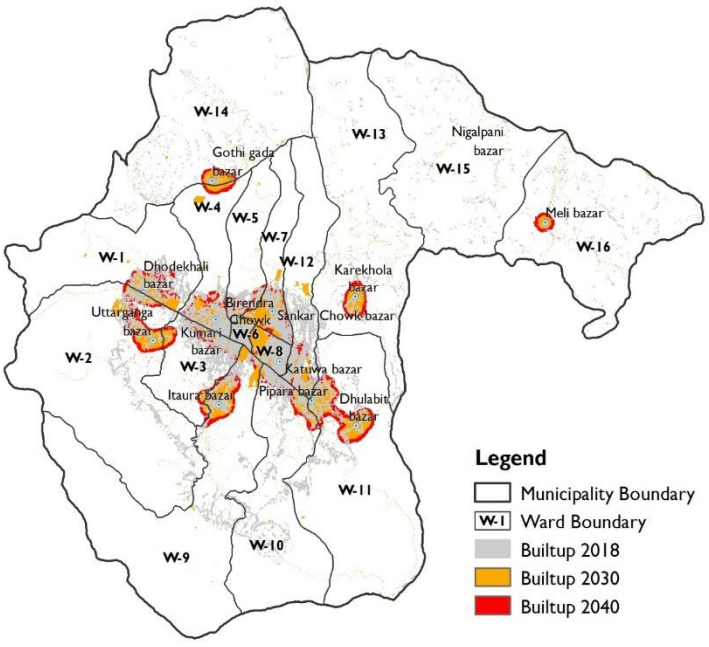
Department (IMD) the minimum temperature is 10^{0}C or below and is 4.5 notches less than normal. A "severe" cold wave is when the minimum temperature dips to 2^{0}C or the departure from normal is more than 6.4^{0}C. But Government of Nepal has not fixed the above types of criteria. The results of coldwave in Birendranagar are found to be the number of contribute cold waves (CWF) are 0.19 per year increasing, the number of individuals cold waves (CWN) trend are increasing 0.002 each year and the length of the longest cold wave (CWD) is also increasing 0.19 per year and the number of contribute cold waves (CWF) are 0.28 increasing per year.

Similarly, the projected CMIP6 data heatwave (HWF) is more procurance in the mid future from three scenario (ACCESS-CM2, ACCESS-ESM1-5 and CanESM5) and the individual peak (HWF) found be too hot start from mid future to far future too. The number of days contribute to 'cold waves' of ECF_HWN (CWF) are found to be decreasing trend start from near future and it is continuously going cold up to the far future. It is very essential to make decisions from our government about the heatwave and coldwave.

3. URBAN GROWTH CHANGE AND TREND

The annual urban growth rate from 2011 to 2018 was 0.19 percent. Highest annual urban growth was observed in ward 9 (0.03%) and least was observed in wards 13 and 16 (0.0001%).

