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Analyzing Urban Expansion and Spatial Growth Patterns in Barahathawa Municipality of Central Tarai Region, Nepal

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ABSTRACT

The rapid transformation of rural settlements into municipalities in Nepal has brought significant changes in land use, and urban expansion and growth patterns mostly through the conversion of agricultural land into the built-up area. The issue is studied taking a case of the rapidly growing town, Barahathawa Municipality of Tarai Region of Sarlahi District. After the declaration of the municipality, several new roads have been opened and upgraded; and the municipality is well-connected to the national transportation network. After promulgated the Constitution of Nepal 2015 and functioning the elected local body, the municipality budget has been increased significantly as a result of increasing municipal investment in socio-economic and physical infrastructure development and environmental protection which has attracted people, goods, and services creating the zone of influence on the municipality. One of the changes found in the municipality is the increasing built-up area and expansion of urban growth through the decreasing agricultural land. Urban growth has been observed taking place around the Barahathawa Bazaar and main roadsides. The built-up area in Barahathawa municipality has remarkably increased by 183percent with the decrease of shrub and agricultural land within 10 years. Implications of such spatial and temporal dynamics have been a core issue of urban planning in most of the newly declared municipalities in Nepal.

1. Introduction

In Nepal, urbanization has generally practiced analyzing regarding the number of municipalities and people livings in them, and these municipalities are at the flux of the struggle to achieve better living standards in the developing countries^[1] and are concentrated mainly in the valleys (Kathmandu, Pokhara), inner Tarai and main highway corridor and in the towns nearer to the Indian border. These urban areas are becoming a center of attraction of the people and are expected to serve as a hub to provide markets

for goods and services, and improve 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.

However, urban growth is a complex phenomenon and a non-linear process^[5]. Though, various factors have generally affected to impact urban expansion and spatial patterns of town. Classical theories such as urban economic

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base^{[6][7]}; threshold and range of goods^[8]; and basic and non-basic components of urban function^[9] are one and or other ways have discussed the urban expansion and spatial pattern of growth of the town. Similarly, Von Thunen's model (1826), Burgess concentric zone model (1925), acknowledged that urban areas expand outwards from their Central Business District (CBD), while Hoyt's sector model (1939), and Harris, and Ullman's Multiple Nuclei Model (1945) developed ideas further by theorizing that urban expansion happens along with existing transportation network, in a suitable topography, in the vicinity of similar land uses and outwards from multiple market centres^[4].

By examining in the Nepalese context, urban settlements are more dynamic and constantly changing over time. The changes have been found both in spatial and temporal dynamics. One of the most changes found in the urban area is in the farmland and farming system that is shrinking due to the expansion of the urban built-up area. Increasing urban services and facilities in the municipalities has attracted more people from surrounding areas, particularly from the rural regions. In the municipality, changes can be analyzed in terms of the land use and spatial expansion as well as functional characteristics of the town. Such changes collectively affect the process of planning and policy formulation, which is related to the social, economic, environmental change patterns and trends of urban expansion. In Nepal, most of the urban areas/municipalities have rural characters and have agriculture as the main sources of income and employment. However, with the increasing investments in infrastructure development and as the consequence of population migration in the municipalities, the unregulated built-up areas are increasing day by day. Increasing informal sectors and informal settlements are the consequences of rural to urban migration in Nepal^[10]. This leads to haphazard urban growth causing irregular, substandard, and inaccessible housing patterns and significantly increased vulnerability to disaster^[11] which again causes the growth of squatter settlements in the urban areas^[12]. In this context, the main objective of this paper is to analyze urban expansion and spatial patterns of growth of Barahathawa municipality.

2. Materials and Methods

This study is based on the primary and secondary data collected through fieldwork in 2018 during detailed consultation meetings at the municipal and ward level. A land-use map has been prepared based on 0.5 m spatial resolution satellite imagery. Land use data of the past was collected from the ICIMOD Geo-data portal^[13] and processed using the ARC GIS10.4. It has also analyzed the

land-use changes in the last ten years by overlaying on the GIS environment.

2.1 The Study Area

Barahathawa is a small market and has declared the municipality status in 2015 by incorporating seven small villages (previously known as Village Development Committee (VDC)^[14]. From the very beginning, it has been developed as a rural market center. It is located in Sarlahi District in province no Two (Figure 1). The total area of the municipality is 107.04 Square Km.

