

Mitigating Urban Risk through Risk Sensitive Land Use Planning (RSLUP) “A case of Changunarayan Municipality”

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Abstract

Nepal, being a risk prone country, the increased trend of urbanization has simultaneously increased the risk of disasters due to high population density, unplanned development practices, unsafe construction, inadequate urban planning, poverty, and high inequality in terms of access to public services whenever a disaster strike. It is thus essential to take preparatory measures in identifying the possible risks and planning out emergency response and resilient development in a scientific manner. Risk Sensitive Land Use Plan (RSLUP) is a tool that identifies and mitigate the disaster risks embedded in the current land use and development practices through building bye-laws and regulatory ordinances, reduces losses by facilitating faster responses providing open spaces, well planned evacuation road networks for rescue operations. It promotes controlled urban growth without generating new risks through rebuilding and upgrading infrastructure. The study has prepared RSLUP of Changunarayan Municipality to contribute Building Resilience through Disaster Reduction.

The study has identified the multi-hazard risk zones such as landslide, flood, and liquefaction. It also identified safest areas in order to prioritize immediate investments in urban development and infrastructure development such as buildings, roads, urban centers etc. Based on the existing land use and identified risk zones, the study has proposed conservation zones which consists world heritage sites, cultural villages, eco village; agriculture buffer zone; natural Resource management area consisting green belt, river corridor; and development nodes. The study has also identified humanitarian open spaces located in the municipality for safe evacuations during disaster.

Introduction

Risk Sensitive Land Use Planning – Concept

*Risk Sensitive Land Use Planning (RSLUP) identifies the safest areas in order to prioritize immediate investments in urban development and infrastructure projects (Jha et al. 2013). In general, the process of mainstreaming disaster risk management parameters in land use planning is termed as **Risk-sensitive Land Use Planning** (World Bank and EMI 2014). Risk-sensitive Land Use Planning identifies and mitigate the disaster risks embedded in the current land use and development practices through building bye-laws and regulatory ordinances for use of land in hazard prone areas; reduces losses by facilitating faster responses by providing open spaces, well planned evacuation road networks for rescue operations and promotes controlled urban growth without generating new risks through rebuilding and upgrading infrastructure – “**building back safe**” using hazard resistant construction.*

Why Risk Sensitive Land Use Planning in urban municipalities?

Most often the component of risks and hazards are overlooked or given very less priority for disaster risk reduction (DRR) during urban development planning process. RSLUP guides urban form and its development for economic, social and physical development opportunities. It contributes in conservation of environment and heritage for economic and social development. The approach for RSLUP is relatively new in the context of DRR and urban planning in Nepal. *Per se*, integration of DRR parameters into urban planning to “Make cities and human settlements inclusive, safe, resilient and sustainable (SDG 11)” is a noble concept where Land Use Planning, DRR context and Urban Development are integrated for addressing SDG challenges (economic, social, environmental goals). Development of RSLUP and building-

by laws will enable the municipality to sustainably and safely plan its growth as well as build resilience against disaster and climate change impacts. This will promote safe construction practices ensuring safe land tenure and overall development of the municipality through regulated land management and infrastructure development. Most often marginalized people are living in marginalized land which is more susceptible. Therefore, RSLUP guides the planner for safer settlement even for the marginalized people.

Risk Sensitive Land Use Planning – Framework and Development Process

Risk sensitive land use plan adds two new considerations in the conventional land use planning approaches (World Bank and EMI 2014):

- Disaster Risk Reduction (DRR) goals and objectives are formulated and integrated in the conventional land use planning approaches based on the information related to hazard, vulnerability, risk and capacity parameters together with the disaster/emergency management requirements.
- Integration and mainstreaming in formal government activities by undertaking measures to ensure understanding, acceptance, ownership and support for the plan through improving competency and knowledge about the risk-sensitive land use planning among the policy makers, planners, development professionals and through raising awareness and fostering support of all the stakeholders

The RSLUP Framework and Process has shown in figure 1.

