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Abstract

Despite the widespread recognition of the persistent challenges posed by land use conflicts, a critical research and literature gap exists in understanding its dynamics within specific urban contexts of Nepal. This case study addresses this gap by examining the interactions between settlements, rivers, and industries in Biratnagar Metropolitan City, Eastern Nepal. The study aims to identify key drivers of land use conflicts, analyse their impacts on the natural environment and local communities, assess the effectiveness of existing legal and institutional frameworks, and recommend apt mitigation strategies as well as further research avenues. In a region shaped by industrial history, rapid urbanisation, and socio-political dynamics, this research endeavours to provide valuable insights for subnational government actors, planners, and policymakers. By recommending evidence-based policies and practices, the study seeks to fill the knowledge void, fostering sustainable and equitable land, river, and industrial management in Biratnagar Metropolitan City. The findings aspire to contribute not only to the resolution and mitigation of local conflicts but also to the broader understanding of similar challenges faced by urban areas nationally.

Keywords

Land Use, Land Use Conflict, Biratnagar Metropolitan City, Conflict Resolution

Background

Land use conflicts between industries, rivers and settlements have existed since the onset of civilisation. Industries and settlements can have significant impacts on rivers, including water and air pollution, alteration of river morphology and flow patterns, and depletion of water resources. Settlements can contribute to river pollution through domestic wastewater discharge, solid waste disposal, and agricultural activities. Industries, on the other hand release toxic chemicals and heavy metals into the river through their wastewater discharge, and may also alter the river's physical characteristics through construction of dams, embankments, and other infrastructure. These impacts have serious consequences for both the rivers as well as the local community that relies on it, including reduced water quality, loss of aquatic and terrestrial habitats, and negative impacts on human health and livelihoods. Likewise, industries can have significant impacts on settlements, including air and water pollution, noise pollution, and negative impacts on human health and livelihoods. Industrial activities can release toxic chemicals and heavy metals into land, air and water, which can contaminate soil, crops, and drinking water sources. This contamination can lead to a range of health problems, including respiratory illnesses, cancers, and developmental disorders. In addition, industrial activities can generate noise and traffic that can disrupt the quality of life of nearby settlements, and can negatively impact local businesses and property values.

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In the context of Nepal, land use planning and land use conflicts stem from its diverse geography, rapid urbanisation, socio-political dynamics, and competing resource interests. Agriculture dominates rural areas with crops like rice and wheat, but faces challenges due to limited arable land. Forests provide timber and ecosystem services, yet deforestation persists. Urbanisation strains metropolitan cities like Kathmandu, Pokhara, and Biratnagar, leading to conflicts over space. Tourism thrives, but conflicts arise over resource allocation and environmental impact. Conflicts also revolve around conserving protected areas and natural resources while sustaining local livelihoods. Infrastructure projects and water resource allocation cause environmental degradation and disputes. Balancing development with ecological concerns is critical. Addressing these conflicts requires participatory approaches, strong land tenure systems, and comprehensive urban planning, with the government playing a focal role. As such, it is essential to understand the nature and scope of these conflicts and to develop effective strategies for their mitigation and resolution.

Similarly, the concept of integrated planning has a long history in Nepal, marked by confusion between immediate annual plans and long-range plans. Despite efforts initiated by the Ministry of Urban Development and the Ministry of Federal Affairs and General Administration, such plans, known as Periodic Plans, Integrated Urban Development Plans (IUDP), and others, faced challenges in implementation due to political instability. Notable plans for the Kathmandu Valley, including the 1969/73 general plan and the 1987 structural plan, aimed at guiding development with a 20-year perspective. However, the lack of community participation, implementation will, and periodic revisions hindered their effectiveness. In recent years, Periodic Plans and the latest planning practice, Integrated Urban Development Plan (IUDP) or Comprehensive Town Development Plan (CTDP), have been introduced. However, the tendency to outsource these plans to private consulting firms, though providing expertise, tends to be highly technical in nature and may lack citizen involvement, thus limiting ownership and effectiveness. Moreover, these plans lack integration with a multi-year Capital Improvement Program for budgeting purposes, with annual plans prepared separately. At a specific level, efforts to organise residential settlements include site-and-services schemes, guided land development, and land pooling. While these initiatives have been practiced to some extent since the 1970s, challenges in post-project development, beneficiary realisation of objectives, plan processes, and equitable implementation persist. Guided Land Development (GLD), using infrastructure provision to guide urban development, offers a cost-effective and equitable approach but faces challenges such as low success rates due to lack of awareness, inadequate cadastral mapping, and limited compensation. Recent government regulations on allowable built-up area and restrictions on changing agricultural land further complicate land development, as reflected in the Land Use Act 2019, requiring a comprehensive amendment process involving all levels of government.

Review of Literature and Global Cases

Land Use and Land Use Conflicts

Land use and land use conflict are complex topics that have been widely discussed in literature. In Nepal's context, since the change in the government structure with local governments empowered with land use control, the topic is very relevant and hence needing much understanding and dialogue between all stakeholders. Land use refers to the way land is used for various purposes, such as agriculture, residential, industrial, commercial, or conservation. Appropriate and meaningful planned land uses can be the sole reason why some communities thrive, if done right. However, land use planning is not without its challenges, and some of the most significant challenges are compatibility between adjacent land uses, whether appropriate to the nature and conditions of land, the economic implications to the land owners and the general health, safety, and welfare of the citizens who reside within the community.

Land use is a critical component of urban and rural development, and it affects human activities, the environment, and social welfare (U.S. Environmental Protection Agency, 2023). Land use patterns vary significantly depending on the location, culture, and economic conditions of a region. When there are varying land uses, arising land use conflicts is obvious. The conflict is a significant challenge that arises when different land use activities compete for the same resources or have a negative impact on each other. The literature on land use and land use conflict is vast and has been studied from different perspectives, including planning, policy, and geography. Understanding the causes and consequences of land use conflict is essential for developing effective strategies and policies that can help reduce conflict and promote sustainable land use practices. This literature review summarises some of the key findings and perspectives from a few existing studies on conflicting land uses at various locations around the world.

Land use conflict occurs whenever land-use stakeholders have incompatible interests related to land areas that result in negative effects (Brown and Raymond, 2013). As such land use conflict is prevalent in many regions globally, and it is an issue that involves multiple stakeholders with competing interests. Land use conflicts can arise between urban and rural land use activities, on the fringes of urban and rural communities, between residential and commercial land use activities, or between different agricultural practices, to mention a few. The causes of land use conflict are multifaceted, and they include population growth, urbanisation, industrialisation, and globalisation, among others (Goetz et.al., 2005, Lambin and Meyfroidt, 2011).

A review of the literature on land use and land use conflict reveals that scholars have studied these issues from different perspectives, including planning, policy, economy, and geography. In the planning domain, researchers have explored land use planning methods and tools that can help reduce land use conflict. For example, several studies have shown that participatory planning processes involving multiple stakeholders can lead to more effective land use planning outcomes that reduce conflict (UN, 1992, Gotez et.al, 2005). In the policy domain, scholars have analysed the legal and regulatory frameworks that govern land use activities and identified gaps that contribute to land use conflict (OECD, 2017). In the geography domain, researchers have examined the spatial distribution of land use activities and their impact on the environment, economy, and social welfare (Cromley and McLafferty, 2012).

Several studies have examined land use conflict in specific contexts, such as urban-rural fringe areas, where different land use activities intersect. For example, study on peri-urban and rural areas in India has shown that agricultural land is increasingly being converted to non-agricultural uses, leading to conflict between farmers and developers (Prusty, 2018). Similarly, studies on the urban-rural fringe in the United States have shown that conflicts arise between urban development and farming activities, particularly in areas with limited water resources (Handel, 1998).

Land Use, Environment and Climate

The interrelationship between land use, land use conflicts, environment, and climate has garnered significant attention due to its implications for sustainable development and environmental change. Studies by Lambin and Meyfroidt, (2011) and Turner et al. (2015) emphasise how socio-economic, political, and environmental drivers shape land use patterns, including urbanisation, agriculture expansion, and industrial development. These patterns, however, lead to divergent stakeholder interests, giving rise to land use conflicts as highlighted by Blaikie and Brookfield (1987) and Adger (2006). Such conflicts revolve around resource access, tenure rights, and land management strategies, and are influenced by power dynamics and social inequalities.

The environmental consequences of land use changes are evident through habitat loss, biodiversity decline, and ecosystem disruption as highlighted by Foley et al. (2005) and Rudel et al. (2009). Moreover, deforestation, industries, and human activities contributes to carbon emissions, affecting both local and global climates (Bonan, 2008, OECD, 2017).

Land use practices also significantly influence climate systems. Ecosystem damage and land degradation contribute to carbon dioxide emissions, altering regional climate patterns (Pielke, 2005, OECD, 2017). Moreover, the feedback loops between land use, conflict, environment, and climate are complex and bidirectional. Land use conflicts can impede sustainable practices, exacerbating environmental degradation and climate vulnerabilities (Turner et al., 2015). Climate-induced shifts, such as changing precipitation patterns, can escalate resource scarcity and intensify conflicts (Djoudi and Brockhaus, 2011).

The multifaceted relationships between land use, land use conflict, environment, and climate call for integrated approaches that consider social, economic, and ecological dimensions in land use planning. Effective governance, equitable resource allocation, and adaptive strategies are essential to minimise conflicts, mitigate environmental impacts, and enhance climate resilience in a rapidly changing world.

Land Use and Economy

There is a strong connection between land use, land use conflicts, and the economy which requires significant attention of researchers and policymakers alike due to their significant implications for sustainable development and resource management. Land use patterns, a reflection of the delicate balance between societal needs and economic aspirations, are moulded by a variety of factors. Lambin and Meyfroidt, (2011) and Turner et al., (2015) highlight the role of socio-economic drivers in shaping land use, including urban expansion, agricultural intensification, and industrial diversification.

The emergence of land use conflicts arises as a natural consequence of competing interests and evolving societal norms. Blaikie and Brookfield (1987) and Adger (2006) emphasise how differing stakeholder perspectives, resource scarcity, and institutional gaps often culminate in conflicts surrounding land access, tenure rights, and usage permissions. The resulting conflicts can disrupt economic activities, delaying investments and impeding economic growth.

Inextricably linked to land use, the economy is both a driver and a recipient of land utilisation decisions. Foley et al. (2005) and Rudel et al. (2009) illustrate the dual nature of land conversion, demonstrating that while land transformation can bolster economic advancement, it can simultaneously contribute to ecological degradation and the erosion of essential ecosystem services.

Land use practices are fundamentally intertwined with economic incentives, reflecting the quest for balance between prosperity and environmental integrity. Bonan (2008) underlines the role of land management in mitigating climate change by outlining the economic benefits of sustainable practices such as greenery preservation and carbon sequestration.

The relationship between land use conflicts and the economy is characterised by both challenges and opportunities. Addressing conflicts through effective negotiation and conflict resolution mechanisms, as discussed by Turner II and Paul (2008), can not only stabilise economies in conflict-prone regions but also create conducive environments for economic growth and development.

The connections among land use, land use conflicts, and the economy calls for holistic and multidimensional approaches to land management. Keeping a balance between economic advancement, environmental protection, and societal well-being requires adaptable governance structures, participatory decision-making processes, and robust institutions to manage conflicts and harness the economic potential of land resources.

Land Use and Human Health

Land use, land use conflicts, and human health have far-reaching implications for sustainable development and societal well-being. Land use patterns, reflective of societal values, economic dynamics, and ecological constraints, shape the land we inhabit. Urbanisation and industrial growth, as explored by Lambin and Meyfroidt, (2011) and Turner et al. (2015), are expressions of these factors that can directly impact human health.

Emerging alongside these patterns are land use conflicts, often sparked by competing demands and interests. Blaikie and Brookfield (1987) and Adger (2006) emphasise how varying perspectives on resource access, land tenure, and management practices can catalyse conflicts that intersect with human health. Displacement or disturbances due to conflicts can lead to adverse health outcomes for affected communities.

The repercussions of land use on human health are diverse. The works of Foley et al. (2005) and Rudel et al. (2009) highlights how land conversion can alter ecosystems, disrupt habitats, and contribute to the transmission of diseases. Flooding and inundation, for instance, can increase the risk of vector-borne diseases by altering local ecosystems.

Land use practices, intertwined with human activities, have direct and indirect impacts on health. Bonan (2008) emphasises that land management decisions, such as reforestation and sustainable farming practices, can positively influence air quality,

water availability, and disease regulation, thus benefiting human health.

The link between land use conflicts and human health is cogent. Ongoing conflicts can disrupt access to healthcare, lead to food insecurity, and compromise well-being. Land use conflict cases also negatively cause mental stress affecting their behaviour at work and their social lives as a result of how these conflicts are taken up as mentioned by Fienitz and Siebert (2022). Resolving conflicts, as discussed by Turner II and Paul (2008), can contribute to community stability, promoting better health outcomes for affected populations.

As such interrelationship between land uses, land use conflicts, and human health entails holistic approaches to land management that encompass economic, environmental, and health considerations. Maintaining balance between development, health equity, and ecological preservation requires adaptable governance structures, participatory decision-making, and resilient institutions that can navigate conflicts and promote better health outcomes for communities. According to Fienitz and Siebert (2022) it can also be perceived as an opportunity for communities to work together to derive solutions for overall betterment.

Land Use Conflict Resolution: Global Cases

This section examines instances of land use conflicts in Nepal and worldwide, shedding light on dynamics of conflicting interests, its consequences, and the challenges posed by inadequate land use planning, insufficient communication and consultation with communities, and a lack of responsive amendment processes.