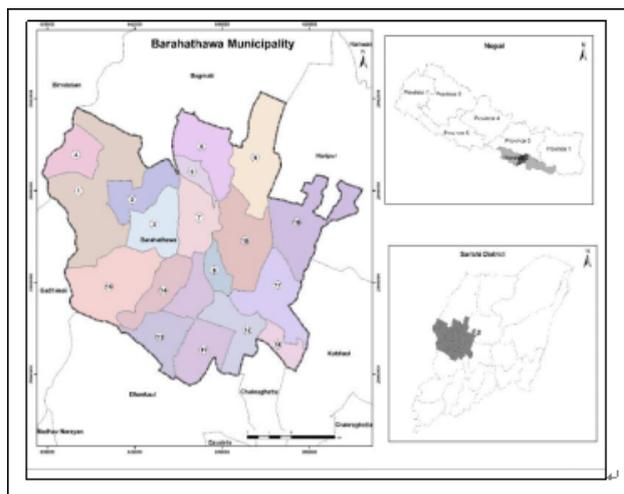


Figure 1. Location of the Study Area, Barahathawa Municipality

2.2 Topography, Climate, and Rivers

The municipality falls in the Tarai physiographic region, which covers the northern rim of the Gangetic plain. The land is most flats with minor relief. Elevation of Barahathawa Municipality ranges from 86 to 110 meters, and the climatic condition is sub-tropical monsoon type. The rainfall distribution is irregular but the trend is higher in July and lowers in Nov and Dec. Bagmati and Lakhandei are the main rivers and Ekadasi Nala, Pathailaiya Nala, and Manusmara river are also drained in the municipality originated from the northern Siwalik and hill region and flow down to the south with a flash flood during the rainy season.

2.3 Roads and Accessibility

Barahathawa municipality is connected by blacktopped and graveled roads which link to the east-west highway (to the north) to Malangawa (to the south-east). Roads connected from Barahathawa to surrounding municipalities and market centers such as Hajariya, Murtiya, Laukath, Sundarpur Choharwa, and Bagmati (Soltee Bazar) are

earthen roads. Nayaroad-Barahathawa (10 km), Kaude-na-Janakinagar (15 km), Hariwon-Janakinagar (5 km), and Janakinagar-Baraudharan (20 km) are major roads in the municipality (Figure 2).

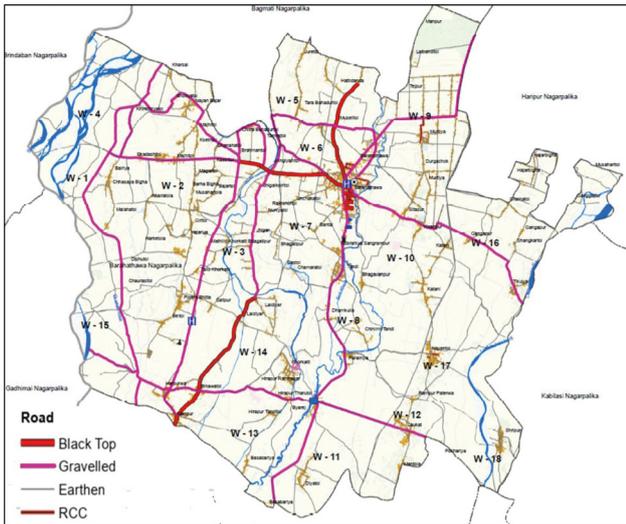


Figure 2. Road Network (Surface types) in Barahathawa municipality

The total road network in the municipality is 191.5 km, of which 71 percent are gravel, and 15 percent are earthen. Except few, many parts of the study area do not have proper drainage and sewerage facilities. Open drainage at Bazaar areas has been observed.