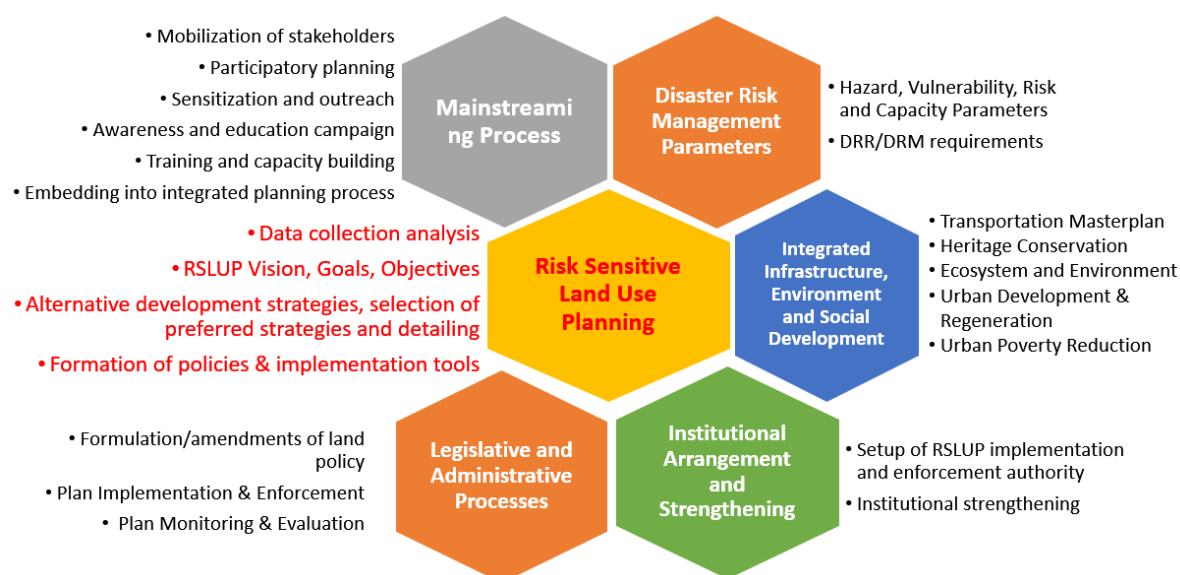


Figure 1: Framework and process of RSLUP [Adapted from (Bendimerad 2012)]

These additional considerations require scientific and evidence-based assessment of hazards, vulnerability and risk along with coping and adaptive capacities of the communities including the governance system; review of information, aspirations, perceptions of the targeted communities and stakeholders; assessment of the legislative framework and institutional capacities of the government and implementing authority and supporting agencies; assessment of non-government organizations and private sectors to support implementation of the tools and business models of the plan for successful and sustainable implementation.

Risk Sensitive Land Use Plan – Foundation for Other Plans and Policies

RSLUP development evolves from generation of relevant baseline information; multi-hazard, vulnerability and capacity assessment; adaptation of best practices, participatory planning and mainstreaming into development activities. Development of information and knowledge base needed for evidence-based decision support in planning. Participation of stakeholders and concerned in collaborative decision making. Development of RSLUP and its implementing tools and bye-laws and Development of stakeholder's engagement plan and information, education, communication action plan for implementation of municipal

RSLUP. RLUP provides a guidance to other plans and policy instruments by recommending “safe place” for investments in infrastructure, economic activities, conservation and protection and urban development. RSLUP also provides base for DRR/DRM plans by recommending safer use of land.

At the municipal level, RSLUP recommendations are translated into legal documents such as Building Bye-Laws and other municipal ordinances for implementation. Integrated Urban Development Plan (IUDP) which incorporates infrastructure, economic, social development and environment protection should be prepared on the foundation of RSLUP recommendations on safe and sustainable use of land resources. The activities and programs recommended by the RSLUP should be mainstreamed into the annual municipal activities and budgetary plans. Therefore, RSLUP must not be considered as an independent or a separate plan for urban development, rather it is a foundation plan for any other development related policies and plans. It also helps to take decision of local government to address the issues of marginalized people settled in the most vulnerable area.

Research Project Area

Changunarayan Municipality is one of the hard-hit municipalities among four municipalities of Bhaktapur district by 2015 Nepal Earthquake. The municipality consists of traditional cultural heritage sites and tourist destinations. It is gradually developing into an urban center and is near by the Kathmandu City. Landslide, flood, road accidents, drought and windstorm are the major hazards reported in the municipality. Every year, these hazards make huge loss and damage in property including loss of lives. The 2018 landslide of Changunarayan municipality killed 3 people with huge damage in the property. More than 200 landslide spots were identified and mapped in Geographic Information System. The slope landscape of the most of part of the municipality lead to the risk of landslides in rainy season. Similarly, every year Manahara River flood cause huge damage in infrastructure and property. Local government has developed **Disaster Risk Management (DRM) Plan and Emergency Preparedness and Response Plan (EPRP)**; however, it is important to mainstream these plans in the yearly and longer-term development programs. Rapid population growth and gradual shifting to new urban centers, the municipality needs to consider the multi-hazard risk factors in infrastructural planning. More than 80 percent of the land cover of Changunarayan is included in the New Town project, hence the consideration of risk sensitivity can't be avoided for safe and resilient infrastructures. This pilot research is hence expected to sensitize the municipal representatives for taking appropriate measures to mitigate the risk in urban development planning. Evidently, Changunarayan RSLUP will direct the future urban spatial form and growth vision of the municipal region. The Changunarayan RSLUP can be considered as a model plan for replicating to New Town development in the Kathmandu Valley and elsewhere in the country.

Objective of the Research

The overall objective of the study is to strengthen Changunarayan Municipality by developing Risk Sensitive Land Use Plan (RSLUP) and its implementation framework.

Study Methodology

The development process of RSLUP in Changunarayan has engaged elected leadership and representatives from the onset of the undertaking, starting with a sensitization workshop at the municipal office. Several consultation meetings and participatory planning works have been organized at the municipal office and ward offices with very strong participation of the leadership and ward representatives in defining the vision, mission and goals as well as in the planning processes. The use of spatial information on hazards and vulnerability and integration of spatial planning with participatory planning using spatial analysis approaches is a paradigm shift from the conventional urban planning process in Nepalese context.

