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M.SC PROGRAM IN URBAN PLANNING

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“IMPACT OF BAGMATI CORRIDOR DEVELOPMENT ON  
LOCAL LAND USE AND ENVIRONMENT”  
(CASE STUDY FROM JWAGAL TO BALKHU SECTION)



BY  
ASHA SHREE RAJBHANDARI

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RAJ

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SUBMITTED TO DEPARTMENT OF ARCHITECTURE AND URBAN  
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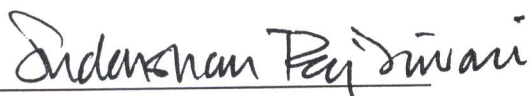
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The undersigned certify that they have read, and recommended to the Institute of Engineering for acceptance, a thesis entitled "Impact of Bagmati River Corridor Development on Local Land Use and Environment (Case study from Jwagal to Balkhu section)" submitted by Asha Shree Rajbhandari (067/MSUP/202) in partial fulfillment of the requirements for the degree of Master of Science in Urban Planning.

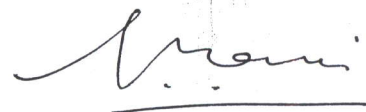


Thesis Supervisor

Prof. Dr. Sudarshan Raj Tiwari

Department of Architecture and Urban  
Planning

Institute of Engineering, Pulchowk Nepal

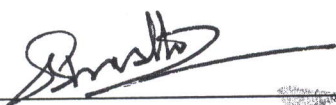


External Examiner,

Mr. Kumar Prasad Lohani

Superintendent Engineer (Retd.)

DUDBC



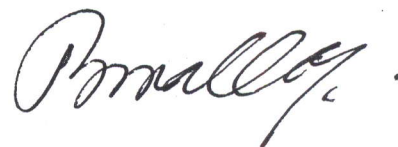
Program Coordinator

Dr. Sudha Shrestha

M.Sc. Urban Planning

Department of Architecture & Urban Planning

IOE, Pulchowk Campus



External Examiner

Mr. Umesh Bahadur Malla

Director General, DUDBC

Former President of Regional &  
Urban Planners Society of Nepal  
(RUPSON)

Date: October 7<sup>th</sup> 2012

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## ABSTRACT

Urban river corridors are considered to be prolific areas for development. They not only have numerous commercial potential but also are usually considered potentially attractive and ecologically interesting urban spaces. They have become prime targets for redevelopment in Western and European countries, offering the opportunity to create mixed use, high-density and high-quality communities and further adding to city beautification and environmental protection.

The Bagmati River flowing through the core has very high environmental, social, historical and cultural value. However haphazard and tremendous urban growth as a result of improper planning, management and numerous problems has resulted in the degradation of the river converting it into virtually an open sewer. This has degraded not only the environment but also affected the economic opportunities of the surrounding land.

In this aspect the research tries to identify the existing situation of the study area in relation to road development and the land use and environmental problems encountered as a result. This research examines the changes that have occurred in the study area over a period of four decades mainly focusing on the land use and river environment aspect, ultimately analyzing the present scenario. A descriptive approach including several field observations, questionnaire survey of buildings along the river corridor road and analysis of aerial and satellite images through digitization was applied in the study.

In the existing situation commercialization is inevitable in the area and so should be further promoted in a planned manner together with keeping the river environment in mind. Ultimately the main aim of this study is to help in guiding future urban river corridor road developments in order to realize their full potentials, to learn from the existing problems encountered by the Bagmati River Corridor Road and so to provide the necessary guidelines and recommendations for proper development in future cases.

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## **ABBREVIATIONS**

- A D. / (AD) Anno Domini (in the year after Christ)
- B.S. / (BS) Bikram Sambat
- BAP Bagmati Action Plan
- BLR Bagmati Link Road
- ADB Asian Development Bank
- CBS Central Bureau of Statistics
- DHUD Department of Housing and Urban Development
- DLR Department of Land Revenue
- DOB Department of Building
- DOTM Department of Transport Management
- DOR Department of Roads
- DUDBC Department of Urban development and Building Construction
- Ha. Hectare
- HPCIDBC High Powered Committee for Integrated Development of Bagmati Civilization
- ICIMOD International Centre for Integrated Mountain Development
- JICA Japanese International Cooperating Association
- KMC Kathmandu Metropolitan City
- KVEO Kathmandu Valley Environment Outlook
- KVTDC Kathmandu Valley Town Development Committee
- KVUDPP Kathmandu Valley Urban Planning Development Plans and Programs
- LSGA Local Self Governance Act
- LSMC Lalitpur Sub-Metropolitan City
- MLD Ministry of Local Development
- MOPE Ministry of Population and Environment
- MPPW Ministry of Physical Planning and works
- SWMRC Solid Waste Management Resources Mobilization Center
- TDC Town Development Committee
- VDC Village Development Committee
- WWTP Waste Water Treatment Plant

## CHAPTER I: INTRODUCTION

### 1.1 THESIS TITLE

#### Impact of Bagmati River Corridor Development on Local Land Use and Environment (Case Study from Jwagal to Balkhu Section)

### 1.2 BACKGROUND

Urban populations are increasing all over the world. By 2010, there were 2.5 billion urban dwellers in low and middle-income nations; which accounts to roughly the same as the world's total population in 1950 (World Disaster Report, 2010). Urbanization has resulted in rapid population growth in cities and Kathmandu is no exception.

Kathmandu Valley	1950's	1980's	2001
Population in the Valley	410,995	766,345 (doubled)	1,645,091 (quadrupled)
Population Density (ind./km <sup>2</sup> )	457	852 (doubled)	1759 (quadrupled)
Urban population in Valley	181,082	363,507 (doubled)	995,966 (>5.5 times)

Source - CBS (2002), ICIMOD/UNEP/MoEST (2007)

Migration is the main cause for this rapid population growth after the 1950's. According to CBS study, about 42% of the population of urban areas of Kathmandu Valley is migrants. The 2001 census population along with the projected population of the two major municipalities is given below:

Municipality	2001 Census Population	2011 Population
Kathmandu Metropolitan City	671,846	1,011,105
Lalitpur Sub- Metropolitan City	163,923	229,852

Source: Pant, P. R & Dongol, D (2009)

It is seen from the population projection that at present, in a span of a mere 10 years the population has almost doubled. Of the population of 26.6 million in Nepal in 2011, 17% was living in urban areas and it is increasing with rate of 1.4% per annum (CBS 2011 census, Republica on 27<sup>th</sup> September 2011). **This rapid urbanization is transforming the social, economic and cultural fabric of the society.** However, increase in population gives rise to various other serious problems and needs. Cities are increasingly stretched to provide urban infrastructure, services, and safe affordable living for all. This leads to problems such as unplanned development resulting in sprawl, growth of slums and squatters, improper road networks leading to traffic congestions and air pollutions, improper sanitary provisions, the river pollutions resulting in environmental degradation, etc.

One of the main factors manifesting the positive change in land use is through **physical infrastructure development**. Physical infrastructures are the foundation for economic development and prosperity; of which the development of road networks is of major importance. Not only are roads and bridges for transportation of people and goods from one place to another but also are the underlying means for development and stimulation of the socio-economic activity of the area, its inhabitants and the surroundings.

According to the Department of Transport Management (DoTM), the increase in number of public vehicles registered in Bagmati Zone was estimated to be around 12 percent per annum (Source:2000/01 – 2005/06 data). However it is obvious that the road networks within the Valley is inadequate to cater to this large growth in vehicle numbers; thereby leading to increased congestion and road accidents, difficulties for pedestrian movements- pedestrian/vehicular conflicts, environmental degradation and poor public transport operation and services. The road networks have to be properly planned to serve the community as many social and economic benefits can be derived. So, **alternate routes are necessary** such as the corridor link roads along the rivers.

The construction of **link roads** along the banks of Bagmati, Bishnumati and Dhobikhola rivers in Kathmandu Valley has eased the traffic woes to a certain extent. These river side road corridors was initially proposed by JICA as part of an inner ring road concept in their study on 'Kathmandu Valley Urban Road Development' in 1993 with the long term goal of establishment of road network for well-balanced urban development. The other benefit that should be gained from laying these link roads along river corridors is also to help in the river management and contribute to the development of the overall area. So, the development of link roads seems to be the *most viable option* in today's context assuming that land is still available near the river banks, thus making land acquisition comparatively easier and cheaper. As of 2010, 25% of the vehicles were using those roads but the use would increase if the roads were complete (Source: as stated in the article by Mathema (2010)). Clearly, link roads offer an alternative and logical way of extending the length of the valley's roads while providing 'short cuts' across the different routes.

Development of road thus leads to **land use change**. However, with the development of roads, further impacts on land use change may broadly be categorized as **environmental and socio-economic**. Kathmandu Valley is rich in small rivers and watersheds. Almost all the watercourses flow through the middle of the city. These **Urban River Corridors** are prolific areas for development to occur. Not only are these areas important for their religious and

cultural values but also have great potential for urban development. The planning intervention on City Rivers as water front development was very popular in Europe and America in the fifties and sixties. Nepal has initiated few development works in the Bagmati corridor, conservation of the Bagmati River etc and on other river corridors like Bishnumati, Dhobikhola. However much remains to be seen in terms of sustainability.

Sustainable development of Urban River Corridors means the **holistic approach** of treating *the river and the urban setting as a system and not as individual entities*. The road, the river and the urban setting all should comprise the system. Each if treated in isolation, sustainable development is not possible. The **Bagmati Corridor** refers to the Bagmati River, the adjacent link road and bridges and the urban setting of that area.

**IDENTIFICATION:** The Bagmati Corridor stretch from Jwagal to Balkhu is developing and with construction of the link road and its blacktopping, changes in land use pattern is seen. Initially the road that existed was a 1.5m wide dirt road (in 2055B.S.) and the area comprised of agricultural fields and outgrown bushes. It was not considered a safe area. After the UN Park acquired the land and initiated the development of road, changes in the land use pattern and overall environment of the area occurred. However, the changes that are occurring are not satisfactory as compared to the potential of development that should have been. In the actual construction of this road corridor there were no formal planned development unlike in the Bishnumati corridor and Dhobikhola corridor. This road segment was constructed as and when budget was allocated and so black topping is neither complete. However the main negative effect of overall development of the Bagmati Corridor area is the degrading Bagmati River environment and its impacts on the surroundings. Following are the drivers which are contributing to degradation condition of Bagmati River:

**Population Growth, Urban Growth and Expansion, Agricultural Development**

The Bagmati River is considered as one of the holiest rivers of Kathmandu Valley by its inhabitants (chiefly by Hindus everywhere) as it flows through the heart of the valley on the bank of the holy temples Pashupatinath, Guheswori and is a religious symbol. Several monuments of religious, cultural and historical significance are found on the river banks.

Until a few decades ago, the Bagmati River was healthy to support the civilization with provisions ranging from drinking water, for irrigation, for religious and cultural purposes to disposing the waste water produced by the valley due to its own self-purification capacity. But now due to tremendous increase in population and unplanned growth and

development, the volume of waste water discharge exceeds beyond the river's self-purification capacity and tremendous pressure has resulted in its degradation. It has been converted into a repository for sewage. The city is becoming an example of a terribly polluted city with open sewers and unhygienic disposal of waste leading to the pollution of all the existing rivers in Kathmandu. Not only this, but there has been extensive loss of flood plains and agricultural lands as a result of urbanization and the pressures related to it. The river territory has been significantly manipulated and encroached for various purposes (Source:UN Habitat--Water for Asian cities Programme Nepal, 2008, p.18).

Thus, despite the rivers' fundamental role since ancient times as the first place of urbanization, riverside areas are frequently afflicted by tremendous problems of overcrowding, conflicting uses, and pollution, often due to the absolute lack of planning and management (Pant & Dongol 2009, p.6).

### **1.3 RATIONALE OF THE STUDY**

Cities in under-developed and developing countries are facing concerns of congestion and urban growth. The concern in cities like Kathmandu is that the growth is very rapid as both urbanization and development are ongoing processes that have not yet peaked. Urban, a way of life is different from rural and conversion of agricultural land to other uses seems rational. Furthermore impact of urbanization on the environment and land use is now becoming a major concern. Examination of the land use change and its relationship with corridor road development and impact on the Bagmati River environment can be done on a spatial context to pinpoint locations for concern. "Like many urban processes the spatial nature of these problems is self-evident" (Srinivasan, p.2).

With the construction and development of the Bagmati link road, the surrounding area's (from Jwagal to Balkhu) land use pattern has changed tremendously. Not only has the distance for travel been reduced, development of the area has taken place. Once agricultural fields, now what we see is a dominance of mixed land uses (mixed areas of residential and commercial). It is preceded by the apparent domination of residential land use pattern; this area is highly urbanized and boasts of various institutional developments (schools, colleges). Now, with the black-topping of the road, further development of the area has been witnessed commercially rather than residential with people's perceptions changing due to the inevitable rise in land value.

Even though the area has been developing, it may be to some extent at the cost of the Bagmati River or looking at it from another perspective; we can also say that the development potential of the area has not fully been exploited due to the existing state of the Bagmati River. *In both cases the land use change, development and the river are interconnected and interrelated.* River corridors are considered to be prolific areas for development to take place. However haphazard and tremendous urban growth of the valley results in the increase of waste water discharge and solid waste disposal in the Bagmati river. This results in the environmental degradation of not only the river but the surroundings as well, thus having a direct impact on the well-being and socio-economic impacts of the inhabitants of those areas.

***“There are significant social, economic and environmental gains to be made by integrated and innovative interventions in urban river corridors”*** (www.ursula.ac.uk).

#### 1.4 PROBLEM STATEMENT

The area under consideration i.e. Jwagal to Balkhu section of Bagmati corridor is developing, and with further development and improvement of the link road corridor its land use has been rapidly changing.

**Physical Change:** Changes in the land use pattern that has been witnessed over the years. Previously agricultural lands were converted to residential uses but now a mixed type of development, with commercial growth can be seen. Urban growth in the area which has resulted in haphazard growth and development with unplanned construction of the buildings and roads. The full potential of the area has not been realized.

**Socio-Economic Change:** Change in the society, historical and cultural setting of the area mainly due to in-migration. The **socio-economic drivers** of land use change comprise of several factors such as demographic, social, economic, political and institutional factors and processes such as population and population change, industrial structure and change, technology and technological change, the market, various public sector bodies and the related policies and rules, values, community organization and norms, property regime. Development leads to increase in land value and increase in commercialization.

**Environmental Change:** Reduction in agricultural lands and open spaces (ecological patches) due to urbanization and growth. Encroachment of the river banks, untreated sewage discharge resulting in pollution of the river, loss of aquatic life and habitat, unmanaged solid

waste disposal resulting in degradation and narrowing of the river. All of these have led to a degraded river environment.

The Bagmati River should be a boon to a city as it is in the case of developed nations, riverfront development and preservation efforts have been made a top priority. Urban open spaces, such as the Bagmati River Corridor are key ingredients for the cities' development and sustainability. However, ours is an under-developed country and to compare with the developed nations would be unfair. Rather lessons and applicable examples and strategies may be adopted where possible; ultimately, clear and well monitored regulations may ensure fruitful outcomes. There lies many potentials for the development of the area and these need to be explored and proper policies drawn out. An integrated sort of holistic development perspective seems to be lacking in our case. Treating of the river as a separate entity from the road and urban setting has not resulted in sustainable development of this urban river corridor.

## 1.5 STATEMENT OF PURPOSE

### 1.5.1 OBJECTIVES OF STUDY:

The main objective of this research is to *study the impact of the Bagmati Link Road on land use and environment of the river corridor*. In specific to analyze the

- **Local land use change perspective** and urban growth of the area: time series analysis (1965AD, 1987AD, 1999AD and 2012AD).
- **Socio-economic perspective:** impacts of change on land prices and economic activities along the corridor. Analyze the trend of growth and urban development as a result of better accessibility due to roads and bridges.
- **Socio-cultural perspective:** Taking into account the changes in religious practices related to the Bagmati River of the area and the emerging practices.
- **Environmental perspective:** degradation of the Bagmati River; to identify, analyze and outline the environmental issues encountered by the Bagmati river as a result of haphazard and tremendous urban growth. What all can be done to improve the environment of the Bagmati river. Concept of river corridors as Greenways.

### 1.5.2 HYPOTHESIS

*Urban roads when situated too close to river corridors can have more negative consequences in terms of environment, particularly the river system.*

## 1.6 METHODOLOGY

This research is done to understand the existing scenario of the study area and the choice of research method is the **case study research strategy**. Theoretical studies will be followed by the case study research strategy. Information will be deduced through **case-specific studies** using the deductive approach.

This is a descriptive study following combined approach of ontological basis and the epistemological basis. The site observation, the perception generated after visiting site and the interaction with the people will be the part of ontological stand. Whereas the epistemological stand is that urbanization will impact in degradation of the environment and thus effect overall development. The following activities will be involved in carrying out the research:

- **Literature Review:** It includes studying past thesis, research materials related to the topic, journals, articles and publications related.
- **Data Collection:** It includes primary as well as secondary data.
  - ✓ **Primary data** includes field investigation, visual survey and observation for analyzing the existing situation of the area (visual assessment), questionnaire survey of a small purposive sample in order to know the existing status of the study area and interviews with key informants. Interviews also with the officials of municipalities, government and non-government offices.
  - ✓ **Secondary data** includes aerial photographs (present as well as previous years) to analyze the land use change, base maps, Google images, reports, literature, previous research works.
- **Data analysis:** Collected data will be processed and analyzed within the objective framework to arrive at logical conclusions. Programs such as excel, autocad, SPSS will be used.
- **Synthesis and Findings:** Analyzed results will be interpreted and generalized including drawing inferences of findings to address the research questions. The final output of the data analysis will be presented in the form of graphs, charts, tables, maps and literature. The data will be synthesized to give a conclusion as the main findings of the research. This will include finding out the problems and the potential of the area in the development.
- **Conclusions and Recommendations:** On the basis of calculated data and interpretation conclusions will be made and all the research objectives addressed.

The recommendation for the problems will be made in the form of guidelines, policies, plans and programs.