2.4 Socioeconomic Characteristics of Municipality

Barahathawa Municipality has 84,522 populations of which 50.68 percent are male and 49.32 percent female^[13]. The municipality has 13,863 households and an average household size is 6.1. The population density of the municipality is 790 people per sq. km, and the sex ratio 103. In the past, the municipality had a 69,822 population with 11,853 households^[15]. The average annual population growth rate in the period 2011-2018 has been calculated as 3.5 percent. Among others, wards no 18, 10, 6 and 7 have the highest population growth rate (more than 6 percent) and ward no 2, 14, and 12 have the lowest population growth rate (below 0.3 percent). There is an uneven distribution of the population in the municipality. Among others, ward no 7, 5, and 1 have the highest population density. Population density ranges from 422 to 2356 per square Km with highest in ward no 6 to lowest in ward no 17 (Figure 3).

People have been migrated from one place to another for better livelihood. Youngsters are going abroad for income, employment, and higher education as well. However, as the municipality has a direct link with the district headquarters, Malangawa, and easy access to the east-west highway, and

hills districts, municipalities, and rural municipalities of Province No 2 and Bagmati province; there is a high possibility for increasing population in the municipality. Focus Group Discussion (FGD) at Barahathawa revealed that the municipality is the best destination due to its good connectivity, relatively cheap land value, and suitable location. Therefore, people from the northern hill districts and the municipalities/rural municipalities have selected Barahathawa as the best place for lives and livelihood (FGD, 2018 at Barahathawa). It has also been found that 1527 population from 303 households were migrated in the Barahathawa municipality from nearby villages of Sarlahi and Rautahat districts; whereas, 671 population from 179 households were migrated to the nearby towns, villages of Rautahat, Sarlahi and Kathmandu districts in 2018^[14].

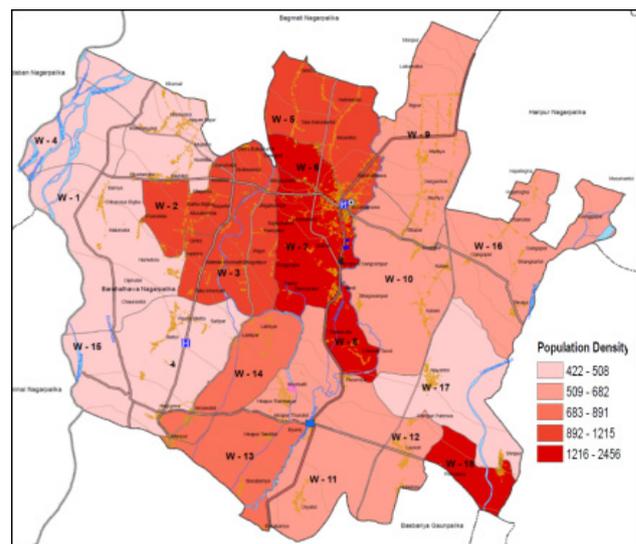


Figure 3. Population Density, Barahathawa Municipality 2018

However, as the municipality has a direct link with the district headquarters Malangawa and other urban centers developed along the east-west highway and easy access to the Indian markets, and hills districts, municipalities, and rural municipalities of Province 2 (Center Tarai); there is a high possibility of increasing population in the municipality. Well-road connectivity, increasing urban services and facilities, increasing trade and local business will collectively attract people, goods, and services to the municipality in the coming years. As of municipal profile, Barahathawa has 84,522 population in 2018 with an annual growth rate of 3.5 percent, which is very highly compared to the national population growth rate (1.35 percent)^[15]. If the population growth rate remains the same, the population of Barahathawa municipality in the next five-year would be 97,985 (e.g., 2023), and will reach 131,686 in the next 15 years (e.g., 2033)^[15] (Figure 4).

Agriculture is the main occupation of the people in Barahathawa municipality characterized by the Tarai low-land cultivation. This municipality has taken off towards commercialization from its state of subsistence agriculture. The present level of farming in this municipality is in the semi-commercial stage farming system of this municipality is agriculture-based with a specialization of few selected crops in larger areas/blocks. Paddy, maize, and wheat are the main cereal crops, whereas, sugarcane, turmeric, potato are the main cash crops grown in the municipality. There are three distinct seasons: monsoon, winter, and spring. The crop grown in different seasons overlaps each other. Hybrid maize, sugarcane, turmeric, rapeseed, and potato are considered major high-value crops of this municipality. There is a large market of agricultural production at this place that supplies cereal grains to Kathmandu and other urban cities of the country, as well as exporting to nearby Indian markets.

