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ARTICLE

Peri-urban Development: Discussion with Land Use Zoning, Statutory Provision, and Issues inside Katahari Rural Municipality, Nepal

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ABSTRACT

The peri-urban area is a transitional zone between the city and its hinterlands characterized by mixed land use and intensive flows of resources, people, goods, and services from and to the city center. These zones are generally misguided and haphazardly developed without a proper planning framework. The peri-urban area at present will be the urban area in the future; therefore, it needs planning intervention in its initial stage of growth. Katahari, a peri-urban area of Biratnagar metropolitan city, is developing a spontaneous lack of land use plans. Recently, the Government of Nepal has encouraged the local government to implement land use plans in the provided framework, policy, and guidelines. This study, in this context, attempts to analyze and identify land use issues and potential zones for Katahari rural municipality that also supports planning urban development in the future. The study is based on primary and secondary data and information supported by maps and figures. It is concluded that Katahari has been developed as a multi-function center adjoining the Biratnagar metropolitan city, and future expansion of the city will cover a wide range of rural municipalities. The postal highway that passes through it has attracted a wide range of urban functions. Agriculture, residential, commercial, and industrial are the main land use category at present and needs development control through providing land use zoning and related planning instruments through the increasing role of the stakeholder and the government agencies in the decision-making processes and implementation of spatial development frameworks to regulate peri-urban development in the area which will guide the future planning for liability, economic viability, social inclusion, and environmental sustainability in the area. Spill-over development activities of Biratnagar, have increased the number of economic activities, population growth, and mixed-use development.

Keywords: Peri-urban; Land use; Urban expansion; Spill-over development; Rural municipality; Agriculture

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1. Introduction

In Nepal, urbanization has generally been practiced analyzing terms of the number of municipalities and people living in them, and these municipalities are at the crux of the struggle to achieve better living standards [1] and are concentrated mainly in the valleys (Kathmandu, Pokhara), inner Tarai (Triyuga, Hetaunda, Chitwan, Dang-Deukhuri) and main highway corridor and in the towns nearer to the Indian border. These urban areas are becoming a center of attraction for the people and are expected to serve as hubs to provide markets for goods and services and improved living conditions and employment for the city dwellers as well as those in the surrounding rural localities [2]. Urban growth is inevitably linked to peri-urban areas [3] through the process of spatial expansion of the functions in the periphery [4] and there also exists a spillover effect of the nearby cities.

The conversion of rural space into urban is an important indicator of urban growth in Nepal. Rapid migration from rural to urban centers has demanded land for housing, industry, trade facilities, open space, waste disposal, etc. in the peripheral area of the urban centers. Moreover, the reclassification of rural into urban areas is one of the main driving forces of urban growth in Nepal [5]. These urban areas have focal or nodal characteristics [6], and people will have continued to leave rural areas and move to urban centers to escape adverse conditions [1]. However, urban area depends to a considerable extent on the outside area for their support [7]. The outside area of the urban center which is also called a 'peri-urban' or 'urban fringe' or 'suburban', is growing rapidly in many cities today.

Land use zoning is a tool to control the haphazard growth of a city. It promotes the city as more sequential, orderly, and planned. Land use zoning is the most common form of land-use regulation and is used by cities and municipalities to guide development. Many people have understood that the term 'zoning' and 'planning' same and have similar meanings. But these are different meanings having complementary natures. Urban planning is the way that people adapt the land to suit their needs whereas zoning is how the government regulates the land. It allows for a better site for planning, design, and development intervention in the large flank of urban space. Both emphasized land (space). Land use planning provides a framework for the spatial development of the urban area. A well-planned urban area is a well-prepared urban area, anticipating the future allows for better preparedness; and good land use planning positively impacts the development of the urban economy.

Many urban centers are growing without proper planning in Nepal. Although, huge planning documents were prepared in the past in the context of planning urban development. One of the major components of these plan documents was to manage urban areas through proper land use zoning. But these are poorly implemented. As a consequence, most of the urban centers are accreting desultorily. In this scenario of urban development, there is an urgent need to regulate urban areas through proper land use planning and zoning. Many urban centers including newly emerging municipalities do not have land use planning. Moreover, peri-urban areas are spontaneously developed around the relatively big urban area full of lack land use plans. Recently, the Government of Nepal has encouraged all rural municipalities, and municipalities to prepare land use plans in the framework by providing policy and guidelines. In this context, this study attempts to identify land use issues and potential zones in the context of Katahari rural municipality. This study focuses on the land use plan prepared based on the existing urban development trends and scenarios.

2. Review of literature

Understanding Peri-Urban Zone: In much urban literature, the peri-urban area has been defined in terms of a 'transitional zone between the city and its hinterlands characterized by intensive flows of natural resources, goods, and services from and to the city [8-10], which has developed on the particular landscape and distinct but interconnected spatial units and open spaces with a wide range of functions [11], and characterized by changing local economic and em-

ployment structures from agriculture to manufacturing, rapid population growth, and migration, rising land values and mixed land use and weak institutional structure [8,9,12]. These features are coexisted and develop beyond the legal administrative boundaries and frequently evolve into a new form of dynamism that expands and shrinks geographically, moves to the peripheral area, and is swallowed by the core area [13]; a city, in this context, rely on the distributive role through providing services including the population of the peripheral areas/regions through sustainable transport networks: Systematic integration of migrants into the urban economy; regulating access to outside entrepreneurs and investments [14].