3.1 URBAN GROWTH PROJECTION (2030-2040)



Map 3 Urban growth projection using business as usual scenario

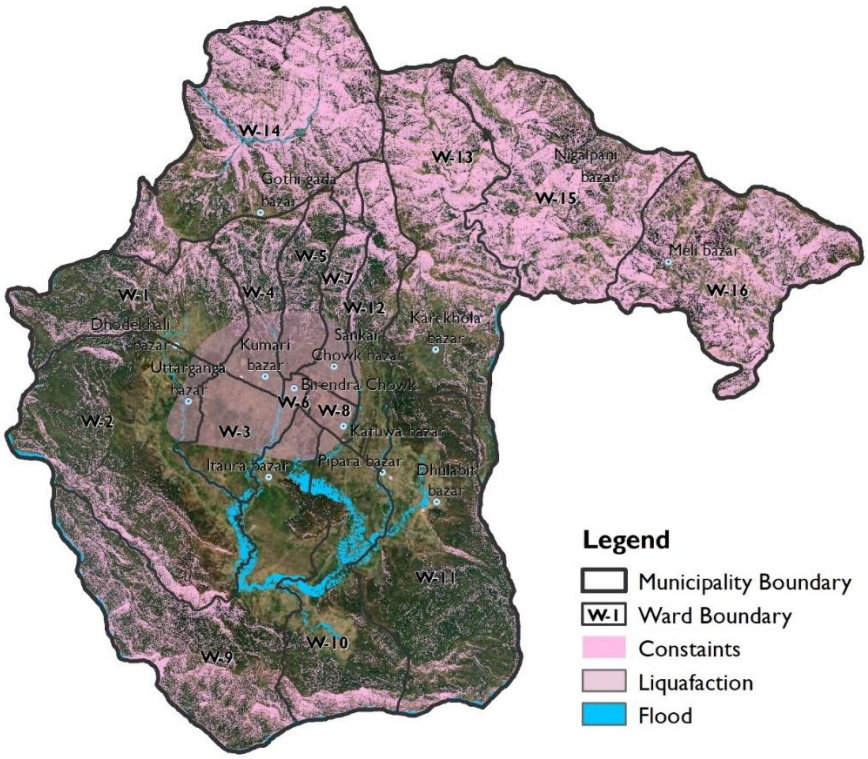
Potential area of settlement growth for the years' 2030 and 2040 were projected to forecast the scenario of growth considering the current and prevailing regulations/norms and practices the "business-as-usual scenario" model and a "controlled scenario model" considering the regulated growth. The projections modelling was done using Markov Chain (MC) algorithm. Both the model showed that in 2030, the total built-up area was projected to be around 1987.98 ha, which is an increase of 342.51 ha, while in 2040, the total built-up was projected to be around 2363.27. The annual growth rate (AGR) from the subsequent decade seen was 0.19 percent in the decade of 2009-2018, 0.19 percent in the decade of 2018-2030; and 0.18 percent in the decade of 2030-2040.

4. DEVELOPMENT CONSTRAINTS AND OPPORTUNITIES

Spatial Multi-Criteria Evaluation (SMCE) is used to identify spatial constraints and opportunities. SMCE is a powerful tool for decision makers to make land development process more efficient and attractive. It is "concerned with the allocation of land to suit (Eastman, 2012) a specific objective on the basis of a variety of attributes that the selected areas should possess".

4.1 SPATIAL CONSTRAINTS

Constraints are spatial conditions restricting the horizontal and vertical expansions of built-up area. Constrains are either physical constraints attributed due to the geo-physical conditions of the terrain, development restrictions (to be) enacted by the regulations or bye-laws and environmental constraints considered for safety and ecological conservation context. Constrains could be due to one of these factors or the combination of any of these. The constraining factors of the growth are natural hazard prone areas such as seismically hazardous areas, flood plains, liquefaction susceptible areas, landslide and erosion prone areas, fire hazard areas etc., physical constraint are slope, development constraint are open space, right of way, setbacks from river, waterbodies, archeological sites, transmission line, security forces, landfill sites, ecological sensitive areas and fault line The different constraints used in this study are presented in respective sections.



Map 4 Constraint Map

4.2 SPATIAL MULTI-CRITERIA EVALUATION FOR CONSTRAINTS AND OPPORTUNITIES

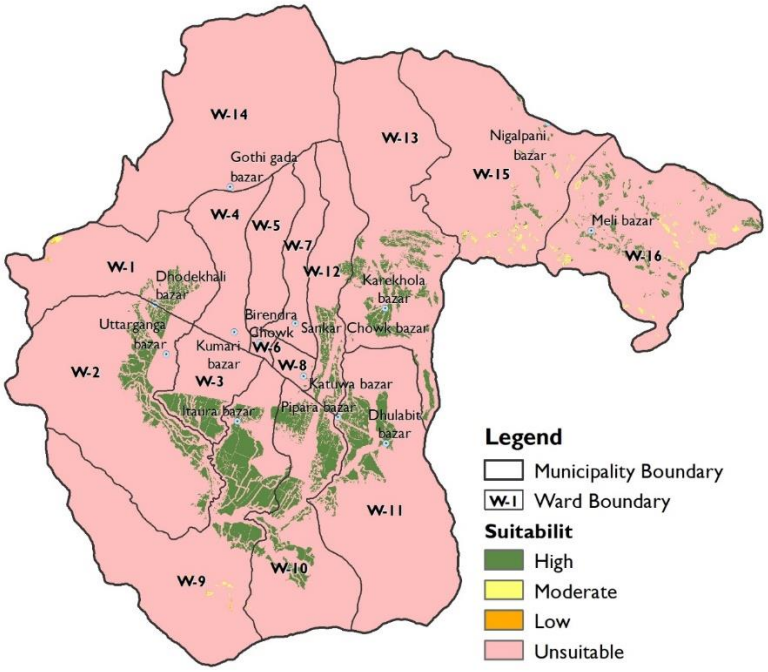
A Spatial Multi-Criteria Evaluation (SMCE) approach was adopted to assess spatial criteria which includes constraints and factors (or opportunities that influences the growth). For suitability analysis nine constraints and seven factors were identified. The constraints discussed in above section were used as the constraints for performing SMCE. The constraints were subcategorized, and suitable areas were given value of [1], whereas unsuitable areas were given value of [0]. The factors were subcategorized, and weights (degree of suitability) were given to the sub categories of each factors.