- **Further Research:** Maximum effort will be used to collect, analyze, conclude and recommend the research objectives questions. The study will focus on the impact of the road corridor on land use and the environment. Other factors will not be covered by the study and further research work will be required to research to study area. Thus it is recommended to future scholars to elaborate rest of the problems which have not been considered in this study.

### 1.7 EXPECTED OUTCOMES

- ✓ Analysis of the trend of land use change and general environmental scenario in the areas adjacent to the link road.
- ✓ To establish the type of relationship between development of link road and the socio-economic aspect (shorter distance, less time, more productivity, better development)
- ✓ Impact of development of the road corridor and urban setting on the environment (degradation of the Bagmati river)
- ✓ Plans and policies for sustainable development in terms of physical, social and environmental change. Concepts of city beautification and River Corridors as Greenways.

### 1.8 SCOPE AND LIMITATION

The scope of the study is limited to the development pattern along the Bagmati corridor starting from the new Bagmati Bridge in Jwagal till the Balkhu pool. The Bagmati Corridor refers to the Bagmati River, the adjacent link road and bridges and the urban setting of that area. The land use change analysis only of the areas adjacent to the link road will be taken into consideration. This may involve areas up to 50m-100m inside from the main link road.

The study research will be based primarily on- field visits, visual observations and analysis, aerial images from previous years till date and review of secondary data. Concerned literatures and references only will be reviewed.

## CHAPTER II: LITERATURE REVIEW

### 2.1 LAND AND LAND USE

Brissoulis in 'Analysis of Land Use Change: Theoretical and Modeling Approaches' is of the view that 'land' is the stage on which all human activity is being conducted and the chief source of the materials needed. Human use of land resources gives rise to "*land use*" which varies with the purposes it serves, whether they be food production, provision of shelter, recreation, extraction and processing of materials, and so on. So we can see that land use is being shaped under the influence of two broad sets of forces – *human needs and environmental features and processes*. "Neither one of these forces stays still; they are in a constant state of flux as *change* is the quintessence of life" (Brissoulis, p1, ch.1).

Land use is also often used to refer to the distinct land use types in zoning. Land use involves the management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements. It has also been defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it" (FAO, 1997a; FAO/UNEP, 1999). Albert Guttenberg (1959) "'Land use' is a key term in the language of city planning." (Source: online; [http://Wikipedia.org/wiki/Land\\_use](http://Wikipedia.org/wiki/Land_use))

Changes in the uses of land within various time periods are the material expressions of environmental and human dynamics and of their interactions which are mediated by land. These changes have at times beneficial, at times detrimental impacts and effects, the latter being the chief causes of concern as they impinge variously on human well-being and welfare. What is most important, however, is that, with few exceptions, it is human and not nature's agency which brings about these changes and which is responsible for their magnitude and severity.

#### 2.1.1 The Purpose of the Analysis of Land Use Change

**Descriptive studies** of land use change are almost indispensable in any analytical endeavor as a first step towards more refined analyses. Description of land use change documents changes from one type of land use to another over a given time period and within a given spatial entity. Changes in both the qualitative as well as the quantitative characteristics of land use are described, the level of detail conditioned by the spatial level of analysis and the availability of requisite data.

Description alone is not enough to provide the basis for understanding the observed land use changes or to guide policy and decision making towards effective ways to cope with the adverse implications of these changes. Explanatory analyses attempt to fill this gap. **Explanation** attempts to address the question of "why" these changes have occurred (or, are occurring) and to uncover the factors or forces that bring about these changes directly or indirectly, in the short or the longer run.

In addition to describing and explaining land use change, an important purpose for conducting such analyses is to predict future changes in land use. **Predictions** may be unconditional or conditional. Unconditional predictions, also called trend extrapolations, provide future images of the land use patterns in an area that will exist if past trends continue into the future. Conditional predictions of land use change produce alternative land use futures of an area under hypothetical conditions or scenarios. Conditional predictions are based usually on scenario analysis.

Another important purpose of the analysis of land use change is **impact assessment**. The contemporary interest is not so much on land use change itself as is on its various environmental and socio-economic impacts at all spatial levels. In addition, as policies are designed to address several of the environmental and socio-economic problems in which land use change contributes in one way or another, policy impact assessment has emerged as a significant scientific activity.

Finally, analysis of land use change may be undertaken for evaluating either past, present or future (policy-driven) changes in patterns of land use in terms of certain criteria such as environmental deterioration (or improvement), economic decline (or growth), or social impoverishment; or, more generally, against the criterion of sustainability. The results of these evaluations may be used to suggest land use alternatives (i.e. changes over those on which the evaluation was based) that would contribute to the attainment of these goals.

**Land use change** may involve either (a) *conversion* from one type of use to another i.e. changes in the mix and pattern of land uses in an area or (b) *modification* of a certain type of land use. Modification of a particular land use may involve changes in the intensity of this use as well as alterations of its characteristic qualities/attributes – such as changes from low-income to high-income residential areas (the buildings remaining physically and quantitatively unaltered), changes of suburban forests from their natural state to recreation uses (the area of land staying unchanged), and so on.

### 2.1.2 Land Use Change: Environmental and Socio-Economic Impacts

The analysis of land use change revolves around two central and interrelated questions: "what **drives/causes** land use change" and "what are the (environmental and socio-economic) **impacts** of land use change". The **socio-economic drivers** comprise demographic, social, economic, political and institutional factors and processes such as population and population change, industrial structure and change, technology and technological change, the family, the market, various public sector bodies and the related policies and rules, values, community organization and norms, property regime.

The **impacts of land use change** are broadly categorized into environmental and socio-economic, the former having received more attention and publicity than the latter. One of the reasons for this imbalance in attention may be that the latter are more subtle, longer-term and subject to the influence of many more complexes, and less visible and verifiable, factors than the former. But, it should be noted that the environmental and the socio-economic impacts are closely interrelated; the former causing the latter which then feedback to the former again, potentially causing successive rounds of land use change.

[Reference: Briassoulis, H, (Ph.D.); *Analysis of Land Use Change: Theoretical and Modeling Approaches*, Regional Research Institute, West Virginia University]

**Conclusion and Relevance to the study:** Changes in land use may basically occur under the influence of human needs or environmental processes. Environmental changes resulting in changes in land use can be seen in the study area, for example the degrading Bagmati River and the surrounding areas. But the existing environmental condition of the area is as a result of human processes rather than natural changes. So, it is human and not natural processes that bring about these changes in the land use of the area and also which in turn degrades the environment.

## 2.2 LAND USE AND TRANSPORTATION

There is an important link between land use and transportation. Transportation and land use interact with each other in a mutual and dynamic manner. Shaw (2009) was of the view that "Changes in transportation systems create new accessibility levels that influence land-use patterns. Land-use changes in turn modify activity and travel patterns, which induce further changes in transportation systems. In addition, transportation and land-use interaction is influenced by other ongoing dynamic processes in an urban system. However, it remains a challenge to identify and forecast transportation and land-use interaction in contemporary

urban areas since the interplays between different processes occur at various spatial and temporal scales and it is difficult to isolate the effect of one process from the others.”

The link between land use and transportation can be seen in terms of development and the relationship can go both ways. Land use planning and development can dictate where roads and transportation networks are needed based on demand from the population and types of existing land uses. On the other hand existing transportation infrastructure can lead to increased development where the transportation networks currently exist.

Examples of two-way linkages between land use and transportation are:

- ✓ Transportation networks determine how people travel between land uses
- ✓ Land use policies can determine how roads will connect different uses
- ✓ Increased density will allow for higher volume of arterial roads
- ✓ Directed transportation networks can control density and growth

Transportation promotes spatial interaction between activities or land uses. This interaction is measured by accessibility, which reflects both the attractiveness of potential destinations and ease of reaching those (Handy, 1993). Accessibility includes the attractiveness of a place as an origin (what opportunities there are to reach other destinations) and as a destination (how easy it is to get there from all other origins). The pattern of land uses is important because it determines the opportunities or activities that are within range of a given place. The potential for interaction between any two places increases as the cost of movement between

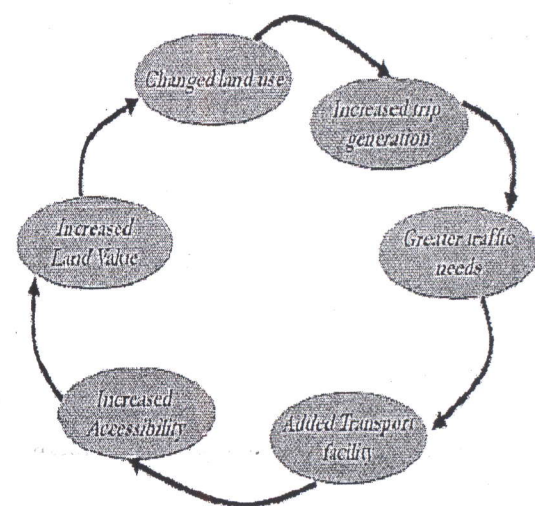


Figure 1: Land Use & Transportation Cycle

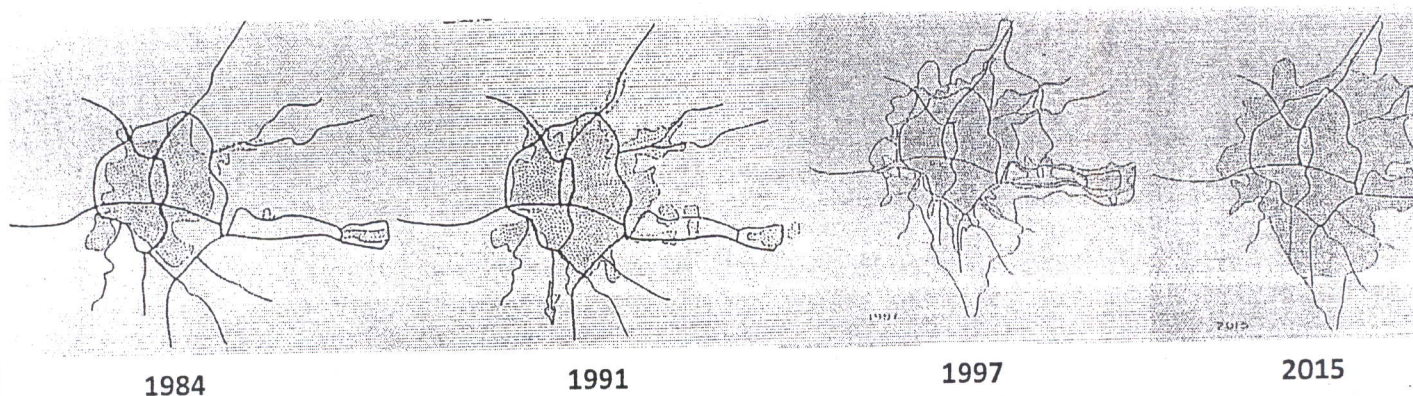
them either in terms of money or time decreases. Consequently, the structure and capacity of the transportation network affect the level of accessibility.

The relationship between transportation and land use can thus be conceptualized as an interaction of the supply of and demand for accessibility that is further affected by public policies. The supply side considers the physical aspects of land use and transportation, while the demand side considers the preferences of individuals and firms.

References: (Quade, Brinckerhoff, Parsons and Douglas, Inc, October 1998 Land use Impacts of Transportation A Guidebook- [online]-Google Books)

**Conclusion and Relevance to the study:** Land use change is directly affected by development especially infrastructure development like roads. Better roads results in better accessibility- ease of transport from one place to another. Ease of transport meaning lesser time, safer travel, shorter distance and direct links between places. Even in the study area, with the construction and development of roads, the land use of the areas gradually shifted towards commercial use changing from agricultural and residential uses. Urbanization also plays a major role for the change of land uses as well. However it is with the provision of access that further opens up these areas to development, thus exposing areas to the impacts of development.

### 2.3 URBAN EXPANSION OF KATHMANDU VALLEY



**Figure 2: Expansion of Urban Area**

(Source: JICA 1993)

Urban area is expected to almost reach urban expansion boundary set up by DHUD in beginning of early 21<sup>st</sup> century. Urban area has increased from 2,850 ha in 1984 to 7,195 ha in 1991. Urban area increase in 2015 is estimated to be 2.1 times that of the urban area in 1991 (JICA, 1993).

Urban area has increased by 7% of the total Kathmandu Valley surface area over the period between 1984 and 1990 (Halcrow Fox and Associates, 1991). Within the same period the valley's prime agricultural land has declined from 63% to 56% (IUCN2, 1995). According to the Kathmandu Valley town development committee of 2001, cultivated area covers highest percent of land about area of 302sq.km. Forest coverage is about 224sq.km; settlement with sparsely distributed cultivated land and core settlement or built up area is nearly equal which is about 89sq.km. About 2% of the total area has been declared as conservation area. Rivers and ponds occupied about 5% of the total land

Population of Kathmandu Valley within the watershed area is 1,512,362 which are increasing rapidly according to population census 2001. The annual national population growth rate is 2.25. Central bureau of Statistics has estimated annual urban population growth rate of 6.44 and rural growth rate of 1.71% in population projection for Nepal 2001-2021 (CBS, 2003).

Assuming the urban growth rate for five municipalities and rural growth rate for VDCs within Kathmandu Valley, the population projection for thirty years can be estimated to be 11 million (Bagmati Action Plan 2009-2014).

Year	Population
2001	1,596,208
2008	2,219,845
2011	2,573,988
2021	4,324,180
2031	7,502,301
2038	11,195,353

Table 3: Population Projection for Kathmandu for 30 years  
(Source: Bagmati Action Plan)

## 2.4 WATER AND URBAN DEVELOPMENT

Four of the world's ancient civilizations emerged along large rivers in dry climates, around 6000-4000 BCE, and it was not by chance. The rivers played a key role in the emergence of ancient China, the Indus Valley civilization, Mesopotamia, and ancient Egypt. Broadly speaking, the rivers not only made the civilizations possible by making food plentiful but also made them necessary by giving the people in those four areas new challenges that only "civilization" could solve. Between 5000- 4000 BC man started using water to irrigate his fields and till the age of industrialization main use of rivers was for irrigation, fishing and navigation. The next stage of development of urban settlements was the growth of cities by riversides. The river was the only safe mode of transportation at that time. Water was a resource for sustenance, communication and defense of the settlements. Due to the increasing interdependence of cities on one another, exhaustive trade and commerce were started. This gave rise to cities with a commercial waterfront.

## 2.5 IN THE CONTEXT OF NEPAL- KATHMANDU VALLEY AND RIVER CORRIDORS

### Urbanization, land use and River banks

Urbanization in the valley has started in the late 1950s. Most of the cities in Kathmandu valley were located away from the rivers. These rivers used to have many cultural values, like there used to have ghats in banks of river. Ghats are stone steps along the bank of the river and are used for many important rituals, which mostly involved holy bathing, traditional rituals and cremations etc. As well as the people of lower caste used live beside

the river banks which mostly includes butchers, sweeper. There used to be a buffer strip of agricultural land between the river and city. (HMG/ World Bank,1994). Now, urban growth has occurred rapidly in Nepal especially in Kathmandu Valley with the highest urban growth rate in the whole south Asia at 6.5% per annum (UNEP 2001). Now the urban areas have expanded from 24% of the total area in 1971 to 61 % in 1991, at the expense of prime agricultural land. (MOPE, 1999).

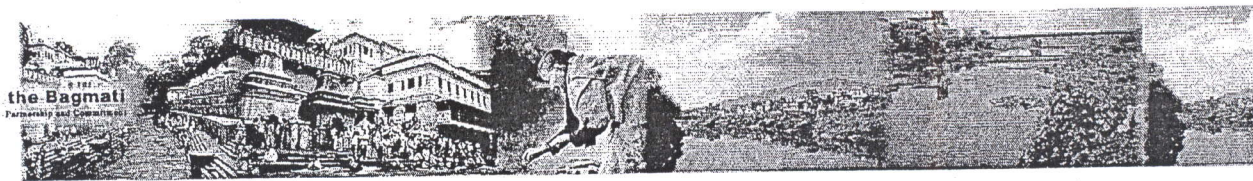
**Cultural Aspect:** Kathmandu Valley is highly rich in culture as well as heritage. There is a huge diversity of culture and tradition. Most of the cultures are directly linked with rivers that people perform in their life. It is believed that the civilization of the Kathmandu Valley starts from the river side. Majority of temples and *ghats* lie along the river bank. These rivers are not only culturally important but equally important from historic prospect as well. Kings and commoners alike built *pati*, *pauwa*, stone spout, temples etc near the river bank in memory of the deceased member of their family or for religious purpose. Most of the popular and renowned temples like Bajrayogine, Gokarna, Budhanilkantha, TikaBhairav, ShovaBhagwati lies near the river side. Among the seven UNESCO heritage site, PashupatiNath temple lies along the bank of Bagmati River and Changuarayan lies near the Manahara River. Not only the rivers but also the confluences are equally important from cultural point of view for performing rituals (Bagmati Action Plan 2009-1014).

Bathing on ceremonial occasions is a recognized religious ritual for Hindus. Bathing in rivers and holy tanks or kundas is supposed to wash away sins, thus people bathe themselves prior to undertaking every important worship and on specified days. Hence, elaborate ghats have been constructed by pious donors along the important rivers of the valley. The Bagmati and Bishnumati are the two most holy rivers. The source of the Bagmati at Bagdwar is a holy site. There are several ghats in the area of Pashupati where people bathe on all auspicious days. The other sacred points along the Bagmati are Sankhamul, where the Manohara river joins it, and Tripureswor and Teku, where it meets the Bishnumati.

The Bagmati with its 57 tributaries is the main arteries of Kathmandu Valley. Bagmati River originates from Bagdwar in Shivapuri watershed area and joins the River Ganges in India. The most important tributaries of the Bagmati are – Manohara, Dhobikhola, Tukucha, Bishnumati, Balkhu, Nakkhu, Kodku and Godawari. The Bagmati basin is composed of a broad variety of landscapes and specific human cultures.

Just a few decades ago, Bagmati, the largest river of Kathmandu Valley, used to boast crystal clear water. What used to be a pristine river—not to mention a major source of drinking water for residents of Kathmandu—is now nothing more than an open sewer. The unprecedented growth of urban population and rampant developmental activities in the city has eroded the charm of the 35.5-kilometre river, decreasing its cultural, historical and natural significance. Though the river is currently polluted almost to the point of saturation, efforts are being made to restore it to its former glory by concerned organizations, government authorities and local people.