Nepal

The Lapsiphedi substation project in Shankarapur Municipality-3, near Kathmandu, Nepal, has become a challenging issue between local communities and the Nepal Electricity Authority (NEA). The disagreement centres on the construction of a crucial 400-220-132-11 kV substation, vital for transmitting hydroelectricity from the Tamakoshi and Sunkoshi rivers to the Kathmandu Valley (THT Editors, 2023). Land acquisition plan for the substation covered an area of 172 *'ropanis'*[c] and included 50 landowners, with compensation settlements totalling approximately NRs 500 million (THT Editors, 2023, Spotlight Editors, 2023). Local residents demanded the substation's relocation in a different area, while the NEA argued against it, citing the advanced stage of transmission line construction and asserting the current site's optimality (Shrestha, 2023).

Involved Parties:

Nepal Electricity Authority (NEA):

NEA played a lead role in the construction of Lapsiphedi substation, and in addressing the challenges surrounding the construction of the substation (THT Editors, 2023, Shrestha, 2023, Spotlight Editors, 2023).

Agitating Locals:

A group of locals has been protesting against the planned construction, demanding the relocation of the substation to a different area due to concerns about its impact on their settlement (Shrestha, 2023).

Government Representatives:

The Ministry of Energy, Water Resources, and Irrigation, Area Administration Office-Sankhu, Shankharapur Municipality, and Ward 3 Office are engaged in coordination and dialogues aiming to discuss the positive and negative impacts of the transmission

c. *'Ropanis'* - 1 Ropani = 508.74 sq. metres

line projects with the locals (THT Editors, 2023, Shrestha, 2023, Spotlight Editors, 2023).

Asian Development Bank (ADB):
Providing financial assistance to the project under the "Electricity Transmission Expansion and System Improvement Project"(THT Editors, 2023).

Non-Government Organisations:
Organisations like Struggle against Marginalisation of Nationalities and Nepal Tamang Dhedun, opposed substation plans, citing concerns about the eviction of indigenous nationalities and locals, arguing it violates international conventions Nepal is party to (Shrestha, 2023).

Approaches Adopted:

Public Notice and Compensation:
In June 2017, the NEA released a public notice for the acquisition of land from the landowners for the substation, with the compensation being finalised by the authority in January 2018 (Nepal Minute Editors, 2023). The NEA also claimed that compensation to the affected locals has already been disbursed (MyRepublica Editors, 2023).

Protests and Clashes:
Several protests and clashes erupted between the locals of Lapsiphedi and security forces at the site of the under-construction substation (MyRepublica Editors, 2023, Shrestha, 2023).

Political Influence:
The NEA alleges that the dispute was artificially created to politicise the issue and influence elections, Shankarapur Municipality even included an agenda to make efforts to transfer the proposed substation to another location in their budget and programme for the fiscal year 2022-23 (Shrestha, 2023).

Stakeholder Dialogue:
In response to ongoing protests, the NEA engaged in negotiations with agitating locals, resulting in a three-point agreement to ease the situation (Shrestha, 2023). Similarly, in a stakeholder meeting, the Ministry of Energy, Water Resources, and Irrigation assured that public concerns are being considered and addressed (Spotlight Editors, 2023).

Temporary Work Suspension:
As part of the agreement, the NEA agreed to suspend drilling and survey works at the proposed substation location for five days, with the assurance that work would resume without obstruction from the sixth day (Shrestha, 2023).

Committee Formation:
A coordination committee was formed comprising government officials and locals to interact with the affected stakeholders, understand their demands, and submit a report to facilitate further discussions (Shrestha, 2023).

Outcome:

Government Reassurance:
Ministry of Energy, Water Resources, and Irrigation reassured stakeholders that the legitimate concerns of the local residents would be taken into account (Spotlight Editors, 2023).

Local Cooperation:
The locals agreed to discontinue the ongoing obstruction, and the local administration committed to withdrawing the police mobilised in the area (Shrestha, 2023).

NEA Cooperation:
NEA temporarily suspended drilling and survey activities, demonstrating a commitment to addressing local concerns and facilitating further discussions (Shrestha, 2023).

Committee Mobilisation:
The coordination committee plays a vital role to foster dialogue, assess the impacts of transmission line projects, and address the demands of the locals (THT Editors, 2023, Shrestha, 2023, Spotlight Editors, 2023).

Project Delay:
The obstruction has led to delays in completing the transmission line project, affecting the delivery of power from the Upper Tamakoshi Hydropower Project to Kathmandu Valley (Shrestha, 2023).

Potential Load Shedding:
NEA Managing Director warns of load shedding in Kathmandu Valley if the Lapsiphedi substation construction is further delayed (Shrestha, 2023).

The Lapsiphedi substation dispute highlights the difficulties involved in public infrastructure projects, emphasising the importance of effective stakeholder engagement and conflict resolution. The temporary agreement provides a window for further dialogue, and the formation of the coordination committee reflects a commitment to addressing local concerns and ensuring the timely completion of vital energy projects in Nepal. The resolution of this dispute will likely set precedents for the construction of other infrastructure in Nepal, influencing land use planning and conflict resolution decisions.

United States

The Hudson River pollution case involves the historical contamination of the Hudson River in New York state, primarily by polychlorinated biphenyls (PCBs), discharged by General Electric (GE) during its industrial activities. Between approximately 1947 and 1977, GE released 1,300,000 pounds (590,000 kg) of PCBs into the river. The PCBs came from the company's two capacitor manufacturing plants at Hudson Falls and Fort Edward, New York. The pollution has had significant environmental and public health impacts along the river and led to a protracted legal and regulatory battle (U.S. Environmental Protection Agency, 2022).

Involved Parties:

General Electric (GE):
An industrial conglomerate with operations in various sectors, including electrical and electronic products. GE released PCBs into the Hudson River from its capacitor manufacturing plants in Hudson Falls and Fort Edward, New York (Riverkeeper, 2023, Sparling, 2023).

Environmental Advocacy Groups:
Organisations like Riverkeeper and Scenic Hudson have been advocating for the clean-up of the Hudson River and raising awareness about the pollution's impacts on the ecosystem and communities (Riverkeeper, 2023, Sparling, 2023).

Government Agencies:
The U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) have been responsible for regulating and overseeing the clean-up efforts. (Riverkeeper, 2023, Sparling, 2023).

Local Communities:
Residents along the Hudson River, including recreational and fishing communities, have been affected by the pollution and are concerned about the river's health. (Riverkeeper, 2023, Sparling, 2023).

Approaches Adopted:

Scientific Studies: Extensive scientific research was conducted to understand the extent of PCB contamination, its impact on aquatic life, and its potential risk to human health (U.S. Environmental Protection Agency, 2022).

Legal Action:
In 1976, the EPA ordered GE to conduct a clean-up of the Hudson River under the Superfund program, a federal initiative to address hazardous waste sites. Legal battles ensued over the scope, methods,

and responsibility for the clean-up (U.S. Environmental Protection Agency, 2022).

Clean-up and Remediation:
GE initiated a multi-phase clean-up process involving dredging contaminated sediment from the riverbed and capping areas with clean material to contain pollution (U.S. Environmental Protection Agency, 2022). From 2009 to 2015, it is estimated that GE spent around USD 1.6 billion in the clean-up process (History Editors, 2020).

Public Engagement:
Public hearings, community meetings, and stakeholder input were solicited to ensure that local concerns and perspectives were considered in the decision-making process (U.S. Environmental Protection Agency, 2022).

Outcome:

As demonstrated by the EPA (2022), Riverkeeper (2023), and Sparling (2023) the Hudson River pollution case has seen several important developments:

Leal and Regulatory:
Environmental activism nationwide led to passage of the federal Clean Water Act in 1972 and the Toxic Substances Control Act of 1976. The federal government designated the contaminated portion of the river, 200 miles (320 km) long, as a Superfund site in 1984.

Dredging and Clean-up:
A major aspect of the clean-up involved dredging sections of the river to remove contaminated sediment. This process aimed to reduce the concentration of PCBs in the riverbed.

Long-Term Commitments:
The clean-up has been a long-term endeavour, with multiple phases of dredging and monitoring required to ensure that contamination levels decrease and the river's health improves.

Controversy and Debate:
The extent and effectiveness of the clean-up have been subjects of debate and controversy. Some stakeholders argue that the dredging did not address all the contamination and that long-term monitoring is necessary.

Environmental Improvements:
While progress has been made in reducing PCB levels, the full recovery of the Hudson River ecosystem and its fish populations remains a challenge.

The Hudson River pollution case highlights the difficult nature of addressing historical industrial pollution and its impact on both the environment and human health. It stresses the importance of collaboration among government agencies, corporations, environmental groups, and communities in seeking effective solutions for land use conflicts.

France

The Notre-Dame-des-Landes airport project was a contentious proposal to build a new international airport near Nantes, France. The project aimed to replace the existing Nantes Atlantique Airport and improve air transportation capacity. However, it faced prolonged opposition due to concerns about environmental impact, land use, and local communities (Environmental Justice Atlas, 2018 and Pieper, n.d.).

Involved Parties:

French Government and Airport Authority:
The French government and the airport authority supported the project, citing the need for improved air infrastructure and economic growth (Pieper, n.d.).

Vinci Group:
Builder involved in the planned development of the airport, one of the world's biggest building corporation (Pieper, n.d.).

Environmental Activists and Local Residents:
Activist groups like the "ZAD" (*'Zone à Défendre'*[d]) and local residents opposed the airport's construction due to concerns about its environmental impact on wetlands, farmlands, and biodiversity (Environmental Justice Atlas, 2018).

Farmers:
Farmers who would be affected by land expropriation for the project protested against the loss of agricultural land (Environmental Justice Atlas, 2018).

Supporters of Development:
Some local authorities and business groups supported the airport project, seeing it as an opportunity for economic development (Pieper, n.d., Khallouki, 2019).

Approaches Adopted:

Occupation and Protests:
Activists occupied the proposed construction site for years, creating the "ZAD" as a symbol of resistance. They held protests, constructed makeshift communities, and expressed their opposition to the project (Environmental Justice Atlas, 2018 and Pieper, n.d.).

Legal Challenges:
Opponents of the project filed legal challenges, arguing that environmental assessments were insufficient and that the project violated regulations protecting natural areas (Environmental Justice Atlas, 2018 and Pieper, n.d.).

Public Debate:
The conflict led to extensive public debates about the need for the airport, its potential economic benefits, and its environmental drawbacks (Environmental Justice Atlas, 2018 and Pieper, n.d.).

Compromises and Delays:
The French government faced challenges in moving forward with the project due to the combination of legal challenges, public opposition, and evolving political situation (Environmental Justice Atlas, 2018 and Pieper, n.d.).

Outcome:

Review of Environmental Justice Atlas (2018), Pieper, (n.d.), Gliszczynski (2020) and Khallouki (2019) shows that the Notre-Dame-des-Landes airport project had a series of outcomes:

Project Abandonment:
In January 2018, the French government officially abandoned the airport project, acknowledging the strength of public opposition and the difficulties in moving forward.

ZAD Dispersal:
After the project's abandonment, authorities cleared the ZAD, leading to clashes between activists and law enforcement.

Alternative Solutions:
The French government explored alternative solutions to address transportation needs, such as renovating the existing Nantes Atlantique Airport and investing in rail infrastructure.

Compensation Claim:
After the State's decision to abandon the Notre-Dame-des-Landes airport project, discussions between the State and the Vinci group on the amount of compensation for the construction group and concessions proceeded. The amount of compensation advanced by Vinci, was around one billion euros according to sources within the State.

Legacy of Activism:
The case left a legacy of environmental and social activism, and discussions about sustainable development, land use, and citizen engagement.

The Notre-Dame-des-Landes airport project case highlights the power of citizen activism and public opposition in shaping decisions about major infrastructure projects, underscoring the importance of considering environmental and community concerns in development planning.

d. *Zone à Défendre*- French phrase that translates 'Zone to Defend'

India

The Posco steel plant project in Odisha, India, involved the establishment of a 12-million-tonne-capacity steel manufacturing facility by South Korean company Posco. The project was one of the largest foreign direct investments in India's steel sector at that point of time, at $12 billion. However, it encountered significant opposition and public resistance due to concerns about land acquisition, displacement, and environmental impacts (The Economic Times, 2013, Sahu, 2017 and Prusty, 2018).

Involved Parties:

Posco:
A South Korean multinational company specialising in steel production, Posco sought to establish a major steel plant in the Jagatsinghpur district of Odisha (Prusty, 2018).

Local Communities and Farmers:
Farmers and residents of the affected area expressed concerns about the acquisition of fertile agricultural land, displacement, and potential loss of livelihoods (Prusty, 2018).

Environmental and Human Rights Activists:
Various environmental and human rights groups raised issues related to the potential environmental degradation, impact on local ecosystems, and the rights of affected communities (Prusty, 2018).

Government of India and State Government:
The Indian government and the Odisha state government supported the project as a means of attracting foreign investment and promoting industrial growth (Prusty, 2018).

Approaches Adopted:

Protests and Resistance:
Local communities, farmers, and activists organised protests, demonstrations, and blockades to oppose land acquisition and the establishment of the steel plant (Sahu, 2017 and Prusty, 2018).

Legal Challenges:
Legal cases were filed by affected communities and activists, questioning the validity of land acquisition and demanding proper compensation and rehabilitation for displaced families (The Economic Times, 2013, Sahu, 2017 and Prusty, 2018).

Environmental Impact Assessment (EIA):
Environmental impact assessments were conducted to evaluate the potential ecological and social consequences of the project on the local environment and communities (Sahu, 2017 and Prusty, 2018).

Government Negotiations:
The government engaged in negotiations with stakeholders to address concerns and find ways to move forward with the project (Sahu, 2017 and Prusty, 2018).

Outcome:

As stated in The Economic Times (2013), Sahu (2017) and Prusty (2018) the Posco steel plant project had a series of outcomes:

Project Delays:
The project faced significant delays due to protests, legal challenges, and issues related to land acquisition and environmental clearances.

Project Withdrawal:
Due to public resistance to the project as well as regulatory hurdles – the South Korean steel manufacturer officially withdrew from the project in 2017. Posco requested the government to take back the acquired land handed over to it.