Data Sources and Credits

GIS datasets and their associated attributes were used during the study. Building footprints, road network and land use data were extracted from Pleiades 0.5m MSS satellite imagery dated 3 January 2018. Geological and geotechnical investigation was undertaken during October-November 2018, community level data were collected from ward level consultative meetings during November 2018 for the study. Sources of other data and maps are cited in the report. Different principles, models and procedure were followed for the hazard risk assessments such as field surveys, use of logic tree, ground model, seismic field survey etc. Different statistical analysis tools for hazard susceptibility ranking were used. Major hazard reported in the Changunarayan Municipality are Landslide, flood, soil erosion, and earthquake.

Multichannel Analysis of Surface Waves (MASW) was performed in one location for field verification of the prepared data. The multichannel analysis of surface waves (MASW) method is one of the seismic survey methods evaluating the elastic condition (stiffness) of the ground for geotechnical engineering purposes. MASW first measures seismic surface waves generated from various types of seismic sources—such as sledge hammer—analyzes the propagation velocities of those surface waves, and then finally deduces shear-wave velocity (V_s) variations below the surveyed area that is most responsible for the analyzed propagation velocity pattern of surface waves. Shear-wave velocity (V_s) is one of the elastic constants and closely related to Young's modulus. Under most circumstances, V_s is a direct indicator of the ground strength (stiffness) and therefore commonly used to derive load-bearing capacity. After a relatively simple procedure, final V_s information is provided in 1-D, 2-D, and 3-D formats.



Fig2: Seismic field survey (MASW) performed behind the Kathmandu Medical College, Duwakot, Ward 2, Changunarayan Municipality

Results and Analysis

Urban Growth Trend and Projection

Changunarayan Municipality witnessed an increase of 140.39 ha in built-up area from 508.38 ha in 2012 ha to 648.77 ha in 2018. Around 136.31 ha of agriculture and 8 ha of sand mining area were converted to built-up during the course. Tree clusters (from urban and rural area) were also converted to built-up area. Potential area of settlement growth for the years' 2028 and 2038 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, in which the state of system can be determined by knowing its previous state and the probability of transitioning from each state to each other state (Eastman 2012). Based on the earlier (2012) and later (2018) land use/cover map, influence of variables for determining future change (drivers), projection of the transitional potential into the future, the MC project's how much land would be expected to transition from the later date to the prediction date. The model also has the capability to include constraints and incentives for projecting land use.

Table 1: Built-up projection for BAU Scenario Model

Year	Built-up (ha)	Change (ha)	Increase (%)	Annual Growth rate (%)
2012	508.38			
2018	648.77	140.39	27.61	0.37
2028	867.45	218.67	33.71	0.35
2038	1068.34	200.89	23.16	0.32

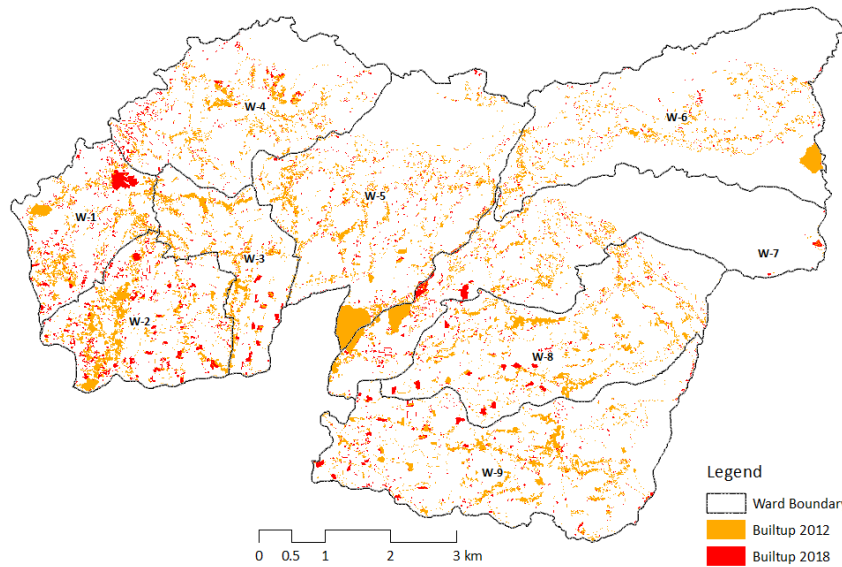


Figure3: Built-up area change in Changunarayan municipality (2012 to 2018)

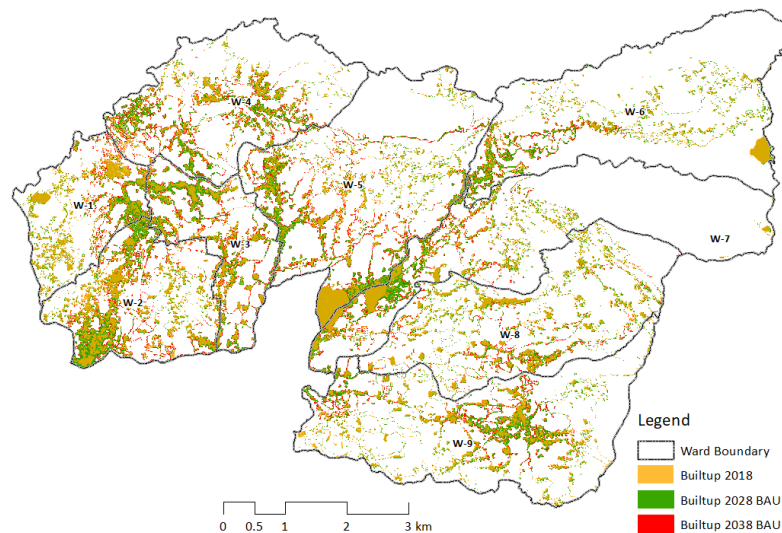


Figure 4: Built-up area projections for the year 2028 and 2038 for Business As Usual scenario Model