## 2.6 EXISTING SITUATION OF BAGMATI RIVER AND ITS TERRITORY: GENERAL OVERVIEW



*River corridors are considered to be prolific areas for developmental activities. However, rapid and uncontrolled infrastructure development works along with many other problems have posed maximum threats to the natural water body.*

The issues identified of Bagmati River and its territory were: Land and physical development aspect; Environmental aspect; Wastewater treatment system; socioeconomic aspect; squatters' settlement; historical, cultural and religious elements; Institutional and legislative aspect; and sand mining (Source: UN Habitat- Water for Asian cities Programme Nepal, May,2008).

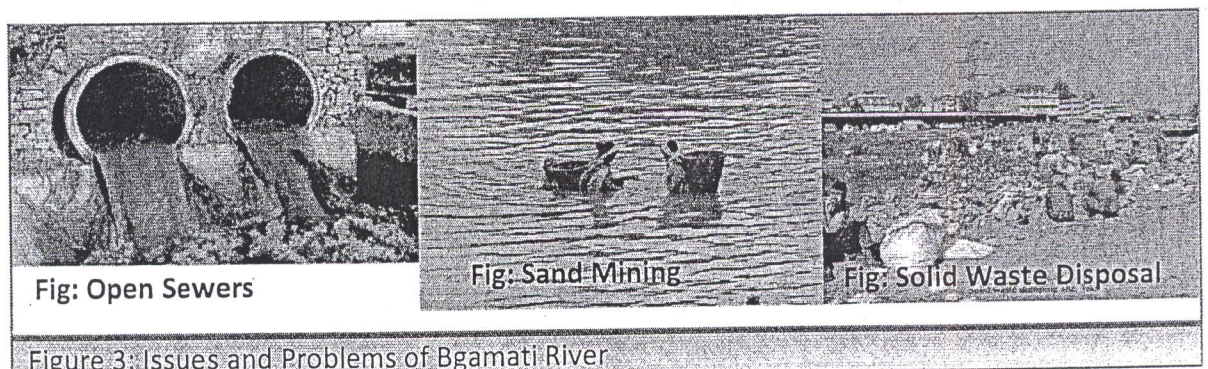


Figure 3: Issues and Problems of Bagmati River

### i. Land and physical development:

Bagmati river territory at present has been defined by the natural river course and the banks of the river which does not seem to have a clear demarcation. Due to improper demarcation of the Bagmati River and land territory, *land and physical development issues* related to

Bagmati is complex. The river flow depicted in the 2021 cadastral map varies with that of 2044 cadastral map which again does not coincide with the actual flow of river. Hence the river territory has been significantly manipulated and encroached for various purposes (Source: UN Habitat- Water for Asian cities Programme Nepal, May,2008).

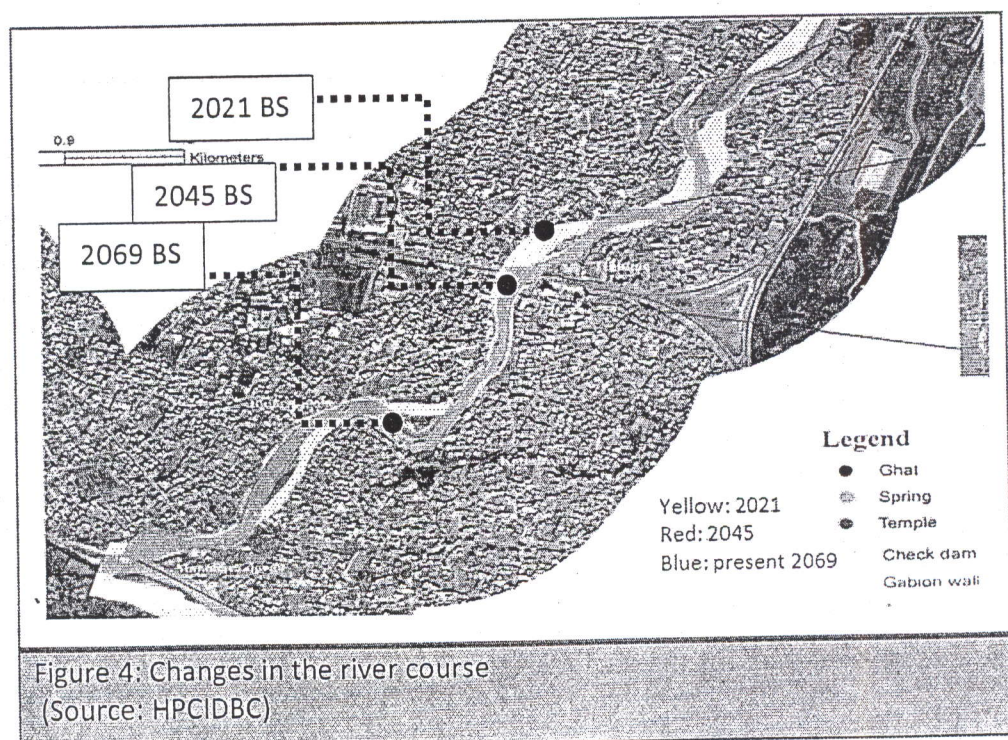
In the present context of rapid urbanization especially in the Kathmandu Valley land has become a scarce and so valuable resource. The land by the river side has become attractive to real estate developers and others alike, including the squatters. In the absence of an authentic demarcation of river, it is seen that the land has been encroached for various purposes like squatter settlements, residential, commercial, institutional developments, infrastructure development etc.

#### Changes in River Course:

(Source: UN Habitat-, Environment Improvement for Bagmati corridor; May,2008).

Change in river course is a natural and continuous action. The course of Bagmati River has been changed due to continuous movement of river under natural conditions. Changes in river course due to different natural and man-made reasons have great impact in river areas.

The data sources used to analyze the state of river area are first Cadastral maps of 1964 AD (i.e., 2021 BS), updated Cadastral maps of 1987 AD (i.e., 2044 BS), Aerial photographs of Kathmandu Valley of 1964 AD (i.e., 2021 BS), and Quick Bird Satellite Image of Kathmandu Valley of 2006 AD (i.e., 2062 BS).



The river path from Sundarijal to Gokarna is found to be deviated from its normal path at different places. River flow in 1964 has been indicated by yellow and river in 2007 by blue. The width of the river is found decreased in Chobar and Manohara khola whereas it is slightly increased in Dhobi Khola, Thapathali in 2007 compared to 1964. The area occupied by the river from Sundarijal to Chobar gorge has been found decreased from 205 hectares to 144 hectares in last four decades with the total loss of 608 hectares of river land.

#### Bagmati River in 2021 BS

According to the Cadastral map 2021, the total river area of the Bagmati River from Sundarijal to Chovar gorge is 20.48 square km, the length of this stretch is about 28.75 Km. There is no significant difference between river area demarcated in cadastral map and the river area according to aerial photo. Adjoining land of the river area is dominated by agriculture field without any structures during that period with reference to aerial photo and cadastral map 2021. The only structures present during the period were the monuments and areas of religious importance. The areas of such importance were mainly observed in Sundarijal to Chovar area of Bagmati river territory.

#### Bagmati River in 2064 BS

Bagmati River from Sundarijal to Chobar prepared on the basis of Cadastral Map 1964 AD and Aerial Photograph Kathmandu Valley of 1964. The total length of Bagmati river stretch in the valley is 28.75 km from Sundarijal to Chobar gorge and the total area covered by the river is found to be 204.8 hectare based on Cadastral map of 1964 AD. Aerial Photographs of 1964 shows the adjoining land of river area from Sundarijal to Chobar was mainly dominated by agricultural land along with the few monuments and religiously important places. From the 2064 BS satellite image. It can be noted that total calculated river course area from Sundarijal to Chovar is 14.40 square km.

River area changes				
SN	Date/Source	Coverage Area	Stretch length(km)	Area in SqKm
1	2021 BS Cadastral map	Sundarijal – Chovar	28.75	20.48
2	2064 BS Satellite image	Sundarijal – Chovar	28.75	14.40
Changes in area				6.08

Table 4: Bagmati River area changes from 2021 BS to 2064BS  
(source: UN Habitat-, Environment Improvement for Bagmati corridor; May,2008)

From 2064 satellite image it can be noted that total river course area has decreased from 20.48 sq. km in BS 2021 cadastral map to 14.40 sq. km in 2064 BS by 6.08 km.

## ii. Environment and Sanitation and depletion of aquatic biodiversity

Human settlement and various physical works along the River corridor not only alter the practice of land use but also spoil the river environment. The deterioration of the River environment has several unpleasant consequences the important one being the health issues of the inhabitants. The sanitation system of Katmandu valley and other aspects have played a major role in degrading the river environment.

Different studies show that there are significant decreases in aquatic biodiversity due to highly polluted water especially in urban core area. Trend of decreasing aquatic biodiversity increases as river flows down towards urban core. Varieties of clean river water species prevail in the headwater region and only a few tolerant species dominate in the highly polluted city core region because of organic waste (Pradhan B. 1998- extract from BAP 2009-2014).

### ✓ Solid Waste Disposal

Solid waste dumping along the banks of the river is one of the major causes of river environment degradation. Dumping of solid wastes is more acute as the river moves towards the city core. Individual households as well as municipal authorities are responsible for these activities. About 3000m<sup>3</sup> of solid waste is estimates to have accumulated in the Bagmati river during the dry season (WECS 2008- extract from Bagmati Action Plan). More than 70% of the total municipal waste generated is organic.

Municipality	Generation (2004)	Collection (2004)	Projected generation (2015)
Kathmandu	308.4	250	547.9
Lalitpur	75.1	52	135.4
Bhaktapur	25.5	19	46.2
Madhyapur Thimi	14.3	5	27.8
Kirtipur	11.6	4	18.1
Total	434.9	330	775.4

Table 5: Waste generation in five Municipalities (tons/day)

Source: KVEO, 2006

Solid waste disposal is not limited to the banks but into the river and the piers of the bridge as well. The disposal has resulted in breaking flow of river and diversion to some extent. Remnants of animals and slaughter house wastes are another big problem. Construction debris thrown haphazardly along the corridor is also another source of pollution. The river banks are also used by the municipalities to dump the solid waste in some parts.

### ✓ Water pollution

Municipal sewage disposal without any treatment along Bagmati Corridor is one of the major sources of water pollution turning the river virtually into an open drain. Including the disposal of untreated sewage from the municipal sewers, other illegal sewerage disposal points on both sides of the river banks are observed. Adhoc lying of sewer network in the Valley by the municipality itself or by the public has further threatened the riverine environment. Trunk sewers have also been discharging the sewage directly open into the river at various points. Besides that, human fecal wastes can also be observed along the whole stretch comparatively high-towards the downstream and mostly at the bridges areas. Toilets are very common at the squatter areas and the waste water is being directly discharged into the river. Utilization of Ground water source (hand pump and shallow boring) is intensive in squatter areas for household use as well as for industrial use.

Site Description	SWQC		Biotic score	
	Post- monsoon	Pre-monsoon	Post- monsoon	Pre-monsoon
Bagmati, Kupandol	IV	IV	2.2	2.2
Bagmati, Teku	IV	IV	2.1	2.1
Bagmati, Tekudovan	IV	IV	2.2	2.1
Bagmati, Chovar Gorge	III-IV	IV	2.9	2.1

Table 6: Water Quality of the Bagmati River at different locations, (Source: HPCIDBC)

Water quality is the worst with Class IV (extremely polluted) category and this is basically found in the portion of Bagmati River flowing through the highly urbanized zone of Lalitpur and Kathmandu and where various rivers join the Bagmati.

#### ✓ Air pollution

Major cause of air pollution is seen to be due to cremation practices at Ghats along the stretches. It is most common at Pashupati, Gujeshwori and Pachali Ghats. Other sources of air pollution along

the river are due to lack of topping over the earthen link road constructed and solid waste burning practice, decomposition of dumped solid waste and sewage.

#### ✓ Waste water management system

Lack of proper waste water management system has been a crucial element in causing river water pollution. The existing wastewater management system of the entire Kathmandu

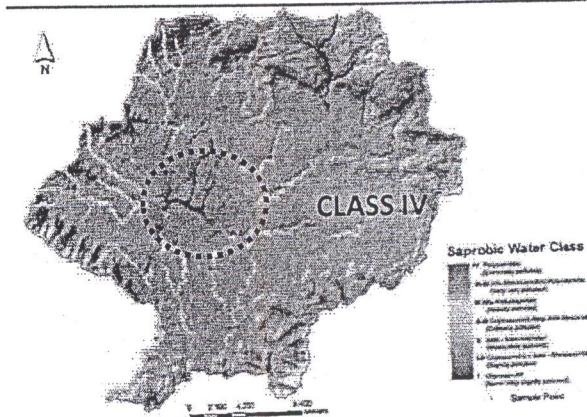


Figure 5: Water Quality Map of Bagmati River  
Source: Map-ICIMOD

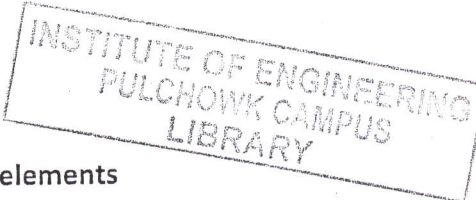
valley is chaotic. Sewage is also directly connected to storm water drains in most of the cases which causes added load to the treatment units.

✓ **Socio-economic aspects**

The socio-economic condition of the area governs the habits and practices of the individuals thus governing the relationship of the inhabitants with the river on which their civilization persist. The economic base for the majority of the Bagmati corridor area is observed to be agriculture even today. The growing trend of population and industrialization indicates possibility of establishment of more industries. Currently along the valley many small scale to medium scale trades are being practiced.

✓ **Squatter settlement along the corridor**

The establishment of the squatter community along the river is also one of the major contributors of the river deterioration. These settlements include the community thriving below the poverty line, and thus are capable of directly exploiting the river environment to their benefit as well as the most vulnerable lot to the river disasters like water borne diseases, flooding, etc.



✓ **Historical/ cultural/ religious elements**

Since time immemorial Bagmati River has been designated as the holy river. Several religious rituals have been taking place at the very bank of the river. The bank is thus marked with several religious ritual areas throughout the stretch. In one aspect, the degradation of river environment reduces significance of its historical, cultural and religious value, whereas the other aspects highlight the river environment deterioration due to the several rituals which directly impacts the ecology of the river. Most of the monuments have been constructed are along the Bagmati River between Teku and Thapathali, and Shankhamul and Pashupati. There are about ten important ghats, dozens of sattals and numerous small shrines and temples in the Teku-Thapathali riverine area. Pollution in and around Bagmati River has severely affected these Historic monuments.

iii. **Institutional / Legislative Aspects**

In the present context there seem to be lack of clarity in terms of institutional set up regarding the management of such an important water body. Although, several institutions share their responsibilities the case here is like that of the crisis of the common property. With the establishment of the High Committee for Integrated development of Bagmati

Civilization (HCIDBC) one milestone is achieved but yet the proper management demands the co-operation of several other institutions which are directly or indirectly responsible for its management and which carries the required authority to carry any activities within the Bagmati Corridor.

#### iv. Sand mining in the Bagmati river

Sand mining can be observed in various patches throughout the stretch of the river in small and in medium scale levels. This activity leads to riverbed deepening and narrowing of rivers. Such mining activities may also lead to erosion of banks (source: BAP 2009-2014). Deepening of the river channel increases the flow velocity of the river that damages the infrastructure (e.g., bridges) and settlements along the river side.

Originally the Bagmati and other major rivers in the urban stretch was braided and flowed over gravel and sand bed. Now, the river is confined to a single deep channel. The river bed between Teku and Thapathali is currently about 2.5 meters lower than the old bed and this has adversely affected foundations of ghat and other structures. Structures to protect private land and schools, squatter settlements and roads constructed along the river banks in the core are other reasons of river channeling. The collapse of the Bagmati Bridge at Thapathali in 1991 was attributed to excessive sand mining (source: UN Habitat- Water for Asian cities Programme Nepal, May, 2008). Sand extraction and associated degradation of the bed have had a severe impact on bridges, ghats, and other infrastructures.

## 2.7 DEGRADATION OF WATER QUALITY OF BAGMATI RIVER: A MAJOR ENVIRONMENTAL PROBLEM

The main reason for the deteriorating water quality of the Valley Rivers is:

- discharge of untreated sewage in the urban areas of Kathmandu
- solid waste dumping along the river

The deteriorating water quality is also associated with decreasing flows at the source over the last 25 years.

**Ground water pollution:** The water quality of groundwater is affected by many factors including precipitation, surface runoff, groundwater flow, and the characteristics of the catchment area. Seasonal variations in these factors have a strong effect on the concentration of pollutants. The relative water levels between the groundwater and polluted surface waters determine the amount and nature of the deterioration in the groundwater quality along the river corridor. Inappropriate disposal of septage and effluent

-have serious impacts on groundwater quality. Shallow groundwater from dug wells is widely used as a supplementary water source for drinking and other domestic uses, this pollution is potentially significant to the community's health.

**Sources:** Large volume of sewage discharge into river systems of the Valley via the sanitary and storm water sewers. The effluent contains high concentrations of bacteria, nutrients and organic matter.

**Effects:** The Rivers of Kathmandu Valley are highly susceptible to pollution because loads are high and flow volumes are low, except in the monsoon. The rivers are highly polluted with faecal coliforms, BOD, COD and nutrients frequently exceeding acceptable standards.

**Pollution of Rivers:** The main reason for the deteriorating water quality of the Valley Rivers is discharge of untreated sewage in the urban areas of Kathmandu, although solid waste dumping along the river is also a contributing factor.

The pollution level in each river is generally a function of the flow volume and the volume of sewage and industrial effluent entering the river. The most polluted stream is the Tukucha, which often contains virtually pure sewage followed by the Bishnumati, Bagmati, Dhobikhola, Hanumante and the Manohara. The groundwater in the urban area is also highly polluted by sewage which, presumably, is seeping from septic disposal systems. The levels of faecal coliforms in the groundwater often exceed accepted standards for drinking water. The reduced water quality has numerous detrimental effects, including ecological, social and health effects

Increasing trend of BOD and decreasing trend of DO at different points in the rivers clearly indicate the degradation of water quality in the rivers. Degradation increases significantly as rivers enter the core area of the city (source: Bagmati Action Plan 2009-2014). The BOD level in different stretches of Bagmati River at different seasons provides a clear indication of high level of pollution at all seasons of the year. Table 7 provides an indication on the variations of BOD level in pre-monsoon, monsoon and post-monsoon seasons.

