Drivers and Impacts of Urban Sprawl: A case of Imadol

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Abstract
Due to rapid growth in Kathmandu valley, the peripheral areas of the valley are experiencing urban sprawl. Imadol has also experienced sprawl development due to the outgrowth of built-up areas in Kathmandu valley. There are various drivers of urban sprawl such as lower land price, population growth, availability of roads and private vehicle ownership. Likewise, impacts of urban sprawl include agricultural land-use change, increased infrastructure delivery cost, greater commuting time and social segregation. This research studies the drivers and impacts of the urban sprawl in ward no 2 of Mahalaxmi municipality which lies in Imadol city. Explanatory research design has been adopted for the study. 269 homeowners and 10 key informants were surveyed for the research. Structured questionnaires were used with close-ended questions for both homeowners and key informants. In the study area, the physical drivers are availability of roads and open space. The economic drivers are land speculation, economic opportunities, proximity to job and private vehicle ownership and the social drivers are presence of relatives, proximity to health and education facility and local policies. Likewise, the physical impacts are on land-use and urban form. The economic impacts are occupational change and emergence of new markets. Negative impacts were not observed on the social parameters taken for the study. The area has inefficient transportation and infrastructure services since the development in the area is not a planned development. Proper landuse plan and implementation of building byelaws can be carried out to guide the urban development in the area. Likewise, agricultural land conservation and vacant land taxation can be other methods for controlling urban sprawl.

Keywords
Urban sprawl, drivers, impacts, physical, social, economic

1. Introduction

Two defining influences of the last hundred years have been population growth and rapid urbanization . More than half of the world's population now lives in urban areas (55 percent, up from 30 percent in 1950)[1]. Urban areas are partly characterized by dispersed land-use patterns, which have many interrelated causes and effects. Urban dispersion processes can be described by the terms suburbanization and urban sprawl, depending on the spatial scale considered. Suburbanization is the regional process of both population and employment migrating toward the urban fringe. This process is often accompanied by a specific local pattern of dispersed urban development—urban sprawl. This is generally defined as a physical pattern of low density expansion of large urban areas under market conditions mainly into surrounding agricultural areas. Sprawling is the leading edge of urban growth and implies little a

dispersed manner toward the municipal borders [2].

Nepal is also going through rapid phase of urbanization. The number of municipalities has increased upto 293 including 11 sub-metropolitan cities and 6 metropolitan cities. This is a huge change as there were only 58 municipalities in 2011. In conjunction with rapid urbanization, urban areas in Nepal are also facing the issue of urban sprawl. Kathmandu Valley consists of 3 districts, Kathmandu, Bhaktapur and Lalitpur together covering an area of 899 sq.km. whereas the area of whole valley is only 665 sq.km. The valley encloses the entire area of Bhaktapur district, 85% of Kathmandu District and 50% of Lalitpur district [3]. The urban area has increased from around 3% of the total land in 1967 to 14% in 2000 with consistent growth of 5% in 1991 and 2000. Unplanned urban sprawl development is going on in the Kathmandu Valley which lead to haphazard land fragmentation, leapfrogging into new

peripheral areas and creation of wasteful land and gated communities [4]. Among the peripheral areas of Kathmandu valley experiencing urban sprawl, Imadol is also one of them.

There are various causes and impacts of urban sprawl. Some of the causes are globalization, lower land price in fringe areas, population growth, local policies etc. Likewise, the impacts of urban sprawl are an increase in the time spent travelling between homes, places of work and places, loss of agricultural land leading to reduction of crop and dependence on imported food, social segregation among the groups of populations of sprawl regions, potential increase of crime, displacement of less affluent people away from the core city due to high residential price [5].

2. Research Questions

The research questions of the study are:
1. What is urban sprawl and its drivers in the context of Kathmandu and Imadol?
2. What are the impacts of the sprawl in Imadol?
3. How can we guide urban sprawl to create planned urban neighbourhood?