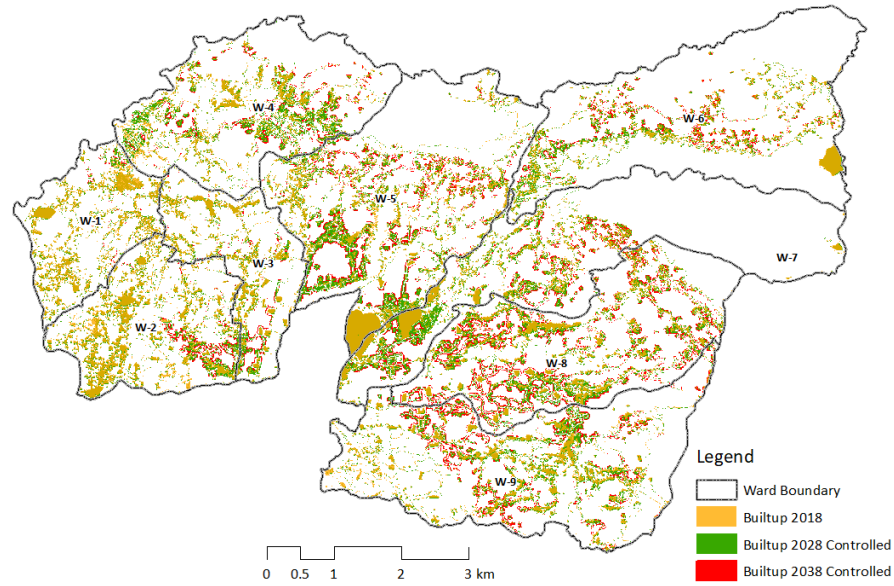


Figure5: Built-up area projections for the year 2028 and 2038 for Controlled Scenario Model

Table 2: Built-up projection for Controlled Scenario Model

Year	Built-up (ha)	Change (ha)	Increase (%)	Annual Growth rate (%)
2012	508.38			
2018	648.77	140.39	27.61	0.37
2028	867.44	218.67	33.71	0.35

Liquefaction Susceptibility

Table 3: Classification of liquefaction susceptibility

Value	Susceptibility class	Remarks
PL = 0	No / Very Low Liquefaction	Liquefaction susceptibility is very low or not at all.
0 < PL < 5	Low	Liquefaction susceptibility is low. Detailed investigations on soil necessary for important structures.
5 < PL < 15	High	Liquefaction susceptibility is high. Detailed soil investigation necessary.
15 < PL	Very High	Liquefaction susceptibility is high. Detailed soil investigation mandatory

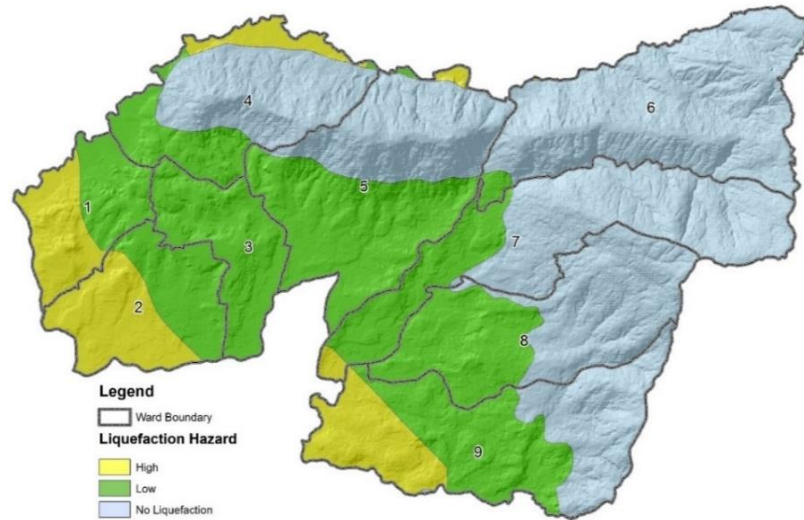


Figure6: Liquefaction Hazard Map of Changunarayan Municipality for 200 years return period

The liquefaction hazard map and the ward wise distribution of the liquefaction hazard for 200 years return period shows that most of the part of the Changunarayan Municipality will have no to low liquefaction hazard. High liquefaction hazard is present at the northern, eastern and southern edges of the Changunarayan Municipality. Wards 1,2 and 9 have the high liquefaction hazard for the 200 yrs. return period. The liquefaction hazard map and the ward wise distribution of the liquefaction hazard for 475 years return period shows that most of the part of the Changunarayan Municipality will have no liquefaction hazard. Very high liquefaction hazard is present at the northern, eastern and southern edges of the Changunarayan Municipality. Wards 1, 2, 4 and 9 have the very high liquefaction hazard for the 475 years return period.