Season	Sundarijal	Pashupati	Tilganga	Sundarighat	Chovar
Pre-monsoon	1.7	3.5	63.4	239.4	162.4
Monsoon	2.1	2.8	84.7	47.3	51.4
Post-monsoon	2.1	3.1	119.4	93.7	71.3

**Table 7: Average variations in BOD mg/L at different locations of Bagmati River**  
Source: ADB, 2010. Conceptual Wastewater Master Plan

It is observed that Dissolved oxygen (DO) is extremely low within the reaches in Kathmandu (e.g. Teku) as shown in table 8. No fresh water aquatic lives are expected to survive in such an environment. Water quality dramatically improves as it flows downstream of the Chovar Gorge. Particularly after merging Khokana River into Bagmati, the BOD level is considerably reduced and DO levels improve significantly.

Location in Bagmati	pH	DO	BODs
Teku	7.23	0	420
Khokana	7.48	1.9	195
Kulekhani	7.26	6.9	16.5
Nepal/Indian Border	7.89	6	7

**Table 8: Water Quality Parameters**  
(Source: ADB, 2010. Conceptual Wastewater Master Plan)

The main problems and causes in the wastewater sector in Kathmandu are as follows:

- Poor or unknown condition and extent of sewerage infrastructure
- Infrastructure capacity lagging growth
- Inadequate operation and maintenance of existing assets
- Absence of overall wastewater network planning
- **Disposal of untreated or inadequately treated sewage to water courses:**
  - ✓ Inadequate treatment plant capacity
  - ✓ Poor enforcement of industrial discharge regulations and absence of discharge standards for domestic wastewaters
  - ✓ Inadequate operation and maintenance of existing wastewater treatment plants
  - ✓ High frequency of long power outages
  - ✓ Inadequate disposal of septic tank septage
  - ✓ Lack of viable alternative on-site systems

There are already five waste water treatment plants in the Valley, i.e. at Hanumanghat(1975AD), Sallaghari(1983AD), Kodku(1982AD), Dhobighat(1982AD) and Guheshwori(2002AD). A new one is being proposed at Khokana.

Parameter	Hanumanghat	Sallaghari	Kodku	Dhobighat	Guheshwori
Year estd.	1975	1983	1982	1982	2002
Catchment Served	North-east Bhaktapur	North & South Bhaktapur	East Lalitpur	Kathmandu & Lalitpur	Gokarna & Chabahil
Existing Operation Status(2010)	Partial treatment – significantly below design intentions	Partial treatment – significantly below design intentions	Partial treatment – significantly below design intentions	Not operational since c1982	Partial treatment – significantly below design intentions

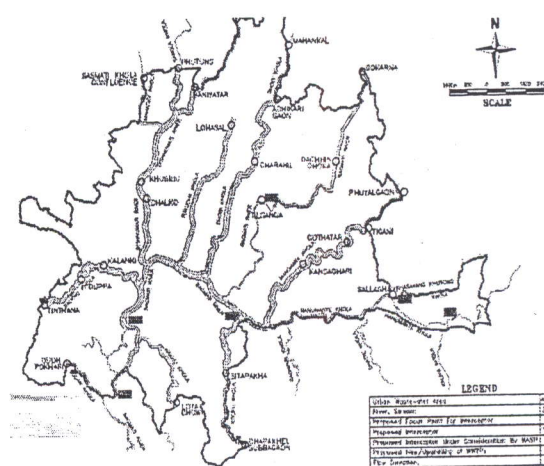
**Table 9: Existing Centralized WWTPs**

(Source: ADB, 2010. Conceptual Wastewater Master Plan)

**Issues - Centralised treatment plants:** The wastewater treatment practice of the valley is in a very poor state despite the large investment made in the sector. None of the six plants

(five domestic WWTPs and one septage plant) are functioning at a satisfactory level – only Guheshwori is providing a reasonable level of treatment at present. Many of the underlying reason are institutional and management issues and increased volume of the wastewater generation. The capacity of the existing treatment plants, if operated as originally intended would be of the order of 170,000 people. Thus, if the existing treatment plants were rehabilitated; only 9% of the sewage collected could be treated. This percentage will decrease as the connected population increases. Considering increased population growth and limitation of decentralized plants to serve a large population, the centralized plants have to be operated properly and further augmented if the **water quality in the Bagmati is to be improved.**

In the Conceptual Waste Water Master Plan, ADB, 2010, all treatment plants are proposed to be designed for ultimate minimum 50/50 effluent (50 mg/L BOD5 and 50 mg/L SS), however the initial stages of Dhobighat WWTP and Khokana WWTP will be to a lower standard (provisionally set at 130 mg/L BOD). Ten septage facilities will be provided. Small decentralised plants will provide for ultimate treatment of approximately 100,000 people. Target is for 2025AD (Source: ADB, 2010. Conceptual Wastewater Master Plan).



**Figure 6: Plan of WWTPs**  
Source: ADB, 2010. *Conceptual Wastewater Master Plan*

Most of these designs are conventional centralized system and have addressed waste water management for urban core which required significant fund for construction as well as operation. Such technology is appropriate for densely populated city core areas. This is not so appropriate for scattered small settlements. There is a new approach known as Decentralized Waste Water Treatment System (**DEWATS**) appropriate for small settlements out of city core. DEWATS is in very initial phase in Nepal, there is only one small plant newly installed for 250 households in Thimi (source: Bagmati Action plan 2009-2014).

**Conclusion and Relevance to the study:** River water quality analysis data shows that the river water within the valley is bad but as the River passes through the valley the quality of water improves slowly. The polluted river water has seriously impaired the aquatic ecology and biodiversity along the Bagmati River. Fresh water fish have been completely wiped out

from their habitats in the upper sub-basin and are declining in the river stretches of the upper middle and lower middle sub-basins. The river is losing its religious and spiritual significance. The sacred river water for Hindu devotees has now become filthy and unsuitable for use on religious and cultural grounds. Although there exists sewage network to carry waste water, there does not exist any efficient system in the city for treatment before discharging waste into the river.

## 2.6 THE ROLE OF GREENWAYS IN RIVER CORRIDORS

### 2.6.1 Greenways as an Adaptive Urban Landscape Form

Greenways as a form of landscape have undergone changes over the past few decades in the US. According to Seams (1995) urban greenways, as a landscape endeavor, have expanded explosively over the past two decades. However, today's greenways reflect more than a current landscape phenomenon or fad. They are a response to classic human needs and part of an evolving, centuries-old landscape form. More than just parks and amenities, *greenways are an adaptation that helps mitigate and provide counterpoint to the loss of natural landscape as a result of growing urbanization.* With changing times, the perception of greenways has also changed to address different needs and challenges.

Seams (1995) identified three distinct stages or 'generations' in the emergence and evolution of greenways as an urban landscape form. They were:

**Generation 1:** axes, boulevards and parkways that were the *ancestral greenways*.

**Generation 2:** *trail-oriented recreational greenways* that provide access to rivers, streams, ridgelines, rail beds and other corridors within the urban fabric. Often, these greenways are automobile free.

**Generation 3:** *multi-objective greenways* that go beyond recreation and beautification to address such areas as habitat needs of wildlife, promoting urban flood damage reduction, enhancing water quality, providing a resource for outdoor education, and other urban infrastructure objectives. The emerging third generation of greenways brings together a range of formerly divergent disciplines such as civil engineering, landscape architecture and wetland ecology to address complex problems posed by expanding human development.

One of the common features of Generation 1 and Generation 2 greenways is that they are primarily amenity oriented. That is, they were developed to address aesthetic and

recreational needs of city dwellers-beautified axes and corridors as well as non-motorized routes of movement. Indeed, they were an adaptive response, a way to offset and mitigate the effects of crowding, automobile fumes, noise, and other ills of urbanization. They were intended to help heal the human psyche by providing alternative corridors that offer attractive visual form and, in most cases, greenery and solace.

Although Generation 3 greenways also serve this mitigating function, they have a significantly broader mission. In addition to serving human needs, which remains a vital aspect of Generation 3 greenways, these new greenways pursue multiple objectives such as habitat protection, flood hazard reduction, protection and preservation of flood plains and agricultural lands, water quality, historic preservation, education, interpretation, and other purposes. The increasing environmental awareness of species being compromised or lost, along with the impacts of natural disasters, greenways are now seen as a potential tool to help address a range of issues including destruction of habitat, loss of biological diversity, degradation of water quality, erosion, flood damage and other considerations.

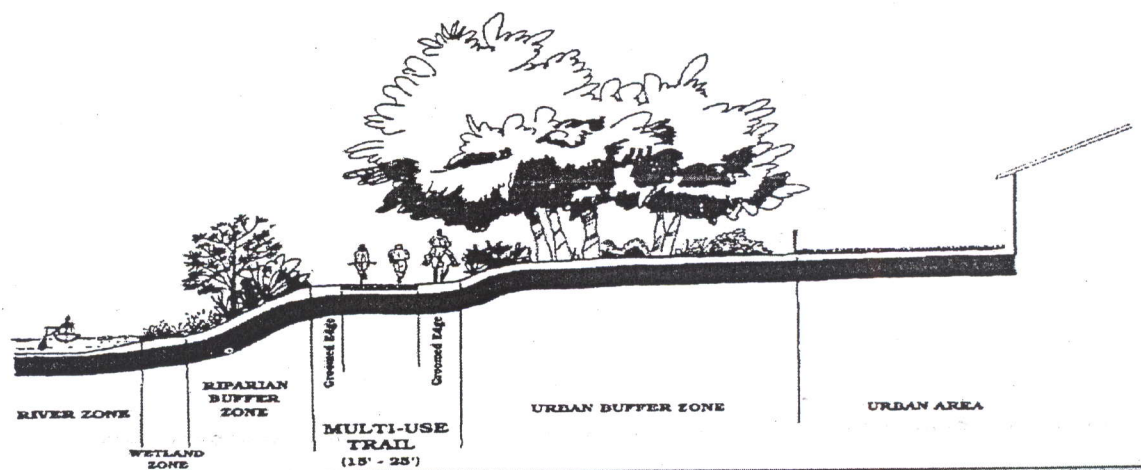


Figure 7: Cross-section of a greenway that attempts to integrate trail & preservation objectives  
Source: Seams, 1995 (Urban Edges Inc.)

### 2.6.2 Greenways and the Hydrological System

In addition to reducing the introduction of harmful contaminants into the water, a successful water quality plan must also address excess sediments caused by stream bank erosion and stream bottom degradation. This implies considering stream geomorphology how a stream works its way through the terrain (Williams, 1993- )-going beyond traditional drainage engineering, which primarily focuses on conveying storm water from point to point. Stream geomorphology is also important because excessive down-cutting (erosion of the stream bottom) threatens riparian vegetation by lowering the water table.

Addressing both contamination and geomorphologic issues calls for looking at more than just the river or stream. It means looking at the entire watershed, because **what happens on the high ground ultimately affects the stream below**. Ground water quality is also affected. Even air pollution can affect water quality when airborne contaminants enter runoff water. Healthy, slower-moving drainage systems with vegetated stream edges and wetlands can help absorb some contaminants.

Similarly, the cumulative effects of straightening tributaries or paving over more land for parking lots upstream lowers the permeability of a watershed, and often dumps an unnatural volume of storm runoff water into the system. This results in more erosion and other impacts. With the introduction of such alterations upstream, preservation of a natural stream corridor downstream becomes a near-impossible task.

**Greenways** may help to a certain extent in reducing erosion, preserving more natural stream corridors and leaving streamside strips of vegetated, undeveloped land to buffer stream edges. Ideally, all land in the 100 year floodplain (area with a 1% chance of flooding in a given year) should be left undeveloped. This would leave room for a stream to meander naturally, and space for wildlife habitat or recreation-uses that can tolerate periodic flooding.

*[Reference: Seams R. M. 1995, 'The Evolution Of Greenways As An Adaptive Urban Landscape Form']*

### 2.6.3 River Banks and Floodplains as Open Space in Kathmandu Valley

The resultant policy in Kathmandu Valley for conserving a greenbelt on either side of the rivers is a product of default, and does not achieve satisfactory open space provision. Nor does it always negate risk of flooding. Moreover the environment of these greenbelts is hardly consistent with the rhetoric that justifies them and their ecological value is negligible. Generally they are abused by the population and may eventually become squatter colonies, as is happening already along the Bagmati and Bishnumati.

Open space (parks) should be considered a necessary land use, which the government has a duty to provide. **River greenbelts** (if properly defined and managed) can have a role, but as linear links between larger more worthwhile areas that have the potential to provide the many functions expected of city parks. (Source: KVUDPP- Halcrowfox, 1991)

In the present context of rapid urbanization especially in the Kathmandu Valley land has become a scarce resource with land prices increasing at high rate each year. Land has thus become a valuable resource. Lack of open spaces in the city hubs is becoming more and

more visible with the increasing trend of haphazard urban development. The Bagmati spine seems to be the only open space left in certain city core areas. The land by the river side has become attractive to real estate developers and others alike, including the squatters. In the absence of an authentic demarcation of river, it is seen that the land has been encroached for various purposes like squatter settlements (Source: UN Habitat, 2008)

**Conclusion and Relevance to the study:** These greenways may be utilized along river banks, especially the Bagmati River thus providing not only an ecological patch and aesthetic beauty but also for flood hazard reduction, habitat protection, river preservation, historic preservation, etc. Since there is the Bagmati link road along the river, the greenery will help in reducing pollution levels and provide a relief for the nearby areas, besides also serving as a recreational area. This will help towards the city beautification.

## 2.7 BAGMATI ACTION PLAN (2009-2014)

(Source: GoN/NTNC, 2009, Bagmati Action Plan (2009-2014). Kathmandu, Nepal.

### 2.7.1 Background

In order to curb further environmental degradation of the Bagmati River and adjoining area as well as to restore the condition of once pristine Bagmati River, the Government of Nepal formed a High Powered Committee for Implementation & Monitoring of the Bagmati Area Sewerage Construction/Rehabilitation Project (BASP) in 1995 A.D. The main objectives of this committee are as follows:

- Construction of Trunk Sewer pipeline along both the banks of river.
- Construction of secondary Sewer pipelines.
- Construction of wastewater Treatment Plants.
- Construction of River Training Works.
- Construction of roads and green belts along the banks of the river and
- Creation of public awareness program

### 2.7.2 Key issues

The Bagmati Action plan identified many issues related to the Bagmati River based on previous studies and reports. Based on the field visits, discussion and observations, the following four primary issues have been identified as critical for immediate restoration and conservation of the Bagmati River:

<p><b>1. River Ecosystem And Waste Water</b></p> <ul style="list-style-type: none"> <li>▪ Decrease in water discharge;</li> <li>▪ Degradation of river water quality;</li> <li>▪ Degradation of catchment quality;</li> <li>▪ Narrowing and deepening of water way; and</li> <li>▪ Depletion of aquatic biodiversity</li> </ul>	<p><b>2. River Side Land Use And Socio-Economic Conditions</b></p> <ul style="list-style-type: none"> <li>▪ Changes in riverside land use; and</li> <li>▪ Eroding aesthetic values</li> </ul>
<p><b>3. Culture And Heritage</b></p> <ul style="list-style-type: none"> <li>▪ Deteriorating culture and heritage; and</li> <li>▪ Eroding cultural values and norms</li> </ul>	<p><b>4. Key Challenges</b></p> <ul style="list-style-type: none"> <li>▪ Integrating conventional planning with ecosystem management;</li> <li>▪ Demand management, payment for services and incentives for conservation; and</li> <li>▪ Enforcement, coordination and stakeholder participation</li> </ul>

### 2.7.3 Zoning for effective management

Different management interventions for the restoration of the Bagmati River were identified. The issues are complex; improvement of the river ecosystem is very challenging. So, a strategic and systematic approach is essential to develop and implement the Bagmati Action Plan. For this the action plan implementation team has classified the river based on observed various situation and pollution in different areas. The water quality classes are as **Class I: Non-polluted; Class II: Moderately polluted; Class III: Heavily polluted; and Class IV: Extremely polluted.**

It is clearly noticed that the river water quality in the Shivapuri conservation area and surrounding hills is still in good condition and is gradually deteriorating as it flows down towards the urbanized area. The water quality is in worse condition mainly in central part of the valley. The categorization of river as safe, unsafe, and extremely unsafe as IUCN (1995) also indicates that river of the central part of the valley is extremely unsafe.

They also have identified the various different issues and management need for different classes. **Zone 4** is the urban zone and is highly urbanized zone consisting of the five municipalities of the Valley. Almost all major tributaries pass through this zone and the confluences of the tributaries are located at the central part of this zone. Water quality is the worst with Class IV (extremely polluted) category.

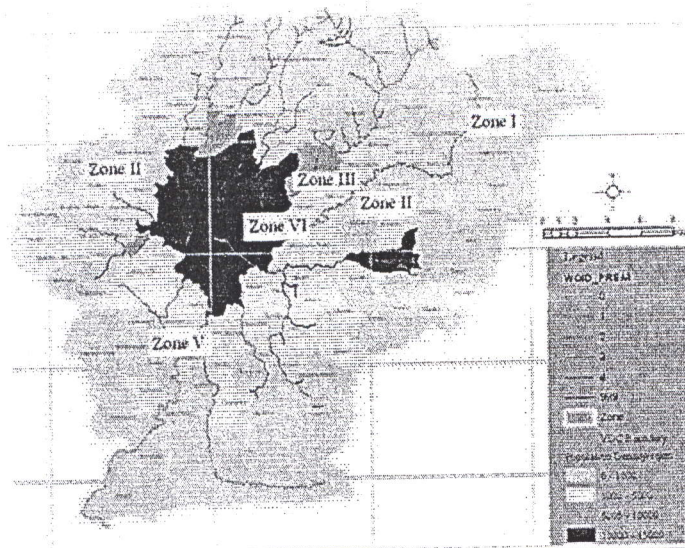


Figure 8: Different zones of Bagmati  
source: BAP 2009

**2.7.4. Action Plan:** Has set the overall vision for restoration and conservation of the Bagmati River system and defined goals, objectives and activities for each zone. Certain key activities which are valid in all the zones are include as cross cutting activities. These activities are either common for all zones or their outputs help to build the capacity of HPCIDBC and other agencies working for the

restoration and conservation. Other activities identified for each zone are based on key issues identified in corresponding zones.