Divided Community:
The project divided the village community. One group, the United Action Committee, which was influential in Nuagaon, the biggest of the affected villages, supported Posco's entry. This led to clashes between pro-Posco and anti-Posco groups, claiming lives and causing riots.

Public Awareness:
The case raised awareness about issues related to land acquisition, displacement, and environmental concerns associated with large-scale industrial projects.

Policy Discussions:
The Posco project case led to discussions about the balance between industrial development, environmental protection, and community welfare in India.

The Posco steel plant project case demonstrates the challenges of balancing economic development with concerns for land rights, environmental preservation, and community welfare in India's context. It highlights the significance of transparent decision-making, meaningful consultation with affected communities, and sustainable development practices.

Napa Valley Agricultural Preserve - A Model for Foresighted Land Use Planning

The exploration of global land use conflicts reveals diverse land use challenges. These cases demonstrate the critical role of foresighted strategic land use planning, community engagement, and forward-thinking policies to avoid such conflicts in the first place. As such, The Napa Valley Agricultural Preserve case stands as an enlightening example of foresighted land use planning and community-driven preservation, offering invaluable lessons.

Located in California, United States, Napa Valley is renowned for its wine production, and agricultural preservation is a significant concern in the region. Local governments often implement measures to protect agricultural lands, including zoning regulations, land-use policies, and preservation programs. The inception of the Napa Valley Agricultural Preserve was driven by a deep understanding of the region's unique qualities. Stakeholders recognised that the valley's fertile lands were not just spaces for homes and development but served as a hotspot for cultivating fine wine grapes (Napa County Historical Society, 2023). Local farmers and preservationists foresaw the intrinsic value of preserving these lands for agricultural purposes, rather than succumbing to the pull of development profits (Franson, n.d. and Napa County Historical Society, 2023).

The zoning classification, Agricultural Preserve (AP), crafted with precision, was strategically designed to safeguard the fertile valley and foothill areas (Franson, n.d. and Daniels, 2018). It was conceived not only to protect agriculture as the predominant land use but also to prevent incompatible uses and deter urban-type developments detrimental to the region's agricultural and open space attributes. This classification became a legal guardian, ensuring that the Napa Valley retained its economic and aesthetic assets.

The success of this zoning classification is evident in Napa County's continued reliance on agriculture as the leading source of revenue (Daniels, 2018). While neighbouring counties witnessed the displacement of farmland due to rapid development, Napa County's commitment to the AP classification secured its agricultural significance. Approximately 45,000 acres, or about 9 percent of the county, are dedicated to vineyards (Franson, n.d.). The sustained dominance of agriculture in Napa County stands as a model to the enduring impact of well-crafted land use plans.

Furthermore, the Napa Valley case does not merely exemplify legal and policy measures but also showcases a robust community engagement model. The measures taken to protect the valley go beyond legal

frameworks – they encapsulate a shared vision and commitment. The establishment of regulations in 1968 paved the way for subsequent measures like Measure A in 1980 and Measure J in 1990 (Franson, n.d.). These measures, supported by community votes, imposed restrictions on growth and rezoning, extending the legal space over Napa County's agricultural land preservation.

In essence, the Napa Valley Agricultural Preserve demonstrates that when communities and government actors, guided by a shared vision, actively engage in the planning process and enact visionary policies, they can safeguard their unique geography against the pressures of urbanisation and industrial expansion. It establishes a formidable shield against potential land use conflicts in both the near and distant future.

Introduction

Biratnagar, situated in Eastern Nepal, is a metropolitan city and the capital of Koshi Province. It boasts a significant population, making it the largest city within the province and also serving as the administrative centre of Morang district. Positioned along the Koshi Highway in Eastern Nepal, Biratnagar is part of the Greater Birat Development Area, which includes neighbouring cities such as Biratchowk, Dharan, Itahari, and Gothgau. Located approximately 399 km (248 mi) to the east of Kathmandu, Nepal's capital, and only 6 km (3.7 mi) north of the Indian town of Jogbani in Bihar, Biratnagar holds strategic geographical significance.

Established in 1951 as a municipality, the city attained metropolitan status on May 22, 2017, expanding its population through the addition of new wards. Standing as the sixth most populous city in Nepal, following Kathmandu, Pokhara, Bharatpur, Lalitpur, and Birgunj, Biratnagar counted 243,972 inhabitants residing within 56,919 households according to the 2021 Nepal census. Distinguished by its high population density outside the Kathmandu Valley, Biratnagar has made notable contributions to Nepal's industrial scene as the home of the Biratnagar Jute Mills, the nation's pioneer large-scale industry. Beyond its industrial importance, the city has played a key role in Nepal's democratic movement, notably as the birthplace of five prime ministers of democratic Nepal and the starting point of the first labour strike during the anti-Rana movement.

In contemporary times, Biratnagar serves as a gateway to both eastern Nepal and north-eastern India. It stands as the third Nepalese city, following Janakpur and Birgunj, to establish rail connections with the Indian Railways. Moreover, it uniquely hosts an integrated check post (ICP) on the Indian border, a distinction shared only with Birgunj and Bhairahawa. This strategic location further enhances Biratnagar's significance in facilitating cross-border connectivity and trade.

Within this context, the study's objective was to devise three case studies to explore and comprehend the complexities of land use conflicts among industries, rivers, and settlements, aiming to recommend effective strategies for resolution and mitigation. More specifically, the study aims to:

- Identify the key drivers of land use conflicts between the proposed land uses;
- Analyse impacts of these conflicts on the natural environment and the local communities;
- Understand effectiveness of existing legal and institutional arrangements and mitigation options; and

- Recommend apt legal and institutional arrangements, capacity and mitigation options sustainable, equitable, and acceptable to relevant stakeholders.
- Identify areas where further research is necessary to understand the dynamics of land use conflicts in the region.

Overall, the study aims to support subnational government actors, planners, and policymakers to advocate evidence-based policies and practices that promote sustainable and equitable use of land and water resources, while minimising negative impacts to the economy, environment and the local communities.

Methodology

This section outlines the methodology employed to conduct the case study, which focused on investigating and gathering a generic understanding of land use conflicts between industries, rivers, and settlements in the Biratnagar Metropolitan City area of Koshi Province. The study period spanned from March 2023 to December 2023 and involved a combination of primary and secondary data sources, as well as geographic information system (GIS) mapping, tables, and charts for illustration purposes.

Research Design:

The research design for this case study was predominantly qualitative, utilising a mixed-method approach to comprehensively explore the nature and extent of land use conflicts and to provide actionable recommendations for mitigating and resolving these conflicts.

Data Collection Methods:

Focus Group Discussions (FGDs):

Local communities and stakeholders participated in focused discussions to gain insights into their perspectives, concerns, and experiences regarding land use conflicts. FGDs allowed for in-depth qualitative data collection and the identification of key issues. Three FGDs were conducted between 5th June 2023 and 6th June 2023 with local communities and stakeholders of Biratnagar Metropolitan City. FGDs took place at Ikrahi 4, Naharchowk 13, and Roadcess Chowk 12, ensuring representation from communities in the areas affected by such land use conflicts. As such the FGDs were structured around the themes of the case study, i.e. land use conflicts in river-settlement, industry-settlement, and industry-river. Participants were selected based on their proximity to the land use conflict sources and a total of 63 persons participated in the three FGDs.

Survey:

Surveys were conducted within the community to gather quantitative data on perceptions, preferences, and impacts of land use conflicts. These community surveys helped quantify trends and provide a broader understanding of the issues. Surveys were distributed to 62 community members (29 female, 33 male) between 27th August 2023 and 29th August 2023. The surveys were administered in Wards 2, 3, 4, 7, 8, 13, 14, and 17 targeting a diverse cross-section of the community within the conflict prone areas of Biratnagar Metropolitan City. The chosen locations were selected to ensure adequate representation of different settlements and demographics as well as proximity to the land use conflict sources.

Industrial Survey:

In collaboration with FNCCI Koshi and its district chapters, an Industrial Survey was conducted to gather comprehensive data on industries in Koshi Province for the development of the FNCCI Economic Profile. The survey aimed to collect essential

information covering various aspects, including financial data, human resources, raw material sources, production details, locality information, energy sources, and industrial emissions. Morang District's industrial data from this survey pertaining to Biratnagar Metropolitan City has been analysed and utilised in this case study to gain deeper insights on industries located in the city. A total of 130 industries from Biratnagar employing nine or more employees were included in the survey. Data collection took place during the months of January and February 2023.

Key Informant Interviews (KIIs):
Interviews with key stakeholders, including government officials, industry representatives, and community leaders of Koshi Province, provided expert insights and a comprehensive understanding of institutional arrangements and potential mitigation options. A series of KIIs were conducted individually with 13 key stakeholders, representing Ministry of Internal Affairs and Law, and its Land Department, Ministry of Industry, Agriculture and Cooperatives, Ministry of Economic Affairs and Planning, Ministry of Tourism, Forest, and Environment, Chief Minister's Office, Nepal Red Cross Society, I/NGOs, FNCCI Koshi, and Morang Merchant Association. The KIIs were carried out between 27th September 2023 and 28th September 2023.

Structured Engagement Exercise:
Biratnagar Metropolitan City officials were engaged to assess the legal and institutional framework at the metropolitan level, with a specific focus on areas related to land use, environmental management, water resource, and industry. The engagement aimed to evaluate the capacity of metropolitan office and examine the current legal provisions. Officials included representatives from various departments handling sectors like land management, building permit, environmental conservation, disaster management, planning, sanitation, and legal affairs. Additionally, Ward Chairmen and the Chief Administrative Officer took part in the meeting. A total of 15 officials were engaged, which took place on September 26, 2023.

Sharing Event:
A sharing event was organised to disseminate the findings and recommendations of the case study. This event facilitated knowledge exchange among stakeholders and encouraged their active engagement. The event took place on December 19, 2023 at Biratnagar, and it was attended by 35 participants. Stakeholders included Biratnagar Metropolitan City's Mayor, Deputy Mayor, Chief Administrative Officer, and representatives from departments handling sectors like land management, building permit, environment, disaster management, and planning. Additionally, representatives from Koshi Province Ministry of Internal Affairs and Law's Land Department, Ministry of Tourism, Forest, and Environment, District Administration Office Morang, Katahari Rural Municipality, Budhiganga Rural Municipality, FNCCI Koshi, and different I/NGOs were also present.

Secondary Data Sources:
Secondary data, including existing research, reports, and documents related to the Biratnagar Metropolitan City area as well as national and international literature, were utilised to complement and enhance the understanding of the local context, industries, settlements, and rivers.

Analysis Techniques:

The collected data underwent thematic analysis to identify patterns, common themes, and variations. Qualitative data from FGDs, KIIs, and meetings were coded and categorised to extract meaningful insights. Quantitative data from surveys were analysed to generate descriptive statistics and establish correlations. The

quantitative analysis was also used as a means of verification to complement qualitative findings, ensuring data validity.

Limitations and Biases:

The methodology was subject to certain limitations, including small sample size, potential biases in data collection from self-reported perceptions, and reliance on the accuracy of secondary data sources. Additionally, language barriers, cultural differences, knowledge & awareness of the subject matter, and pre-existing opinions of participants might also have introduced biases.

Nature of the Land Use

Description of River

In the geographical confines of Biratnagar Metropolitan City, two significant rivers, the Singhiya River in the east and the Kesaliya River in the west, demarcate the city's boundaries. As such the metropolitan city is situated between these watercourses. Government land use data shows that 1.26 square kilometres, or 1.64% of Biratnagar's land, is currently covered by rivers and other water bodies.

Singhiya River:

The Singhiya River, as documented by Limbu et al. (2023), is a perennial river originating from the periphery of Hattimuda, Gulary, and Sundar Haraicha. Its journey takes it through the Budiganga Municipality and Biratnagar Metropolitan City, ultimately crossing the border into India from Buddhanagar. The river's geographical coordinates lie at 26.4591° N latitude and 87.2973° E longitude. Singhiya River primarily serves as a vital source for irrigation, sustaining the agricultural activities along its banks. The river's riparian vegetation is a mix, with bamboo and coniferous forests, and its riverbed comprises cobbles, pebbles, gravel, and sand. The catchment area of Singhiya River spans 163.6 square kilometres.

The residents residing in the river's catchment area and its surroundings depend on the Singhiya River for their livelihoods. Small and large industries are scattered throughout this region, contributing to the local economy. However, increased anthropogenic activities in proximity to human settlements have caused the river's water to become muddy and polluted, although it remains clear in its upper reaches. Singhiya River flows through Ward 1, 2, 7, 8, 14, and 19 of Biratnagar. These areas predominantly consist of agricultural land, settlements, and industrial establishments.