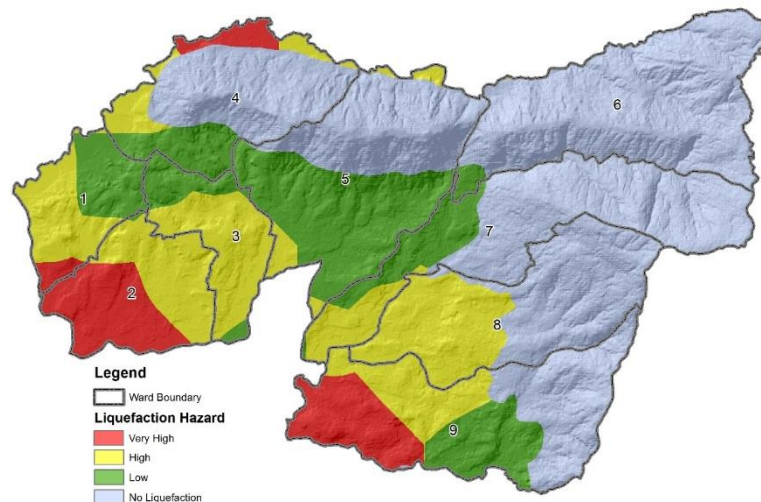


Figure7: Liquefaction hazard map of the Changunarayan Municipality for 475 years return period

Erosion and Landslide Hazard Susceptibility

Erosion hazard map and the distribution graph shows that high erosion hazard is prevalent in the western part of the municipality including wards 1,2, 3 and 4. Erosion susceptibility is higher in parts of wards 5 and 9. Soft sediments, haphazard sand quarry and development works such as road and building construction are triggering the erosion as well as slides in these areas. Similarly, landslide hazard map and

distribution chart show that high landslide hazard is mostly present in the eastern part of the Changunarayan Municipality especially in wards 7 and 8. The hills on the northern part are also highly hazardous to landslides. Signs of creeping can be observed at various places especially near the Changunarayan Temple area.

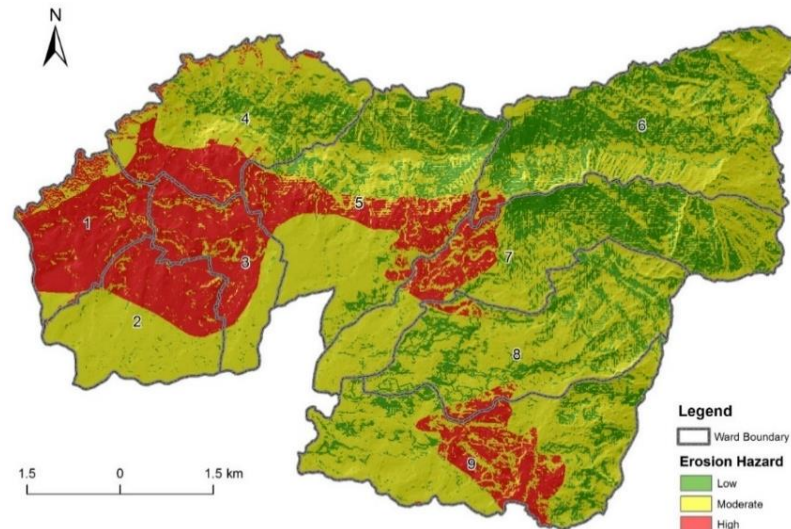


Figure 8: Erosion hazard map of the Changunarayan Municipality

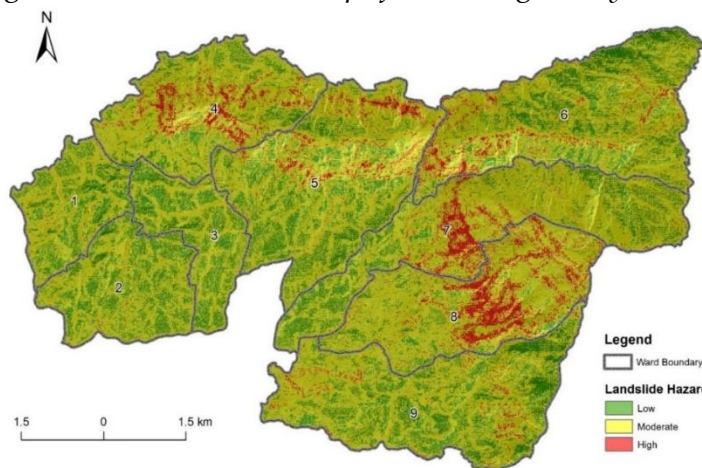


Fig 9: Landslide Hazard map of Changunarayan Municipality

Proposed Risk Sensitive Urban Form

Translating ‘Strategies for Spatial Planning and their Context’ into spatial form with due considerations of the ‘Spatial Constraints and Opportunities’, the envisioned ‘*Urban Form*’ of Changunarayan Municipality is proposed as the following ‘*Physical Planning Zones*’.