**Planned activities in different zones:** Based on various rules acts and policies, the committee has prepared various short term and long term action plans. The main vision for this is clean, green and healthy river system in the valley. They have prepared various plans based on different zones and locations. The activities as listed in Bagmati Action Plan document are as follows;

**1. Natural Conservation Core Zone**

**2. Rural zone**

**3. Peri Urban zone**

**4. Urban zone; Activities:**

- To improve river water quality and quantity through proper management of water and waste water
- Take measures to protect river side land, aquatic biodiversity and aesthetic value of rivers and their surroundings
- Control and relocate squatter settlements from the river banks
- Maintain and renovate heritage sites
- To promote tourism

The study area falls under the urban zone, and all of the above activities are of urgent necessity for the improvement of the area. Besides just focusing on the river system in

isolation, a broader vision seems to be necessary. In the long run, the improvements should be sustainable; meaning that if a holistic approach is followed i.e. by treating the river and the urban setting as a single entity then this approach will be more viable and sustainable in the long run. So, basically the point is that when the urban setting and development corridors are situated close to rivers, they should be properly planned so that one does not negatively impact the other.

### 5. Downstream zone

**Conclusion and Relevance to the Study:** Successful implementation of the Action Plan could bring change in the management paradigm in restoration and conservation of the Bagmati River and its tributaries. More importantly, the successful implementation of the Action Plan not only brings the river back to life but also enhances the overall urban environment of the Kathmandu Valley. However this demands serious commitment on the part of the government such as providing adequate resources, smooth implementation process, strengthening related agencies (HPCIDBC) in terms of technical capacity, financial resources and legal back-up.

## 2.8 PLANS AND POLICIES RELATED TO LAND USE, INFRASTRUCTURE AND ENVIRONMENT

(Sangachhen, S. B., Class lectures, 2069)

### LEGISLATION ON URBAN GROWTH AND DEVELOPMENT:

There are ten major acts aiming at regulating urban growth and development, besides, there are other acts which also concern urban environment and management. The Ten major acts are:-

- 1) Public Road Act 1974 (2031)
- 2) Solid waste management and Resource mobilization Act, 1987. (2044)
- 3) Town Development Act 1988 (2045)
- 4) Kathmandu Valley Development Authority Act, 1988. (2045)
- 5) Industrial Enterprises Act, 1992 (2049)
- 6) Labor Act. 1992. (2049)
- 7) Motor Vehicle and Transport management Act, 1993 (2050)
- 8) Local Self Governance Act, 1998. (2055)
- 9) Environmental protection Act (2053)
- 10) Ancient monument preservation Act 1956 (2013)

### Acts Concerning Urban Planning and Management

1. Town Development Act, 1988
2. The KVDA Act
3. Local Self Governance Act, 1998

Kathmandu Valley Development Authority Act 1988, and Local Self Governance Act, 1998. These Acts are important to regulate land use and zoning for construction, planned development of the urban areas, pollution control and promotion of health and sanitation schemes. This will enhance the quality of life.

**The KVDA ACT 1988** empowers the Kathmandu Valley Development Authority to develop Kathmandu Valley into a principal administrative, touristic, cultural and economic center of the country. This Act also has provision for protection, preservation and development of religious, Cultural and historical heritage in the Kathmandu Valley.

**Local Self Governance Act, 1998** empowers local Authority to protect, preserve and wisely use natural heritage, forests and water bodies, including drinking water facilities. It is the duty of municipality and VDC to maintain and protect plantation along public roads, and protect public property.

#### Public Road Act (1974)

This Act prescribes rules for planned road construction with defined boundaries and road width. Prohibits any work on road without prior approval and empowers the Department of roads to demolish house or structures built within road boundaries. However, the Act is silent over a large number of unplanned roads being developed in the urban areas, the narrow roads 1-3 meter wide, in recently developing residential areas.

#### The Solid waste management and Resource Mobilization Act 1987 (2044)

This Act regulates the collection, recycling and disposal of solid wastes in municipalities of the country. There is penal provision for polluting public spaces, roads. This act, if strongly implemented, could really make city clean and healthy. The Act should be amended to include all urbanizing areas.

### **LEGISLATION ON LAND USE**

The 5 major Acts on regulating protection and use of land include:

1. Land (Survey and Measurements) Act 1961 (2018)
2. Land Act, 1964 (2021),
3. Land Revenue Act, 1977 (2034),
4. Land Acquisition Act, 1977 (2034)
5. Local Administration Act, 1971 (2028).

**1. Land (Survey and Measurement) Act, 1964:** This act describes land position and defines public land, government land, land owner and tenant. Surveying and measuring all or any section of land throughout the country.

**2. Land Act, 1964:** This act deals with agricultural land, maintaining a harmonious relationship between landlord and tenant. It has provision for land ceiling up to 2.5ha of agricultural land and 0.25ha of agricultural land and 0.25ha for household per person in the city area of Kathmandu valley.

**3. Land Revenue Act, 1977:** This act lays down provision for land use under which district level revenue office has to maintain record and registered all land. It prohibited registration of public land or the government forest area.

**4. Land Acquisition Act, 1977:** Land acquisition through expropriation is governed chiefly by the land acquisition act; 1977. This act empowers the government, by notifying publicly in the specified places, to acquire private land for the well-being of the general public.

#### **ENVIRONMENTAL POLICIES AND LEGISLATIONS IN NEPAL**

Till the 4th Five Year Plan (1965 -1970), the planning documents lack specific policy principles related to the environment. 5th Five Year Plan (1970 – 1975) for the first time registered environmental policy on the conservation of natural environment. National Parks were created and National Parks and Wildlife Conservation Act was enacted.

The 6th Five Year Plan incorporated environmental policy with regard to natural and social environment related to the mega development Project. Thereafter environmental concerns were reflected in all subsequent Five Year Planning Documents and in the Sector Specific Policies (Industrial Policy, Water Resource Development Policy, Hydropower Policy, Forest Policy, Transport Management Policy etc.) of Government of Nepal.

- **Environment Protection Act (EPA), 1996 (2053 B.S.)**
- **Soil and Watershed Conservation Act, 1982:** Comprehensive as it integrates land and its vegetation cover with water resource. The Act empowers the government to

designate any area as "Protected Watershed Area" and to implement biological actions like afforestation and specific crop cultivation, as well as engineering actions like check dams for enhancing the quality of watershed area and maintaining the flow of water in natural conditions.

**Conclusion and Relevance to study:** Numerous Plans and legislations for land use have been dealt in Nepal of which Kathmandu Valley has been given top priority. Many acts and regulations have been made, amended, extended and enacted as change in political scenario and ideologies. Similarly, lack of an efficient and autonomous implementing organization for implementing of prevailing acts, rule and regulation have been big problem. In Land Measurement & Survey Act of 2019 B.S. all the rivers are defined as government land and the ownership of these land lie on the government. Keeping in view of the above definition and legally the Bagmati River is under the ownership of the government. Regarding the Territory of Bagmati River, the land survey & measurement Act of 2019 have legal status and the map is based on this survey. The demarcation shown in the cadastral map is the only legal proof of the Territory of Bagmati and all the strategies and plan should be based on this map. At present there is great deviation in 2021 map and present condition. This Act gives legal authority to the government to fix the Territory of Bagmati as shown in the map and other documents of survey of 2021.

## 2.9 RELEVANT STUDIES: PLANNING INITIATIVES

The government of Nepal with the assistance of the United Nations reviewed the overall situation of Kathmandu Valley and prepared a 'Physical Development Plan for Kathmandu Valley' in 1969. The main objectives of this plan were the preservation of historical and cultural heritage, guided urban development through land use planning and densification of the fringe areas. The plan was a guiding principle for ordered urban development implementation Act in 1972 to implement it. Kathmandu Valley Town Development Committee (KVTDC) was established under this act and entrusted with the overall responsibility of planning and regulating urban growth in Kathmandu Valley.

In 1991, after the general election, the government launched another study to guide and regulate urban development activities. This study was funded by Asian Development Bank and it examined issues related to land use, financial investment, environmental protection,

and institutional re-organization. Several policy options were recommended, including establishment of a valley-wide development authority and a 10 year infrastructural investment program.

In 2002, the government approves a Long Term Development Concept for Kathmandu Valley prepared by Kathmandu Valley Town Development Committee. The concept evolved through extensive consultations with politicians, the private sector, and local authorities. A new legislation was also proposed for establishing a Kathmandu Valley Development Council to replace the Kathmandu Valley Town Development Committee.

### **2.9.1 Physical Development Plan for the Kathmandu Valley, 1969**

Key words: flood plains and drainage/runoff, agriculture and irrigation

*The physical Development Plan of 1969 A.D has been reviewed taking into consideration the rivers of the Valley, emphasis given to the Bagmati River and related data of that period.*

However extensive Nepal's total water resources are, unique topographic features have left certain regions without the abundance of water which characterizes the country as a whole. Kathmandu Valley is one of these regions. The Valley is drained by only one river, the Bagmati. In the dry season the amount of water flowing out of the Valley is unusually small as very few of the tributaries of the Bagmati River are perennial.

**The Bagmati River:** originates at Shivapuri Lekh at an elevation of about 2,650m. Near Sundarijal two streams come together to join this river. From Sundarijal, flowing to the South, it follows the north then the west boundaries of the Gokarna Forest, and passes near the Pashupati Temple. The Manohara River joins the Bagmati near Koteswor where the river changes its direction to the West, forming the boundary between Kathmandu and Patan. The Bagmati River turns to the south at Teku upon its confluence with the Vishnumati River. The river leaves the Valley through Chobhar Gorge. The approximate length of the Bagmati from its source to Chobhar Gorge is 27 km. This is the most intensively exploited river in the Valley, being used both for drinking water supply and hydro-electric power generation.

**Flood plains and Run-off characteristics:** The rivers of the Valley have meandering courses and in some areas wide flood plains caused by the relatively flat topography of the Valley and its soft, deep sedimentary deposits. These river systems drain the Valley in a centripetal pattern converging on the center and existing via the narrow Bagmati Gorge near Chobar. The general gradient of the Valley is towards the center and then towards the southwest.



**Figure 9: Run-off characteristics in 1969 AD**  
Source: Physical Development Plan 1969

The Valley is cut by the Bagmati River and its numerous tributaries. The Bagmati leaves

the Valley at its southwest boundary through the Bagmati gorge. The general slope of the area is towards the central portion (Bagmati River) and thence to the South-west. The central slope has an average gradient of about 1 in 236, and gives, therefore the direction of flow of the tributaries which converge radially to the Bagmati River. The system of drainage of the Valley is basically centripetal and includes extensive flood plains due to the relatively flat topography. The runoff characteristics of the Valley Rivers vary with altitude above the low lying areas.

*In present times flood plains have significantly decreased and that of what remains, most have been encroached upon for various purposes ranging from development purposes to illegal settlements to waste disposal. The run-off characteristics have also been altered due to increase in impervious covers and decrease in ecological patches; thus affecting river flow.*

#### **Agriculture: Major Aspects**

- The Land: 61.12% of the land of Kathmandu Valley was cultivated in 1969 AD. *This percentage has decreased by 20% and is 41.4% as of 2000 A.D. (Source: Long Term Dev. Plan 2020)*
- In Lalitpur cultivated land was 14,300 hectares out of total land of 23,310 hectares i.e. 61.35% in 1969 AD.
- Land devoted exclusively to the production of vegetables was generally found in areas having easy access to irrigation facilities the year round. This type of land is usually found in the river basins of the Bagmati, Bishnumati, Manohara and the

banks of rivulets like the Tukucha nad Dhobikhola. *Even in present times, this can be seen but the areas have decreased significantly and agriculture has mostly been shifted to the outskirts.*

**Sewerage:** Sewerage system in the Valley in the period around 1960's AD comprised only of drainage and not waste disposal. Malla period- constructed and maintained an extensive drainage system; however gradually deteriorated since the end of Malla period. Except for a relatively small number of family water-seal toilet septic tank combinations, a system for sewage disposal was non-existent in the valley. Sewerage systems are urgently needed in the densely populated urban centers of the Valley and must be developed as independent systems for each of the main cities with Kathmandu and Patan perhaps sharing a common treatment plant. These systems must be integrated with the drainage systems of the cities to provide maximum use of scarce water resources.

*The sewerage system in the present times has not improved much from 1969 AD. Instead, the condition of the river has been destroyed. Due to rapid urbanization, the Bagmati River has been converted into an 'open sewer' for discharging the wastes produced by the Valley, and a dumping ground for garbage disposal.*

### 2.9.2 Kathmandu Valley Urban development Plans and Programs (1991) – Halcrow Fox & Associates/ DHUD/ADB

**Under the Landuse strategy:** Urban expansion area should be defined with designated accelerated development areas. First priority should be the floodplain areas of the Bagmati, Bishnumati and Dhobikhola corridors. The Bagmati and Bishnumati Corridors have been put under the category of high priority accelerated development areas as these areas had just begun to develop under guided land development. However, indications suggested that their land use, infrastructure and environment is (will be) unsatisfactory. If properly planned they represent an opportunity, at the very heart of the capital city of Nepal, which should not be missed. More efficient and rapid residential development are recommended to meet the objective of accelerated development and to incorporate strategic trunk infrastructures (roads, drainage, sewerage).

**Under the Environmental Strategy:** Polluted river water is the most serious problem affecting the Valley and should be remedied by the construction of interceptor sewers. The

central objective should be to collect and carry sewage/effluent away from population centers. Habitual and religious use of rivers (and their environment) may thereby be enhanced irrespective of treatment.

ISSUE	SOURCE OF PROBLEM	EFFECT	GOVERNMENT'S ROLE
River pollution	Sewage Industrial effluent	Health Hazard Ecological degradation Aesthetic Impact	Interceptor sewers along rivers Treatment System Enforce connection to sewerage systems
Groundwater pollution	Sewage Industrial effluent Solid waste disposal	Health Hazard	
Solid waste pollution	Haphazard disposal of solid wastes	Aesthetic impact Health hazard	Collection and disposal systems
Watershed degradation- <ul style="list-style-type: none"> <li>▪ soil erosion</li> <li>▪ River siltation</li> <li>▪ Landslides</li> <li>▪ Riverbank erosion</li> <li>▪ Flooding</li> <li>▪ Reduced river flows</li> </ul>	Deforestation/agriculture	Reduced soil fertility Flooding/reduced storage Loss of Life/property Loss of agricultural land Damage to property Reduced water supply	Government forestry programs

*Source: Halcrow Fox and Associates, 1991*

#### **Under the Infrastructure Strategy:**

People have the provision to develop their land but they don't have the right to develop infrastructure. Provision of infrastructure should be planned and implemented only by the Government, through coordinated programmes linked to the land use/environmental strategies. Thereby the ability of the government to control and guide development is enhanced and the environment is improved by appropriate infrastructure provision in parallel with development rather than afterwards. Environmental conditions in urban areas are serious as a result of infrastructure deficiency.

**Sewerage:** In accordance to the land use and environmental strategy, trunk interceptor sewers should be extended along major rivers within Greater Kathmandu to serve both existing areas and the proposed accelerated development areas.

The highest priority for environmental protection in the Valley is the prevention of untreated raw sewage from being discharged directly to the rivers, in particular the Bagmati, the Bishnumati, the Tukucha, and the Dhobikhola, through the provision of sewerage and sewage treatment. The existing sewage discharge should be intercepted at the discharge points along the rivers via trunk sewers placed along the banks of the rivers. An interim measure for improvement would be to discharge intercepted sewage to the Bagmati downstream of Kathmandu.

**Drainage and Flood Plains:** Drainage has been neglected throughout Nepal and no line agency has overall responsibility. The Department of Roads has responsibility for constructing road side drains, which however have seldom been designed in relation to the local catchment, consequently localized flooding frequently occurs. In other instances localized flooding occurs due to lack of maintenance and cleaning and in some cases due to absolute lack of drains in the area.

New urban residential areas, particularly those developed informally, pay insufficient attention to drainage. Road alignments are often at variance with natural drainage of the land so that road side drains (if any) cannot properly discharge. There is no clear policy with regard to separate or combined drainage provision. Residents tend to connect both sewage and storm water from yards and gutters to whichever pipe is put in the ground first, whether it is intended for a drain or a sewer.

Urban development within flood plain areas were prohibited within designated conservation areas on either side of the rivers based on a perceived notion of areas prone to flooding. But the areas so defined had no rational basis for their delineation and were subsequently reduced to a narrow margin on either side of the river. Clearly flood plains and flood storage need to be properly defined so that the government would then have a sound basis for refusing development in such areas. Development of the remaining flood plain land can then be encouraged and properly planned to incorporate necessary drainage improvements.

**Access:** Urban development is highly dependent on road access. Accordingly roads should be planned in close collaboration with the Land Use and Environmental Strategy. Strategic roads are proposed along the river corridors. Relief provided by the strategic roads proposed along the Bagmati and Bishnumati corridors will be an important pre-requisite to traffic management in core areas.

### 2.9.3 The Long Term Development Concept of Kathmandu Valley (LTDCV), 2020

Long term Development Concept of Kathmandu Valley, 2020 drafted by KVTDC, has been approved by the government of Nepal on 2059 Shrawan. It is strategic plan for the whole valley, which will be used by the individual municipalities and VDCs as a guideline to develop detailed action plans and programs. The plan expects to control and manage urbanization through fiscal decentralization, increased population density in urban areas and delineation of urban expansion area.