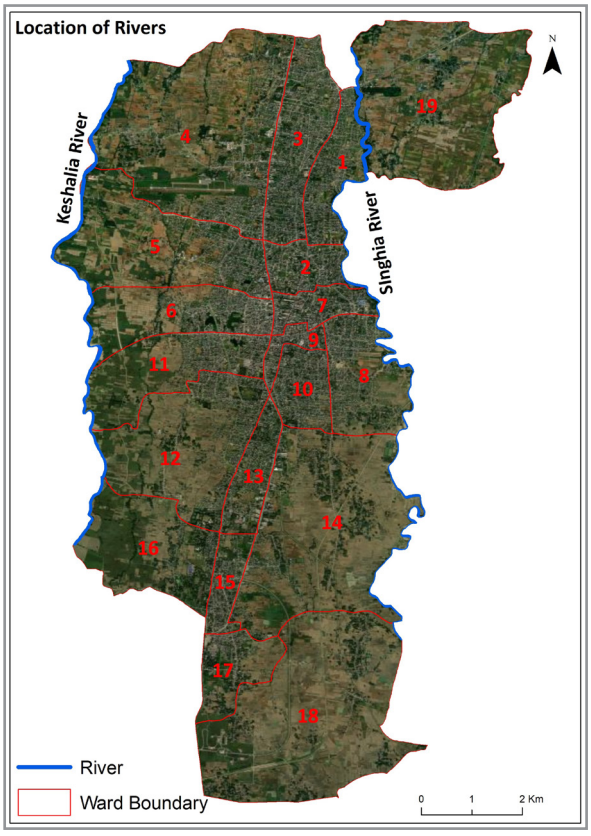

Figure 1: Location of Kesaliya and Singhiya River

Kesaliya River:

The Kesaliya River according to Shrestha (2017) takes its origin from the Rajarani Lake in Dhankuta district. It begins as a small tributary called Budhi River in the upper region of Yangsila, Morang. As it flows southward, it crosses the border between Panbari and Satisale, traverses the Charkoshe jungle, and joins with its tributary, Dale River. The river continues its course, crossing the East-West highway and meeting Gachhiya River at Khanar. The Budhi River further crosses the Dharan Biratnagar highway at Duhabi, transitioning into the Keshalia River as it flows in a southwest direction. Kesaliya River delineates the border between Sunsari and Morang districts and ultimately heads south towards India. The river's geographical coordinates lie at 26.4833° N latitude and 87.2443° E longitude. The catchment area of Kesaliya River spans 378.7 square kilometres.

Kesaliya River, meandering through the western periphery of Biratnagar, carries with it a multitude of challenges and influences from upstream settlements, farms, industries, and various drainage systems. Industries such as sugar mills, sawmills, metal, textile, plastic, packaging, cement, brick and tile manufacturing, food and beverage production, agriculture, and settlements line its banks. These establishments release farm runoff, domestic sewage, and solid waste into the river, posing ecological and environmental concerns.

Wards 4, 5, 6, 11, 12, and 16 of Biratnagar are traversed by the Kesaliya River, and the areas along the riverbanks encompass mostly agricultural land, sparse settlements, few industries, and the proximity of Biratnagar Airport. These wards experience the confluence of economic activities, environmental challenges, and the management of a vital water resource.

Settlements along the two rivers also suffer from regular erosion, flooding, and inundation. Consequently, river side areas of Wards 1, 2, 4, 5, 6, 7, 8, 11, 12, 14, 16, 18, and 19 are the most vulnerable in this context. These challenges demonstrates the interrelationship between environment and urban development, necessitating strategic planning and management to safeguard the well-being of both the rivers and the communities they embrace.

Description of the Settlement

Biratnagar Metropolitan City is situated in the Eastern Terai plains of Nepal, stretching geographically from 26.5131° to 26.3731° N latitude and 87.3248° to 87.2369° E longitude. This expansive region covers a total area of 76.7 square kilometers, with elevations varying from 55 to 114 meters above sea level. The climate in Biratnagar is characterised by its warm and temperate nature. Notably, the region experiences a greater influx of rainfall during the summer months compared to the drier winter season. The wettest months typically fall in May and June, where the average temperature reaches 28.1 degrees Celsius. Conversely, January is the coldest period, with an average temperature of 16.6 degrees Celsius. Over the course of a year, Biratnagar receives an average rainfall of approximately 1670mm.

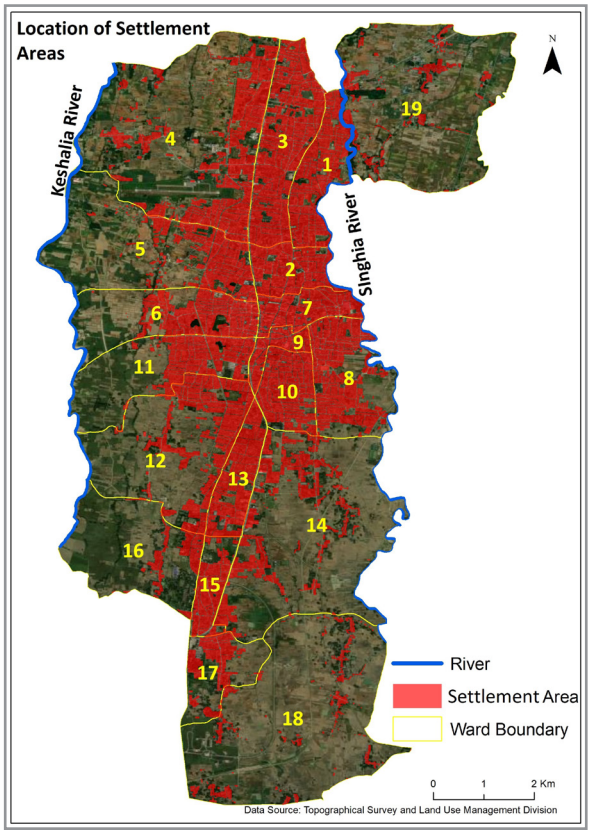

Figure 2: Location of settlements

Government land use data reveals that 22.81 square kilometres, or 29.72% of Biratnagar's land, is currently in use for settlement purposes. According to the metropolitan city's Risk Sensitive Land Use Plan (2023) more than 120 settlement areas have been identified in the city, including market centres, junctions, and small to large settlements. The city's built environment as per municipal data, comprises 35,214 buildings constructed with Reinforced Cement Concrete (RCC). Additionally, 11,608 buildings feature zinc tin roofs, while 4,828 are structurally substandard buildings made of materials like stones, mud, straw, leafs, and/or wooden boards. These building types collectively contribute to the city's architectural fabric, further shaping the land use dynamics.

Biratnagar has a rich historical diversity. Since its foundation, it has seen the influence of various communities and significant historical events. The city's population is ethnically diverse, comprised of a cross-section of native Terai-Tharu communities and hilly communities that have gradually migrated to the region. This blending of cultures is evident, with a mix of Terai, Hilly, and Indo-Nepalese cultures coexisting within the city.

According to the 2021 census, Biratnagar Metropolitan City is home to a total population of 243,927 individuals, with an almost equal split between the two genders, each accounting for 50% of the population. The city is distributed across 56,919 households, with variations in population across its wards. In terms of population density, Biratnagar accommodates approximately 3,168 individuals per square kilometre. Ward 4 is the most populous, housing 21,944 residents, while Ward 9 has the lowest population at 5,776. In terms of households, Ward 3 has the highest number at 5,726, whereas Ward 9 has the lowest with 1,186 households. On average, a household in the city comprises 4.3 individuals, and the gender ratio is nearly balanced at 99.98. The literacy rate is 83.6 percent. The male literacy rate is 89.1 percent, while the female literacy rate is 78.2 percent.

Economically, the 2021 census data shows that 55.85% of the population aged 10 years and above, which amounts to 115,425 individuals, are actively engaged in economic activities. Among the economically active population, occupations vary, with a substantial 35.6% engaged in elementary work roles, 12.2% in service and sales occupations, 11.3% in managerial roles, 9.3% in crafts and related trade, 7.9% in professional roles, 6.6% as skilled agroforestry and fishery workers, 6% as plant and machine operators and assemblers, 4.4% as office assistants, and 0.2% in the armed forces.

In terms of monthly income, out of the total households in different wards, 1,567 households have an average monthly income of less than Rs 5,000, while 6,796 households earn between Rs 5,000 to Rs 10,000. Similarly, 15,399 households earn between Rs 10,001 to Rs 20,000, and 2,436 households have incomes exceeding Rs 70,000 per month. This income distribution reflects the city's economic diversity and challenges, particularly in income disparities among its residents.

Biratnagar also grapples with housing disparities, with a significant percentage of structurally substandard buildings made of materials like stones, mud, straw, leafs, and/or wooden boards, totalling 4,828. The city is also home to numerous squatter slum settlements, primarily inhabited mostly by marginalised communities such

as Musahar, Paswan, Dom, and Muslim communities, further compounding issues of housing and land use.

Regarding waste management, the city's municipal waste collection vehicles do not cover all wards for waste collection. Consequently, residents from unserviced wards adopt various waste disposal methods, including disposing waste on their premises (20.4%), relying on municipal waste collection vehicles (28.9%), disposing waste haphazardly (9.9%), using rivers for disposal (4.1%), and designating fixed areas for disposal within their localities (36.7%). This diverse waste management practice presents challenges for maintaining a clean and sustainable urban environment in Biratnagar.

Description of the Industry

Biratnagar, renowned as the 'industrial capital' of Nepal, boasts a rich industrial heritage and plays a significant role in the economy of eastern Nepal. Notably, it houses the Biratnagar Jute Mills, Nepal's first large-scale industrial establishment, demonstrating its historical importance. Today, the city stands as the economic centre of the region, driven by a burgeoning start-up culture that has given rise to several small enterprises, some of which have grown into multi-million industries. The entrepreneurial spirit and innovation of Biratnagar's residents have contributed to its reputation as a hub for business and industry.

Furthermore, Biratnagar's significance extends beyond its national borders. It serves as the second largest land port in Nepal, facilitating critical connectivity through major custom routes with India. This strategic positioning elevates its role in cross-border trade and commerce, fostering economic growth within the region.

An evaluation of Biratnagar's government land use data reveals that approximately 2.37% of its territory, equating to 1.82 square kilometres, is being used for industrial activities. The city accommodates a spectrum of industries, ranging from small to medium and large-scale enterprises, dispersed throughout its expanse. Wards 15, 16, and 17 consists some old industrial establishments, while the Biratnagar-Duhabi-Itahari road corridor has witnessed the clustering of numerous industries in recent times. According to the National Economic Census of 2018, Biratnagar houses 1,125 manufacturing industries, collectively engaging around 10,005 individuals. Wards 9 and 6 has the highest number of industries at 182 and 133 respectively, while wards 14 and 16 have the lowest number of industries at 16 each.

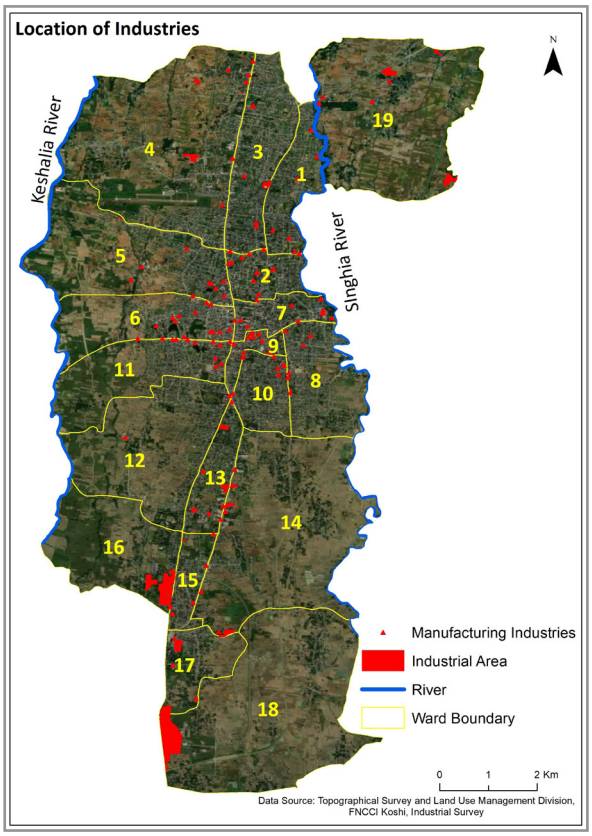

Figure 3: Location of industrial areas and industries

These industries represent diverse sectors, as revealed by an industrial survey of 130 manufacturing establishments with nine or more employees, dispersed across all 19 wards of Biratnagar. Their production activities span various domains, with the following distribution:

- Textile and Clothing: 20%
- Food and Beverage: 16%
- Plastics and Rubber: 15%
- Wood and Furniture: 13%
- Printing and Press Activities: 11%
- Metallic Products: 5%
- Bottled Water: 5%
- Electrical Equipment: 5%
- Chemical Products: 3%
- Paper: 2%
- Ornaments: 2%
- Bricks and Tiles: 2%
- Leather Products: 1%

These industries are dispersed across the city in various locales, including residential neighbourhoods (70%), a combination of residential and agricultural zones (15%), areas in proximity to residential neighbourhoods and rivers (9%), areas near agriculture (4%), and residential, agricultural, and riverfront locations (1% each). In terms of energy sources, the industries exhibit diverse use, with electricity (50%), a combination of electricity and petroleum (43%), a mixed source (5%), and coal (2%).

While the key environmental outputs from industrial activities consist of mixed or multiple types of waste and emissions, evaluating the most prominent waste and emissions generated by these industries reveals a range of environmental challenges:

- Solid Waste: 38%
- Chemicals and Dyes: 22%
- Noise: 19%
- Waste Water: 8%
- Smoke: 6%
- Foul Smell and Dust: 5%

These challenges in the industrial operation requires strategic planning, environmental management, and innovation to ensure sustainable growth and harmonious coexistence with the environment and communities of Biratnagar.

Nature of the Conflict

River and Settlement

The River-Settlement Conflict in Biratnagar has been explored through surveys, FGDs, and KIIs, providing valuable insights into the nature of the land use conflict. Surveys targeted river-side communities in Wards 2, 4, 7, and 8, while FGDs were conducted in Ward 4. KIIs involved a diverse group of representatives, including provincial and local government, private and non-government sectors. The findings reveal a multifaceted conflict scenario with several interconnected elements.

Field observations, secondary research, and insights from local stakeholders highlight the challenges faced by the Singhiya and Kesaliya rivers. These challenges encompass the disposal of domestic and commercial effluents, overfishing, the use of unconventional fishing methods (such as poisoning or electrofishing), soil erosion, open toilets, waste dumping sites, and the mixing of sewerage and drainage deposition of degradable and non-degradable solid waste. Adding to the problem, the canal that runs through Biratnagar's centre faces similar problems. This canal often becomes dirty and polluted due to the mixing of garbage and pollutants from industries, settlements, markets, and other sources. The pollution of the canal mirrors the challenges faced by the Singhiya and Kesaliya rivers, amplifying the overall environmental concerns within the metropolitan area.