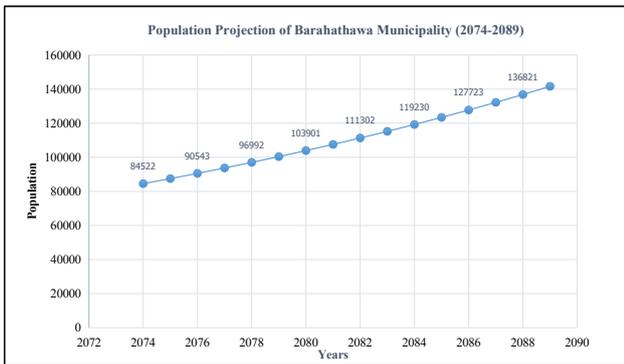


Figure 4. Population projection in Barahathawa municipality (2018-2033)

3. Urban Expansion and Spatial Growth

Expect few, many areas of the municipality have rural characters and have dispersed, and compact settlements. Dispersed settlements are ones where the houses are spread out over a wide area. They are often the homes of farmers and can be found in rural areas. Settlements like Barahathawa, Sundarpur Choharwa, Laukath, Sreepur, Hajariya are developed in a compact form, and in a leaner pattern (Figure 5). These are small market centers as well, where most of the urbanization seem to be concentrated in the future. These markets are providing services to surrounding settlements and villages. The municipality is well-connected by graveled roads which connect Malagawa in the south-east (the district headquarters) Nayaroad, Harion (east-west highway) in the north. Roads connected to Barahathawa- Malangawa, and Barahathawa-Nayaroad are also all-weather roads. Other urban roads in the municipality connected different settlements.

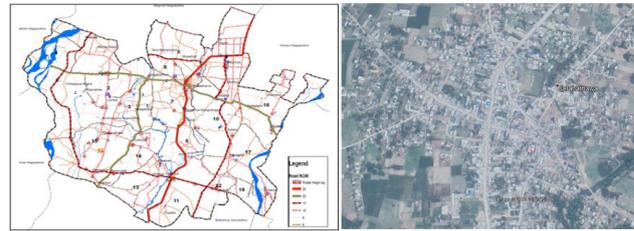


Figure 5. Overview of Urban Structure around Barahathawa

Source: Google Earth Achieve Image, 2018. Bazar

Nayaroad-Barahathawa, Barahathawa-Laukhat, Barahathawa-Hajariya, Barahathawa-Murtiya, and Barahathawa-Soltee Bazar road corridor's area will grow significantly in the future. Among others, Barahathawa and Murtiya are the most urbanized market centers in the municipality; and it has also been observed that urbanization seems to be high in and around these areas. It has also expected that the population of Barahathawa Municipality in the next 15 years (2033) would be 131,686; the populations will concentrate mainly in and around Barahathawa and Murtiya sides. If we look at the past, urban expansion had concentrated in and around the Barahathawa and Murtiya (Figure 6).



Barahathawa & Murtiya; April 2018



Barahathawa & Murtiya; November 2002

Figure 6. Spatial Growth Trend, Barahathawa (2002-2018)

Source: Google Earth Achieve Images of different time interval

Barahathawa municipality has also posed diverse spatial characteristics. Covering dominant plain (Tarai) topography and river channels have fertile land. Based on the topographic diversity, it has different potentialities of agricultural production, settlement development and urban expansion in different areas.

In terms of the settlement system and its spatial distribution, settlements are mostly dispersed and some are agglomerated. However, some settlements along the Barahathawa-Hajariya, Murtiya to the south roads have developed as a linear pattern. Barahathawa is moving towards agglomerate while other settlements, for example, Murtiya and Hajariya, are developing mostly in the compact linear pattern. Urban expansion seems to be developed along the Barahathawa-Hajariya, Murtiya to the south roads. Settlements hierarchy have been identified based on their size, functions, strategic location, and services they provide. Based on this, Barahathawa Bazar remains in the first order settlement while Hajaiya, Murtiya, Laukath, Hirapur, Nayatol, SundarpurChaurwa has identified in the second-order settlements. Many settlements in the municipality have been identified in the third, and fourth order settlements (Figure 7).