3. Literature

Urban sprawl is a particular type of suburban development characterized by very low-density settlements, both residential and non-residential ; dominance of movement by use of private automobiles, unlimited outward expansion of new subdivisions and leap-frog development of these subdivisions; and segregation of landuses by activity [6]. The characteristics of urban sprawl are low density family dwelling, automobile dependency even for short trip , spiraling growth from existing urban centers, leapfrogging patterns of development, strip development and undefined edge between urban and rural areas [7] [8] [9] [10] [11].

Likewise, there are various drivers of urban sprawl like population growth, availability of roads, lack of open spaces, land speculation and private vehicle ownership [12] [13] [14]. Population growth is mainly caused by natural increase and rural-urban migration. In the case of developing countries, rural to urban migration is the main cause of rapid increase in population in urban area. This population pressure in the city core moves people to the fringe areas. Private vehicle ownership also allows people to live in the sub-urban areas as

they do not have to depend upon public transportation for commuting. Similarly, urban sprawl has several impacts such as social segregation, land-use change, greater commuting time and more congestion [13][14] [15]. The agricultural land in the fringe areas gets converted to residential land due to urban sprawl. As they live far from the city core, the commuting time is larger and due to inefficient transportation systems, they also experience traffic congestion during their commute.

There are various methods to tackle urban sprawl such as infill development, urban growth boundary and land development programs. Infill development is the process of developing vacant or under-used parcels in otherwise built-up areas where infrastructure is in place. Urban infill is a potential tool in our present urbanization trend as it is dispersed development. Likewise, urban growth boundary is a tool which draws an imaginary polygon around a city prohibiting development outside it for a certain period of time. UGB is a zoning tool that sets two distinct zones; one allows urbanization and the other restricts it [16]. It is not easy to justify the exact boundary for urban growth. The approach is criticized as needlessly restricting the size of the city leading to land and housing cost escalation. Unlike green belts, UGB is not a physical space but a temporary demarcation. Slightly different form of UGB is urban service boundary which prohibits services beyond defined boundary. Similary, one of the most popular method for land development is land pooling. A land readjustment scheme is typically initiated by the municipal or the national government designating an area which is about to be converted from agricultural to urban land use. A subdivision plan is developed for a unified planning of the area. Provision of infrastructure and services is financed by the sale of some of the plots within the area, often for commercial activities. The original landowners are provided plots within the reshaped area, which, although smaller in size, now have access to infrastructure and services.

4. Study Area

The study area of the research is ward number 2 of Mahalaxmi municipality, which lies in Imadol. The ward has an area of 0.45 km2. The population of the ward as per 2011 census was 6263. As per 2019 survey by ENPHO, the population of the ward was 9695 and the population density was 215.54 per hectare. The

ward is surrounded by Karmanasha Khola on the west and Manohara river on the north. It is in proximity to the Balkumari-Gwarko stretch of Ring road.

Figure 1: Ward no 2, Imadol

Two feeder roads pass through the ward: Gwarko-Lamatar road (F072) and Balkumari-Balkot road (F90). The ward has 1.2 km of black topped road, 2.8 km of earthen and 3.6 km of graveled road. Most of the roads inside are muddy in rainy season and air pollution is prevalent due to the dust from the unpitched roads.People depend upon deep boring for their water supply. Consumer groups are responsible for the water supply. The ward has 90% sewerage coverage.The ward has 4 educational institutions named Gaurishankar English Boarding School, Gamvir Samudra Setu HS School, KMC Lalitpur and Xenium National Academy. KIST Medical College is located in ward no. 1 which has 24-hour emergency healthcare and sophisticated health care services.

5. Methodology

Explanatory research design has been adopted for the study. Questionnaire surveys were conducted with homeowners and key informants. 269 homeowners and 10 key informants were surveyed for the research. Simple random sampling was done for the study. Structured questionnaires were used with close-ended questions for both homeowners and key informants.