The plan 2020 puts thrusts on efficient land use and transportation and identifies necessity to integrate land use and transportation for planned development of urban areas. Expansion of road not only changes land use, land use also causes changes in number of vehicles operating on the street. Therefore siting of offices, industries, educational facilities, airports must be accompanied by proportional provision of road infrastructures. It identifies the need to expand urban areas as per carrying capacity of infrastructures, permit development in desired sound and air pollution and vehicle number on roads. It also permits development in desired locations only and to control development in areas of hazard and environmentally sensitive areas. The main objective of the plan is to integrate land use and transportation for planned development of the valley. The objectives of the plan are:

- To manage urban growth according to carrying capacity
- To preserve social, economic and environmental values and strike a balance between urban development and natural resources
- To increase standards of living of people of the valley
- To promote healthy and green city concept: Roads will be constructed along the corridor of Bagmati, Bishnumati and Dhobi Khola. Greeneries will be expanded through tree plantation along the roads, riverbanks and public spaces.
- To encourage urban development works through identification of possible areas of development with transportation infrastructures
- To identify areas for urban development and analyze their advantages and disadvantages
- To direct land use through reliable transportation facilities

Some of the future projects include:

- Arterial road expansion and improvement programme
- Construction of connecting roads to Buddhanilkantha, Gokarna, Thimi, Dadhikot, Lubhu, Harisiddhi and Chapagaun (Outer Ring road)
- Sewerage and drainage management programme
- River conservation programme

## 2.10 HOW THESE RIVERSIDE ROAD CORRIDORS (LINK ROADS) FITS INTO THE OVERALL SCENARIO OF ROADS IN THE VALLEY?

### 2.10.1 Kathmandu Valley Urban Development Plans and Programs (1991)- Halcrow Fox & Associates/DHUD/ADB

Kathmandu Valley Urban development Plans and Programmes lay out strategies for urban development for the valley. It has been acknowledged here that there is high priority accelerated development within the Bagmati and Bishnumati corridors. However, indications suggest that their land use, infrastructure and environment is (will be) unsatisfactory. If properly planned they *represent an opportunity*, at the very heart of the capital city of Nepal, which should not be missed. Mention has also been made about polluted river waters as the most serious problem affecting the Valley and should be remedied by the construction of interceptor sewers. Environmental conditions in urban areas are serious as a consequence of infrastructure deficiency.

This master plan level study identifies strategic planning for the development of various infrastructure facilities within the Valley, has also recommended that, in ascendance with the landuse and environmental strategy, trunk inceptor sewers should be extended along major rivers within the greater Kathmandu to serve both existing areas and the proposed accelerated development areas.

In order to facilitate the future development, river areas of the Kathmandu Valley will be the only possible route for laying major transport corridors. It is therefore necessary that sufficient land should be reserved for future development through land use and development control regulations. The urban spaces that could be dedicated for new constructions are along the riverbanks of: Bishnumati River, Dhobikhola River, Bagmati River and Manohara River.

The plans and programs state that urban development is highly dependent on road access. *Accordingly roads should be planned in close collaboration with the Land Use and Environmental Strategy. Strategic Urban Roads* were proposed.

- An east-west relief road around the north of Patan to link with the Bagmati Bridge (kuponhole)
- A north-south road through the Bishnumati Corridor

Two broad options for new strategic links were identified: the Bishnumati Corridor to the west of Kathmandu city core, and the Shankhamul Bridge (together with the connecting roads, east-west) to the north of the central area of Patan. These schemes would improve servicing and access opportunities to the historic core areas, and would also allow for the reduction of traffic levels within the centers. Both would open up significant areas of valuable potential development land close to the central areas.

Relief provided by the strategic roads proposed along the Bagmati and Bishnumati corridors is an important prerequisite to traffic management in core areas.

Evaluations were made and the conclusions drawn were that there were substantial benefits from the construction of both the Shankhamol Bridge and the road in Bishnumati Corridor. In particular:

- The bridge in Shankhamul was required to provide additional cross-river capacity and to relieve the existing Bagmati Bridge at Kupondol.
- Similar traffic benefits with the construction of the Bishnumati Corridor.
- The eastern bank with a new bridge across the Bagmati at Teku (and new access roads along the southern side of the Bagmati), doesn't attract much traffic and so is less effective.

However, at present (2069 B.S.) it is seen that there is significant traffic diversion/flow in this area. The proposed road improvements has resulted in reduced travel time and travel distance by road users, and have effects beyond their immediate locality as road users change their travel routes to take advantage of improved road conditions.

#### **2.10.2 The Study of Kathmandu Valley Urban Road Development, Final Report, Summary, march 1993, Japan International Cooperation Agency (JICA)- Review**

This is the most comprehensive study done so far on road development and transportation planning for Kathmandu Valley. The study identifies short-term projects (up to 1997), Middle term (1998 to 2005) and long term (2006-2015) projects for the Valley. The report recognizes the necessity of a second inner- ring road, bypass to Chabahil as well as widening of some arterial roads. Most of the proposed development works have not been realized. In the meantime, the urban sprawl has already engulfed considerable numbers of land parcels where future roads could have been built.

In the past, some comprehensive development plans including "Physical Development Plan for the Kathmandu Valley in 1969" and "Kathmandu Valley Physical Development Concept in 1984" and "Kathmandu Valley Urban Development Plans and Programs" have been conducted. However, in spite of these plans, condition of urban area of the Valley has worsened day by day.

In the study conducted by JICA in 1993 a master plan for the Kathmandu Valley Urban Road Development was formulated with long term plans (target year 2015) and short term plans (Target year 1997). Feasibility studies on high priority projects proposed in the short term master plans were also conducted.

## **TRANSPORTATION DEVELOPMENT STRATEGIES**

### **Short term plan: (Target year of 1997)**

#### **Targets:**

- ✓ Improvement of bottlenecks in urban road
- ✓ Improvement of the transportation poor

#### **Strategies:**

In the strategies for urban transport development (short-term); under the category of road development some of the agendas-

- Strengthening of north-south corridor through the city of Kathmandu
- Enhancement of crossing capacity over Bagmati River
- Improvement/construction of road links in critical parts on road networks
- Integration of bridge constructions with road improvement plan

### **Long term plan: (Target year of 2015)**

#### **Targets:**

- ✓ Establishment of road network for well-balanced urban development
- ✓ Establishment of well-balanced road transportation system as a capital of nation
- ✓ Homogenous development of the Valley

#### **Strategies:**

In the strategies for urban transport development (long-term); under the category of road development some of the agendas-

- Linkage among potential developing places in wider scopes in the light of Outer Ring Road Concept
- Introduction of Inner Ring Road for efficient linkage of central area

- Improvement of radiating roads from the cities of Kathmandu, Lalitpur and Bhaktapur.

### THE ROAD DEVELOPMENT MASTER PLAN

The fourth point: Road Development to streamline the traffic in central area

- i. **Construction of the Inner Ring Road**
  - East-west link section in northern part of Kathmandu city
  - Bishnumati link section
  - Bagmati link section
  - Dhobikhola link section
- ii. **Linkage of the Inner Ring Road with the Ring Road**
  - Teku- Ring Road West (construction)
  - Dhobi Khola at Thapathali – ring Road East South (Construction)
  - Hadigaon- Ring Road East North (Construction)

The fifth point: Road development with impending necessity to improve existing bottleneck points and alleviation of transportation-poor

- Construction of the new Bagmati Bridge
- Improvement of Patan access

### SHORT-TERM ROAD DEVELOPMENT PLAN:

Some of the concepts of road development are outlined as shown below;

- Improvement of Bagmati Transport Corridor
- Improvement of Bishnumati Transport Corridor
- Improvement of Lalitpur access
- Improvement of radial roads connecting with the central area

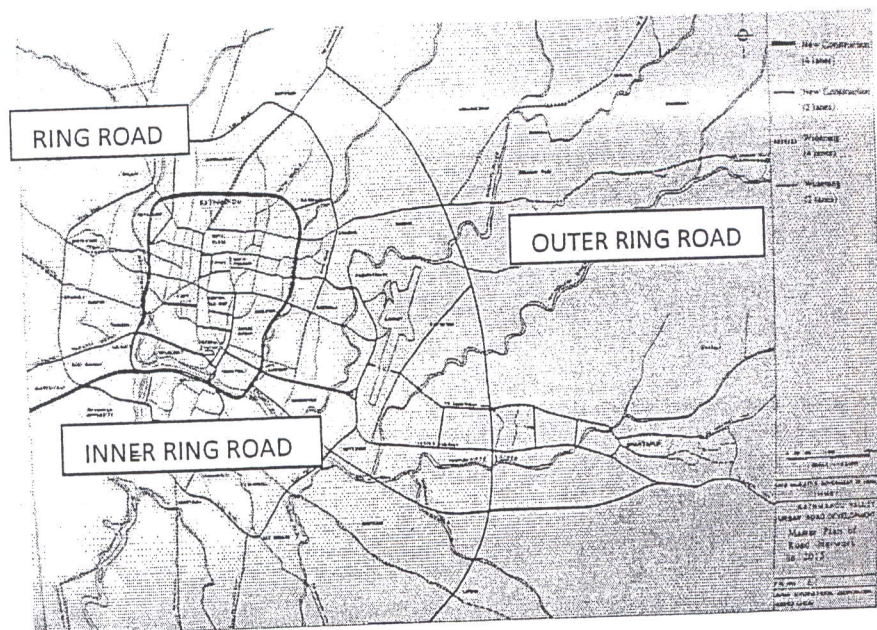


Figure 10: Master Plan of Road Networks in 2015,

Source: JICA REPORT, 1993

**High Priority Projects:** Selection was made taking into consideration the following factors:

- Required amount of construction fund
- Required amount of land/house acquisition and compensation
- Ease of construction from the view point of acquiring land
- Urgency of the project
- Improvement of local traffic movement
- Decrease of the traffic accidents
- Construction Technology
- Improvement of access to the public transport services.

These are selected from among the development plans proposed in the short-term and recommended as a high priority project. Among them this is one:

**Improvement of Bagmati Transport Corridor consisting of:**

1. **Construction of South link of Inner Ring road** – The project is located on inner bank of Bagmati river and connects Dhobikhola bridge on Arniko Highway at east end and Kuleswar kalimati Road at west end.
2. **Construction of Teku Access** from Teku bridge to the Ring Road
3. **Extension of East Bagmati River Side Road** along north bank of Bagmati river
4. **Construction of new Bagmati Bridge** with 2 lanes in Kupondole
5. **Construction of Access** from the south link of Inner Ring Road to Patan city.

## FEASIBILITY STUDIES

### SOUTH LINK OF INNER RING ROAD

Two alternative routes were proposed at the east section through the consideration of river conditions and land acquisition situation. However the alternative that was chosen i.e. route 2 aimed at minimization of land acquisition and building compensation costs, and plans so as to protect bank erosion and river bed degradation. So alternative 2 was recommended taking into account of the construction cost, land acquisition cost, building compensation cost and river conditions.

Staged construction is adopted for the South link of Inner Ring Road considering the future traffic volume in the years 2015. The traffic capacity analysis revealed:

- 2-lane road satisfies the year 1997 traffic demand in the entire length of the South link of Inner Ring Road
- 4-lane road generally satisfies the year 2015 traffic demand. Initial stage construction will be the 2 lane road. And ultimate stage construction will be the 4-lane road. Open space to be utilized for widening to 4-lane carriageway in the future should be used as a green belt for the time being until the widening work will be commenced.

The proposed road starts from the intersection of Kalimati-Teku Road and connects Arniko Highway at east of the Dhobi Khola Bridge with the total length of 3720m.

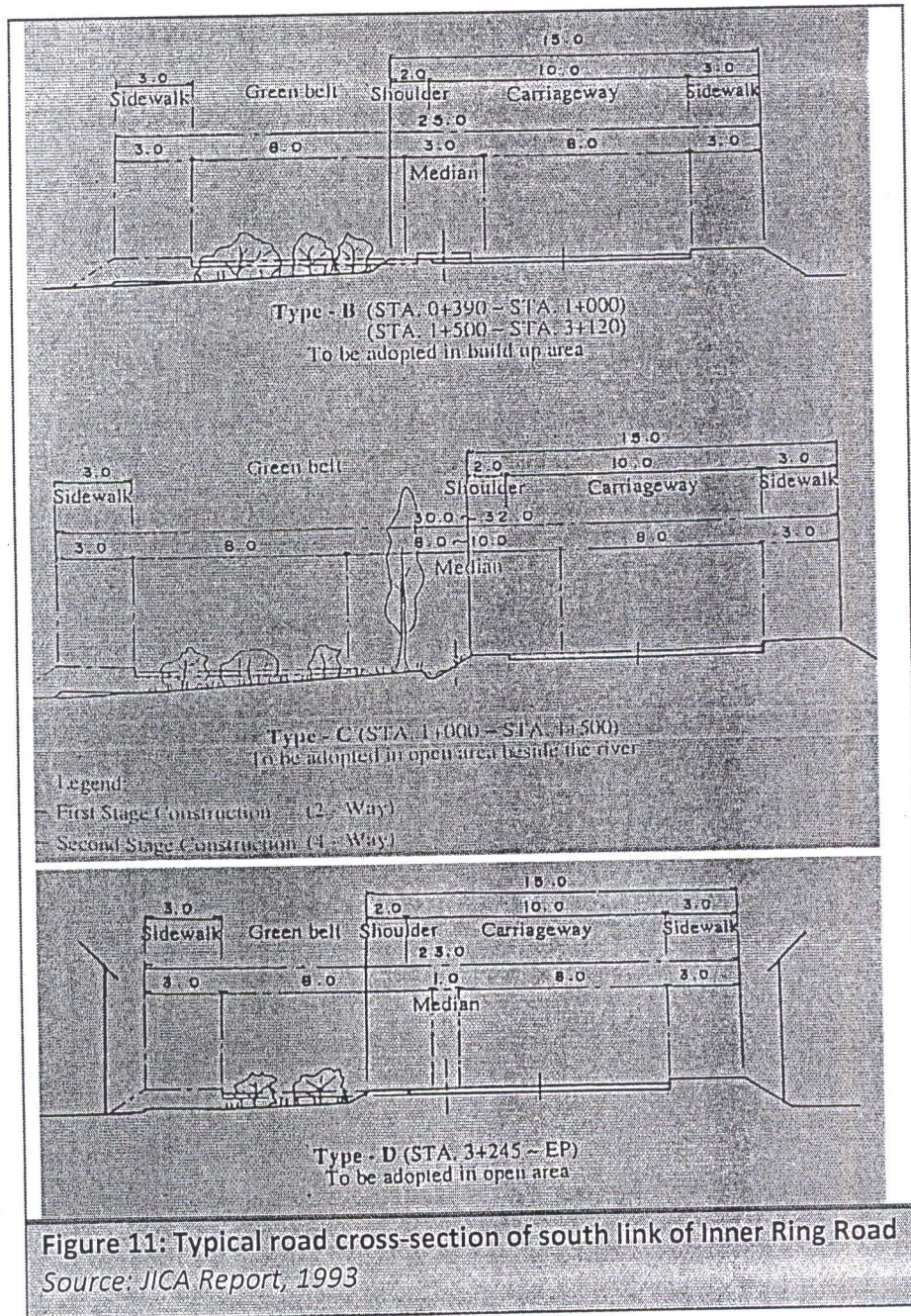
**The proposed road was aligned near the bank of Bagmati River so that it would give a positive impact on the river environment and public activities as follows:**

It will sever the river from the residential area which may stop the pollution activities and result in cleaner river bank. The open space between the proposed road and the bank could be used for public facilities such as playground, park, pedestrian and bicycle road, green belt, open market, etc.

**Sanepa Access:** Sanepa access is planned to connect east of Bagmati Bridge on Ring Road (Balkhu pool) with South link of Inner Ring Road. The estimated route length is 480m. The alignment of this access road was determined so as to minimize the construction cost as well as to minimize acquiring land and houses. Temples, historical monuments and public utilities, such as transmission lines and water main, were also avoided in order to minimize the effects on the environment.

**Drainage System:** The road drainage system is broadly divided into two systems namely, the road surface drainage and road side drainage.

**Executing Agency:** The Department of Roads, Ministry of Works and Transport, is the government agency responsible for the execution of the construction of the project roads.



## ENVIRONMENTAL CONSIDERATIONS

a. Present Condition of the Bagmati Corridor: The tradition of using the flood-plain areas as the agricultural land was prevalent in Kathmandu Valley. But rapid growth of population and lack of zoning has lead all most all flood plains in the Valley to be urbanized and this trend is continuing at an accelerated rate. The settlement in this flood plain has very poor

infrastructure facility and living condition is very low. In the vicinity of Proposed Bagmati transport corridor, there exists many temples and ghats of historical and religious importance, such as Shankhamul Ghat, Tripureswor temple complex, Pachali Ghat and Ram ghat are important religious places. People collect sand for construction purposes from the Bagmati River. Large amount of sand is taken from the river which decreases the water level of the river. The level of dust in the air exceeds accepted standards and the lead content is alarmingly high along the busiest road in the Valley.

b. Effect on Economic and Social Activities: Following impacts on economic and social activities are expected through the implementation of the project:

**Short-term impacts caused by the project-** The alignment of the proposed roads were located near the river bank along the Bagmati so that the acquisition of land and houses could be minimized, however some negative impacts are expected in short-term:

- Around 9.2 hectare of agricultural land and approx.. 110 houses including squatters need be demolished for the overall project. The owner of agricultural lands will lose their source of permanent income.
- The *road will effect on religious activities* and make it difficult for people to use the river.

**Long-term impacts caused by the project-**

- The project will open up a new area and will give *opportunities of new activities along the Bagmati River*. The farmers, who lose their permanent income from the land, will receive *benefit by increased value of land*.
- The project road will provide access to areas that have poor access or no access at all, which will promote systematized urban development in the long-term, and the present low density agriculture area will change their nature from rural to urban form.

c. Traffic Impacts

1. The proposed road will give **improved access** to the areas which currently have poor road access. The improvements of accessibility to the areas will relief the transportation poor in the areas.
2. The proposed south link of Inner Ring Road will provide a **new east-west connection** in the northern part of Lalitpur, which will **reduce the traffic congestion** at the main existing Bagmati Bridge.

