

# POLICY BRIEF

Traditional and local knowledge to disaster risk reduction

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## Disasters in the Mountains of Nepal: The Impact of Poorly Planned Development Irrespective of Landforms

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### SUMMARY

Nepal's diverse physiography, comprising the Himalayan north, hilly middle region, and Terai plains in the south, shapes distinct land use practices. Traditional wisdom in land use, driven by an understanding of the environment and disaster vulnerability, is being disrupted by rapid changes, notably driven by road construction. Linear settlements along floodplains, accelerated by road construction and hydropower projects, raise concerns about disaster risk. Challenges stem from the indiscriminate use of land, reflecting poor planning and the absence of a comprehensive land-use policy considering disaster risk. This is driven by multiple factors such as high out-migration for labor market abroad, rural to urban migration and change in livelihoods from agriculture to service-based. Policy recommendations include strategic land use planning, zoning regulations, and geographical vulnerability assessments to mitigate risks. There is need of incentives for safe settlement practices, nature-based solutions, and a strengthened legal framework to promote sustainable land use practices in Nepal.

### Background

Nepal's physiography exhibits remarkable diversity, featuring three distinct regions: the Himalayan north with towering peaks, the hilly middle region, and the fertile plains of the Terai in the south (Vaidya et al. 2019). Land use practices vary accordingly, with the Terai being predominantly devoted to agriculture, cultivating crops like rice, wheat, maize and sugarcane, while the hilly region employs terraced farming for crops such as rice and maize. In the high Himalayas, harsh climatic conditions limit agriculture, leading to a focus on pastoralism (animal husbandry). People often build terraces to farm on the slopes, raise animals like yaks and goats, and grow forests for wood and other products (Chand 2019).

Nepal's historical land use patterns have been influenced by a thoughtful understanding of the local environment and the imperative to reduce the vulnerability to natural disasters (Figure 1). In the hilly mountains, settlements were strategically located in elevated areas, often on hillsides, to minimize exposure to floodwaters and other hazards, including landslides and soil erosion. Flood plains, prone to seasonal inundation, were primarily used for agriculture. Such areas are often fertile due to the deposition of nutrient-rich soil and accessibility to irrigation. Seasonal floods during the monsoon, if any, would have minimal impacts on agriculture, causing limited disturbance and providing time for regrowth. The cropping pattern in such areas is also unique in several ways. Areas very close to rivers are often designated for paddy crops because they favor water, while more elevated areas are used for other crops such as maize. Such traditional land use practices reflect a judicious use of lands based on their economic benefits and potential risks.

Figure 1. A cross-section of land forms use pattern in Nepal's mountains



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However, there is a rapid change in land-use patterns. Roads are the primary agents of land-use change. They are mostly constructed along river floodplain areas in the mountains. In the mountain areas with a challenging topography (e.g., unstable rock, high mountain gradient), there might be limited options for road construction. River floodplains, on the other hand, can offer relatively flat terrain, making it easier and more cost-effective to construct roads. In some cases, the advantages of easy construction and transportation may outweigh the flood risk. Due to limited accessibility compared to flat areas, roadsides are always preferred by people for settlement. They provide connectivity for trade and business, serving as a convenient and accessible route for people to seek medical attention in case of need. Consequently, most of the roadsides in Nepal have been encroached upon for human settlement and business centers, which were previously used as agricultural land.

Additionally, the development of hydropower projects has also contributed to increased human activity in these areas, consequently transforming them into local market centers. As urban centers and economic hubs emerge near these projects, people from rural areas migrate to these centers in search of better livelihoods (Wicaksono et al. 2022). Consequently, agricultural land is encroached upon to accommodate the growing population.

### Leguwa: A case study

Leguwa is a representative settlement among hundreds of others situated along the Arun River floodplain. Over time, it has evolved into a densely populated area (Figure 2). Located close to the river, it is susceptible to the risk of being swept away in the event of a major flood in the Arun River. Previously, such impacts were minimal as the lands were primarily used for agriculture, mostly for paddy and other crops that can tolerate moderate floods. However, with the expansion of roads, these areas became market centers, creating a high-risk zone.

The Arun River and its tributaries consist of several hydropower projects, including the 900 MW Arun III, which is currently under construction. Landslides and rockfalls in rivers, whether induced by dam construction and roads along riversides, have increased the risk of flash floods that could engulf riversides downstream. During our communication in Chiyabasi, Tumilingtar, and Leguwa, locals expressed fears of flash floods.

In 2023, a large flood in the Hewa River significantly damaged the Super Hewa Khola Hydropower Project. The flood resulted in the deaths of several workers and the destruction of several houses along the riverbank as it swept away.