The following parameters were observed:
1) Drivers
a) Physical: availability of roads, drainage, water supply, open space
b) Economic: land speculation, economic opportunities, proximity to job, affordability, private vehicle ownership
c) Socio-political: Safety/security, presence of relatives, proximity to health and education facility,

local policies

2) Impacts
a) Physical: landuse change, urban form, traffic congestion
b) Economic: occupational change, commuting time, affordability, emergence of new markets
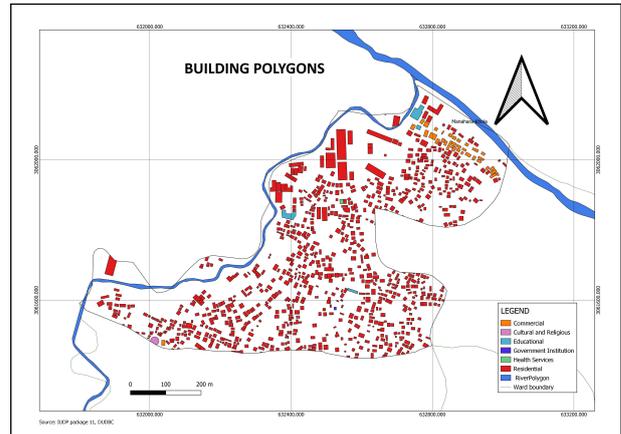c) Social: safety, social harmony, cultural conflict

Figure 2: Building polygons map

Table 1: Building Types

SN	Building type	Number
1	Residential	895
2	Commercial	31
3	Cultural and Religious	1
4	Educational	4
5	Governmental institutions	1
6	Health services	1
	Total	941

Out of the total building types in the ward, residential buildings were selected as the total population for the study. A total of 895 residential buildings were identified and the Slovin's formula given in equation 1 was used for calculating the total number of samples with 5% error of margin which resulted in 269 samples. 269 homeowners were selected as the sample of the study. Likewise, 10 key informants were also surveyed for the study using close-ended questionnaires.

$$n = \frac{N}{1 + Ne^2} \qquad (1)$$

where,
n = total number of samples
N = total population

e = margin of error

6. Description and Analysis

Out of the samples of the community survey, there were 128 males and 141 females. Likewise, the most surveyed age group was 45-54. The total responses in each categories were calculated and the mean response from each group were calculated. The responses higher than the mean response were considered to be the drivers and impacts.
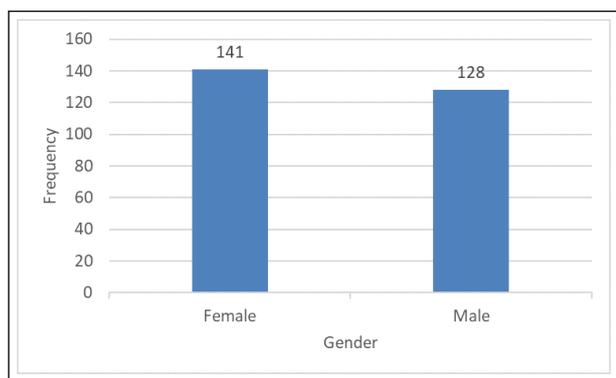

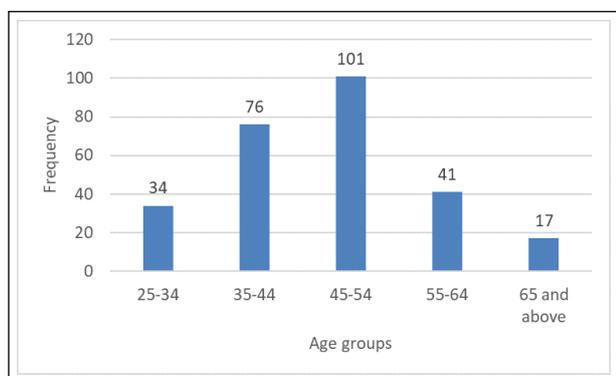**Figure 3:** Genderwise distribution of sample

Figure 4: Agewise distribution of sample

1) Drivers
a) Community survey
Regarding the physical reasons to choose the location, 199 choices were for open space, 183 for availability of roads, 101 for availability of drainage and 36 for availability of water. Regarding economic reasons, 199 choices were for land speculation, 135 for economic opportunities, 102 for proximity to job and 67 for affordability. as the economic reasons for choosing the location. Likewise, for social reasons, 175 choices were for presence of relatives, 148 for health facility,

70 for education facility and 67 for safety/security. Regarding transport choice, 236 out of 269 people used private vehicle for commuting.