The peri-urban area can be differentiated from both urban and rural areas due to its rapid growth and dynamic and mixed physical, environmental and economic as well as social attributes [15]. In recent years, rapid urbanization and growing city are due to job opportunities, security, education, health, and commercial business centers that resulted in huge land and housing lack in cities are giving enormous pressure on peri-urban areas [12]. The boundary of peri-urban areas is porous and transitory [3], and the area of transition from rural to urban and land use change at the urban-rural edge in the peri-urban landscape requires the lens of spatial arrangement from both urban and rural perspectives to shape, manage and preserve the ecosystem that people depend upon [16].

Urban economic base [17], threshold and range of goods [18], and basic and non-basic components of urban function [19] are one or other ways discussed peri-urbanization processes, which support and from the relatively bigger city developed in the adjoining area. Peri-urbanization is not a new issue in the planning literature [8]; however, before industrialization, it had little meant. In the age of industrialization, the urban planner was aware of the potential emergence of a spatial form of urban expansion beyond the urban boundary. Ebenezer Howard (1898), a British urban planner, introduced the concept of 'garden city' by making clear boundaries between the city and countryside, and planning on a concentric pattern of development with open space, public parks, and radial boulevards [20]. Peri-urbanization created immense pressure on the local environment and becoming a challenge to control in recent years in Nepal due to rapid encroachment of agricultural land, unauthorized land fragmentation, and unveil infrastructure and development plans.

Peri-urban land use: City is more than buildings, streets, utilities, steel, concrete, and glass; nevertheless, these are the materials from which the physical structure is made [21]. In addition, the city is a symbol of civilization or historic-cultural and archeological marks, and a product of human nature [22]. Therefore, city planning urges to prepare and implement to improve the esthetic pattern of an urban environment. The initial step in the direction of modern planning can be traced to practices of establishing zoning-a legal permitted of the use of land. Indeed, zoning is a statistical exercise and a prognostication of the urban environment, and not only establishes the uses to which land may be put, but it sets the standards by which improvements upon the land may be developed. Most cities have classified their land into different macro and micro zones today. In a larger city, there may be many zones (class) whereas in a small town there may be few classes. These differences in class/zone of land use do not suggest (less) accuracy in determining the classification, rather they indicate that land used in a small town is less complex than in a large city [21].

Nepal's demographic transformation is characterized by fast-growing population density in Kathmandu valley, highway corridors, and close to the border with India [5]. Non-farm economic activities are concentrated in and around Kathmandu valley and towns developed close to the Indian border. Biratnagar and Birganj are such examples of clustering non-farm activities and play the role of a service center for the rural hinterland, where manufacturing largely takes place. Each larger city/town has its hinterland and range of goods and services beyond the administrative boundary, mostly covering the peri-urban zone at the periphery. In the recent development process, there exists a relationship between the city and its peripheral area in terms of the flow of goods,

people, and services that creates immense pressure on the land resources; as a consequence, agricultural land has been converted into a built-up area. These changes, therefore, become a major challenge to the periphery [9]. The process of converting agricultural land into the built-up area in the peripheries of Nepal with rapid population growth, industrial development, and consequently, rapid spatial and temporal pattern of changes. Increasing numbers of brick kilns around the urban and peri-urban areas of Nepal have decreased agriculture production and productivity in recent years. Study shows that a brick kiln removes an average of 1500 MT of soil per 0.05 ha per year [23]. The removal of fertile topsoil causes a loss of nitrogen (N), phosphorus (P), and potassium (K) in soil [24], which is causing an alarming loss of prime agricultural land [25]. These kinds of changes invite a new way of thinking about the use of land and livelihood diversification [9]. This also makes it a question to retain fertile agricultural land and a farming system to supply food grains. Therefore, to retain fertile agricultural land together with the expanding economic opportunities in the peri-urban area; a new form of planning needs to be imposed, primarily that is land use zoning and ultimately guided planning norms and standards.

Land Use Act 2019, Land Use Policy 2015, and Land Use Regulations 2022 (Government of Nepal) are the major policy instruments to address unforeseen land use changes in the urban and rural areas of Nepal. Even though, poverty and poor landowners in the peri-urban areas have been selling their land due to social obligation to meet their daily needs. As result, land brokers (both organized in the name of the private real-estate developer or in-organized individuals and groups) are always pushing poor communities out of the city and urging them to go periphery. Therefore, peri-urban land is directly or indirectly controlled by them, and makes change the use of land according to their voice and choices which are not planned, surveyed, and without basic infrastructure services. Somewhere, land brokers are buying large plots of farmland and sub-dividing into several small parcels with poor infrastructures and selling parcels at a high price. A large number of small landholders residing in the periphery of the urban area generally sold their land to brokers and purchased it away from the city area [26].

Many private landowners and brokers are acting as a developer in Nepal even without holding a legal license and without planning permits [12]. This is true in the case of many municipalities and urbanized villages in Nepal. Biratnagar metropolitan city, for example, has proposed ring road covering Katahari, Lakhantari, Jhorahaat, Buddhanagar, Tankisinuwari, and Hattimuda of the periphery area are becoming a center of attraction among the land brokers, private developers, and common people. This process of land development has lost fertile agricultural land and created immense pressure on agriculture by developing residential and industrial/commercial units, especially after the 1990s [27].

2.1 Land use plan: The policy context

Land use planning is a tool to support the orderly occupation and use of land and to avoid adverse developments. It primarily relies on an evaluation of the land and on the alternative patterns of its use including the physical, social, and economic conditions which affect that use to choose the most applicable use [28]. FAO's Guidelines for Land Use Planning (1989, 1993) make it clear that in the long run, land use must be economically feasible and socially respectable, and that one major thing of development planning is to make effective and productive use of the land. Modern land use planning holds always an environmental component, and in this respect, it is often restrictive in the kind of land uses permitted. The basic principle in this respect is that good quality land should be preserved and any form of land degradation should be avoided [29,30]. It will also guide urban expansion, open space management, conservation of natural resources, and cultural resources, and sustainable development of (peri) urban area.