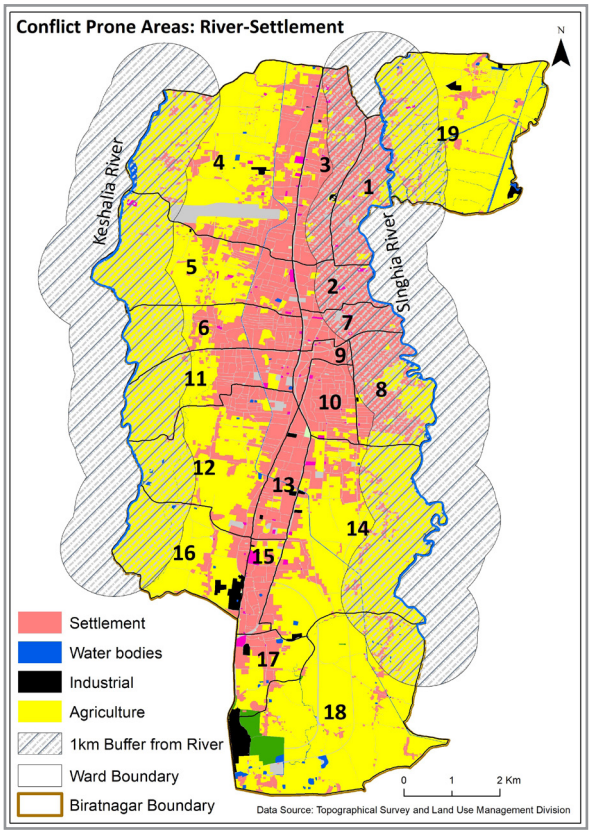

Figure 4: Land use conflict prone areas between rivers and settlements

The rivers also contend with developmental impacts, including dam and bridge constructions, river corridor roadways, buildings constructed near riversides, irrigation channels, and the extraction of sand, gravel, stone, and soil. Nearby agricultural activities, including crop cultivation and cattle farming, introduce chemical fertilisers and manures that often run off into the rivers, further degrading their water quality.

Moreover, the proximity of Biratnagar Airport to the Kesaliya River makes it susceptible to inundation almost every year, primarily due to the poor stormwater drainage system combined with river flooding. This frequent flooding has implications for the airport's operations and infrastructure.

The overall pollution of the rivers has significant consequences for both the environment and the settlements nearby. Water from the rivers can no longer be used for domestic and agricultural purposes, impacting cattle, fisheries, and general household use. The once-available space for cattle grazing in riverside areas is now rendered unsuitable due to the pollution. The challenges extend to informal settlements along the riverbanks, which are frequently displaced by monsoon flooding. While they receive compensation and aid from the government, they often return to these areas after the flooding subsides, perpetuating the cycle of vulnerability.

Encroachment of agricultural land due to land subdivision (plotting), settlement expansion, and building construction compounds the challenges. Such expansion contributes to the degradation of agricultural soil, affecting agricultural production. The affordability of riverside land has led to a significant influx of the population to these areas, impacting both the river systems and the settlements adversely.

The community survey results provide a further understanding of the perspectives of those directly affected by the river-settlement land use conflict:

Primary Land Use Conflict:
The majority of respondents (95%) identified "Flooding and Inundation" as the primary land use conflict they face. This highlights the annual threat of flooding and inundation as a severe challenge to the river-side settlements.

Consequences of the Conflict:
Respondents reported a range of consequences resulting from the river-settlement land use conflict. These include "Physical Damage or Loss" (45%), "Financial Loss Due to Physical Damage" (25%), "Health Problems" (20%), and "Food Security" concerns (10%).

Knowledge and Awareness of Land Use and Zoning:
The survey results reveal that a significant proportion of respondents lack knowledge and awareness of land use and zoning. Notably, 95% of respondents indicated that they know "Nothing" about land use and zoning, with only 5% claiming to have an "Average" (basic) understanding. The lack of awareness regarding land use and zoning stresses the need for educational and awareness initiatives in this area.

Awareness of Biratnagar Metropolitan City's Land Use Regulations:

The survey results indicate a significant lack of awareness among respondents regarding Biratnagar Metropolitan City's current land use regulations and practices. Only 10% of respondents reported being aware of these regulations, while a substantial 90% were not aware of them. Again, this result highlights the need for improved education, awareness, communication and transparency regarding local land use regulations.

Government Involvement in Land Use Regulation:

When asked whether the government should be more active in land use regulations, introducing new laws, and tightening enforcements, 60% of respondents expressed a desire for a more active government role in these matters. However, 30% were opposed to increased government involvement, and 10% held a somewhat neutral stance. This finding highlights varying opinions on the role of government in land use regulation.

Challenges and Barriers to Effective Land Management:

When asked about the challenges and barriers to the local and provincial government in effective land management, respondents pointed to several factors. The most prominent challenge identified was "Lack of Finances/Budget," cited by 55% of those surveyed. "Lack of Political Will" was mentioned by 35% of respondents, while "External Interference" (from private sectors, politicians, certain groups, etc.) and "Not a Priority Issue" (due to other pressing priorities and concerns) each received 5% of responses. These findings highlight the multifaceted nature of the challenges faced in effective land management.

Industry and Settlement

In the context of Biratnagar, the dynamics between industries and settlements are critical in understanding land use conflicts. Surveys, Focus Group Discussions (FGDs), and Key Informant Interviews (KIIs) were conducted to explore this aspect of the city. Surveys targeted community members residing in close proximity to industrial establishments, specifically those in Wards 3, 7, 13, 14, and 17. An FGD was conducted within a settlement near an industry in Ward 13, while KIIs engaged representatives from provincial and local government bodies, private sectors, and non-government organisations.

The proximity of industries to settlements leads to a multifaceted land use conflict, with contrasting perspectives and arguments. Those in favour of industries emphasise their contribution to local employment, particularly among women residing in the vicinity. Women benefit from the accessibility of such industrial jobs, which eliminates concerns about transportation and safety.

It's essential to recognise that the nature of industries can vary significantly. Some exert minimal impact when situated within settlements, while others can significantly affect the environment and the surrounding communities. This variability necessitates a comprehensive examination of the factors contributing to such complexities, including operational contexts and regulatory aspects.

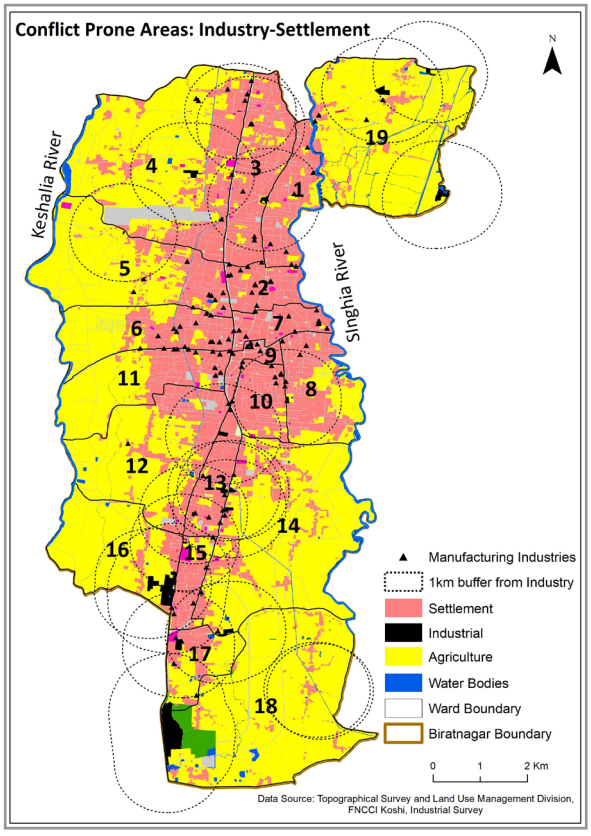

Figure 5: Land use conflict prone areas between industries and settlements

In cases where industries predate the settlements, there are arguments that the settlements are encroaching on industrial areas against established regulations. This has led to debates about the need to relocate settlements away from industrial zones. To resolve these conflicts, it is crucial to assess how settlements expanded to surround industries over time and address the existing challenges while considering the economic significance of these industries. Industries are not the sole contributors to this conflict; commercial and public facilities, such as hotels, hospitals, markets, and sanitation centres, also affect the settlements due to their activities and waste production.

Settlements facing industry-related issues include concerns about industries emitting noxious gases and liquid waste, sawmills and furniture factories causing structural damage due to activities like wood cutting and log dropping, and the disturbance caused by the movement of freight vehicles around industrial areas. These industries also occasionally generate conflicts with the settlements, such as when electricity generators are employed during power cuts, causing noise and air pollution and leading to disputes.

Addressing these historical and contemporary issues is crucial to prevent their persistence into the future. Effective policies and practices that grades different tiers of industries and their separation from residential, commercial, and institutional uses is essential. Similarly, regulation and policies need to be in place that allows low-impact industries and settlements to coexist harmoniously. However, in cases of high-impact industries, a clear separation from settlements is recommended to mitigate conflicts and protect the well-being of both industries and residents.

Survey results provide valuable insights into the perspectives and experiences of those directly affected by the industry-settlement land use conflict:

Primary Land Use Conflict:
The survey reveals that the majority of respondents, 81% identified "Air Quality Related Issues (Industrial Odour/Smoke)" as the primary land use conflict they face. While 9% reported "Water Quality Related Issues", 5% "Noise Related Issues" and 5% "Traffic and Crowd Related Issues". This emphasises the pressing concern of air quality issues in areas where industries and settlements are in proximity.

Consequences of the Conflict:
Respondents reported various consequences resulting from the industry-settlement land use conflict. These include "Environmental Damage (Air/Noise/Water)" (52%), "Health Problems (Physical and/or Mental)" (33%), "Geo/Physical Damage" (10%), and "Socio-Political Issues (Argument with authorities-neighbours-family)" (5%). These findings shows the multifaceted challenges faced by the communities in these conflict-prone areas.

Knowledge and Awareness of Land Use and Zoning:
The survey results reveal a lack of awareness among respondents regarding land use and zoning, with 76% indicating that they know "Nothing" about these issues. Only 19% claimed to have an "Average" (basic) understanding, and a mere 5% had a "Good" understanding. These findings highlight the need for educational initiatives to improve awareness of land use and zoning among the affected population.

Awareness of Biratnagar Metropolitan City's Land Use Regulations:
The survey results indicate a significant lack of awareness among respondents regarding Biratnagar Metropolitan City's current land use regulations and practices, with 86% reporting no awareness of these regulations and practices. Only 14% of respondents claimed to be aware of them, emphasising the need for enhanced communication and transparency regarding local land use regulations.

Government Involvement in Land Use Regulation:
The survey demonstrates strong support for government involvement in land use regulation, with 95% of respondents expressing a desire for more active government participation. None of the respondents opposed increased government involvement, and 5% held a somewhat neutral stance. This finding highlights the community's expectation of a proactive role from the government in managing such land use conflicts.

Challenges and Barriers to Effective Land Management:
When asked about the challenges and barriers to effective land management, respondents identified various factors. The most significant challenge identified was "Lack of Effective Laws and Regulation" (38%), followed by "Lack of Political Will" (29%), "Lack of Effective Implementation of Existing Laws" (24%), and "Unaware/ Uninterested Citizens" (10%). These findings illustrate the multifaceted nature of the challenges faced in land management in industry-settlement areas.

Moreover, the industrial survey conducted in Biratnagar encompassed 130 manufacturing industries employing nine or more individuals and located across all 19 wards. Data from this survey was analysed to understand the nature of these industries, their operational characteristics, and their proximity to residential settlements, shedding light on the nature of the industry-settlement land use conflict.

The significance of these survey results becomes apparent when considered within the context of the industry-settlement land use conflict. Many industries are situated in close proximity to residential areas, with 70% of these industries located near residential zones and 15% located near residential-agricultural zones. This proximity intensifies the challenges associated with balancing the coexistence of these industries with residential communities. Furthermore, the survey examined the sources of energy used by these industries. While 50% of the industries rely on electricity, a significant portion (43%) employs a combination of electricity and petroleum. This data underlines the diverse energy requirements and consumption patterns of industries in Biratnagar, emphasising the importance of regulating energy usage and emissions to mitigate potential conflicts with residential areas.

Additionally, the survey investigated the types of waste and emissions produced by these industries, offering crucial insights into their environmental impact. These emissions encompass solid waste (38%), chemicals and dyes (22%), noise pollution (19%), wastewater (8%), smoke (6%), and foul smells and dust (5%). This categorisation was derived from a thorough examination of the production processes, energy source, materials used, and potential by-products. The existence of these emissions, including noise pollution and various pollutants, indicates potential environmental and health concerns for nearby settlements. These concerns include air quality degradation, noise disturbances, and exposure to harmful substances, underscoring the need to address these issues effectively.

The industrial survey results emphasise the extent of the industry-settlement land use conflict in Biratnagar. As industries of various types and sizes coexist closely with residential areas, it is imperative to address the associated challenges effectively.

Industry and River

The Industry-River Conflict in Biratnagar has been explored through surveys, focus group discussions (FGDs), and key informant interviews (KIIs), providing a comprehensive understanding of this specific land use conflict. Surveys were conducted among river-side communities

residing in close proximity to industries in Wards 3, 5, and 7. An FGD took Ward 12 where environmental activists, academics, and journalists participated, while KIIs included a diverse group of representatives, including provincial and local government authorities, private sector entities, and non-governmental organisations. The findings shed light on the challenges associated with the Industry-River Conflict.