Assigning Weightage

Analytical Hierarchy Process (AHP) method (R. W. Saaty, 1987), was used to determine the weight of each factor and check the consistency of the weight. Following weights were assigned to each factor: distance to road [0.391172], distance to settlement [0.245391], slope [0.152311], distance to commercial area [0.093925], distance to urban node [0.036063], distance to institutional area [0.0057883] and distance to cultural area [0.023255].

Suitable Settlement Area

Suitable areas for settlement development are delineated using Spatial Multi Criteria Evaluation (SMCE) analysis of the aforementioned constraints. Using SMCE analysis, about 1875.20 ha (7.40%) of land was found highly suitable for settlement area, whereas 74.76 ha (0.29%) was moderately suitable, and 23379.46 ha (92.24%) was not suitable for settlement area.



Map 5 Suitability Map

5. STRATEGIC DEVELOPMENT PLAN

5.1 SWOC ANALYSIS FOR URBAN DEVELOPMENT

The strengths, weaknesses, opportunities and challenges of the municipality was identified through interaction with local bodies during visioning workshop. Analysis of strengths, weakness, opportunities and challenges guide the sustainable land and physical development of the municipality. Following are the SWOC identified in the Birendranagar Municipality.

STRENGTH

- Presence of Master plan of the municipality; Delineation of Park and Open spaces according to Master plan
- Building Byelaws 2072 has been followed
- Presence of Ward wise disaster management and Fund
- Water sources
- Abundant Prime agricultural land
- Watershed area and forest area on northern belt (potential area for medicinal herbs)
- Access to markets

WEAKNESS

- Master plan does not cover all municipal area
- Absence of byelaws for river and streams
- Increase in Pollution
- Unplanned settlement growth
- Lack of irrigation facility
- Development of roads and infrastructure without following standards and norms.
- Encroachment of river banks
- Building byelaws are not effective
- Lack of resources for implementation of plan and policies
- Flood inundation from the streams during rainy seasons

OPPORTUNITIES

- Initiative for modern urbanization master plan and investment
- Adequate water resources due to forests in the northern catchment area Bulbule, Kakre Bihar, Deuti Bajei, locations in Bheri River can be developed as tourist destinations
- Capital of Karnali Province
- Mines and minerals area in Ward no 14
- Medicinal herbs processing and marketing (Sinkauli, Timur, Yutra, Gurjo)
- As there is more forest area than settlement, there is potential for greenery, agricultural products, herbal tourism etc.
- Temporary camps can be set up in case of disaster due to adequate open space
- Open area, road standards can be prepared in places where there is no master plan

CHALLENGES

- The municipality does not have its own authority, but falls under the ownership and jurisdiction of the city development committee
- Inability to determine the jurisdiction of the river, as well as the construction of structures within the jurisdiction of the river
- Decreased level of consciousness. Lack of modern agricultural techniques
- Difficulty in infrastructure development
- Inaccessibility to fire brigade during fire in most settlements
- Encroachment of public/government parcels.