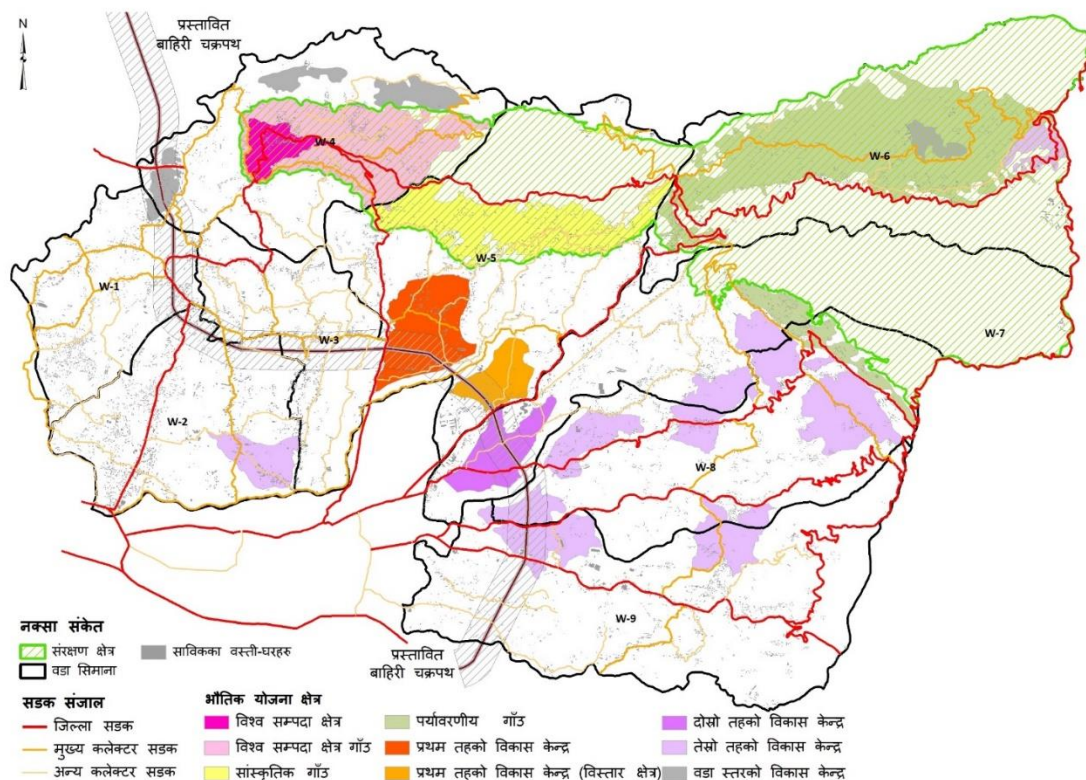


Figure: Proposed Risk Sensitive Land Use Planning of Changunarayan Municipality

Conservation Zone

“**Conservation Zone**” is designated to protect and conserve UNESCO World Heritage Site, forests and greenery, watershed areas of surface and underground water sources and other natural resources.

- Northern region in the municipality above 1400 m elevation, densely forested area and area containing the UNESCO World Heritage Site is designated as the Conservation Zone covering an area of 20.6 km².
- The main objective of the Conservation Zone is to conserve natural form of the environmental sensitive area allowing regulated minimum density development of settlements and basic infrastructures.
- Conservation Zone is located in the northern region of the municipality in wards 4, 5, 6 7 and 8, covered by forested areas at higher elevation zone (above 1400m MSL).
- This region is also the watershed area for Manohara, Kashyang Khusung and Hanumante rivers of the region as well as ground water recharge area of entire Bhaktapur region.
- Existing settlements and potential Developable Area in Ward 4 within the Conservation Zone is proposed to be designated as “**World Heritage Site Village**” with planned Traditional Settlement development, exhibiting its unique identity.
- Existing settlements and potential Developable Area in Ward 5 within the Conservation Zone is proposed to be designated as “**Cultural Village**” with the development of planned Traditional Settlement to promote local culture, art, craftsmanship etc. and to promote activities related to these.

- Existing settlements and potential Developable Area in Ward 6 within the Conservation Zone is proposed to be designated as “**Eco Village**” with the development of planned Traditional Settlement to conserve environment and ecology.
- Protect and conserve dense forest and green areas within the Conservation Zone.
- Establishment of Tertiary Node **around** existing tourist destination and market area in Nagarkot Ward 6 within the Conservation Zone to extend tourism businesses including hotels, restaurants, café, tourist information and service centre, bus park. Taxi park and other tourism related services. Promotion of eco-friendly tourism infrastructures and services in the designated Tertiary Node.
- Establishment of ward level Service Node **in** Ward 6 around Gairigaun area for planned development of medium density (50-100 pph) settlement and provision of basic urban infrastructures and services.

Agriculture Buffer Zone

“**Agriculture Buffer Zone**” is designated to protect and conserve fertile soil and prime agriculture land in the municipal area. Agriculture Buffer Zone is located especially in the high and medium risk areas due to soil properties and location along the river flood plain. Agriculture Buffer Zone is located in traditionally cultivated lower terraces, areas along the river flood plain and areas undergoing regular erosion.

- Agriculture Buffer Zone provides buffer area between existing traditional and unplanned settlements, newly proposed developable areas and Conservation Zone in order.
- Agriculture Buffer Zone is designated to prevent and mitigate the adverse impacts on environment, natural landscape and public health due to excessive extraction of soil from the prime agriculture land for production of bricks.
- Agriculture Buffer Zone is designated for the promotion of commercial agriculture, commercial fish farming (pisciculture), commercial cattle (cow, buffalo, goat) for dairy and meat production, commercial vegetable farming, commercial fruit farming, commercial cut flowers and floriculture with an aim to enhance the local economy through sustainable commercial agriculture.
- Agriculture Buffer Zone is designated to promote environmentally friendly small and medium scale agro-based industries for processing, storage and distribution to support commercialization of the agriculture sector.
- Agriculture Buffer Zone is designated in high and medium hazard risk zones, therefore strict adherence to Structural Building Code and safe construction practices should be made mandatory for any infrastructure, industries and other structures.
- Densification of existing settlements through strictly regulated development and safe building practices to control further spread and sprawl of unmanaged settlements.
- Control excessive excavation of soil and building materials through gradual displacement of existing brick kilns from the municipal area.