It is evident from field observations, secondary research, and input from local stakeholders that the Singhiya and Kesaliya rivers face significant pollution primarily caused by industrial activities, not only within Biratnagar but also upstream in various municipalities. These industrial effluents often contain a range of toxic chemicals, including cadmium, lead, iron, mercury, zinc, aluminium, copper, chloride, and cyanide (Shrestha, 2017), all of which pose severe risks to aquatic life and human uses of the rivers. Moreover, the use of acidic and alkaline chemicals in industries can alter the pH of the river's water, further exacerbating the environmental impact. Some industries even discharge hot water effluents directly into the rivers, compounding the pollution.

It is essential to recognise that the Industry-River Conflict is not solely the domain of industries. Other facilities, such as hospitals, hotels, markets, sanitation centres, landfills, and settlements, contribute to the pollution and disruption of the river systems both directly and indirectly. Even industries located further away from the rivers or in vacant land areas inadvertently contribute to river pollution. This occurs through rainwater and runoff channels, which carry industrial pollutants and waste into the rivers. Notably, it is standard practice for industries to collect waste and by-products in vacant land areas, which become inundated during monsoons, leading to the discharge of waste into the rivers.

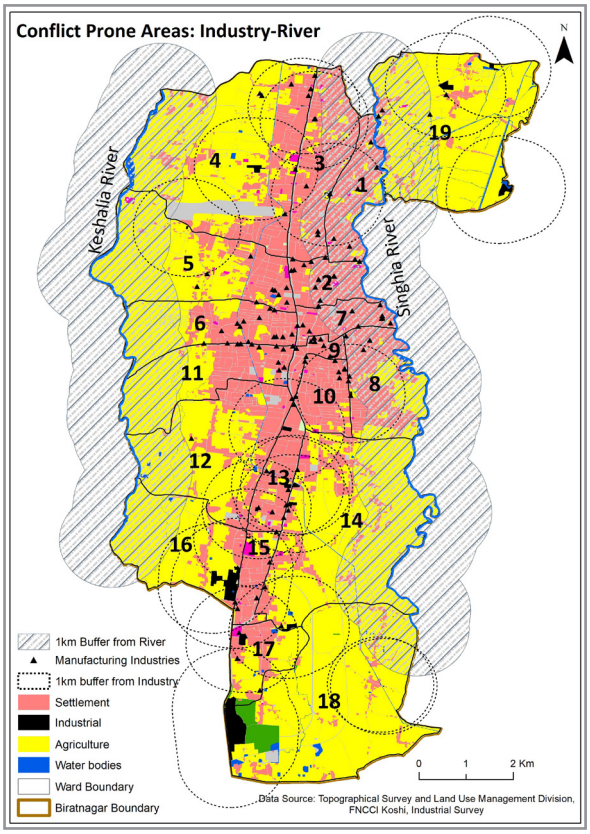

Figure 6: Land use conflict prone areas between industries and rivers

The majority of pollutants mix upstream before reaching downstream areas, primarily due to industrial activities in different municipalities of Morang and Sunsari. Therefore, it is crucial for these municipalities to collectively shoulder the responsibility of enforcing regulations on industries and overseeing waste management, including the management of industrial waste. The establishment of wastewater treatment facilities, waste recycling facilities, and the introduction of scientific waste management techniques within industries are critical to mitigate these issues. Furthermore, classifying industries based on the types of waste and emissions they produce and allocating suitable locations according to the industry's nature can significantly contribute to resolving these problems.

This trend of industrial pollution has adverse effects not only on the rivers and industries but also on the settlements that the rivers traverse. The following community

survey results provide insights into the perspectives of those directly affected by the industry-river land use conflict:

Primary Land Use Conflict: A substantial majority of respondents (76%) cited "Industries Mixing Liquid Waste" as the primary land use conflict they face due to the proximity of industries and rivers, while 24% pointed to industries mixing solid waste. This highlights the pressing issue of industrial pollution and its consequences.

Consequences of the Conflict: Respondents reported a range of consequences resulting from the industry-river land use conflict, with "Environmental Damage (Water/Aquatic Life)" being the most prevalent (67%). Other consequences included "Health Problems" (13%), "Food Security" concerns (10%), and socio-political issues, such as arguments with authorities, neighbours, or family members (10%).

Knowledge and Awareness of Land Use and Zoning: The survey results revealed a lack of knowledge and awareness of land use and zoning among a significant proportion of respondents. A striking 95% indicated that they know "Nothing" about land use and zoning, while only 5% claimed to have an "Average" (basic) understanding. This lack of awareness underlines the need for educational and awareness initiatives in this domain.

Awareness of Biratnagar Metropolitan City's Land Use Regulations: Only 5% were aware of Biratnagar Metropolitan City's current land use regulations, while a significant 95% were not aware of them. This underscores the need for improved communication and transparency regarding local land use regulations.

Government Involvement in Land Use Regulation: A strong consensus emerged among respondents regarding government involvement in land use regulation. A substantial majority (95%) expressed the belief that the government should be more active in land use regulations, introduce new laws, and tighten enforcement.

Challenges and Barriers to Effective Land Management: Respondents identified various challenges and barriers to effective land management, including "Unaware or Uninterested Citizens" (33%), "Lack of Political Will" (29%), "Lack of Effective Laws and Regulations" (29%), and "Lack of Effective Implementation of Existing Laws" (10%). These findings emphasise the multifaceted nature of the challenges involved in effective land management and call for coordinated efforts to address them.

The Industry-River-Settlement Conflict in Biratnagar reveals environmental challenges, primarily stemming from industrial and settlement pollution. These findings emphasise the urgent need for effective mechanism, regulation, waste & emission management, and community engagement to address these issues. As the community grapples with environmental and health concerns, it becomes increasingly important to implement sustainable practices for the coexistence of industries, rivers, and settlements in Biratnagar.

Stakeholder Analysis

As Biratnagar Metropolitan City navigates the challenges of rapid urbanisation, agricultural & industrial sustainability, conservation needs, and economic upliftment, understanding the diverse interests at play is paramount. Stakeholder analysis emerges as a vital tool in Biratnagar's context, offering a lens through which relationship between individuals, communities, organisations, and government bodies with vested interests in land use decisions can be understood.

Within the land use planning sphere in Biratnagar Metropolitan City, a diverse group of stakeholders exists. These stakeholders encompass government entities, local communities, environmental

organisations, businesses, landowners, advocacy groups, and media outlets, each with distinct interests and roles in the land use decision-making process. Government stakeholders, prominently represented by Biratnagar Metropolitan City, is mandated considerable authority in shaping land use policies and regulations at the micro level. Ward offices and their chairpersons are integral to community engagement and represent the local voice. The provincial government, with its ministries overseeing land, infrastructure, industries, and the environment, along with entities like the Province Planning Commission, Province Investment Authority, and district level entities such as the Urban Development and Building Office, Infrastructure Development Office, Water Resources and Irrigation Development Division Office hold a macro-level regulatory as well planning and advisory roles. In specific cases, the federal government and its line agencies may become stakeholders, particularly in the context of national and large-scale projects.

Community stakeholders residing along the banks of the Singhiya and Kesaliya Rivers are deeply interested in the protection of their living environment. Farming communities along the riverbanks are particularly concerned about the degrading quality of the rivers, which has a direct impact on their agricultural activities, including farming and cattle rearing. Meanwhile, communities in proximity to industries are concerned about the impacts of industrial land use on their quality of life and natural environment. Environmental advocates from within the community champion the cause of conservation and sustainable land and river use. Industry stakeholders, operating within Biratnagar, have a direct economic stake in land use decisions. They are increasingly concerned about the encroachment and expansion of settlements into the historically assigned industrial zones. This phenomenon poses a significant challenge as it could potentially impact industrial operations, safety, and the overall business environment. The coexistence of industrial and residential areas in close proximity raises legitimate concerns regarding land use compatibility, zoning regulations, and the need for effective urban planning to address these conflicting interests. As such, business and industry associations, such as FNCCI Koshi, the Chamber of Industries, Morang Merchants' Association and the Confederation of Nepalese Industries, advocate for the interests of the local industrial and business community.

The relationships between these stakeholders are marked by a multifaceted nature of alliances and conflicts. Understanding these relationship is crucial in shaping collaborative efforts, dialogue, and overcoming barriers to conflict resolution. The government stakeholders should maintain firm relationships with the local communities they serve, while also interacting with industry players, advocacy groups, and media outlets. Community stakeholders often find themselves at the centre of land use conflicts, with relationships influenced by shared concerns and occasionally conflicting interests. Industry stakeholders and business associations have engaged mostly with government bodies and local media outlets through established channels. Similarly, advocacy groups, various I/NGOs, CSOs (*'tole'*[e] development committee) and local and national media stakeholders should act as bridges, conveying community concerns to the government and industry stakeholders and influencing public perception, awareness, knowledge and discourse on land use issues.

e. *'Tole'*: Nepali word for Neighbourhood

Legal and Regulatory Framework

Land use in Biratnagar Metropolitan City is profoundly influenced by existing as well as upcoming legal and regulatory frameworks, at the national, provincial, and local level. This framework provides the guiding principles, constraints, instruments and mechanisms governing land use decisions and conflict resolution. It defines institutional arrangements locally, specifying roles and responsibilities. Additionally, it outlines crucial aspects such as zoning, land subdivision, and environmental considerations for sustainable land use. Procedures for land acquisition, allocation, and dispute resolution are also encompassed within these regulations. Understanding this multifaceted legal landscape is key for comprehending and addressing land use challenges in Biratnagar.

At the national level, the evolution of Nepal's land use laws and policies spans distinct historical periods. Acts such as the Land (Survey and Measurement) Act, 1963, and the Lands Act, 1964, and Land Acquisition Act, 1977 originated during the *'Panchayat'*[f] period. At present, legislation like the Land Use Act, 2019 has been devised, attempting to define and dictate the governance of land use. These acts underpin land governance, encompassing processes for land acquisition, allocation, and dispute resolution to some extent, while overarching policies such as the Land Use Policy, 2015, National Land Policy, 2019, and the Land Use Regulation, 2022 set the stage for land use and management.

Legal provision extends to urban land management and development, comprising acts like the Town Development Act, 1988, Local Self-Governance Act, 1999, and the Local Government Operation Act, 2017, which empower local authorities to govern urban growth and development. Policies including the National Housing Policy, 1996, National Urban Policy, 2007, Planning Norms and Standard, 2013, Land Acquisition, Resettlement and Rehabilitation Policy, 2015, and the most recent National Urban Development Strategy 2017 provide strategic direction for urban development, with regulations such as the Building Act, 1998, National Building Code, 2003, Building Rule, 2009, and Fundamental Construction Bylaws on Settlement Development, Urban Planning and Building Construction, 2015 setting standards for construction.

Similarly, The Solid Waste Management Act, 2011 seeks to govern waste management by minimising waste generation through source reduction, re-use, processing, or discharge, and ensuring a clean and healthy environment by mitigating adverse effects on public health and the environment; it also specifically addresses industrial waste management, assigning responsibility to individuals or entities producing harmful waste, health-related waste from institutions, chemical waste, or industrial waste to adhere to prescribed processing and management standards. The Industrial Enterprise Act, 2016 enables entrepreneurs to acquire land for registered industries, offers government land leasing for priority industries, and allows exemptions from land ceiling limits when needed. The Disaster Management Act, 2017 outlines policies for creating an effective response framework for disasters like fire-fighting, flooding, deforestation, and infrastructure damage. Its objectives include assessing disaster impacts, developing early warning systems, involving the public in rescue efforts, and raising awareness about national development. The Environment Protection Act, 2019 aims to safeguard citizens' right to a clean environment, provide compensation for environmental damage,

f. *'Panchayat'*: Political system in Nepal that was in place from 1961 to 1990 that placed all governmental power under the King of Nepal.

balance development and environmental preservation, mitigate biodiversity impacts, and address climate change challenges.

In Koshi Province, there is a progressive effort to draft and enact laws, policies, and regulations pertaining to various aspects of land use, planning, environmental management, and infrastructure development.

The Disaster Management Act, 2018 has been devised with the primary objective of reducing disaster risks and effectively managing disasters to protect the lives and properties of the public, private entities, and individuals. It also seeks to preserve natural and cultural heritage while ensuring the safety of physical infrastructures against both natural and non-natural disasters. This comprehensive act encompasses provisions for punishing individuals and entities responsible for causing disasters, categorising disaster risk areas, managing unsafe buildings and infrastructure, developing risk-sensitive land use plans, and mitigating potential damage and destruction caused by disasters.

The Greater Birat Development Area Act of 2019 outlines the amalgamation of 18 municipalities and rural municipalities of Morang and Sunsari districts to form the Greater Birat Development Area. This initiative is geared towards fostering integrated development activities and projects within the region. The act also elaborates institutional arrangements and stakeholders involved in this comprehensive development endeavour.

The Province Building Act, 2019 was introduced to streamline the processes of building design, building permit system, and the establishment of standards and regulations governing the construction of safe and convenient residential, commercial, and institutional buildings. It covers various aspects, including building categories, building codes, building design, standards, and building-related offenses. The Environment Protection Act, 2020 serves as the provincial counterpart to the federal act of the same name, aligning with similar objectives and purposes within the province.

Likewise, the Province Industrial Enterprise Law of 2020, akin to its federal counterpart, encompasses provisions related to land acquisition, leasing, and exemptions for industrial activities. It mandates the submission of environmental impact studies and reports before the registration of industries. This law places the responsibility on industries to mitigate any adverse environmental impacts they may cause.

The Drinking Water and Sanitation Act, 2022 focuses on ensuring citizens' access to clean and high-quality drinking water and sanitation services, along with the management of sewerage and wastewater. The act addresses critical aspects such as protecting all water sources and water bodies, controlling flooding, preventing the mixing of pollutants, including sewer, into rivers, lakes, and ponds, and connecting households to sewerage systems. It also establishes provisions for punishments related to offenses like the mixing of pollutants and sewers into natural water bodies and emphasises the development of water quality standards for rivers near settlements.