5.2 LONG TERM DEVELOPMENT VISION

Development vision defines a "Long Term Multi-Dimensional Future Foresight" that the place is envisioned and will evolve into. For Birendranagar Municipality, the development vision is conceived as:

"शैक्षिक, प्रशासनिक, पर्यटकीय शहर, स्वच्छ, सम्मुन्नत वीरेन्द्रनगर"

The municipality include drinking water supply, drainage, sewerage and sanitation, solid waste management, transportation management, economic development, environment and disaster management, social infrastructure development, tourism and historical heritage management.

5.3 GUIDING PRINCIPLES FOR THE PROPOSED LAND USE PLAN

Guiding principles embraces theoretical interpretation and normative position of the vision to guide the planning processes and practices. Following are the guiding principles for proposed land use plan:

1. Effective and maximum utilization of land and land resources
2. Identification of multi-hazard risk areas and mainstreaming of risk sensitivities in all areas of development
3. Control over development in risky and environmentally sensitive areas
4. Climate change adapted development
5. Balanced development between urban and rural areas
6. Guided integrated development
7. Development in line with infrastructure capacity
8. From vulnerability to resilience
9. Regional approach and holistic approach
10. Urban Development Centers and their hierarchical arrangements
11. Land use and transport interrelationships
12. Inclusive access to infrastructure, social services and facilities
13. Improving bearing capacity of urban areas
14. Protection of agriculture and cultivable areas

15. Conservation of forest and biodiversity
16. Promotion and preservation of heritage with historical and archeological importance
17. Protection and management of watershed
18. Secure land for future urban expansion
19. Low carbon emissions land use
20. Climate-friendly village and city concept
21. Development of environment friendly industries, transport and physical infrastructure
22. Adoption of ecosystem-based disaster risk reduction and climate change adaptation measures

6. RISK SENSITIVE LANDUSE PLAN FOR BIRENDRANAGAR MUNICIPALITY

6.1 AGRICULTURAL PROMOTION AREA

Agriculture Promotion Zone is assigned to protect the fertile agricultural lands of the municipal area. It is especially located in high and medium risk areas. It serves as a buffer zone for existing settlements and newly proposed developable areas and conservation areas.

Physical form:

- Primarily open agricultural land
- Infrastructure for Commercial agricultural such as greenhouse / tunnel, processing, storage, distribution, small and medium enterprises.

Total area – 376640 ha.

Developable Area – 2469.3 ha.

Population Density: Low density up to 10 PPH (gross density)

Land use:

- Commercial agriculture-based usages
- Existing Settlements
- Strict prohibition on any land use practices that can potentially impact the natural environment

6.2 FOREST ZONE

To protect the forest area, 20 meters setback from the forest boundary is recommended for any development activities in the designated development nodes. This will help to reduce the risk of forest fire and human wildlife conflict.

Physical form:

- Primarily national, community and other forest areas, forest along rivers and streams, degraded forests, national parks buffer area, wildlife corridors and other areas with rich biodiversity.

Land use:

- Forest and grazing land
- Strict prohibition on any land use practices that can potentially impact the natural environment

6.3 RIVER CONSERVATION ZONE

River Corridor area that falls within the high flood level of naturally flowing rivers and streams are designated as River Conservation zone. Construction of any structure within 100 meters of the main river should be prohibited. Agricultural areas, open areas, grazing land, etc. shall be allowed. Riverine trees will be planted, and Bio-dykes will be used to prevent flooding.

Physical form:

- River, canal and downstream area, river bank area, bank cutting area and river delta.

Land use:

- Rivers, shores, riverine areas, wetland areas
- Strict prohibition on any land use practices that can potentially impact the natural environment
- Discourage physical development and slum development

6.4 DEVELOPMENT NODE

Development nodes are urban centers where development activities are promoted in an organized manner. Development nodes are "urban committed areas" where investments in urban infrastructure and services are prioritized for a planned growth. Development nodes are categorized as primary, secondary and tertiary based on their functions.

6.4.1 PRIMARY NODE:

Primary Node contains dominantly high value investments comprising of financial, commercial, entertainment, tourism, corporate, private and multinational businesses, retails and other associated with the urban Finance and Business Hub. Primary Node also contain high density residential land use along with public and social amenities.