Natural Resources Management Zone - Natural Corridor

Natural Resources Management Zone (Natural Corridor) is designated to forested area, green area, rivers/streams/canals, ponds, riverbank corridor in the municipal area. This zone will be protected as a special natural conservation zone.

Forest Area

Forested areas cover about 20.5 percent (1,287 ha) of the municipal region. Natural forests are located in Nagarkot, Bageshwori, Telkot, Changunarayan and Tathali Pipalbot area. Major tree species in these forests are Khari, Thulo Phalant, Dudhilo, Musure Katus, Chilaune, Uttis, Kattus, Kaffal, Salla are the major species present in the area. These forests hold religious values as well as are vital for surface and ground water sources in the entire region. There are around twenty community forests in the municipal region where the communities manage and protect their forests. However, there is increasing trend of

encroachment and conversion of forested land. To protect the forested areas, 20 m setback from the forest boundary is recommended for any development activities in designated development nodes. This also helps to mitigate the risk of forest fire and its potential spread into the settlement area.

Green Belt

Natural vegetation covers about 11 percent of the municipal area. Vegetation growing naturally along the rivers and streams, slopes of hillocks, in the periphery of settlements and farmlands as well as in public and private lands. These natural vegetation areas or corridors are zoned as Green Belt. Conservation of these vegetated areas in the public land is very important to maintain the natural aesthetics of the municipal area as well as to create a barrier from floods, erosion and landslide in the region. To protect these vegetated areas, 20m buffer setback is recommended for any form of development in designated areas.

River Corridor

Corridor area within high flood levels of naturally flowing rivers and streams are designated as River Corridor. Areas within 100m buffer region from the high flood level of the major rivers and 20m buffer region from the high flood level of streams are designated as River Corridor.

Development Nodes

Development Nodes are 'urban centres' where planned urban development activities are promoted through investments in urban services and physical infrastructures which catalyzes planned growth. Development nodes are hierarchically categorized as primary, secondary, tertiary and ward level service nodes based on their designated functions. These development nodes are spatially planned at the most suitable location based on these criteria:

- strategically located near existing urban centres
- multi-nuclei development/growth nodes
- suitability of location based on multi-hazard risk sensitivity, availability of land and land natural resources
- compact and balanced settlements/development suitable for different functions exhibiting unique identity
- transit oriented primary and secondary nodes (, pedestrian oriented tertiary and service nodes (walkable radius of 250-1000m)

Functional characteristics of development nodes in Changunarayan Municipality are defined as below:

Primary Node: Primary Nodes is the Financial and Business Hub (Central Business District - CBD) in the municipal region and contains mainly of financial, commercial, tourism and hospitality, entertainment, retail businesses; corporate, private, multi-national offices. Primary Node also consists of high density residential along with public and social amenities and urban infrastructures. In Changunarayan Municipality, Primary Node is spatially planned in the southern part of Ward 5, in the east of Byasi-Changunarayan Road located in the region of Pakaune Pati, Kalikatar, Gaidagaun and Gundigaun (पकाउने पाटी, कालीकातार, गैडागाँउ, गुण्डी गाँउ). The designated Primary Node is at a distance of 3 km from the centre of Bhaktapur City and spatially located at the centre of the municipal region, accessible and well-connected from all the wards. This Primary Node can be promoted and developed as a tourist hub with hotels and other touristic services to cater for the tourists arriving in Bhaktapur. Alternative cycle route can provide an eco-friendly alternative connecting Bhaktapur to this node. This node can also be developed as the main commercial centre of the district. This node can be extended up to Nagarkot Road in the east as a Primary Node Extension. Proposed Outer Ring Road connects the Primary Node with the extension area. Planning norms for the Primary Node is proposed as under:

Secondary Node: Secondary Node is proposed to be developed as the municipality's main administrative and institutional zone. Governmental institutions, education institutions, health services and other public infrastructures, various line agencies and institutions, vocation and technical training infrastructures are proposed in this secondary administrative node. In Changunarayan Municipality, Secondary Node is spatially planned in the southern part of Ward 7, along the east of Army Camp-Nagarkot Road, crossed by Manjushree Road (District Road) and located in the region of Nayabasti and Bansbari. The designated Secondary Node is at a distance of 1.5 km from the Primary Node and is accessible and well-connected from all the wards.

Tertiary Node: Tertiary Nodes are proposed for ward level services and other specialized services/infrastructures for tourism sector, religious and cultural activities, agriculture extension, sports and entertainment activities. Tertiary Nodes also consists of planned compact settlement with access to basic urban infrastructures.