Most of the municipalities/rural municipalities in Nepal are lacking land use plans for line-up development and therefore are lacking land regulation and

control development plans. Periodic plans and Integrated Urban Development Plans (IUDP) are sectoral plans mostly the rural municipalities and municipalities are practicing. However, the plan is also lacking proper implementation initiatives and therefore fails to address all level problems of the municipality [31]. Similarly, the periodic plan does not properly address the land use plan and haphazard growth and land use practices are taking place. In this context, a land use plan is crucial for land management in Nepal.

2.2 Land management and statutory provision of land use categories

Looking at the history of land management in Nepal, there was no statutory provision for land classification in Nepal. In the very beginning, the customary land tenure system prevalent in Nepal was Raikar, Birta, Jagir, Rakam, Guthi, and Kipat, declared by the rulers. It means the traditional form of land tenure in Nepal was state ownership, especially before the 1950s [32]. After 1964, a land registration system has been established. cadastral surveying and other legal instruments such as the Land Register (Moth), Restriction Register, Survey Field book, and Parcel Map came into existence. Accordingly, all lands in the country have been divided into different parcels, and each parcel has a unique identity. According to Land Revenue Act (1978), eight different land tenure systems have been noted: Government lands, public lands, Raikar lands (in the name of the owners), Guthi lands, Guthi Raitan Nambari in the name of the owner (Guthi lands converted to Raikar or Raitan Nambari), Land and building on possession in the name of the user, Birta Lands, and Haal Aabadi lands (virgin or unregistered lands) in the name of the tiller. The land classification has also been in terms of the cadastral map. These maps are on different scales such as 1:500, 1:1250, and 1:2500 depending on the land value, parcel size, and population density [32].

Land Act 1963, has graded land into four classes: Abbal, Doyam, Sim, and Chahar in the irrigated (Dhanahar/Khet land) and no-irrigated lands (Bari/Pakho land) of Tarai and hills region of Nepal. Until the promulgation of the National Land uses Policy 2012 and the establishment of the National Land Use Project (NLUP) in 2000, the grading system was dismissed.

The government of Nepal approved the National Land Use Policy 2069 [33] which was replaced by Land Use Policy 2072 (2015) after the earthquake disaster of 2015 and its impacts on the different parts of Nepal. Recently, the government of Nepal enacted the Land Use Act 2076 (2019) and Land Use Regulation 2022 which intended to manage land based on the Geology, carrying capacity and suitability of land, existing land use, and the nation's need [34]; accordingly, land has been categorized into 10 zones such as Agricultural, Residential, Commercial, Industrial, Mines and Minerals, Cultural and Archeological, River-stream-lake-wetland, Forest, Public Use and Open Space, and other zones (Nepal Gazette, August 13, 2019; and June 6, 2022, GoN). For the urban area, due to its sensitivity, micro-zoning provision has also been set up in the land use regulations 2022. It emphasized the safe and secure settlement along with environmental protection and ensuring food security. Furthermore, for the effective implementation of land use zones in the country, Land Use Regulations 2022 has directed for an institutional setup of the Federal Land Use Council at the national level, Provincial Land Use Council at the province level, Local Land Use Council at the local level, and Implementation Committee at Rural municipality and municipality level at the bottom.

3. Materials and methods

3.1 Study area: Katahari rural municipality

Katahari Rural Municipality lies on the right bank of the Lohandra river and the left bank of the Singiya River; adjoining Biratnagar Metropolitan City in eastern Nepal with a total area of 55.4065 sq km (**Figure 1**). The area falls within the Tarai physiographic region of Nepal and the northern rim of the Indo-Gangetic plain (IGP). The total population of the rural municipality was 48,625 in 2021 [35], and divided into seven wards. The annual population growth rate in the rural municipality between 2011-

2021 has been calculated at 2.3 percent.

3.2 Preliminary study and data collection

The methodology for this study comprises of analysis of collected primary and secondary data, as well as the incorporation of suggestions from major stakeholders and communities regarding the preparation of land use planning for Katahari rural municipality. The consultation meeting was organized at the local level in a series of steps and methods. Particularly, rural municipal-level and community-level meetings were organized to collect issues/information to fulfill the objectives of this study. To achieve the objectives of this study, the study adopted the following steps of the methodology and the flow chart of methodology steps shown in **Figure 2**.

Preliminary study and data collection

The first stage of the work includes the preliminary work before starting the field survey. This includes collecting and reviewing relevant documents, literature, maps, and photographs and preparing the datasheet for the records of physical, and socio-economic data as well as an inventory of existing infrastructures.

Supporting documents of the study

Secondary data (Reports, Books, Documents, Profile, Maps, etc.) were collected and natural resources such as rivers, rivulets, ponds, physical infrastructures, Land use (forests, agricultural lands, residential areas, barren land as well as plans and programs) was indicated in map of suitable scale. In addition, socio-economic information and land use studies of the rural municipality have been collected and reviewed. A checklist of information required during field investigation was prepared in the meantime, and formats/data sheets and procedures for the data collection were finalized before mobilization of the fieldwork. At least, the following documents,