In Birendranagar primary node has been designated at Birendranagar Bazar area in ward 7 and 8. It is located in the central part of the municipal area. This area is suitable for hotel and other tourist services. It can be developed as a major business center of the region.

Physical form:

- Central Business District with modern urban amenities.

- Accessible from all the location of the municipality, good connectivity to surrounding, good internal vehicular mobility and pedestrian friendly
- Eco-Friendly Green Zone

Total area – 661.72 hectares

Developable Area – 188.69 ha

Population Density: 200 PPH

Land use:

- Banks and financial institutions, commercial buildings, hotels, shops, cinemas, private corporate offices, other tourist services, bus stops, taxi parks, as well as other services related to tourism.
- Housing and apartments
- Public use and open spaces, parks and gardens
- Strict prohibition on any land use practices that can potentially impact the natural environment

6.4.2 SECONDARY NODES

Secondary Node is proposed for administrative and social facilities including government institutions, municipal office, health services, higher educational institutions and other municipal level amenities such as town hall, public utilities, security and emergency services, etc. In Birendranagar Municipality secondary node is designated at three locations.

Dhodekholi Bazar

Itarura Bazar

Dhulabit Bazar

Physical form:

- Institutional Zone
- Accessible from all the location of the municipality, good connectivity to surrounding, good internal vehicular mobility and pedestrian friendly
- Eco-friendly green zone

Land use:

- Government sectors, Municipal Councils, Administrative sectors, Security, Assembly Halls, Public Services, Hospitals, Educational & Security Services, Technical Education & Emergency Services etc.
- Housing and apartments
- Public use and open spaces, parks and gardens
- Strict prohibition on any land use practices that can potentially impact the natural environment

6.4.3 TERTIARY NODES

Tertiary Nodes are the municipal level functional nodes providing various municipal services for the residents as well as non-residents (tourists, pilgrims, visitors) in the sub metropolitan area. Tertiary Node contains ward level services, other specialized services such as agriculture extension services, tourism and cultural services, sports activity, logistics and transportation service etc. depending on the characteristics and designated usages of these nodes.

In Birendranagar Municipality 6 tertiary nodes have been proposed in different parts of the municipality as follows:

1. Sano Surkhet Residential area
2. Daulatpur Agriculture Service Node
3. Khalakate Residential area
4. Paregaun Residential area
5. Gothikanda residential area
6. Karekhola small and cottage enterprise area

SANO SURKHET, KHALAKATE, PAREGAUN RESIDENTIAL AREA

Physical form:

- Medium density settlement development, market facilities and corresponding activities in accessible areas with access to basic urban services.
- To promote eco-friendly agricultural infrastructure and services in this area

Development radius: 500 meters

Population Density: 80pph (gross density)

Land use: Medium density residential area, daily consumable commercial services, primary school, health care center, disaster management center

DAULATPUR AGRICULTURE SERVICE CENTER/AREA

Physical Form:

- Develop agricultural service villages by well-organized market centers and facilities required for agricultural expansion, including access to urban services in the concept of agricultural service villages, and to encourage activities accordingly.
- Promote eco-friendly agricultural infrastructure and services in this area