Table 2: Drivers from community survey

Categories	Responses	Mean responses
Availability of road	183	
Availability of drainage	101	129.75
Availability of water	36	
Open space	199	
Land speculation	188	
Economic opportunities	135	123
Proximity to job	102	
Affordability	67	
Presence of relatives	175	
Health facility	148	115
Education facility	70	
Safety/security	67	

b) Key informant survey
Regarding the physical reasons for the population growth in the area,10 choices were for availability of roads,4 for open spaces, 2 for availabilty of water and 2 for availability of drainage. Regarding economic reasons, 10 were for economic opportunities,9 for proximity to job and 5 for land speculation. Likewise, for social reasons, 8 choices were for health facility, 8 for education facility, 4 for presence of relatives and 1 for safety/security. Similarly, the local policies for the building construction is also easier here than the surrounding Kathmandu and Lalitpur metropolitan cities since it is only a municipality.

Table 3: Drivers from key informants

Categories	Responses	Mean responses
Availability of road	10	
Availability of drainage	2	4.5
Availability of water	2	
Open space	4	
Land speculation	5	
Economic opportunities	10	8
Proximity to job	9	
Presence of relatives	4	
Health facility	8	5.25
Education facility	8	
Safety/security	1	

2) Impacts
a) Community survey
237 people responded that their commuting time was 0-15 mins whereas 21 people said that it was 15-30

mins. 167 people did not experience traffic congestion during their travel whereas 102 people experienced congestion. 195 people rated the place as affordable and 74 rated it as very affordable. 164 respondents rated social harmony in the place as good and 105 rated the place as very good. Likewise, 201 rated cultural conflict as never and 68 rated it as sometimes.

Table 4: Impacts from community survey

Categories	Sub-categories	Responses
Commuting time	0-15 mins	237
	15-30 mins	32
Traffic congestion	Yes	102
	No	167
Affordabiility	Very affordable	74
	Affordable	195
Safety	Very safe	249
	Safe	20
Social harmony	Very good	105
	Good	164
Cultural conflict	Never	201
	Sometimes	68

b) Key informant survey

Regarding occupational change, for the dominant occupation at present, 7 choices were for business, 3 for private job and 3 for private job. For dominant occupations before 10 years, 8 were for government job, 8 for farming and 2 for business. Likewise, for dominant occupations before 20 years, 10 were for farming and 6 for government job. New markets have also emerged in Yashi Tole, Hari Prasad Marga and around Ganapati Pipal Bot Chowk.

Table 5: Impacts from key informants

Categories	Sub categories	Responses	Mean
Dominant occupations at present	Business	7	4.33
	Private job	3	
	Government job	3	
Dominant occupations before 10 years	Business	2	6
	Government job	8	
	Farming	8	
Dominant occupations before 20 years	Farming	10	8
	Government job	6	