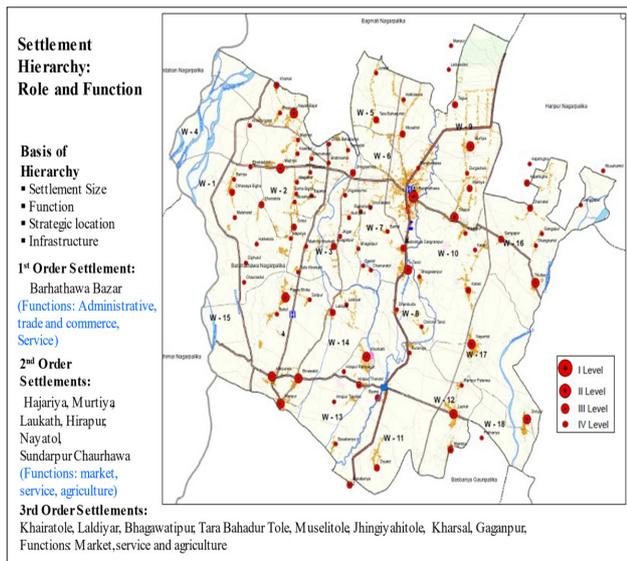


Figure 7. Settlement system and Hierarchy of Barahathawa Municipality

Spatial analysis has also been done through the road accessibility to households. The municipality has good access of roads serving more than 74 percent of households within 500m distance (about 6 minute motorable road access), and more than 19 percent households have road accessed within 1 km (12minute) (Figure 8). Most of the urban roads are gravel in condition.

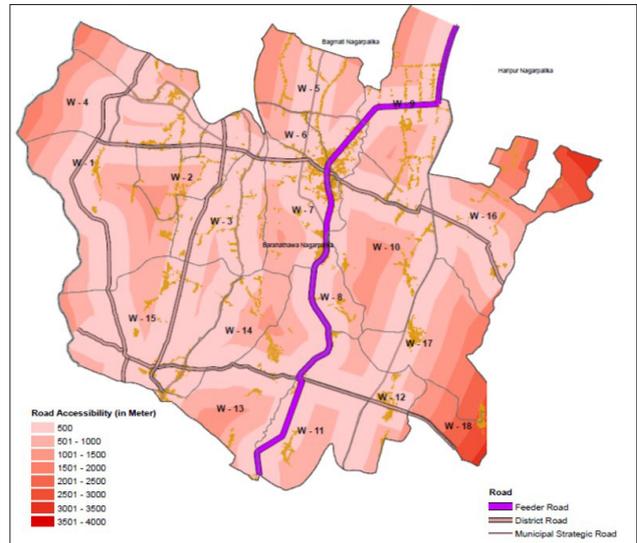


Figure 8. Road accessibility

4. Land Use and Built-up Area

Agriculture and forest are dominant land use, which has covered about 91 percent of the municipal area (Figure 9).

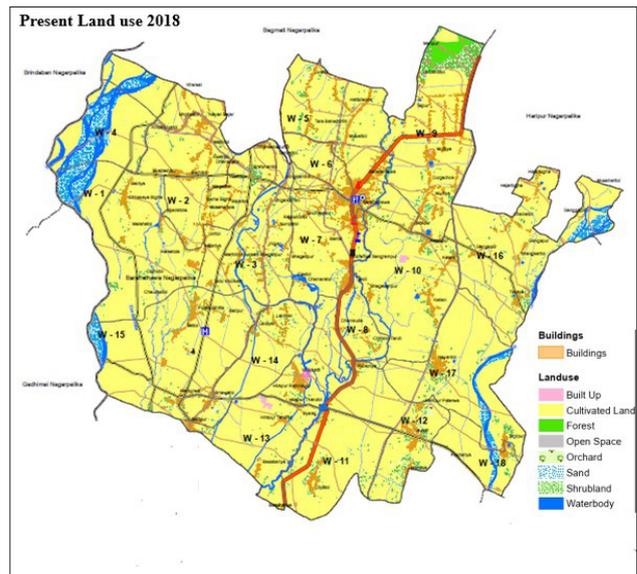


Figure 9. Present Land use Barahathawa 2018

The built-up area is covered only 2.04 percent. The agricultural land use pattern of the Barahathawa municipality has been categorized as Tarai Cultivation with paddy domination. Agriculture, built-up and barren land (along the Bagmati and Lokhandei riverside) are dominant land use categories in the municipality. Except few, most of the area have irrigation facilities through Bagmati Irrigation System (east canal) and local irrigation canals, particularly from the Lokhandei. Agriculture in Baraha-