Likewise, series of regulations have been enacted at the provincial level to address crucial land and environment governance and development aspects. The Province Environment Protection Regulation, 2020 establishes rules governing environmental studies, pollution prevention and control, an environment protection treasury, protected areas, compensation for environmental damage, and the formulation of environmental protection plans. Similarly,

the Province Constituency Infrastructure Special Program Operation Working Procedure, 2022 is designed to bolster infrastructure development within election constituencies, emphasising credibility, ethics, transparency, accountability, and effectiveness. This regulation outlines eligible project types, including river control, road construction, waste management, landfill development, and industrial development, with a priority on aligning projects with local government periodic plans. Additionally, the Ministry of Tourism, Forest, and Environment periodically issues Program Operation and Implementation Guidance for Soil and Watershed Management, detailing activities, projects, and programs for soil, land, and watershed conservation, along with technology capacity building initiatives like GIS training. These efforts, funded through the Ministry's budget, also involve the establishment of mechanisms like division forest offices and soil and watershed management offices, collectively aiming to contribute to effective land use and environmental improvement in the Province.

In the context of Biratnagar Metropolitan City, the development and enforcement of local land use and planning laws, while ongoing, has been progressing at a slower pace than expected. These local laws are mostly being adapted from national legislation to meet the city's specific needs.

The Metropolitan Housing Working Procedure, 2019 addresses the identification of residents in slum areas and along the banks of Kesaliya and Singhiya Rivers within the metropolitan area. This procedure focuses on developing housing plans for their resettlement and long-term housing management, utilising available lands within the metropolitan city.

The Brief Environmental Study and Initial Environmental Examination Working Procedure, 2020 aims to enhance the effectiveness of processes related to environmental study, report preparation, approval, proposal implementation, and monitoring for all plans, programs, and projects in Biratnagar Metropolitan City. This legislation emphasises the importance of environmental studies and examinations in illustrating the environmental and land use impacts of proposed projects, along with corresponding management plans.

In 2021, Biratnagar Metropolitan City Land Use Working Procedure was introduced to ensure organised settlements, efficient land management, the provision of essential urban services in residential areas, and the prevention of unregulated land fragmentation. It also regulates the activities of individuals, firms, companies, and organisations involved in land-related activities in accordance with the national Land Use Act of 2019. Subsequently, the first amendment of the Land Use Working Procedure in 2022 designates specific areas in wards 14, 16, and 18 as agricultural zones, while categorising the remaining 16 wards as non-agricultural zones.

Complementing these efforts, the Metropolitan Housing Program Model Settlement Development Guideline, 2021 was developed within the framework of the Metropolitan Housing Working Procedure of 2019. This guideline is based on the housing master plan devised through the identification of extremely impoverished slum dwellers in Ward 12. Collaborative initiative between the municipality and partner organisations seeks to facilitate the development of model settlements, including housing units, on designated lands acquired for this purpose.

Institutional Arrangement and Capacity

Federal Level	Koshi Province	Morang District	Biratnagar Metro
Federal Land Use Council **Ministry of Land Management, Cooperatives and Poverty Alleviation** ■ Land Management Division ■ Land Administration Unit ■ Land Reform and Settlement Management Unit ■ Planning and Program Section ■ Monitoring and Evaluation Unit ■ Survey, Geography Information and Land Use Unit ■ Survey Department ■ Department of Land Management and Archive ■ National Land Commission ■ Land Management Training Centre **Ministry of Urban Development** ■ Department of Urban Development and Building Construction ■ Rastriya Awas Company Limited ■ Town Development Fund **Ministry of Forest and Environment** ■ Forest and Watershed Division ■ National Forest Unit ■ Forest and Land Use Unit ■ Watershed and Soil Conservation Unit **National Planning Commission**	**Provincial Land Use Council** **Greater Birat Development Area Committee** **Ministry of Internal Affairs and Law** ■ Administration and Land Division ■ Land Management Unit **Ministry of Physical Infrastructure Development** ■ Housing, Building, and Urban Development Division ■ Urban Development Unit ■ Housing and Building Unit **Ministry of Tourism, Forest, and Environment** ■ Environment and Climate Change Division ■ Climate Change Unit ■ Bio Diversity Unit ■ Environment Unit ■ Forest and Watershed Management Division ■ Soil and Watershed Management Unit **Ministry of Drinking Water, Irrigation and Energy** ■ Irrigation and Energy Development Division ■ Irrigation and Water Related Disaster Management Unit ■ Drinking Water and Sanitation Division ■ Sewerage and Sanitation Unit ■ Drinking Water Unit **Ministry of Industry, Agriculture, and Cooperative** ■ Industry and Cooperative Division ■ Industry Unit ■ Directorate of Agriculture Development **Province Planning Commission** **Province Investment Authority**	**Survey Office, Morang** **Urban Development and Building Office, Morang** • Physical Development Unit • Housing Unit • Building Unit **Infrastructure Development Office, Morang** **Water Resources and Irrigation Development Division Office, Morang** **Division Forest Office, Morang** **Agriculture Knowledge Centre, Morang**	**Local Land Use Council and Land Use Implementation Committee** **Urban Development Division** **Planning Unit** **Building Permit Unit** **Legal Unit** **Environment Unit** **Disaster Management Unit** **Sanitation Unit** **Ward Offices** ***'Tole'* Development Committees**

The examination of the institutional arrangement dealing with land and environmental issues in Biratnagar Metropolitan City reveals a comprehensive four-tier structure encompassing the Federal, Provincial, District, and Local levels.

At the Federal Level, a myriad of structures, including different ministries, their respective line agencies, and the National Planning Commission, predominantly engage in macro-level planning, policy-making, and regulatory roles. Focused on national-level large-scale programs and priorities of national interest, these structures guide and support the lower tiers in different ways. Despite a lower level of citizen engagement, they maintain substantial linkages with national and international experts and organisations. Possessing the highest resources—infrastructure, funds, knowledge base, expertise, and human resources—they are also potentially capable in addressing land and environmental issues.

Similarly, the Provincial Level mirrors the Federal Level in terms of institutions and structures. Operating primarily with different ministries, their line agencies, and other public entities, Provincial structures, including counterparts of Federal bodies like the Province Planning Commission and Province Investment Authority, hold macro-level planning, policy-making, and regulatory roles. Additionally, they play a crucial role in guiding, supporting, facilitating, and collaborating with local levels. Several district-level entities, such as the Urban Development and Building Office, Infrastructure Development Office, Water Resources and Irrigation Development Division Office, and Division Forest Office, operate under Province Level Ministries.

While Provincial structures maintain better proximity to local levels and citizens, it is evident that they have close ties and working relationships with the federal government. In fact, many province-level processes, activities, and key position designations are dictated by the Federal government and political actors. Acting as a bridge between the federal and local levels, provinces have several concurrent functions with the Federal and Local Government, serving as intermediaries in the governance structure.

Unlike the federal-level structures, the same cannot be said for province-level structures in terms of access to and availability of resources like infrastructure, funds, knowledge base, expertise, and human resources. This limitation is further exacerbated as federalism in Nepal is yet to be fully implemented and realised. Due to a state of reliance on the Federal government on enabling policies, grants, and even personnel, there are also many legislative shortcomings at the province level. Similarly, the Koshi Province Government faces political instability, hindering parliamentary proceedings and making situations at the provincial level even more challenging.

There are additional provincial-level bodies with the potential to shape land use planning practices of the region, such as the Greater Birat Development Area Committee, mandated by The Greater Birat Development Area Act, 2019. This committee, chaired by the Minister of Physical Infrastructure Development Ministry, coordinates between federal, provincial, and relevant local levels, facilitating planning, implementation, and monitoring of the Greater Birat area initiatives. However due to operational and practical hindrances, the committee has not been fully functional and active.

At the District Level, functional units dealing with land and environment include smaller-scale offices like the Urban Development and Building Office, Infrastructure Development Office, Water Resources and Irrigation Development Division Office, Division Forest Office, and Agriculture Knowledge Centre. These offices serve specialised purposes in urban development, water resource management, forest management, and agriculture development on behalf of the

province government. For example, the Urban Development and Building Office is responsible for the construction and maintenance of government buildings. Additionally, it oversees urban infrastructure development works such as roads, canals, parks, gardens, bus parks, etc. Programs like the public housing program under the housing initiative also fall within the scope of its responsibilities. However, exceptions to these offices are the district Survey Office 'napi' and Land Revenue Office 'malpot,' which still operate under the federal government, despite formal decisions and legal directives to amalgamate their core functions into their respective local governments.

Contrastingly, Biratnagar Metropolitan City, as a local government with 'metropolitan city' status, is endowed with micro-level roles in executing all land use activities. Housing various units such as the Urban Development Division, Planning Unit, Building Permit Unit, Legal Unit, Environment Unit, Disaster Management Unit, and Sanitation Unit, it functions as the frontline representative of the Nepal Government. With direct reach to citizens through its Ward Offices in all 19 wards, the metropolitan city officials possess in-depth knowledge of local land and environmental issues. Additionally, due to its institutional longevity, the metropolitan city holds a better institutional memory, legacy, organisational structures, and physical infrastructure compared to province-level structures. Direct connections to the federal government empower the metropolitan city in negotiations with major federal entities and political parties. Being a metropolitan city, it boasts one of the highest budgets among local governments in Nepal, facilitating access to global and national exposure, technological advancements, expert mobilisation, and funding for land and environmental issues.

Apart from these specialised units at the metropolitan government and their ward offices, Civil Society Organisations (CSOs) like *'tole'* development committees exist at all wards. These committees serve as supportive bodies for the concerned ward office by involving citizens in the economic, social, and cultural discourse of the neighbourhood. Currently, Metropolitan City's records show over 500 such committees in the metropolitan city.

As directed by The Land Use Act 2019, a structure called the 'Land Use Council' is in place at all three tiers of government. The land use council at the Federal level is chaired by the federal minister overseeing land management issues, with members mostly being secretaries of various federal ministries and representatives from the National Planning Commission and four land use experts assigned by the federal government. Similarly, at the Province level, the provincial land use council is chaired by the provincial minister overseeing land management ministry, along with secretaries from various province ministries and four experts assigned by the province government. At the local level, there is a local land use council where the municipal council is bestowed an additional role as the land use council. Alongside the land use council, local levels also have an additional committee called the land use implementation committee comprising the mayor as chair, ward chairs, departmental heads overseeing departments such as urban development, land management, infrastructure, environment, and other relevant departments. These bodies are responsible at their respective levels for executing all land use planning works, including plan and policy formulation, enforcement, monitoring, penalising planning offences, conservation of significant areas, and other general land use-related activities.

In terms of the capacity of departments, structures, and committees at each level, federal entities seem to have the upper hand, as discussed earlier. Given their readiness with political and bureaucratic will, federal entities have the potential to achieve a lot

in this field. However, the same may not be applicable for provincial, district, and local levels as of yet. Field observations, FGDs, KIIs, and structured engagements with these entities have revealed institutional and capacity shortcomings.

At the provincial level, notable gaps exist in the organisational setup to address land and urban development issues. Strikingly, there is an absence of a dedicated ministry of land overseeing these crucial matters. Instead, a 'land department,' operating with minimal personnel, has been established under the Ministry of Internal Affairs and Law. This organisational structure prompts doubts into the effectiveness of their operations given the constraints of limited resources and staffing. The absence of a specialised ministry raises concerns about the comprehensive approach and depth of engagement in tackling pressing land and urban development challenges at the provincial level.

Moreover, certain ministries, such as the Ministry of Industry, Agriculture, and Cooperatives, undertake tasks with potential environmental and land use implications. Their responsibilities include granting approvals for industrial establishments, with an asserted commitment to ensuring new industries adhere to environmental standards. However, when addressing existing environmental and land use issues caused by industries in Biratnagar, there appears to be a gap in adopting a comprehensive approach. For instance, discussions with the Ministry of Industry, Agriculture, and Cooperatives revealed that, when they receive complaints about existing land use or environmental issues, they typically monitor the site of the problem and send letters to all concerned parties, including the industry, metropolitan office, and sometimes the Ministry of Environment. However, at this point, their actions conclude, and no further steps are taken to resolve or penalise such issues. Similarly, discussion with the Ministry of Tourism, Forest, and Environment revealed occasional and demand-based environmental inspections of key sites in Biratnagar. However, they lack proper technology and manpower to fulfil this gap, resorting to hiring external environmental experts.

Additionally, entities like the Province Planning Commission and Province Investment Authority encounter similar obstacles. The practice of political appointment to the position of vice-chairperson of the Province Planning Commission introduces challenges in maintaining consistent and long-term leadership. The frequent changes in leadership with each government transition disrupt the continuity and effectiveness of the commission's initiatives. The prevailing political instability in Koshi Province further compounds these challenges, creating an environment where leadership changes become a frequent occurrence, hindering the stability and operational efficiency of critical entities involved in land and urban planning. The Province Investment Authority in the same way is at its infancy in the province's context and operates with minimal personnel and resources. These hurdles collectively highlight the need for sustained efforts to address institutional and capacity shortcomings at the provincial level, providing a foundation for more effective and enduring governance in the field of land use and urban development.

At the local level, Biratnagar expresses capacity deficiencies. Their key concern is the lack of specialist manpower to handle pressing issues of land use planning, environmental management, and urban planning. Operations are currently handled by a handful of engineers and surveyors, often preoccupied with building approvals, monitoring, and local development projects. They also point out the need for technical manpower for the operation of a GIS unit, and urban planners, environmental engineers, and social scientists to handle land use planning activities. Similarly, at both the provincial and local levels, the

legally mandated Land Use Councils seem inactive, with no frequent meetings or initiation from their side to gear up provincial and metropolitan land use planning and policy-making activities.