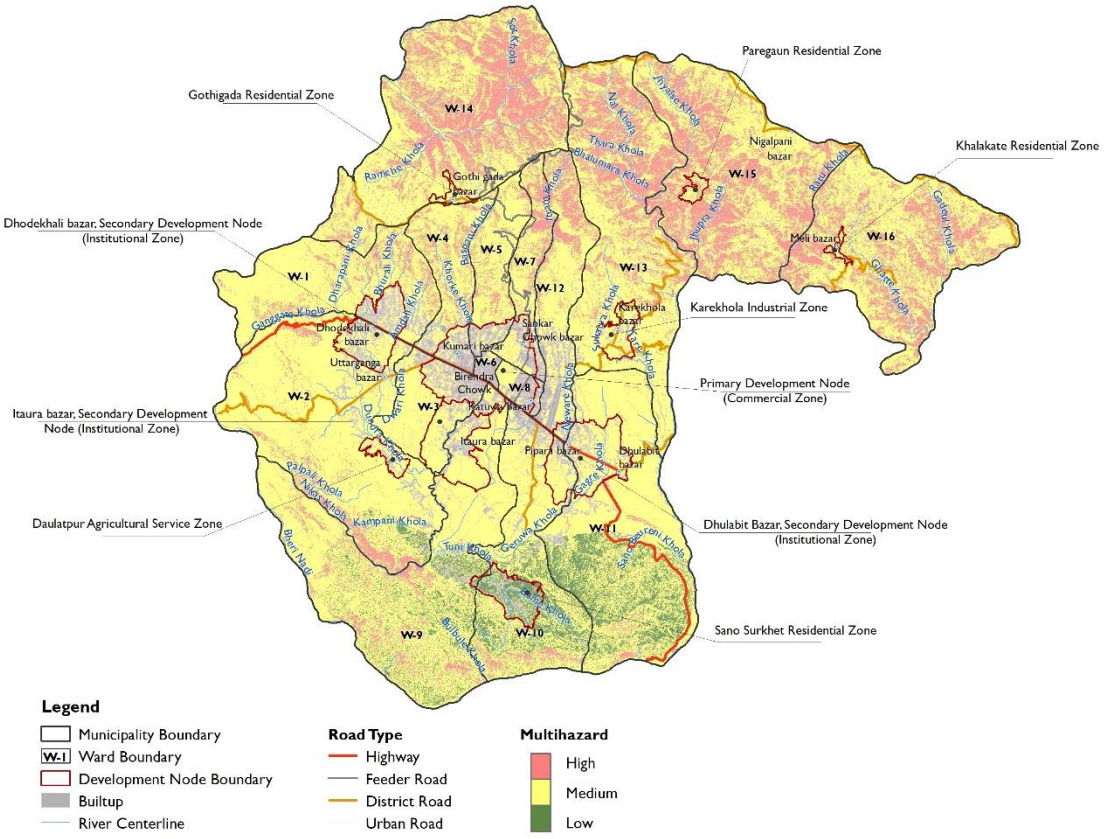
Development radius: 500 meters

Population Density: 80pph (gross density)

Land use: Medium density residential area, daily consumable commercial services, primary school, health care center, disaster management center

KAREKHOLA SMALL AND COTTAGE ENTERPRISE AREA

In order to promote small, home and micro enterprises, it has been proposed as a small and cottage enterprise area in Karekhola located in Ward 13. The area will promote agriculture, fruit, non-timber forest, herbal value chain based industries as well as women centered income generating micro enterprises.



Map 6 Planning sub-zones

7. OPEN SPACE AND EVACUATION ROUTE

OPEN SPACE:

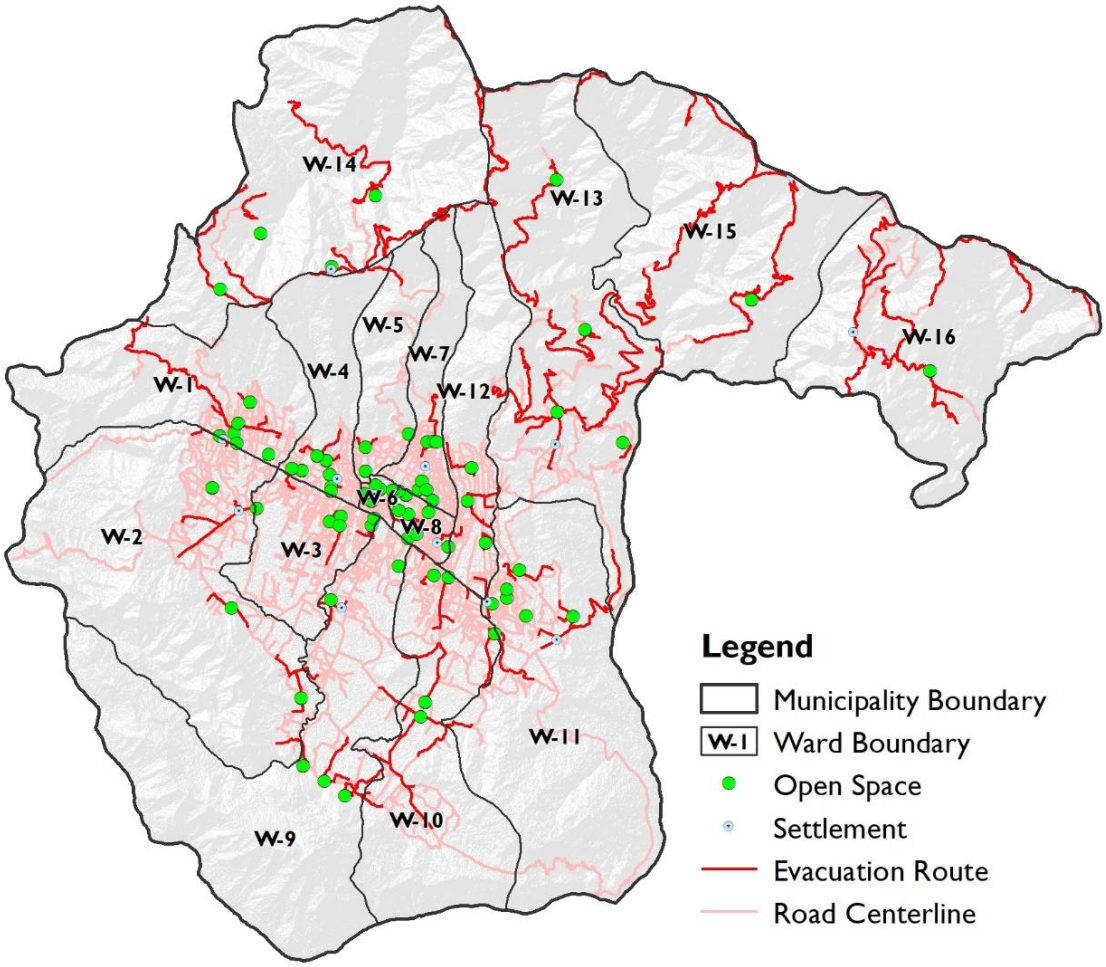
Around 2.5% of the functional area in each development node is designated as a green park. Such park should have a minimum width of 20 meters and a minimum area of 500 square meters.

HUMANITARIAN OPEN SPACE (HOS)

- HOS should be located on the side of the road, or at a distance of 300 meters from the road with a walking time of 3-5 minutes.
- HOS must be located more than 300 meters from the settlement.
- HOS should not be located in high-risk areas.
- HOS should have drinking water supply, toilet and solid waste management system.
- Water source should be onsite or at a maximum distance of 500 meters.

EVACUATION ROUTE

- Exit routes should not be in high risk areas.
- Exit route should be motorable and at least 6 meters wide.



Map 7: Evacuation route

8. RSLUP IMPLEMENTATION MECHANISM

8.1 DEVELOPMENT CONTROL AND REGULATION IN PLANNING ZONES

In order to guide the development and construction in the proposed physical planning zones and its sub-zones, the corresponding control methods have been formulated. The rules (norms and standards) of these methods are proposed in "Land use Planning and Building Byelaws 2078".

8.2 DEVELOPMENT CONTROL IN HAZARD PRONE AREAS

Color zones are used to reflect the intensity (High, Medium and Low) of different hazards in the particular area of municipality. High hazard prone area is categorized as Red Zone, Medium hazard prone area as Yellow zone and Low hazard prone area as Green Zone. Each land use zone may have policies to Avoid, Control or Promote the uses base on risks and constraints.

RED ZONE (AVOID AND PROHIBIT):

- Allowing only the permitted uses as specified in zoning regulation and all construction shall conform to the existing building code.
- Settlements in high hazard prone area to be relocated in safer places.
- Conservation and restoration of forest
- Acquisition of land at high risk area with proper compensation or lease the land.

YELLOW ZONE- CONTROL AND REGULATE

- Allow the new structures in compliance with "Physical Planning and Building Construction Standards 2078" and National Building Code.
- Retrofitting for strengthening identified hazardous building stocks
- Provision of emergency services, open spaces and evacuation routes at ward level and settlement level.
- Control the building height
- Creation of Green parks, garden, picnic spot, open spaces and other community structures

GREEN ZONE – PROMOTE

- Development of low and medium density settlements through planned housing by consolidating land.
- Parks, parks, open areas will be created to promote urban greenery. In addition, *Karesa Bari* (vegetable garden), gardens and right and left side of the road will be planted with suitable species.
- Mixed residential cum commercial, Bus Park and other municipal and regional level structures will be constructed.
- Identify emergency services, open areas and exits and alternative routes at ward and settlement level, raise public awareness in the community.