Figure 2. : Satellite image of Leguwa (a) 2000 (left) and (b) 2023 (right). Data source: Google earth

### Challenges

The indiscriminate use of land driven by road-centered development presents a pressing concern in Nepal. The traditional wisdom of land use patterns based on landforms and disaster risks in the mountains is no longer in practice, nor does government have an explicit landforms use policy considering disaster risk. The rapid expansion of linear settlements along floodplains in Nepal is a reflection of poor land use planning. There are several factors (drivers) of such land use change (Figure 3).

There is a significant transformation in Nepal's socio-economic landscapes, bringing changes in traditional system. In Nepal, there is a high out-migration from rural to urban areas and abroad, resulting in the increasing abandonment of rural areas. According to the 2021 census, the urban population in Nepal has reached 66.17%, compared to 63.19% in 2011. The 2021 census also reveals that a total of 2.2 million Nepalis are abroad, with 81.28% being male and 18.72% female (CBS 2022). This trend has had a profound impact on the demographics

of rural areas, with villages becoming increasingly empty. The outflow of predominantly male migrants from rural communities has left behind mostly women, children, and elderly residents in the villages.

With alternative income sources and a limited workforce due to outmigration to cities, agricultural areas are increasingly becoming abandoned. The growing shift from forest/agricultural-dependent livelihoods to service-based is fueled by the poor and limited support for agriculture-based entrepreneurship from the government and a complete lack of incentives (e.g., legal, economic and communicative) for land use planning.

### Policy Recommendations

#### Strategic land use planning and zoning

The Land Use Act of 2076 mandates the Government of Nepal to classify land based on landform, land productivity, suitability, existing land use patterns, and future needs. Local governments are responsible for preparing this classification,

Figure 3. Drivers of land use change in Nepal



which can significantly impact systematic land use considering ecosystem services and biodiversity conservation. However, local governments often lack experts, and their plans may not be compatible with those of adjoining local governments, nor necessarily serve national needs. Nepal's land use policy is closely linked to riverbank settlements (Nepal et al. 2020). It should incorporate geographical vulnerability assessments to identify areas at high risk of flooding and erosion. The policy should include zoning regulations that prohibit new settlements and infrastructure development in these vulnerable zones, ensuring a safer distance from riverbanks and other hazard-prone locations. This integrated approach is crucial for mitigating the risks associated with riverside settlements and enhancing overall disaster resilience in the country.

#### **Incentivize safe settlement practices**

The government could provide financial incentives and subsidies for relocating existing riverbank settlements to safer locations and supporting affected communities in the process. Additionally, preferential land and housing policies for those who choose to establish settlements in safer areas could encourage the adoption of disaster-resilient practices.

#### **Integrate nature-based solution in disaster risk reduction**

One key proposition of nature-based solutions to disaster risk reduction is maintaining natural floodplain buffers, preserving open spaces that can absorb floodwaters and reduce their impact on settlements. The "room for the river" approach adopts this strategy, incorporating the dynamics of river flows.

#### **Legal and regulatory framework**

The government should strengthen and enforce regulations related to land use, building codes, and environmental protection to discourage haphazard construction in hazard-prone areas. Provisions should be made for penalties for non-compliance with zoning regulations and unauthorized construction near riverbanks.

#### **References**

CBS 2022. Preliminary Report of National Population 2021. Central Bureau of Statistics, Government of Nepal, Nepal

Chand BJK. 2019. P Nepal: Repercussions of land-use policy and implementation gaps in regional and urban planning. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences IV-5-W2:17–24. Copernicus GmbH.

Nepal P, Khanal NR, Zhang Y, Paudel B, Liu L. 2020. Land use policies in Nepal: An overview. *Land Degradation & Development* 31:2203–2212.

Vaidya RA, Shrestha MS, Nasab N, Gurung DR, Kozo N, Pradhan NS, Wasson RJ. 2019. Disaster Risk Reduction and Building Resilience in the Hindu Kush Himalaya. Pages 389–419 in Wester P, Mishra A, Mukherji A, Shrestha AB, editors. *The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People*. Springer International Publishing, Cham. Available from [https://doi.org/10.1007/978-3-319-92288-1\\_11](https://doi.org/10.1007/978-3-319-92288-1_11) (accessed September 15, 2023).

Wicaksono B, Siswanto A, Fransiska W, Kusdiwanggo S. 2022. Disaster and Resilient Infrastructures at Musi Riverside Settlement in Palembang. *IOP Conference Series: Earth and Environmental Science* 1065:012047.

#### **About Us**

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