While *'tole'* development committees play a vital role in involving citizens in the economic, social, and cultural discourse of the neighbourhood, their effectiveness is constrained by certain limitations. A key limitation lies in the absence of fixed thematic discussions during any given session; instead, all topics are collectively discussed without a structured categorisation. Additionally, these committees tend to be activated only on a need basis with specific efforts from the local ward offices. This reactive approach, rather than a proactive and structured system where *'tole'* development committees are consistently engaged, results in minimal and ineffective citizen participation.

Overall, field observations, FGDs, KIIs, and structured engagements uncover a critical challenge at both citizen and government levels. Both the provincial and metropolitan governments face the formidable task of fortifying their institutions and legal mechanisms, primarily due to constraints in financial resources, human capital, and infrastructure. Moreover, inconsistent laws, political instability, setbacks in devolution of power and resources, and a lack of adequate guidance and support from the federal government exacerbate this situation. Among public entities, stakeholders, and citizens, there is a dire lack of awareness and knowledge regarding land use planning and relevant laws and policies. Consequently, the imperative for heightened awareness, comprehensive training, and increased investment in tackling these issues becomes urgent.

Conflict Resolution Options

In navigating the current context of land use conflicts within Biratnagar Metropolitan City, resolving such disputes demands a multifaceted, sustained, and strategic approach. This section proposes a comprehensive array of Conflict Resolution Options tailored to address the challenges inherent in land and environmental management. Ranging from collaborative resource allocation to legal and policy frameworks, each option aims to foster sustainable development, community engagement, and proactive governance. These resolutions not only seek to mitigate existing conflicts but also to strengthen the institutional capacity and resilience necessary for tackling the evolving context of land use planning. The subsequent strategies also focus on capacity development, stakeholder collaboration, legal precision, comprehensive planning, migration control, and the revitalisation and protection of vulnerable areas. As stakeholders explore these resolutions, it becomes evident that their successful realisation depends on sustained efforts, emphasising the need for a collective and enduring commitment from stakeholders at various levels. Therefore, by systematically examining and implementing these options, a harmonious coexistence of urban, industrial, and environmental interests can be achieved, ensuring the long-term prosperity and ecological sustainability of Biratnagar Metropolitan City.

1. Diversified Funding Strategies:

- Utilise Metropolitan City's own source revenues effectively, allocating funds for land use planning initiatives and exploring more ways to increase investment in sustainable land use practices.
- Establishing a structured land market in Biratnagar to facilitate transactions, optimise government revenue, and diminish the influence of informal land brokers. This initiative should aim to shift from the current reliance on informal

brokers to a more organised approach, where formal procedures play a key role in town planning and land management.

- Enhance Metropolitan City's financial capacity by exploring innovative funding mechanisms, such as land pooling, Tax Increment Financing (TIF), Transfer of Development Rights (TDR), impact fees, and development charges, as land value capture tools, to support land use planning initiatives.
- Strengthen partnerships with federal authorities to streamline and secure resource for land use planning initiatives.
- Explore collaborative efforts among external stakeholders to secure and allocate resources effectively across province and local government land use actors.

2. Capacity Development and Training Initiatives:

- In the absence of foreseeable integration of the Land Revenue Department and Survey Department under the provincial and local governments, establish collaboration and coordination mechanisms between metropolitan city and these entities for effective land use planning.
- Along with a dedicated ministry for land, establish a land use planning department at both province and metropolitan level with necessary personnel like urban/ land use planners, environmental engineers, GIS technicians, and other spatial and social experts.
- Equip land use planning department with necessary infrastructure and technology such as linkages with national spatial database, mapping, survey, and design tools/equipment, reliable internet, efficient computers, and up-to date software.
- Identify and disband all non-functional structures and committees pertaining to land use and environment, while reactivating idle structures and committees like the 'land use councils' based on their importance and relevance.
- Integrate land use planning department with other relevant departments and agencies through shared databases systems and close working relation to ensure coordination in planning efforts.
- Using Constitution of Nepal's Article 152, explore the possibility of establishing a 'planning and environment' court at the province level and similar body (enforcement unit) at the metropolitan level to fast-track planning and environment cases and to address or penalise planning and environmental offences.
- Strengthen Metropolitan Government's authority and role in industry establishment approval processes.
- Initiate targeted training programs for government officials at all levels involved in land use and environmental planning.
- Conduct educational and awareness campaigns for citizens and stakeholders across all scenarios to equip them with necessary skills and knowledge.

3. Stakeholder Awareness, Dialogue and Collaboration:

- Foster regular dialogue between all tiers of government, industry operators, citizens, private sectors, experts, activists, and academics for over all land use planning as well as conflict scenarios.
- Encourage collaborative problem-solving to address existing land and environmental issues as well as potential future challenges in river, industry, and settlement areas.
- Promote awareness and education programs for citizens on land use, environmental sustainability, and their role in land use decision and policy-making across all conflict scenarios.
- Develop robust thematic ward and *'tole'*

level citizen engagement platform that serve as watchdogs to conduct regular ward and *'tole'* level discussions on land use and environmental issues, which is then formally forwarded to respective ward and metropolitan offices.

- Develop web-based platforms and software that facilitate digital public engagement to involve the community in the planning process. This may include online surveys, complaints and feedback forms, and interactive maps.
- Facilitate inter-local government collaboration supported by provincial governments to address land and environmental issues collectively, that transcends cross local boundary conflict scenarios.
- Engage non-governmental organisations, donor agencies, and environmental groups to provide expertise and support for land use planning and conflict scenarios.

4. Legal and Policy:

- Seek clarity on federal laws and policies pertaining to land use and environment that create confusions at the subnational level, and devise supplementary laws and policies suitable for the subnational context.
- Devise enabling policy to facilitate land use activities like planning, enforcement, land use plan development, zoning, citizen engagement, institutional enhancement, and funding.
- Categorise industries based on the goods, waste, and emissions they produce, and their impact to rivers and settlements.
- Explore the oversight jurisdiction of industrial effluent discharge into rivers and evaluate/establish municipal and provincial quality standards for effluents.
- Formulate policies restricting settlements and other human activities in high to medium impact industrial, river-side areas, disaster prone areas, and environmentally sensitive areas.
- Develop a one-door policy for addressing or penalising planning and environmental offences and streamline the process across provincial and local government.

5. Devising Comprehensive Land Use Plans and Zoning Regulations:

- Implement zoning regulations that categorise not only agricultural and non-agricultural uses but also all other types of uses, as mandated by the Land Use Act. Provide clear definitions of permissible land uses tailored to the unique characteristics of river, industry, and settlement areas.
- Formulate detailed land use plans that consider environmental, social, and economic factors for all conflict scenarios. Develop periodic processes to conduct land use plan amendment exercise.
- Develop urban land use map for Biratnagar Metropolitan area utilising the Risk Sensitive Land Use Plan, existing cadastral map, and on-site verification.
- Utilise the urban land use map as a tool in the issuance of building permits, monitoring current land use, and addressing land use violations and conversions.
- Establish and implement metropolitan city specific rules/byelaws for right of way of rivers and streams as well as setbacks for building construction.
- Integrate building permit system processes and its bye-laws into land use planning for assessing and mitigating environmental consequences across all conflict scenarios.
- Establish an adaptive management

framework for periodic reviews and adjustments to land use plans and zoning regulations applicable to river-settlement, river-industry, and industry-settlement conflicts.

- Integrate Environmental, Social, and Corporate Governance (ESG) tools into land use planning processes to ensure holistic and responsible decision-making. This approach considers environmental sustainability, social equity, and corporate responsibility, fostering a comprehensive and balanced approach to land use management.
- Encourage public participation in the planning process for all scenarios through consultations, workshops, and public hearings.

6. Migration Control for Conflict Mitigation:

- Implement measures to control migration into areas prone to river-settlement, river-industry, and industry-settlement conflicts.
- Re-evaluate land taxes for areas facing river-settlement, river-industry, and industry-settlement conflicts to reflect differences in environmental impact.
- Address population influx in river, industry, and settlement areas by re-evaluating land prices and zoning to mitigate potential conflicts.
- Explore the possibility of relocating settlements around river and industry areas and industries around river and settlement areas to mitigate the impact on settlements, industries, and surrounding environments.

7. Immediate Mitigation, Revitalisation, and Protection of Key Areas:

- Revitalise and provide buffer to areas prone to river-settlement, river-industry, and industry-settlement conflicts by planting trees, constructing drainage and sewer, increasing green cover, and developing environmentally friendly green spaces.
- Construct embankments, dams, and drainages in areas prone to flooding or erosion across all conflict scenarios.
- Fence and restrict entry to protect vulnerable areas facing river-settlement, river-industry, and industry-settlement conflicts.
- Clearly delineate protected areas through zoning district establishments.
- Apply environmental techniques in industries, such as dust containment and suppression systems, wind-breaking walls, construction of metallic roads, and acoustic systems for noise control.
- Establishment of waste treatment plants by municipalities and provincial governments for managing industrial as well as residential effluents.
- Set fixed times and cargo specific handling methods for freight pick-up and drop-off to reduce noise, traffic, and congestion problems faced by settlements and industries.

Further Research and Study

The examination of land use conflicts in Biratnagar Metropolitan City, while providing insightful perspectives, reveals the need for a deeper exploration into specific themes and critical issues. These recommended avenues for additional research and study are designed to enhance the overall understanding of land use planning and conflict resolution in this context:

- An exploration of land tenure patterns and management practices in Nepal, with a particular emphasis on Biratnagar, becomes imperative. Such research will unravel fundamental aspects, such as the ownership, leasing, renting, buying, selling, and subdivision of land, providing a contextual backdrop essential for comprehending the multifaceted dimensions of land use conflicts within the city.
- The challenges posed by the non-existence of a legal land use plan, land use zoning complexities, and challenges associated with the land use conversion process outlined in existing land use regulations are recommended for examination. This exploration is crucial for enhancing institutional capacity and strategic urban planning.
- Economic factors, such as land pricing, land holding, and absentee landholding, play a pivotal role in shaping land use conflicts. An exploration of these relationships offers insights into the economic drivers influencing urban development and the impacts of designated 'risk-sensitive' or 'vulnerable' areas on pricing and building activities.
- Economic drivers of land use change, including speculative land prices, remittance inflows, and migration patterns, are explored as potential factors influencing the rapid transformation of the urban landscape and potential use conflicts. Understanding the nexus between economic drivers and land use dynamics is fundamental for informed policymaking.
- Investigating the manifestation of conflicts between rivers, settlements, and industries to gain a deeper understanding of the direct implications on the health and well-being of Biratnagar residents is important. Furthermore, examining the land use conflict–climate change interrelationship broadens the scope to encompass environmental sustainability and social dynamics arising from such conflicts.
- Research on the impacts of land use conflicts between rivers, settlements, and industries on arable land, green spaces, open spaces, and other public areas is equally essential. Understanding the repercussions of these conflicts on vital components of the urban and peri-urban ecosystem is crucial for fostering sustainable and balanced urban development.
- Exploring land use conflicts at the neighbourhood level, specifically delving into the tensions between market centres and residential areas, commercial zones and residential spaces, and the conflicts arising along transportation corridors in proximity to schools and hospitals is necessary. The examination of these localised conflicts, including any other conflicting land uses that may emerge will further develop knowledge base in this field.
- A comprehensive review of existing court cases and instances of Public Interest Litigation (PIL) is crucial to uncover the legal dimensions and intensity of land use conflicts. Understanding the outcomes of legal interventions becomes essential for shaping effective conflict resolution strategies and navigating the legal outlooks surrounding land disputes.
- A deep dive into key legislative frameworks regulating land, environment, and industries is recommended to highlight provisions that can contribute to conflict reduction. Identifying possibilities for integration into local building bye laws

and planning regulations is crucial for aligning legal frameworks with the city's unique land use challenges.

- An analysis of the industrial land acquisition process is recommended to understand the role of provincial and local level government in land transactions. Examining the conditions imposed for operating industries and the governance mechanisms influencing these processes sheds light on the industrial land use practices.
- Scrutinising the role of industries in compliance with environmental regulations and assessing the impact of the absence of worker's hostels or housing within industrial premises provides a lens into the socio-economic facets of land use dynamics. Exploring the relationships between industrial practices and land use conflicts is instrumental for sustainable urban development.

Conclusion

This research has delved into different scenarios of land use conflicts within Biratnagar Metropolitan City, a microcosm of the broader challenges faced by rapidly developing urban areas in Nepal. The complexities identified in the conflicts between industries, rivers, and settlements mirror broader issues seen nationally and globally, where the delicate balance between industrial development, environmental sustainability, and community well-being is often strained.

Land use conflicts are not novel but have deep roots in the interactions between industries, rivers, and settlements. The impacts, ranging from water and air pollution to disruptions in river morphology and settlements, resonate with the experiences of Biratnagar, illustrating a broader national concern about the consequences of unchecked urbanisation and industrialisation. The case studies conducted in this research aimed to untangle these problems, identifying key drivers, analysing impacts, and assessing the effectiveness of existing legal and institutional arrangements. The findings reveal the urgent need for adaptive and sustained strategies that account for the specificities of Biratnagar while drawing on broader lessons applicable to urban areas facing similar challenges.

In the pursuit of sustainable, equitable, and acceptable solutions, the study recommends a holistic approach that considers the perspectives of all stakeholders. Balancing industrial growth with environmental conservation and community well-being necessitates not only robust legal and institutional frameworks but also the active participation of local communities and subnational government actors.

As we look to the future, the lessons gleaned from this research contribute to the broader discourse on urban development and land use planning. Bridging the gap between development and ecological concerns requires collaborative efforts, participatory approaches, and evidence-based policies. The recommendations and further research avenues provided aim to empower subnational government actors, planners, and policymakers to navigate the challenges of land use conflicts effectively, fostering a sustainable and equitable future for Biratnagar and similar urban areas.

In conclusion, this research serves as a call to action, advocating for the integration of sustainable practices, community engagement, and adaptive governance in the pursuit of a harmonious coexistence between industries, rivers, and settlements in the evolving urban setting of Biratnagar Metropolitan City.

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