8.3 CONTROL OF URBAN DENSITY AND URBAN REDEVELOPMENT

The local government can control and redevelop the urban property for safer settlements. It can

- Prohibit the construction of tall buildings and structures.
- Promote the infill development on the remaining private open land as per suitability

- Control the density and height of the building according to the appropriate criteria while redeveloping.
- Provide the evacuation route and upgrade the road.

8.4 GUIDED LAND DEVELOPMENT

Planned urban development can be achieved by conducting guided land development program in the existing old settlements and market areas of this municipality. It ensures the economic benefits for the land owners as there is a significant increase in land value after land development.

8.5 LAND POOLING/LAND READJUSTMENT

In the proposed planning zone in this municipality, it is suitable to conduct integrated development by conducting land pooling/land readjustment program. The landowners are benefited through wide road and other infrastructures. Further, it also contributes to the planned residential development in the municipality.

8.6 FINANCIAL MECHANISM AND INCENTIVES

MONETARY INCENTIVE TO LAND/HOUSE OWNER

Financial Incentive can be given as tax rebates, grants to individual and businesses, concessional loans, conditional cash transfer etc. The municipality may structure incentives granted to eligible individuals or projects in two ways, as upfront loans or grants or as grants paid after certain conditions are met. The later one is more preferred and easier to structure since compliance with the defined performance standards is verified before payment.

NON-MONETARY INCENTIVE

Non-monetary incentive can be given as technical assistance, trainings, awareness and public participation. For example- land designated as agriculture and cultivable land can be kept intact by providing agricultural technical assistance, concession in agricultural insurance, market management, strengthening of agricultural cooperatives and market expansion in other municipalities. Similarly, municipality shall provide technical consultation free of cost for the construction of buildings or other structures in compliance with the risk sensitive land use plan.

OFFENSES AND PUNISHMENT

- The municipality shall demolish the building or other risky structure that were constructed against risk sensitive land use plan and building construction standards and the cost of such demolition shall be recovered from the concerned house owner.
- Landowners who use the land other than the specified use in the physical planning area will be punished according to the prevailing law.

8.7 LAND BANK

As per the provisions of Article 21 of the Land Use Act 2076, the Government of Nepal has made arrangements to establish land bank at the local level as per the need to implement the provisions related to land use classification and increase productivity by making maximum use of land.

A model land bank program can be conducted with the participation of the concerned landowners to make maximum use of the agricultural and barren land located within the proposed agricultural

promotion area of the municipality. For this, the municipality can run the program by formulating procedures related to its land bank.

8.8 LAND BASED INVESTMENT

In this concept, investors invest in land and land resources from national and international sectors, build physical infrastructure, commercial infrastructure, tourist infrastructure and provide service-oriented housing, sell service-oriented housing and build high-density housing in the market. Investors pay construction and other process fees to the municipality. The municipality attracts investors by arranging land at minimum rate (sale, rent or lease - land arranged through land bank) as well as exemption on service fee, business tax etc.

9. LAND USE IMPLEMENTATION METHOD

As per the provisions of Land Use Act 2076 and Local Government Operation Act 2074, implementation method has been proposed for implementation of land use plan at local level as follows:

Step 1: Institutional Arrangement of land use implementation body

Step 2 - Land Use Policy and Plan Approval

Step 3 – Preparing land use act, rules and procedures

Step 4 - Orientation Program

Step 5 – Mapping, Data Amendment, Update

Step 6 - Publication of classification information

Step 7 - Complaints and Hearings

Step 8- On-site authentication, real estate developers, components and database updates

Step 9- Capacity building of the concerned branch

Step 10- Implementation of Land Use Plan

Step 11- Land Use Plan Programs mainstreaming Integrated Development Action Plan

Step 12- Program Monitoring, Evaluation, Review and Learning