thawa has highly commercialized dominated by maize, turmeric, sugarcane, mustard, and wheat. Winter agriculture in the southern Laukath and Sundarpur Choharwa has mostly dominated by cereal crops (e.g., wheat, maize, and mustard). However, small patches of bamboo and mango orchards have also been observed. A significant number of people are also engaged in commercial farming. Sugarcane, turmeric, and mustard are noted high-value crops; particularly at Rajghat, Shankarpur, Murtiya, and Barahathawa sides. Both traditional and modern farming practices have been observed.

Agriculture practices have been found slowly decreasing due to increasing human encroachment and expansion of the market center, particularly at the main road sides (i.e. east-west highway, Nawalpur-Malangawa, and Naya Road-Barahathawa). Rapid conversion of agricultural land into residential use has been observed at Barahathawa and Soltee Bazar sides. The rate of conversion of agricultural land into residential or commercial/industrial is reported high. Barahathawa is one of the oldest market centers of Sarlahi and has known for its agriculture production and marketing. At the beginning was a small collection of centers of agriculture production. Table 1, shows the change in land use in Barathawa municipality in the period between 2010-2018.

Table 1. Land Use Changes in Barahatawa (2010-2018)

Land Use Category	Land Use, 2010		Land Use, 2018		Percentage Changes
	Area (sq km)	Percent	Area (sq km)	Percent	
Built-up	1.98	1.85	5.61	5.24	183.2432
Cultivation	92.63	86.54	91.03	85.04	-1.7333
Forest	1.01	0.94	0.72	0.67	-28.7234
Pond	0.59	0.55	0.29	0.27	-50.9091
Orchard/Nursery	1.56	1.46	0.25	0.23	-84.2466
Sand	5.3	4.95	1.33	1.24	-74.9495
Shrub	1.51	1.41	5.32	4.97	252.4823
River	2.46	2.3	2.49	2.33	1.304348
Total	107.04	100	107.04	100	0

Sources: ICIMOD 2010 and DUDBC 2018.

Erosion/river cutting, and flooding have brought a significant change a land use around the riverside. Similarly, the cultivation area has converted into a built-up area (i.e., expansion of the market area, construction of the new residential building, roads, etc.). Linear and cluster settlements have been observed in many areas of the municipality. Brick factories at Laukath, Sundarpur Choharwa, Hajariya, and Barahathawa sides have also been noted, and small-scale processing industries are also increasing,

which have also brought significant changes in land use in the municipality. Three major factors have been identified so far regarding the land-use changes:

Agriculture land has converted into a built-up area: It is because of the increasing residential building/commercial units around the market centers and factories. These scenarios have been observed in and around Murtiya, Barahathawa, Laukath, and Hajariya. Changes have also been observed along the Naya Road-Barahathawa-Malangawa road corridors. Mostly, traditional wooden pillar houses are also observed in municipality areas. Houses having cemented bonded bricks/stone foundation RCC houses are recorded only about 10 percent. However, in the recent years, multi-story commercial and residential building using modern construction materials are gradually increasing by number in Barahathawa, Murtiya and other small market centers like Hirapur and Hajariya.



Photo 1. Traditional vs Modern buildings, September 7, 2018.

River and Waste Land: Bagmati and Lakhandehi Rivers are flowing by making a wide channel. Flooding on the rivers has lost people and amounts of properties every summer season. Marginal areas of Hajariya, Janakinagar, Sreepur, and Sundarpur Choharwa areas are prone to flood and inundation. The western part is

prone to flood from the Bagmati river, whereas eastern parts are prone to flash floods and inundation of Lakhandei river generating from the northern hill region in Monsoon time (Figure 10).



Photo 2. Lakhandei river and wastelands, September 7, 2018.

expanding rapidly in terms of functional range and magnitudes. The gravity of the market is increasing recently; therefore, in-migration has also been increased over the last five years from surrounding municipalities and rural municipalities.