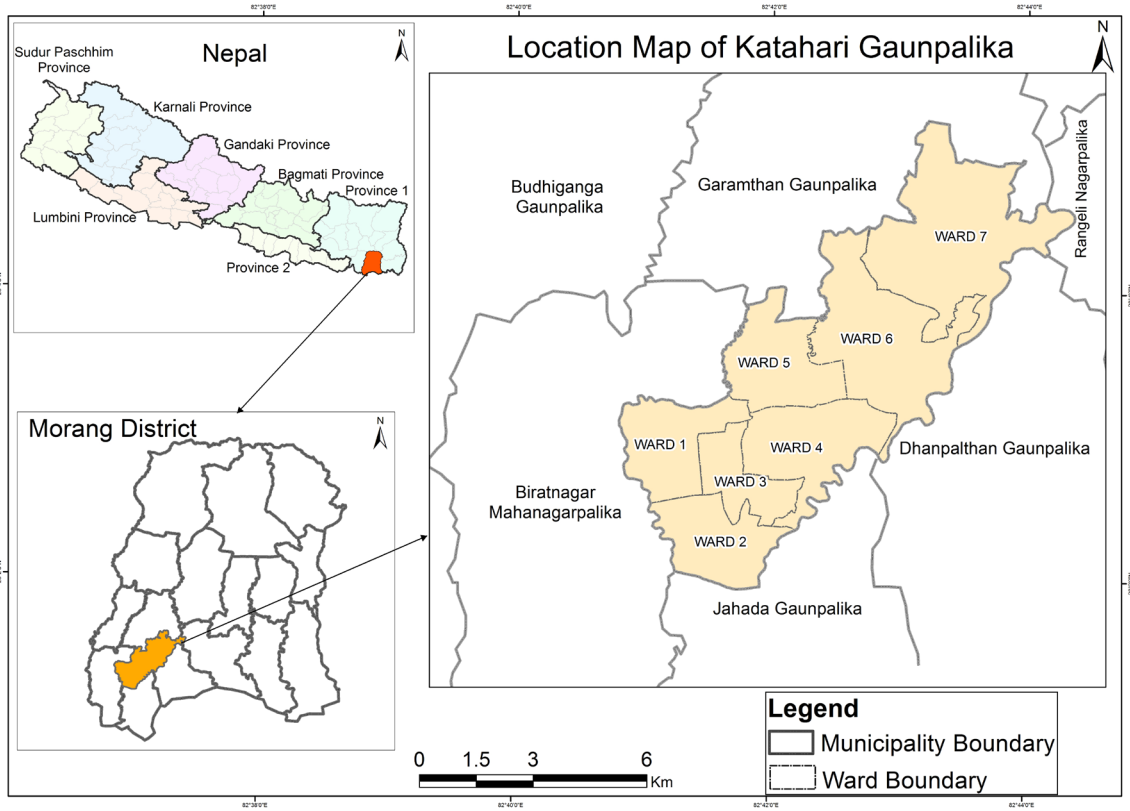

Figure 1. Location of Katahari rural municipality.

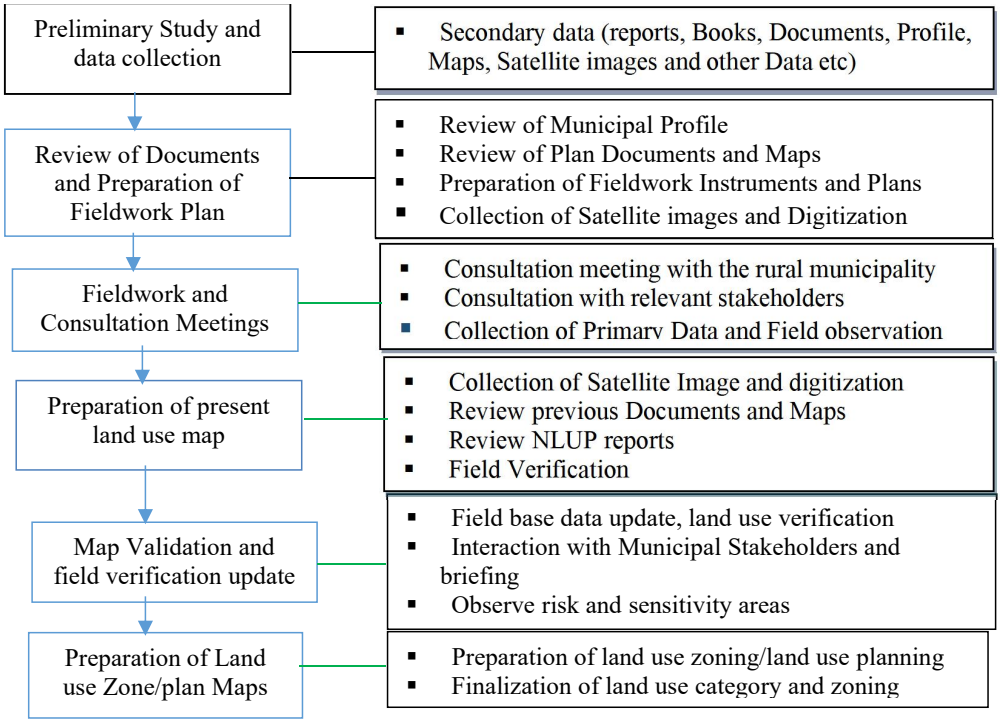

Figure 2. Simplified steps of methodology.

literature, maps, and photographs were collected and reviewed:

- Topographic maps prepared by survey department 1:25000 scale
- Katahari rural municipality maps (including ward division)
- Base map (updated) of Katahari rural municipality
- Integrated urban development plan, Katahari rural municipality 2018
- Integrated settlement concept paper, DUDBC, 2015
- Rural municipality profile
- Building bye-laws and regulation

Field observation and map update

The field inspection and study have been carried out. The inspection and study were done based on an existing development scenario, existing physical infrastructures, industrial areas, institutional areas, business areas, agriculture practices, urbanized areas, residential areas, and environmentally sensitive areas. In addition, the existing situation of the government, and non-governmental institutions within the rural municipality have been located in the maps. During the field investigation, existing land use practices were verified by using satellite images.