c) Secondary data

From landuse maps in figure 5, 6 and 7, it can be observed that the ward has changed from a cultivation area to a residential area from 2000 to 2020. The built-up area has increased from 0.29 ha in 2000 to 43.09 ha in 2020 whereas the cultivation area has decreased from 40 ha in 2000 to 0.51 ha in 2020. Likwise, the urban form has changed from linear and leapfrogging development in 2003 to compact development in 2021.
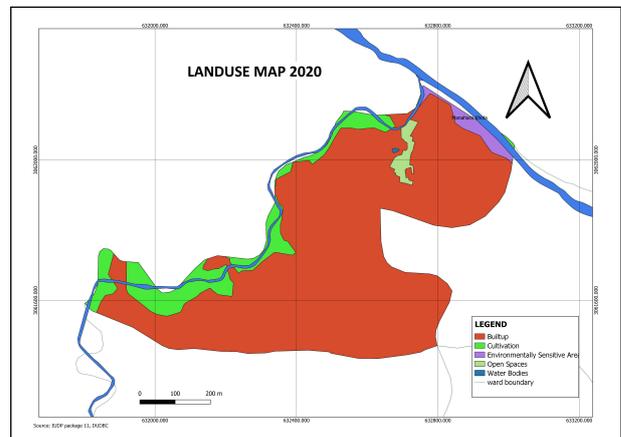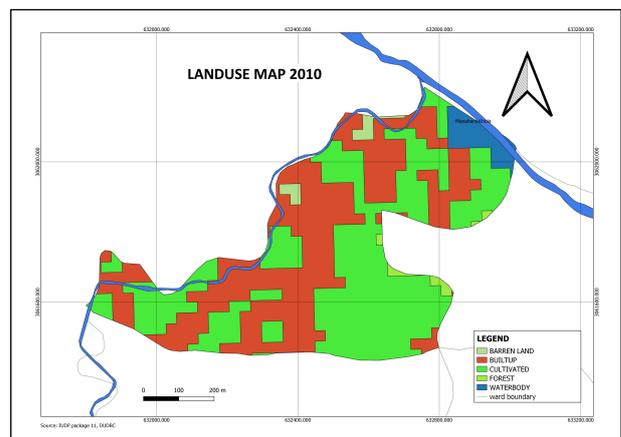

Figure 5: Landuse map 2020
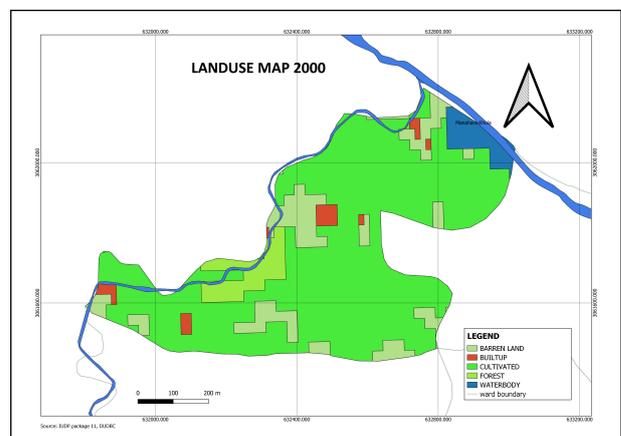

Figure 6: Landuse map 2010

Figure 7: Landuse map 2000

Table 6: Landuse change(Area in hectares)

Year	2000	2010	2020
Builtup	0.29	6.79	43.09
Cultivation	40	36.99	0.51

Figure 8: Ward 2, 2021 showing compact urban form
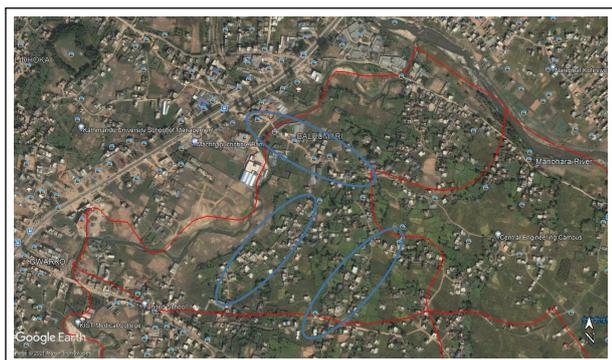

Figure 9: Ward 2, 2011

Figure 10: Ward 2, 2003 showing linear and leapfrogging development

7. Findings and Discussion

Considering the categories that are above the mean response, the drivers and impacts have been taken. The results from community and key informant survey have been combined. The physical drivers are availability of roads and open space. Roads are vital to the development of a settlement. They link producers to markets, workers to jobs, students to schools and sick to the hospitals. Kathmandu and Lalitpur metropolitan cities are full of buildings and the open spaces in the cities are few.This motivates people to choose sub-urban areas where there are open spaces and the pollution is less. Likewise, the economic drivers are land speculation, economic opportunities, proximity to job and private vehicle ownership. Due to lower land price in peripheral areas than the city core, people have chosen the area for living which were agricultural lands in the past. Owning private vehicles also make it easier to leave beyond the city core as they do not have to depend on public transportation. Being near to Kathmandu and Lalitpur metropolitan cities also provides economic opportunities for the people living in the area. The social drivers of urban sprawl are presence of relatives, proximity to health and education facility and local policies.Many people also have chosen the place for residency since they had relatives around the area. Education and health facilities are also vital social infrastructures for a settlement. The local policies for building construction is also easier in municipalities than metropolitan cities due to simpler institutional structure.