3. South Link of Inner Ring Road is a **major arterial road** forming a basic frame of urban road network in Kathmandu city in the long-term. The construction of South link is significant as the first step to building up the **urban road network** in the valley.

d. Improvement on Environment of Bagmati Corridor: The positive impacts on river environment are described as below:

1. The proposed road will sever the river from the settlement. This may stop the pollution and result in cleaner river bank.
2. Open space between the road and river bank could be used for public facilities, such as playground, park, pedestrian and bicycle road, green belt, open market, etc.

e. Impacts on Natural Environment

**Air Pollution:** The emission from vehicle is significant issue in Kathmandu Valley since the vehicles are mostly in a poor condition and old model. Provision of new road facilities as well as improvement of major intersections through the implementation of the projects may improve the traffic movement or traffic flow in the city remarkably and average running speed of vehicles might be increased, which will decrease the volume of emission from vehicles. However, above measures may not be sufficient for improving air pollution in the Valley.

#### **SIGNIFICANCE AND BENEFITS EXPECTED FROM THE PROJECT:**

1. Removal of traffic Bottleneck between Kathmandu and Patan- New Bagmati Bridge at Thapathali
2. Securing the Alternative Route between Kathmandu and Patan
3. Building Up The Basic Frame Of Urban Road Network Inside Kathmandu City- South link is a part of the Inner Ring Road and forms a basic frame of urban road network in Kathmandu City in the long-term. The construction of South Link is significant as the first step to building up the proposed urban road network system in Kathmandu Valley.
4. Improvement Of Accessibility And Enhancement Of Regional Development- Proposed South Link of the Inner Ring Road including Sanepa and Koteshwor access will improve the accessibility from the existing roads to the inner low density areas, which will enhance the development of these inner areas along the proposed route.
5. Improvement of Environment along Bagmati River- improve the environment of Bagmati river-side through the provision of slope protection of river bank. The open space between the proposed road and the river could be used for public facilities, such as riverside park, pedestrian and bicycle road, etc.

### Conclusion and Relevance to the Study:

Even in the earlier plans there have been mention of riverside corridors as being prolific areas for development and if properly planned they *represent an opportunity*, at the very heart of the capital city of Nepal, which should not be missed. However due to lack of necessary infrastructure planning, these very areas, i.e. polluted river waters are the most serious problems affecting the Valley, then and even till this day. There has been mention that roads should be planned in close collaboration with the Land Use and Environmental Strategy. At present The Bishnumati River Corridor development is an example of this implementation. Suitable infrastructure provision i.e. laying of trunk sewer lines and road construction along the Bagmati River Corridor is also underway at present. This is being carried out by The High Power Committee for Integrated Development of Bagmati Civilization (HPCIDBC) in several packages- Package 5 i.e. from Shankhamul to Balkhu is in its design stage. The Government's efforts can be seen, however various other problems such as financial constraints, politics have proved to be setbacks.

The JICA report of 1993 recognizes the necessity of an inner- ring road. The proposed roads were aligned near the bank of Bagmati River so that it would give a positive impact on the river environment and public activities. At present the road has eased traffic at the Kupondole Bridge to some extent and as it directly connects to the Ring Road, travel distance and time has been reduced. But the road is a 2 lane road even now, though there was mention that it would be upgraded to 4 lane to meet the traffic demand of 2015. Even in the plans by HPCIDBC for road up gradation there are no provisions for 4 lane construction due to limited monetary resources. However, this inner ring road concept, especially the south link has been significant in building up the basic frame of Urban Road network system in the Valley, besides also improving access to low density areas. In overall, it has either initiated or enhanced the development of these inner areas along the proposed route. The other major benefit expected from the project was the improvement in the environment along Bagmati River. At present this has not been seen. The UN Park owns the land between the road and the river from Shankhamul to Teku Doven. Even though various plans for development are on the agenda, due to lack of monetary resources, significant work hasn't been carried out. However, greenery is present along the corridor and in a way provides slope protection to the river bank and also as flood protection.

The road corridor definitely allows for development but appropriately planned development may be lacking. This in turn may result in haphazard growth and so adversely impact the river environment, further worsening it. The plan 2020 puts thrusts on efficient land use and transportation and identifies necessity to integrate land use and transportation for planned development of urban areas, which in today's context is a necessity.

## 2.11 SOME RELATED CASE STUDIES

### 2.11.1 Case of an Under-Developed Country: Planned and Sustainable Development of Bisnumati River Corridor

*A feasibility study being undertaken by CDIA(A joint program of ADB,GTZ,SIDA, SPAIN), June 2009*

#### The Bisnumati River Corridor

The Bisnumati river corridor is one of the important corridor linking N-S of Kathmandu and adjoining municipalities. The River corridor is of 2.8 km length between Balaju in the North and Teku Bridge in the south. The river is biological dead. Untreated sewage from adjacent heavily populated areas is discharged directly into the river. For generations, waste has been dumped in or along river. The city's only waste transfer facility exists at Teku. Various unhygienic activities exist along the corridor, the most offensive of which is the open air slaughter of livestock.

Over the years unplanned and the often and illegal urban development has encroached the river. Much of this is occupied by urban poor who have limited access to adequate infrastructure and reside in the sub –standard structures.

#### Strategic Issues

- Link between North and South of Kathmandu and adjoining municipalities
- Connection to Bagmati River Corridor
- Connection to Proposed inner ring road
- Linkage with proposed fast track
- Construction of 4 lane link road with support from ADB is underway and will be completed by April 2010

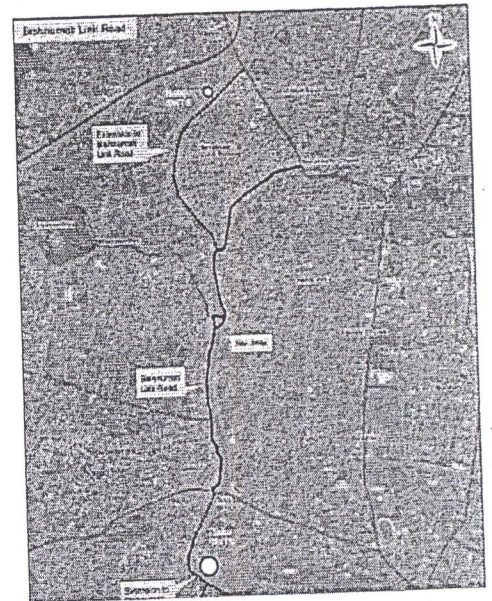


Figure 13: Bishnumati Link Road

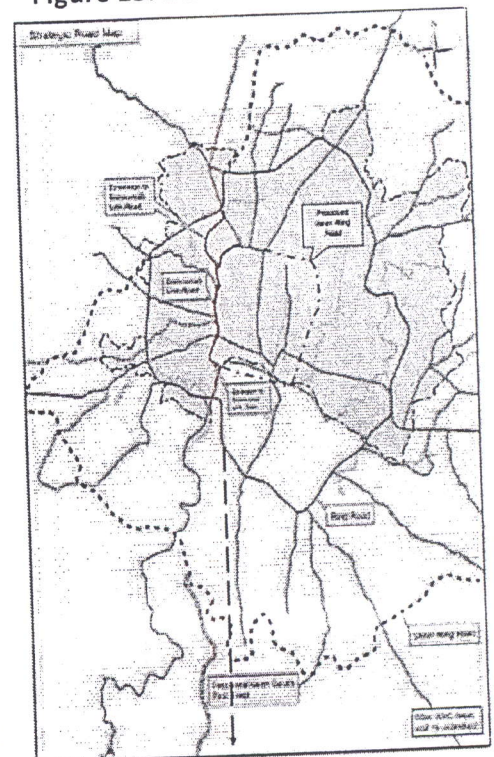


Figure 13: Strategic Role of Bishnumati Link Road

CDIA (Cities development Initiative for Asia) Support to Kathmandu Metropolitan City

1. Prepare Feasibility Studies of Bishnumati River Corridor and Solid waste management.
2. Preparation of investment program for priority urban infrastructure.

3. Linkage of the above mentioned studies with potential investors for financing.
4. To assist KMC in institutional strengthening and re-structuring to better manage the operation and maintenance of municipal services including solid waste.
5. To support KMC in networking and promoting city – city cooperation program with international cities and relevant international agencies and institutions.

### **Bishnumati River Corridor Project**

Feasibility study of the Bishnumati River Corridor and solid waste management of KMC was completed in July 2009.

- Junctions and access roads improvement
- Construction of skew bridge connecting E-W of link road
- Environment improvements
  - ✓ Waste water treatment system
  - ✓ Parks, Greenery and landscaping along bank of river
  - ✓ Parking facilities
  - ✓ Improve solid waste collection
- Conservation of Historic sites and temple along river corridor

### **Linkage of Bishnumati River Corridor with City Core and Historic sites**

- Bishnumati Link road connects the entire city core and most of the historic sites from- S existing access roads connection link road and the city core to be improved and widened.
- Improvement of access roads and traffic management (vehicle restriction) along the roads connecting link road and heritage walk routes.
- Parking facilities along link road proposed by CDIA will be linked with the proposed parking within city center (to be studied under SUT project)
- Sustainable Urban Transport (SUT) project (ADB) study will be linked with the CDIA feasibility study on above activities in order to achieve better result in terms of smooth and efficient traffic flow and better pedestrian movement Bishnumati Link road and city core/historic sites.

### **EVALUATION AND JUSTIFICATION**

The projects summarized above are evaluated in terms of beneficiaries; economic benefits; social impacts; and environmental impacts. Brief comments on each are set out below.

**Beneficiaries:** These are expected to number from 400,000 to 1,000,000 people from 2015 onwards:-

- over 400,000 people from the implementation of the Bishnumati Link Road,
- over 500,000 people from the sewage system,
- over 400,000 people from the Bishnumati Corridor initiatives, and
- over 500,000 people from the implementation of the solid waste component.

In fact it could be argued that the whole population of the city benefit from the sewage sub-project and from the solid waste projects.

**Economic Benefits:** There are several **quantifiable** benefits:-

- Time savings for drivers and operators of motorized vehicles using the Link Road,
- provision of services, increased property values, decreased expenditure on healthcare and/or a decrease in the number of work days lost for residents and visitors to the Bishnumati Corridor,
- Improvements in productivity due to improved solid waste management facilities and practices plus reduced healthcare costs arising from a waste free environment.

Also there are many **non-quantifiable** benefits:-

- A new north-south strategic road will provide a major relief to the serious traffic congestion within the central area of the city and will benefit all road users.
- Realization of the vision for the Bishnumati Corridor will benefit a substantial number of city residents, not only those that live within close proximity to the river.

**Social Impacts:** These are positive for all projects:-

- The Bishnumati Link Road should particularly benefit women and children, as well as the poor and vulnerable, many of whom are pedestrians.
- Environmental Improvements to the Bishnumati Corridor should improve overall living conditions, including better sanitation and reduced health risks, leading to a diminished need to seek medical assistance. This should benefit, in particular, the poor and vulnerable segments of society as they suffer disproportionately from adverse health problems due to their inability to afford appropriate treatment.

- Improvements to solid waste management should result in improved sanitation and a cleaner city environment leading to an improved quality of life with much reduced health risks.
- Willingness to pay and affordability are not considered to be major issues for any of the projects.

**Environmental Impacts:** These are positive for all projects. Benefits will include a very much improved urban environment as a result of a cleaner city and significantly lower levels of air and water pollution.

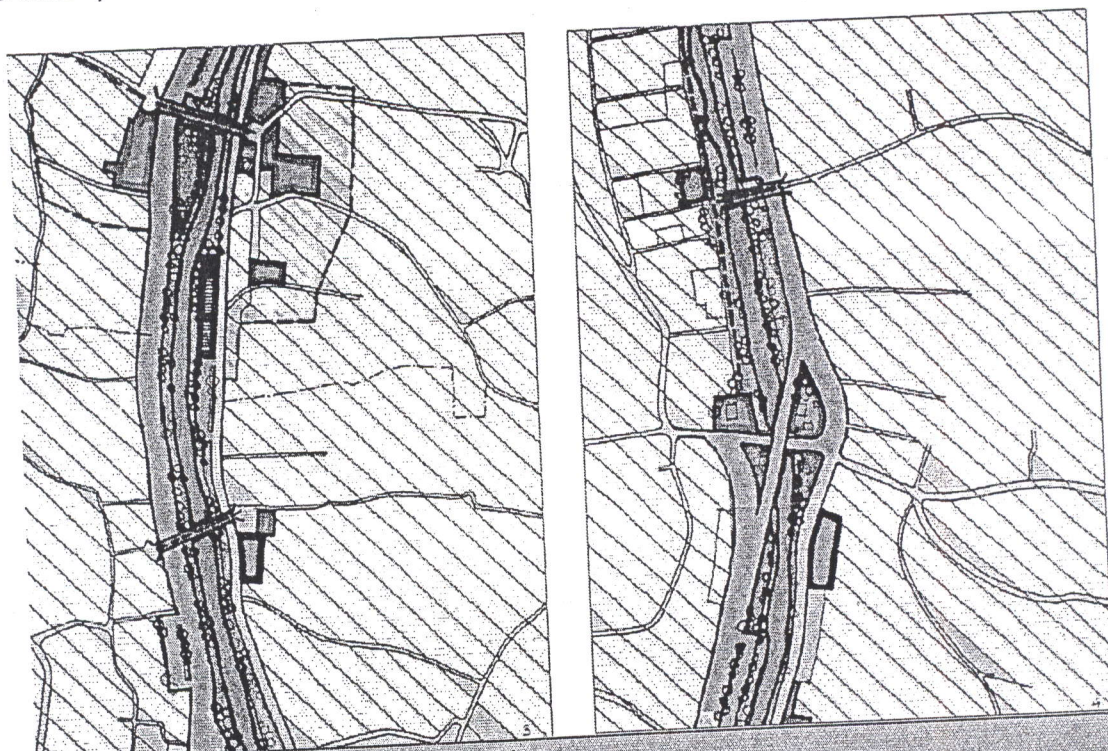


Figure 14: Vision of Bishnumati Corridor  
Source: CDIA, 2009

**Conclusion and Relevance to the study:** The Bishnumati and Bagmati are both the most polluted rivers in Kathmandu Valley. In both cases settlements have started developing in these areas. The environmental problems and factors that have led to the degeneration of this river are similar to that of the problems faced by Bagmati. The constructions of the link roads are also similar to that of the Bagmati Corridor Road and the impacts expected from the project similar. In both cases road subproject will enhance the better road corridor environment and improve the quality of life. Access to social services will be easier to otherwise remote and interior areas of the region. It will have long-term impact for the development of the local area. So, the similarity of both the projects is what was relevant to this research.

### 2.11.2 Case of a Developing Country: Nanjing Qinhuai River Rehabilitation Project

Experiences from China, shows that it is possible to restore and conserve polluted rivers such as, if there is a will and determination to do so.

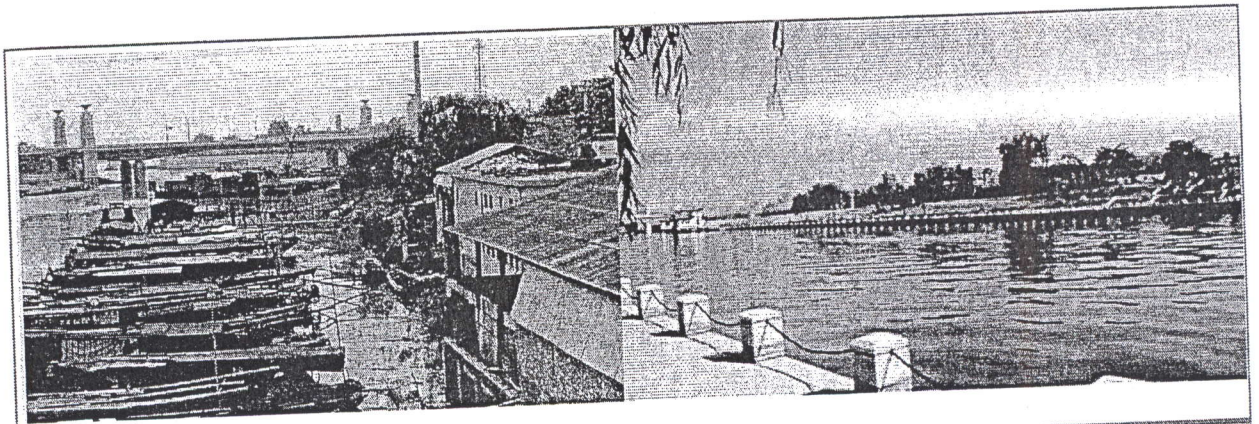


Figure 15: Nanjing River- Then And Now

Qinhuai River is highly polluted river of Nanjing. Illegal slums and squatters along the river, the filthy environment as well as the contaminated smelly river have severely reduced the quality of human settlements environment and urban images. In order to achieve an excellent living environment incorporating ancient and modern civilization Nanjing Commision and Government made a decision of implementing the Qinhuai River rehabilitation at the end of 2002.

**Qinhuai river project**-This project has five components:

**Housing:** Low and shabby bungalows and squatters' settlement along the Qinhuai River were fully demolished. Instead, houses were set up having low rent houses, economically affordable housing and mid-low price commercial housing to address the housing problem for the mid-low income groups. This programme has resettled 6,000 squatter families. Similarly, 138 small scale enterprises along the river were also relocated to the economic development zone with adequate compensation.

**Hydrology project:** Due to low land topography of Nanjing city, this area is very susceptible to the flooding, thus a number of flood controlling activities are implemented. They are - riverside low-land remedial works, river dredging, river course widening, and embankment stabilization. Under the flood prevention function, 20 km long flood wall was constructed along the Qinhuai river. Similarly, 18.1 km river course was widened with two million m<sup>3</sup> dredging works.

**Landscaping project:** Under this component, a large area of greenland was developed, five km of Ming Dynasty great wall was maintained, and more than 10 cultural sites were newly constructed. All these sites are rich in both natural scenery and cultural resources.

**Environmental protection project:** The main cause behind the river water pollution in the Qinhuai river was due to the direct discharge of wastewater into the river. Thus to address this problem the waste water treatment system on the peripheral area was improved to stop wastewater entering into and polluting Qinhuai river. Water transfer and replenishment works were also carried to make water clean and flowing. One hundred and thirty eight pollution enterprises were relocated, twenty five km long intercepted pipes were laid, six pump stations were built or reconstructed, and five hundred fifty sewer outlets were intercepted. Two wastewater treatment plants were built.