Discussion and interaction with stakeholders

An interaction meeting was conducted at Katahari rural municipality office. During the meeting, the approach and methods for the preparation of a land use plan, key indicators to be covered in the land use plan, the definition of the land use plan, etc. were discussed. Furthermore, in such an interaction meeting, presented the land use policies and issues with rural municipal authorities and local communities to identify the rural municipal level issues and problems relating to the land use planning. Similarly, local-level integration meetings at the ward level were held.

4. Results and discussion

4.1 The framework of land use plans inside Katahari rural municipality

Present land use and land use zones

Katahari is a rapidly growing market center with a high degree of functional range and magnitude. Agriculture, built-up, riverine, and lake reservoir are the dominant land use categories in Katahari. Agriculture practices are found slowly decreasing due to increasing human settlements and market centers on the main roads side; particularly in, Katahari and Nayatol areas. Conversion of agricultural land into residential use has also been observed along both sides of Hulaki Rajmarga (postal highway). Market side, Katahari, Nayaroad, Khairbana, Anantaram Chowk, Thalaha, and Bhaudaha are expanding rapidly. Traditional farming practice is common. In recent years, the conversion of agricultural land into residential, industrial, and commercial purpose around postal highway have also been noted significantly. There are altogether 49 industries in the rural municipality. They include poultry farms, sawmills, and brick factories. Among them, brick factories have brought significant changes in local land use patterns. Altogether 16 brick factories are noted and most of them are recorded in the middle and northern sides of the Rural Municipality (Bhaudaha and Thalaha area) (**Figure 3**).

Similarly, the postal highway of Katahari rural municipality section has established several medium scales processing industries and fuel centers; where agricultural land has been rapidly converted into industrial and commercial use. Similarly, migration has also been increasing in recent years in the rural municipality; and people, particularly from the northern hill districts and the vicinity areas, are attracted to settle around the rural municipality which is also brought a significant change in land use. Newly emerging markets, well-established road connectivity, proximity to Biratnagar metropolitan city

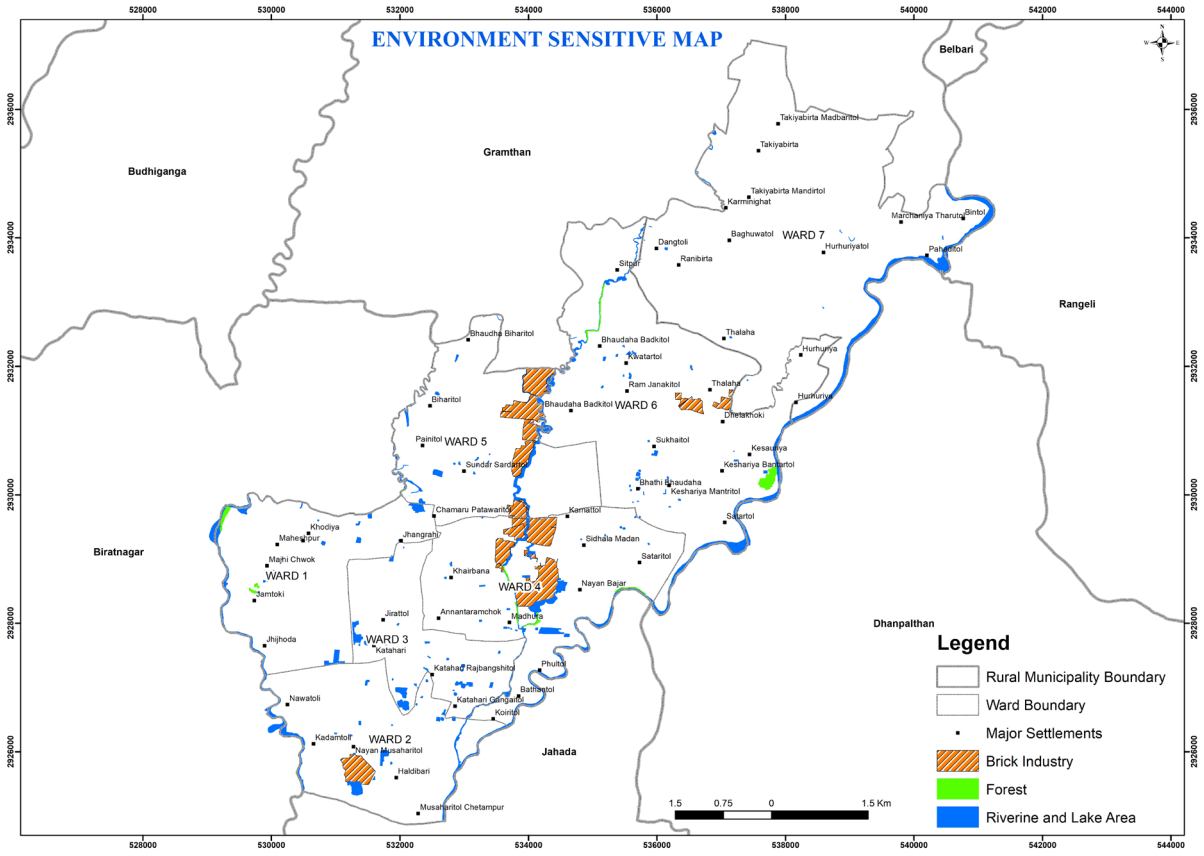

Figure 3. Location of brick factories in Katahari rural municipality.

and Indian markets, and developing infrastructure and institutions are key to attracting people, goods, and services to the rural municipality.