The physical impacts of urban sprawl are on landuse and urban form. Since organic settlements usually develop along the roads because it becomes easier to travel through them, initially the settlements were linear in nature in 2003 which can be seen in figure 10. The settlement has now taken a compact and dense form. From figure 5, 6 and 7, it can be observed that the settlement has changed from a cultivation dominant area to residential area. However, contrary to the impacts of urban sprawl like increased commuting time and traffic congestion, the commuting time for the people is 0-15 mins for the majority of the homeowners. Similarly, majority also don't experience traffic congestion. This might be due to the fact that the homeowners depend upon rent for income and they also open shops on the same building or near to their houses. This has also caused an occupational change for the people of the area as they initially depended on agriculture and government job for income. So, the economic impacts are occupational change and emergence of new markets. New markets have also emerged in Yashi Tole, Hari Prasad Marga and around Ganapati Pipal Bot Chowk which are on the northern and southern portion of the

ward. Likewise, negative impacts have not been observed in the social parameters that were taken for the study. Since the settlement is a new settlement and there were not any traditional settlements, there is not much cultural conflict and the social harmony is quite good in the area. The place is now a compact settlement due to which the chances of crimes is lower and because the houses are near to each other, people feel safe living in the area unlike in places where the development is sparse and the houses are far from each other.

8. Conclusion

Regarding the drivers of urban sprawl, the physical drivers are availability of roads and open spaces. However, the roads inside the ward are graveled and earthern and they are quite muddy in the rainy season. Likewise, the economic causes are economic opportunities, land speculation, private vehicle ownership and proximity to workplace. Similarly, the socio-political reasons are presence of relatives, proximity to education and health facility and local policies. Likewise, regarding the impacts of urban sprawl in the area, the physical impacts are on land use and urban form. The land use has changed from cultivation area to residential area exclusively. The urban form has also changed from linear and leapfrogging development to a compact development as of present. However, traffic congestion is not a major issue for the residents. Likewise, the economic impacts are occupational change and emergence of new markets. The occupation has changed from farming and government job to business in the past 20 years. New markets have emerged along Yashi Tole, around Ganapati Pipal Bot Chowk and Hari Prasad Marga. The commuting time for the majority of homeowners is only 0-15 minutes. Likewise, regarding the parameters of social impacts considered in the study such as safety, social harmony and cultural conflict, negative impacts were not observed. The following parameters were found to be the drivers and impacts of the sprawl.

1) Drivers

  a) Physical: availability of roads and open space

  b) Economic: land speculation, economic opportunities, proximity to job, private vehicle ownership

  c) Socio-political: presence of relatives, proximity to health and education facility, local policies

2) Impacts

  a) Physical: landuse change and urban form

  b) Economic: occupational change and emergence of new markets

9. Recommendations

The development in the ward looks like a semi-formal development due to inefficient road networks and infrastructures. Presence of buildings and roads is not enough for a proper development. The roads inside the ward is earthen and graveled and during the rainy season, it is quite muddy. Regarding water supply, the consumer groups themselves are responsible. Due to unplanned development, the quality of life of the people in the area is not satisfactory. The municipality should only allow planned development in the area with appropriate land use plan and proper implementation of building bye-laws. Vacant land taxation can be applied if the land remains vacant for a long period of time. Likewise, agricultural land conservation should be encouraged by providing subsidies and not allowing development in those areas except for agricultural purposes. Further research in the same topic in different places can be done to contrast the findings of the study.

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