Photo 3. Periodic Haatbazar and Barahathawa Bazar, September 7, 2018.

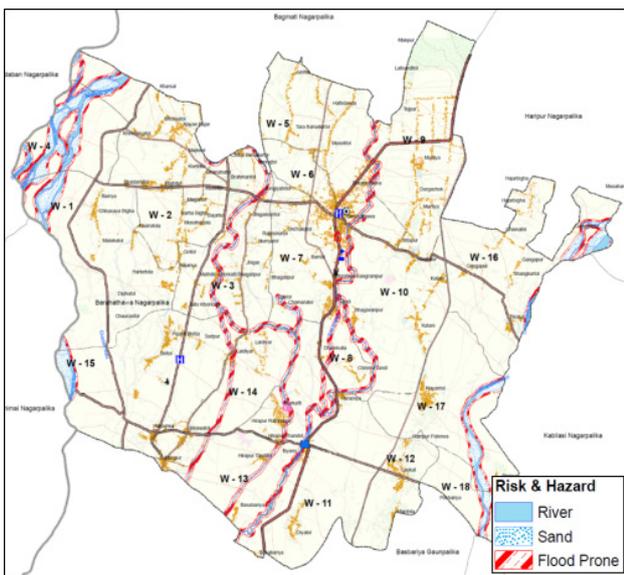


Figure 10. Environmental Sensitive Areas of Barahathawa

Market Center: Particularly Barahathawa market is

Agriculture practices, in general, are found slowly decreasing due to increasing human settlements and emerging new market centers at the main roads side i.e. east-west highway, Nawalpur-Malangawa, and Naya Road-Barahathawa. Conversion of agricultural land into residential use has been observed along both sides of roads particularly at Barahathawa and Soltee Bazar side. Barahathawa is a designated municipality in 2014 incorporating other VDCs of the surrounding areas. Therefore, the rate of conversion of agricultural land into residential or commercial/industrial is reported high. Barahathawa is one of the oldest market center of Sarlahi and has known for its agriculture production and marketing. In the beginning, it was a small collection centers of agriculture production. Figure 11 shows the change in land use in Barathawa municipality in the period between 2010-2018.

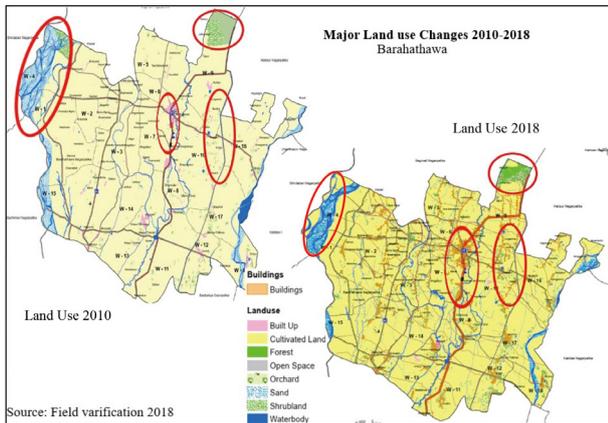


Figure 11. Changed in major land use sites 2010-2018

5. Conclusions

Newly declared municipalities like Barahathawa are rapidly growing and becoming a center of attraction for the people living in the surrounding areas. The conversion of agricultural land into the built-up area has been found significantly high in the municipality. Urban expansion has been found in and around the markets, strategic roads, and junctions. Looking at the planning issues, it has to expand haphazardly, and, therefore, proper planning with a long-term development vision is needed to regulate urban growth. One of the best tools to regulate municipality is zoning. The government of Nepal has promulgated the Land use Act^[17] and Land use Policy^[18], emphasizing the safe and secure settlement along with environmental protection and food security, and has mandated for designation of ten land use zones/classes. The local government needs to focus on the planned urban development of Barahathawa by considering the Land use Act, the existing growth scenario, and local needs. As a newly emerging and rapidly growing municipality, it requires delineating such zones for the long-term development of the municipality. Based on the existing growth pattern and considering the increasing trend of land-use changes which was quite visible during the field visit, growing urbanization and industrialization trend, increasing population, and demand of land for non-agricultural uses, land use zones are needed to be prepared.

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