Thus, taking into consideration the above issues, land use zoning of the rural municipality has been proposed. Agricultural land is proposed for residential, industrial, commercial (mixed as well as commercial), and public use and open space as compensation for the major strategic and district road expansion and to meet the need for population growth. Land of marginal utilization with a low capability of agricultural production is allocated for the residential, commercial, and industrial areas as far as possible. In the exception case, only residential and commercial area was allocated to highly fertile arable land. Mainly, the residential area was allocated to the surrounding residential and infrastructure-developed area. As stated above few residential, commercial, agricultural, and industrial areas have been allocated for public use purposes i.e., roads and open spaces as per the rules of Right of Way. After reviewing the risk factor and land capability of the area, only less-productive lands with very low-risk factors and far from industrial areas and flood-prone areas are recommended for new residential areas. These new residential areas are not proposed in flood-prone areas, areas under industrial pollution, and other risks. Therefore, the residential and commercial areas are almost at minimum risk. The topography of the rural municipality is nearly flat and not susceptible to landslides.

The potential land use zone has allocated the maximum area for the agricultural zone (64.96%) followed by the residential zone (17.31%), industrial (5.63%), and commercial (3.12%). Regarding crops, cereal and cash crops are mostly produced in this area. Rice and wheat are the main cereal crops whereas pulses, oilseeds, and vegetables are the major cash crops grown in this area. Few people have shown their interest in fish farming and agro-forestry, especially along the riverside. Soils are mostly fertile so they are more suitable for agriculture [36]. The mines and mineral sites, Excavation areas, and undersigned other land use sites do not exist however, some river banks are being used to excavate sands and stones informally by the local people, which is not mentioned here due to the low volume of extraction. Compare with the present land use of the study area, the agricultural area is decreased by 931.51 hectares while zoning. The main reason behind this is the allocation of new sites for residential, commercial, and industrial uses. Around 577 ha of agricultural land has been additionally allocated for the new residential site and 163 ha for the new commercial site (**Table 1**). Similarly, a new industrial zone has also been proposed in the study area.

According to the National Population Census 2021 (preliminary result), the annual population

Table 1. Comparison of present land use and land use zoning.

SN	Types	Present Land Use		Land Use Zoning		Difference (Area in ha.)	Absolute Change (%)	Relative Change (%)
		Area (in ha.)	%	Area (in ha.)	%			
1	Agriculture	4530.73	81.77	3599.22	64.96	–931.51	–16.81	–20.56
2	Forest	15.94	0.29	80.36	1.45	+64.42	+1.16	+404.14
3	Residential	381.44	6.88	910.09	16.43	+528.65	+9.55	+138.59
	Land Development	0.00	0.00	48.82	0.88	+48.82	+100.00	0.00
4	Commercial	9.73	0.18	172.79	3.12	+163.06	+2.94	+1675.85
5	Riverine and Lake	284.66	5.14	312.08	5.63	+27.42	+0.49	+9.63
6	Public Use & Open Space	98.58	1.78	104.10	1.88	+5.52	+0.10	+5.60
7	Industrial	218.42	3.94	312.04	5.63	+93.62	+1.69	+42.86
8	Cultural and Arch	1.15	0.02	1.15	0.02	0.00	0.00	0.00
9	Total	5540.65	100.00	5540.65	100.00	0.00		

growth rate of Katahari Rural municipality is 2.3% in between 2011-2021; and it is expected that the population of the Rural municipality in the next 15 (2036) years would be 68,396. It has also been observed that the urbanization rate seems high in recent years, and there also exists a spillover effect in Biratnagar metropolitan city. Internal migration from hills and other areas, proposed railway station, proposed dry port, proximity to Biratnagar, access to India (Jogbani/Forbesganj), close to regional airport Biratnagar, high access to health and education facilities, fertile agriculture land have collectively attracted to the people living in the Katahari rural municipality area. Importantly, due to its locational advantages, many people are choosing this area for better residential and industrial activities. Increasing investment in remittance on residential plots and increasing social trends of the single-family system are also reasons for migration into Katahari. Therefore, significant growth can be seen in residential zoning. Buildings in this area are used for mixed purposes i.e., residential and commercial purposes. Some new commercial and business areas are also proposed considering the future demand of the increasing size of the population in this area. As the Katahari lies in the eastern corner of Biratnagar, many industrialists have chosen this area to establish their industrial and business activities due to its cheap land, labour, and local tax. Most of the forest area and cultural and archeological areas are kept intact while zoning in the rural municipality.

Anecdotal evidence, interaction with the local community, and field verification/observation reveal that some areas of the rural municipality suffered from flood and inundation related to rainfall. Lohandra and Singiya rivers are devastating in nature during the rainy season. Their impacts seem huge along both edges of the river channel. Therefore, these areas are proposed agroforestry in some areas and/or kept in riverine and lake zone for other zoning purposes.

In the present zoning, areas under the agriculture zone are dominant followed by a residential area, industrial, riverine and lake, public use, and open space area. The industrial area is also remarkable growth in the rural municipality. The cultural and archeological areas are not on a significant scale. Mines and mineral sites, excavation areas, and undersigned other land use sites do not exist. The decrease in agricultural area is due to the allocation of new sites and areas for residential, industrial, commercial, and public use and open space use. Most of the agricultural land in the rural municipality has the land capability of class I which has been used for agricultural purposes [37].

To allocate agricultural land for new residential, commercial and industrial, land capability data were reviewed which was prepared by NLUP 2072c [38]. Land of marginal utilization with a low capability of agricultural production is allocated for residential, commercial, and public use and open space areas as far as possible. In the exception case, only residential and commercial area was allocated to highly fertile arable land. Mainly, the residential area was allocated to the surrounding residential and infrastructure-developed area.