In Changunarayan Municipality, ten Tertiary Nodes are proposed in developable areas of Wards 2,6,7,8 and 9 covering total area of 418 Ha. These Tertiary Nodes have specialized functions and are planned accordingly. Following Tertiary Nodes are proposed:

Tourism Village – Ward 6 Nagarkot: Existing tourism area in Ward 6 of Nagarkot, within the designated “Conservation Zone” is proposed to be developed as a “Tourism Village” to enhance tourism based economic activity of Nagarkot area in a planned and sustainable manner.

Eco-Tourism Village– Ward 6 Nagarkot: Developable areas in wards 7 and 8 in and around Banphedi, Majuwa, Padali, Habeli, Chareli, Lapro, Sunuwargaun, Adhikargaun, Kalamasi villages (वनफेदी, मजुवा, पदाली, हबेली, चरेली, लाप्रो, सुनुवारगाँउ, अधिकारीगाँउ, कलामसी) are proposed to be developed as low density ecofriendly “Eco-Tourism Village” to promote homestay for tourists and also to promote coffee and fruit plantations.

Residential Areas– Ward 2, 7, 8, 9: Areas for safer future urban growth are designated in developable areas in wards 2, 7, 8 and 9 in the municipality. These designated Tertiary Nodes - Residential Areas

Ward level Service nodes: The primary function of Ward Level Services Nodes is to provide ward levels basic services to the population leaving in the vicinity.

Regulations for Suitability Zones (Colour Zones)

Color Zones reflect the suitability of land for development based on the availability of risks and constraint free non-built up area. Each color zones are regulated by specific policies or bye laws to **Avoid** or **Control** or **Promote** uses based on the risks and constraints as mentioned below.

Red Zone (AVOID)

- Restrictions in any development of built-up and/or infrastructure
- Existing settlements, built-up and individual houses to be resettled in safer places
- Conservation of forestry and protection of landscape to be promoted
- Retaining of existing agriculture land and promotion of increasing agriculture productivity
- Hazardous land acquisition by government and provide alternative location
- Revealing the information to the owner related to hazards in their property

Orange Zone (AVOID)

- Restrictions in any development of built-up and settlements
- Limited use of lands for construction of hazard-resilient structures following stringent construction codes and practices
- Approval of the municipality and the related agency (DUDBC) required for any construction of infrastructure
- Existing settlements, built-up and individual houses to be resettled in safer places

- Conservation of forestry and protection of landscape to be promoted
- Creating of buffer zone of 15-20m from the forested area
- Retaining of existing agriculture land and promotion of increasing agriculture productivity
- Hazardous land acquisition by government and provide alternative location
- Revealing the information to the owner related to hazards in their property

Yellow Zone (CONTROL)

- All new construction shall conform to the new building bye-laws and the building code
- Retrofitting for strengthening identified structurally vulnerable building stocks
- Provision of emergency services and access
- No land fragmentation lesser than 3 aana¹ in core areas of wards 3,4 and 7 of the municipality, 4 aana in other areas of the municipality for residential sub-zone
- Identification/Allocation of humanitarian open spaces and staging areas along with alternative strategic and evacuation routes
- Restrict high rises and high occupancy residential and commercial buildings
- Creating of buffer zone of 15m from the forested area
- Planned development of residential zones with supporting infrastructures and services
- Promote medium density built-up through organized housing and land pooling
- Affordable housing scheme for low to middle income household

Green Zone (PROMOTE)

- Promote low density residential area development with necessary infrastructure and services
- Planned and regulated development through organized housing and land pooling scheme
- Promote urban greenery retaining/conserving existing vegetation, back garden, home orchards
- Affordable housing scheme for low to middle income household
- Subsidies/incentives for agriculture use
- No land fragmentation lesser than 4 aana
- Promotion of new mixed residential commercial zones, bus park, intuitional zone
- Identification/Allocation of humanitarian open spaces and staging areas along with alternative strategic and evacuation routes in every ward

Recommendation based on geo-technical investigation and geo-hazard assessment study are:

- Sand quarry should be monitored regularly and avoided near the residential area. There has been news of land subsidence due to haphazard extraction of sand in Duwakot area.
- Haphazard excavation of slopes for residential purposes and road construction should be prohibited.
- Drainage management should be done for easy outlet for the running water which may be rain or used ground water.
- Bioengineering should be done on the barren surfaces to hold the fragile topsoil.
- The natural gullies and streams should not be disturbed while constructing roads and buildings. The road from Muhanpokhari to Nagarkot has similar situation where the overflowing materials during monsoon covers the road.

¹ 1 aana = 31.81 sq. m, 1 aana = 342.25 sq. ft

Conclusion

RSLUP is an initiation of broader planning scenario and envisioning of the future urban form to provide the basic right of any citizen i.e. safer place to live and prosper. RSLUP's recommendations and guidelines are implemented through a legal document "building bye-laws" and ordinances by the municipal authority. The building bye-law must be implementable, acceptable and inclusive to translate the future safer growth vision of the municipal region. RSLUP's recommendations and guidelines are implemented through various mechanisms and tools related to urban development, land management, financial incentivizing such as land readjustment (land pooling), transfer of development rights, infill development, building pooling etc. The most appropriate mechanism with legal basis needs to be piloted with stakeholders/citizen's participation, financial investments and upscale considering future sustainability. At the same time, institutional capacity building of the municipal authority is required to implement the RSLUP and its implementing tools efficiently and effectively for resilient urban development.

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