Similarly, the commercial area is allocated at the main core business area in the existing residential extent, and high possibility of industrial activities along the postal highway, commercial activities at the trading nodes/Bazar areas, other major road junctions, and high development of available commercial infrastructure. The final output of the zoning framework is presented in **Figure 4**.

4.2 Rural shrinking vs urban spill over development

Katahari Rural municipality is located eastern part of Biratnagar Metropolitan City. East-west *Hulaki Rajmarga* (postal highway) has also crossed the Rural municipality. But the Rural municipality had a better experience of the shrinkage of trade and business after the construction of the East-West highway in the past decades, due to shifted trading activities towards the east-west highway nearby towns and markets. Some business communities and local people also migrated to Biratnagar and other urban centers for a better livelihood. However, *Hulaki Rajmarga* (postal highway), a national priority project

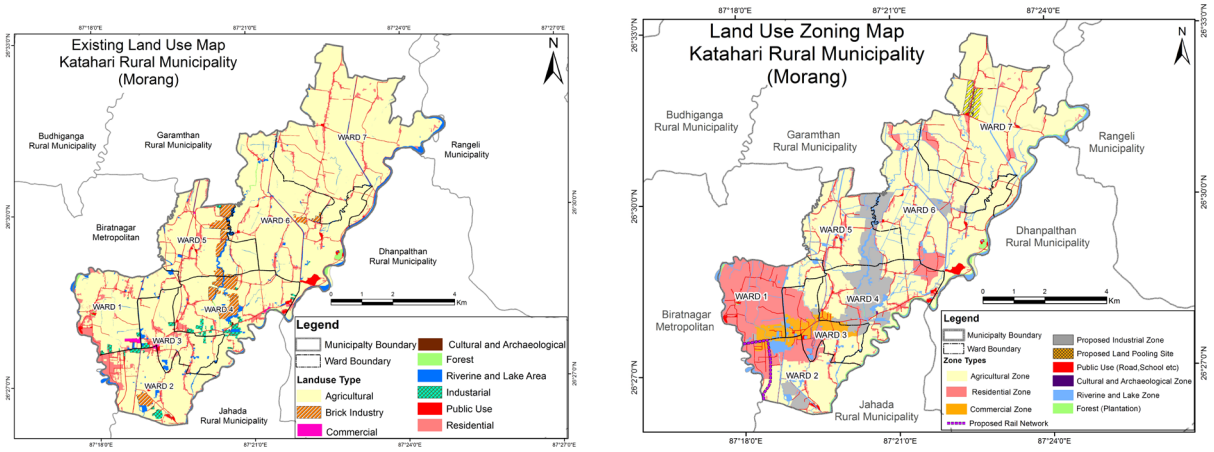

Figure 4. Comparison between present land use and land use zoning in Katahari rural municipality.

is under construction; and it is expected that after the completion of the project, it would enhance the further development of the rural municipality and attract the local business communities and people living in the vicinity areas of the district and region. One of the main attractions is the construction of a postal highway, which is connected Rangeli-Gaurigaanj-Bhadrapur to the east and Biratnagar to the west. Importantly, Rangali and Gauriganj are selected new towns to be developed in the Tarai region of Nepal [39]. Therefore, most of the fertile agricultural fields are rapidly converting into residential, industrial, and commercial zones. The infrastructural facilities such as roads, education, health, electricity, and telecommunication need to be developed to match the current rate of development, which remains a major future concern for urban development and its consequences on land use change in the rural municipality. Katahari is also proposing a site dry port and a railway station in the area. Therefore it is also expected that infrastructure and facilities need to be developed further. After the implementation of land use zoning, Katahari will have experience with planning urban development. As a consequence, the future development scenario of Katahari will depend on:

- Continued construction and eventual completion of the Integrated Checkpoint south of Katahari.
- Construction and upgrading of new strategic and urban /village roads that connects the railway station, and postal highway.
- Proposed Biratnagar ring road covering Katahari.
- Construction and completion of a new rail link from India to a new terminus located in Katahari.
- Construction and completion of Integrated Agriculture Development at ward no 1 of Katahari.
- Increasing the demand for residential parcels and construction of physical infrastructure.

Afterward, Katahari will be experienced with:

- Accelerated population growth, with increasing in migration.
- Increase the demand for residential parcels and the potential of expanding residential areas.
- Potential to overcome mixed use of land.
- Establish an industrial zone at the east of Biratnagar, expansion of industrial activities; potential to increase new jobs and employment mostly for low-income workers.
- A rapid expansion improved brick factories and poultry farms.
- Encouraging agglomeration economies through the promotion of polycentric settlements and functions.
- The potential industrial centre of the east of Biratnagar. The industrial zone to the east will create another center and will be connected by road (Postal highway) and railway (Katahari Junction proposed) and Integrated Checkpoint (Budhanagar, south of Biratnagar).

Katahari Developing as a Peri-Urban zone of Biratnagar Metropolitan City: Biratnagar is located in the eastern Tarai region, close to the border with India, designated municipal status in 1914) and upgraded into metropolitan city status in 2017 (2074 BS). It is an industrial, trading, and administrative center of Nepal; and a provincial capital and had a 2,44,750 population in 2021 [36] making it the sixth most populous metropolitan city in the country after Kathmandu, Lalitpur, Bharatpur, Pokhara, and Birgunj; plays a leading role in the economy of the country. The trade treaty of 1923 between Nepal and British India contributed to the gradual emergence of urban centers in Tarai that helped to achieve some level of industrial development in localized spaces in Tarai from the 1930s which have now become a full-blown city like Biratnagar [2]. The study reveals that there were drastic changes in the temporal and spatial dynamics of land use/land cover afterward. Urban and industrial areas are very much enlarged and cultivated and forest areas considerably decreased during the study periods 1978-2009 [41]. It is a metropolitan city anchored on a core city surrounded by suburban areas whose economies are becoming highly integrated with Biratnagar. Katahari (to the east), Tankisinuwari, Hattimudha, Duhabi (to the north) Buddhanagar to the south are developing as a peri-urban center of Biratnagar. These areas are undergoing profound demographic, economic, cultural, and environmental changes creating considerable challenges and stress for their residents and the ecosystems upon which they depend for their livelihood and quality of life [16].

4.3 Land use issues in Katahari rural municipality

Main land use issues in the study area have been pointed out below:

- Increasing resource consumption in the process of urban development due to the declining viability of agriculture raises the issue of whether agricultural land should still be preserved or not.
- Low-density urban sprawl, mainly through scattered construction of private residences.
- Low-intensity use of many plots in the market area and a city center, i.e. inefficient use of prime land with high commercial potential.

Other issues that address the land use in Katahari are given below:

- Weak implementation: Problems are related to the effectiveness of the implementation process. There is a lack of seriousness in enforcing land use control. Land use classes are vague with a lack of clarity on what is permitted and what is not. Public control measures are not often explicitly laid out.
- The wider scope and significance of land use planning and the need for land use control have yet to be articulated and ingrained in the planning documents.
- Katahari does not yet have a comprehensive regulatory framework that would meet its specific needs in controlling land use. As a result, major challenges remain unsolved regarding how to manage haphazard growth.
- Lack of political will: The planning framework is not adequately legitimized or accepted or implemented, if the political will practice properly in a strategic place.
- There is a lack of qualified and motivated development planners to steer the planning process. It is necessary to train them to enable them to deal with the emerging challenges of urban development.
- Conflict of interest between the elites and relatively rich influential persons.
- In this scenario, the vision of Katahari will not be achieved properly. The vision has been articulated in the Integrated Urban Development Programme (IUDP) prepared by the Rural municipality in 2018 [42].

One of the major objectives of the land use policy enacted in the country is to retain fertile agricultural land. Sustainable Development Goal (SDG-2) has also emphasized food security and sustainable agriculture, which can be possible only through the preparation and implementation of a proper land use

plan. There are several plans and policies prepared in the past for the local government to support sustainable agriculture and other infrastructure development. But these are mostly failures due to their poor performances. Katahari rural municipality (the local government) should prepare their land use plans by addressing the above issues including planned (urban) development which will help to select the land where development should take place. The local government has also encouraged commercial farming and paid attention to promoting medium and small-scale industrial enterprise development in the relatively less productive marginal lands. This study helps local governments to make their land use policy and plan environmentally sustainable, economically vibrant, and socially inclusive.

5. Conclusions

Land use planning is a multidisciplinary exercise. It regulates land resource according to meet people's needs, and discourage sporadic and unwanted development activities on the land resource. The government of Nepal has enacted a land use act and land use policy; and attention has been made to preparing land resource maps (e.g., present land use, soil, land capability, risk layer, land use zoning, cadastral layer superimposed and profile) of the respective rural municipality and municipalities. Although, land use and planning are highly influenced by elites and politicians in society. A lack of long-sighted planning is still prevalent in the area. Whatever prepared pans in the past were not matched spatially in the real ground. Therefore, there is a need for spatial planning for addressing effective implementation. Land use Act 2076 provides ample scope for land use planning through broader categories of the land but these classifications are not yet practiced. Sometimes this created a confused among the farmers, landlords, and developers. This makes challenges for the proper implementation.

Katahari has been developed as a multi-function center with a wide range of functions that intensities of land use change. Biratnagar-Rangeli postal highway passes through this rural municipality, where mostly mixed land use (agriculture, residential, commercial, and industrial) has been developed. Land use patterns in Katahari have emerged sporadically and are not uniform or structured. To reduce this problem, land use zoning and planning instruments need to be intervened through the increasing role of the stakeholder and the government agencies in the decision-making processes and implementation of spatial development frameworks to regulate peri-urban development in Katahari. Land use zones, therefore, have been prepared that guide the future use of land, and the placement of necessary infrastructure. Land uses zones are not mutually exclusive and they are not isolated from each other. In the case of Katahari, spill-over development activities of Biratnagar, have increased the number of economic activities, population growth, and mixed-use development, as a peri-urban area of Biratnagar metropolitan city, is somehow unified spatial features, and it has a fuzzy phenomenon evolving between urban and rural characteristics. After analysis of the situation, it has been suggested that Katahari can be classified into three types of development:

- First: Those areas, that have been socio-economic incorporated into the main city e.g. Biratnagar, as classified as predominantly urban areas.
- Second, potential urban areas experiencing early land conversion and residential development.
- Third, some of the peri-urban areas are dominated by manufacturing and other large land-consuming industrial activities.

Three zones namely: Agriculture, residential and industrial are prominent in Katahari rural municipality that will guide the future planning for liability, economic viability, social inclusion, and environmental sustainability of the area.

Main land use issues in the study area have been pointed out below:

- Increasing resource consumption in the process of urban development due to the declining viability of agriculture raises the issue of whether agricultural land should still be pre-

served or not.

- The wider scope and significance of land use planning and the need for land use control have yet to be articulated and ingrained in the planning documents.
- The planning framework is not adequately legitimized or accepted or implemented if the political will practice properly in a strategic place.
- There is a lack of qualified and motivated development planners to steer the planning process. It is necessary to train them to enable them to deal with the emerging challenges of urban development.
- Conflict of interest between the elites and relatively rich influential persons.
- Some of the peri-urban areas are dominated by manufacturing and other large land-consuming industrial activities.

Conflict of Interest

There is no conflict of interest.

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