**Road network project:** More than 13 bridges were decorated and lighted in order to show the giant figure of bridges across the Qinhuai river. A bridge only for pedestrians was built. The main objective behind this is to make Qinhuai river more beautiful and florid.

By 2005, in the first phase commission accomplished the achievement by resettlement of 380 thousand square meters area; 4356 households have been moved, 94 companies have been relocated 20 km of flood-preventing wall has been upgraded; 25 Kms of sewer interception pipeline has been laid; 550 urban sewer outlets have been intercepted; 5 Kms of city wall has been maintained; more than 10 scenic spots have been created; 110 residential houses have been decorated and 13 bridges decorated and enlightened; forming the green land area of 1 million square meters or so with the total investment of 3.5 billion.

In 2006, second phase of the rehabilitation work was anchored that include rehabilitation of 18 km of river, construction of seven bridges, and construction of ecological wetland park. Now Nanjing-Qinhuai River has become a historical scenic zone, a cultural scenic zone and a tourism scenic zone characterizing the ancient human civilization of Nanjing. (Source: Nanjing Qinhuai River Rehabilitation Project- excerpt from Bagmati Action Plan.)

**Lesson to be learnt:** Sound institutional management and arrangement is the major factor behind the success in the restoration and conservation of the Qinhuai River. The entire project is managed with the principle of clear division of position as well as responsibilities of each organizations and professionals. High quality systematic planning and design is another major aspect. There was a systematic detail designing and planning on each of the identified activities such as flood control, sewage interception, landscaping, heritage

conservation and tourism development. Governmental support and public participation is another key factor for the successful implementation of the project. It can be said that there was an active participation to make Qinhuai river a lively and beautiful river.

**Conclusion and relevance to the study:** Degradation of rivers due to urbanization and development is a common phenomenon the world over. But the methods that are taken to deal with the problems differ. The case of Nanjing is very similar to our case, i.e. the Bagmati River. The problems and issues are also very similar. Such a polluted river with the efforts of the Chinese Government through the rehabilitation project has yielded positive results and its impacts are profound. Not only this, but the total budget for the project was also very close to the budget required for the Bagmati Action Plan. So, experience has shown that it is possible to restore Bagmati as is seen from the case of Nanjing.

Thus, from the Qinhuai River Project, the lesson that can be learnt is that no single agency can implement the Bagmati Action Plan (BAP) and that there should be a clear division of the responsibilities of each partner organization working in the Bagmati. Similarly, there should also be the detail systematic designing and planning on each of the activities identified in BAP. Another important lesson to be learnt from Qinhuai is to search for an alternative way to raise funds to make the project more feasible and sustainable instead of always looking for donor organizations.

CHAPTER III: THE STUDY AREA

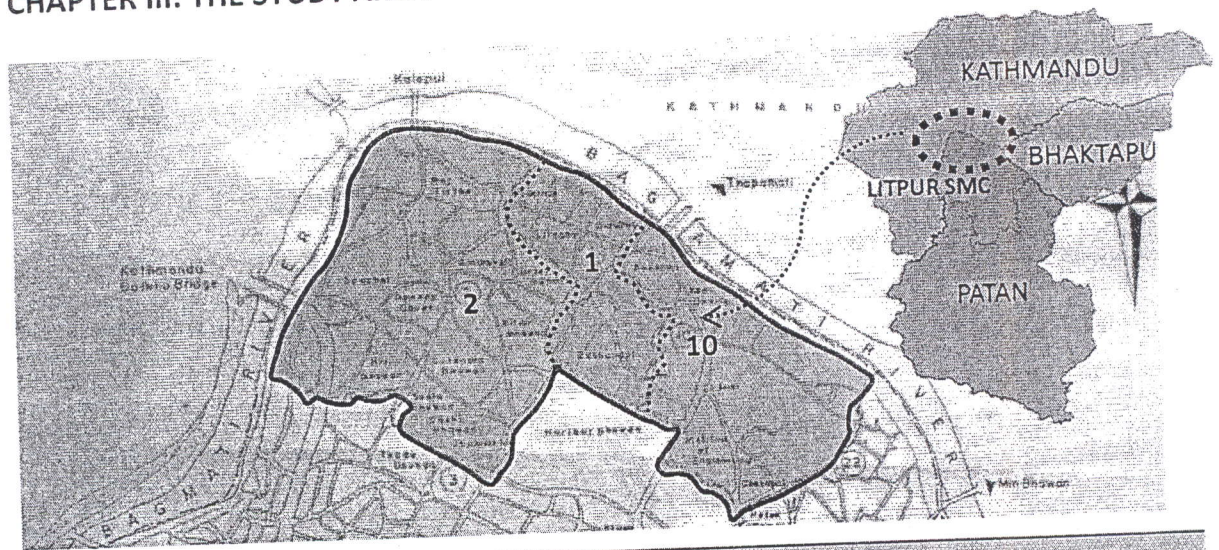


Figure 16: Wards 1,2 & 10 of Lalitpur

3.1 INTRODUCTION TO LALITPUR METROPOLITAN CITY

Lalitpur sub metropolitan city (LSMC), popularly known as Patan is located about 5 kilometers south-east of Kathmandu. With its urban history dating back to as far as 2300 years, LSMC is one of the three major cities located inside the Kathmandu valley, besides Kathmandu and Bhaktapur. The city is spread over an area of 15.43 km<sup>2</sup> and there are 22 wards in the LSMC. Rivers form the natural territorial boundaries of LSMC separating the city from its neighboring cities and VDCs. It is bounded in the north and west by the holy Bagmati River, to the east by Karmanasa River and to the south by Nakhu Khola.

The study area covers portions of ward number 10, 1 and 2. Ward 10 is one of the developed wards in the Lalitpur district; and is also the major entry point from Kathmandu district. Ward 10, ward 1 and ward 2 all are the periphery of the historical town of Patan and is the edge boundary with the Kathmandu valley.

Table 11: Total Glance of LSMC 2001 AD

Description	Lalitpur	Sub-Metropolitan City
	District	
Total Population	3,37,785	1,62,991
Male	1,72,455	84,502
Female	1,65,330	78,489
Sex Ratio	1.04	1.08
No. of Household	68,922	34,996
Average Household Size	4.9	4.66
Area (sq.km.)	385	15.15
Population Density per sq.km.	877	10,758.48
Source: CBS-2001		

Ward wise Population: 1971 AD (2028 BS): Total population of LSMC: 59,049

Ward	Population	Male	Female
1	3768	1637	1831
2	1864	922	942
10	1454	764	690

Source: CBS 2028 BS

Ward wise Population: 2001 AD (2058 BS): Total Population of LSMC: 163,923

Ward	Area (Ha)	House hold	Population	Male	Female	Sex Ratio	Density (Pop/Ha)
1	41.12	1691	7,096	3,993	3,103	1.29	172.58
2	129.75	2284	10,459	5,491	4,968	1.11	80.61
10	81.10	1222	5,430	2,974	2,456	1.21	66.95

Source: CBS 2001., Lalitpur District Profile 2064 BS

So comparing from 1971 AD to 2001 AD, in a span of 30 years or 3 decades the population of LSMC has increased almost three times. In the 1991 census, the total population of LSMC was 1,15,865, with a growth rate of 3.79 per cent per annum from the previous census year of 1981. Therefore, in the intervening ten years, between 1991- 2001 the population increased recording a growth rate of 3.47 per cent per annum, which is much higher than the national growth rate of 2.24 per cent per annum, but somewhat lesser than the previous decade figure.

The major contributing factor to this situation was the migration of the people from other parts of the country. The population of LSMC was expected to reach 2, 29,852 by the year 2011. This gives us the picture of the rapid urbanization in LSMC, sharing a bulk of the greater phenomenon of urbanization currently taking place in the Kathmandu valley as a whole.

Ward	Pre-Primary	Primary Sec Higher	Secondary	Higher secondary	College	Total
1	0	2	1	4	1	8
2	1	5	4	4	2	16
10	2	1	3	1	3	10

Source: Lalitpur City Profile 2008

### Road Network

Lalitpur Sub-Metropolitan City has a well-developed road network of various categories, width and pavement types. From 1985 to 1998 the total length of road under various road categories in the Lalitpur District increased from 290 to 383 kilometers. This drastic increase in road length within a period of three years was a

Category	Length (km)	
	1995	1998
National Highway	0	0
Feeder Road (Major)	0	0
Feeder Road (Minor)	33	33
District Road	175	175
Urban Road	82	175
Total	290	383

*Source: CDS of KMC, 2001, Lalitpur City Profile 2008*

result of increase in urban roads accompanying rapid urban expansion in virgin agricultural lands of the outlying areas of LSMC. Urban road more than doubled (113 %), from 82 kilometers in 1995 to 175 kilometers in 1998:

### 3.2 INTRODUCTION TO THE STUDY AREA

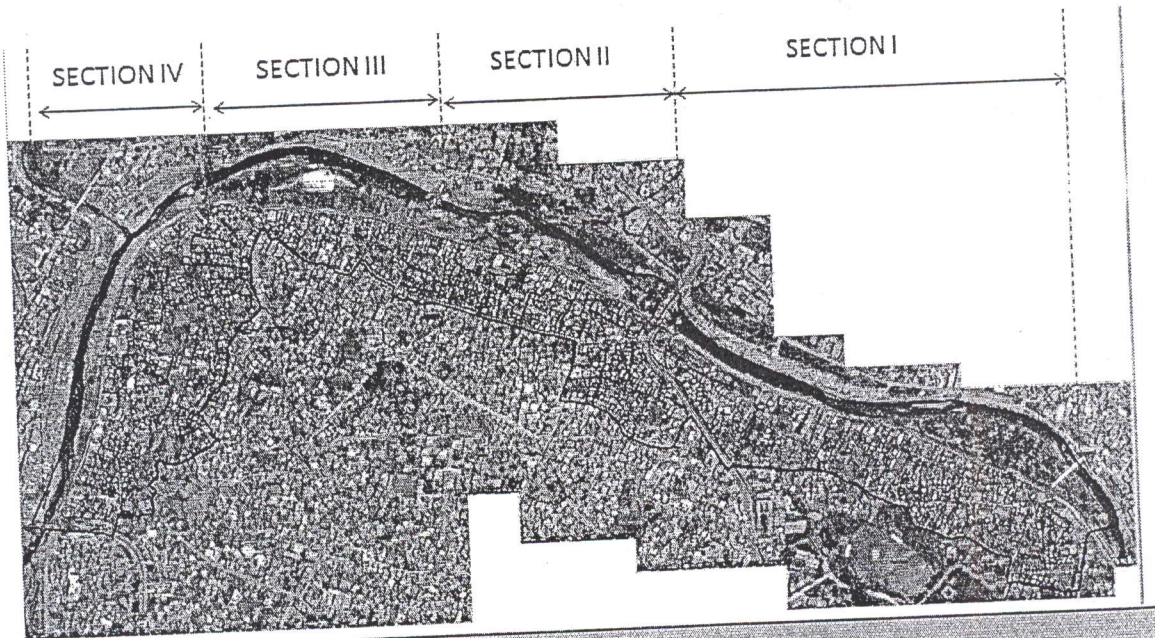


Figure 17: Study Area Demarcation - section wise  
 Source: Google Image 2012

The study area incorporates wards 1, 2 and 10 of LSMC. Study will incorporate the Bagmati River, the flood plains on Lalitpur side, the Corridor Road and bridges and the urban setting up to a certain distance from the edge of the road-

- ✓ Land use change analysis over four decades will be carried out within 200m from the edge of the Bagmati Corridor River Road and

- ✓ The questionnaire survey and existing situation analysis will be carried out up to 50 m from the edge of the road along the 3.4 km stretch.

The study area will be divided into four sections based on the bridges in the area:

**Section 1:** New Bagmati Bridge to Kupondole-Thapathali Bridge; Jwagal area, ward 10

**Section 2:** Kupondole-Thapathali Bridge to Sankata Bridge; Kupondole area, ward 10 & 1

**Section 3:** Sankata bridge to Teku Bridge ('Kalo pool'); Gushingal area & Sanepa area; ward 2

**Section 4:** Teku Bridge to Sanepa Bridge (Balhu pool); Sanepa area & Balkhu area; ward 2

#### **Brief on Study Area:**

The major ward growth and landuse as seen today can be observed in following three divisions-

- Commercial growth/ landuse – Along the Bagmati River Corridor Road and in inner areas
- Institutional Growth –Kupondole, Jwagal areas, also along the Corridor
- Residential growth/landuse – in all the sections

### **3.3. LAND DEVELOPMENT EFFORTS MADE BY THE GOVERNMENT IN THE STUDY AREA**

Various land development efforts have been made by the Government in the study area. Some have been completed; some are still ongoing whereas some are future plans that will be implemented in the future. These are as follows:

#### **3.3.1. Guided Land Development**

Project status: Ongoing

This was initiated in 2046 B.S. It involved guided land development (GLD) of various wards of Lalitpur Metropolitan City, i.e. wards 1 to 10 and ward 15. It involves widening of roads, blacktopping, shifting of electric poles and telephone poles. The road width are of categories 20m, 14m, 11m, 8m, 6m and 4m (Source: Central District office, Lalitpur)

#### **3.3.2. Jwagal Land Pooling**

Project status: Completed

It was started in 2051 B.S and included 229 ropanis of land. This whole project extends from the land next to the Dhanwantari Barahi Temple all the way up to the Prashuti Griha quarters compound. In this land pooling only land readjustment and provision of roads was done,

serviced plots were not provided. The roads designed were of 6m and 4m widths. They had proposed the present Bagmati River Corridor Road as a 6m road back then which was not implemented. (Source: Central District office, Lalitpur)

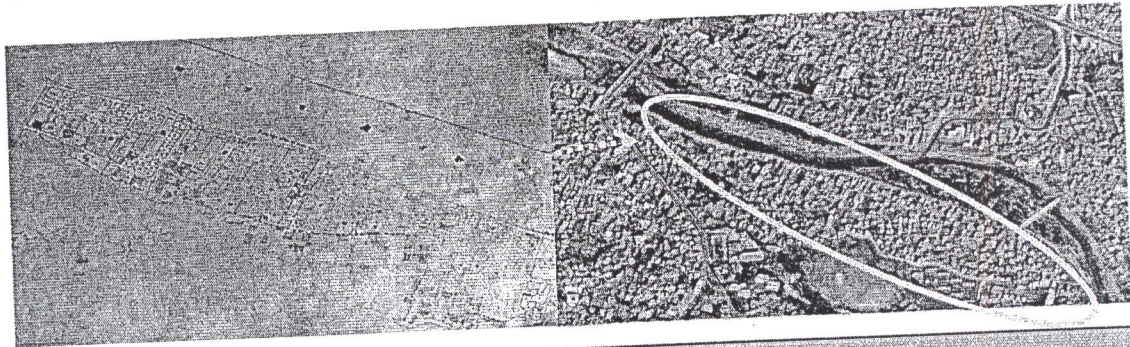


Figure 18: Jwagal Land Pooling  
(Source: Central District Office, Lalitpur)

### 3.3.3. UN Park

Project Status: Incomplete, Ongoing

To commemorate the 50<sup>th</sup> anniversary of UN establishment day, the National Preparatory Committee in Nepal had decided to build a UN Park within the Kathmandu Valley on July 20, 1995. The park is also intended to serve as a memorial in order to respect those Nepalese Army, Police as well as Civilian personnel who have died for the UN peace keeping endeavor abroad.

Various relevant criteria were used for the evaluation and selection of a suitable site. The criteria used were namely, provision for future extension, land ownership, proximity to urban center, topography and existing land use, surrounding environment and vista, existing infrastructure, need for urgent intervention, development impacts and cost. The UN Park steering committee selected the Sankhamul-Teku Dovan Bagmati River Bank as the site for UN Park, includes 1,576 ropanis of land.

#### Goals:

- To mark the 50<sup>th</sup> Anniversary of United Nations the commitment of Nepal to UN will be exhibited through the construction of a huge park to be named as UN Park on the areas on either side of Bagmati River from SHankhamul to Teku-Dovan.
- To save and promote the cultural and religious values of the Bagmati River along the cultural, historical and religious sites and monuments.
- To create a vast pollution free open space at the heart of the city in order to cater to the needs of the adjoining citizens.

- To improve urban environment of Bagmati Corridor.

#### Objectives:

- To construct a park and a memorial pillar dedicated to those Nepalese people who have laid their lives for the cause of United Nations peacekeeping.
- To protect public lands of Bagmati River.
- To control soil erosion.
- To manage sewerage disposal of adjoining area.
- To protect Bagmati River from solid and liquid wastes
- To conserve the historical, cultural and religious sites and monuments
- To provide breathing space to the adjoining citizens
- To promote tourism.

#### Suggestions and decisions

- Roads should not be constructed on the lands of Bagmati River.
- If motorable road is to be constructed, it should be constructed 20m away on either side of the River Bank.
- Sewerage system should be treated as the integral part of the UN Park
- Construction of sewerage lines should be considered as a long term programme, whereas the construction of park as a matter of short term priority.
- River should be considered as an integral part of the Park.
- Minimization of permanent structures
- Flood control designed in 5 years flood
- Enough river width should be provided.

#### The Master Plan (Framework)

The total area was divided into 6 development zones: Zone II, Zone III and Zone IV falls within this study area. The other zones are in Kathmandu side and Zone VI is neutral zone.

Zone I- UN Memorial Pillar

Zone II- (Walking and Breathing Activities): Heavy plantation, walkways, green spaces, car parking

Zone III- Element of Donor Interest

Zone IV- (Recreational Activities): Children's parks, mini Nepal, walking, cycling, plantations, car park, Tourist activities, green areas, kiosks

Zone V- Conservation of Historical, Cultural and Religious Sites and Monuments

Zone VI- River course

**Present Status of Project:**

- ✓ River training from Jwagal stretch to Gushingal
- ✓ Compound wall construction completed in Lalitpur area (2055-2068 B.S.)- for demarcation purposes.
- ✓ Tree plantations in gushingal area
- ✓ Park/ walkway in Jwagal

The project was supposed to be completed in 5 years from 2055 B.S. but due to delays, monetary constraints and changing perceptions, it is still incomplete.

(Source:UN Park Development Committee, 2052 B.S., Anamnagar)

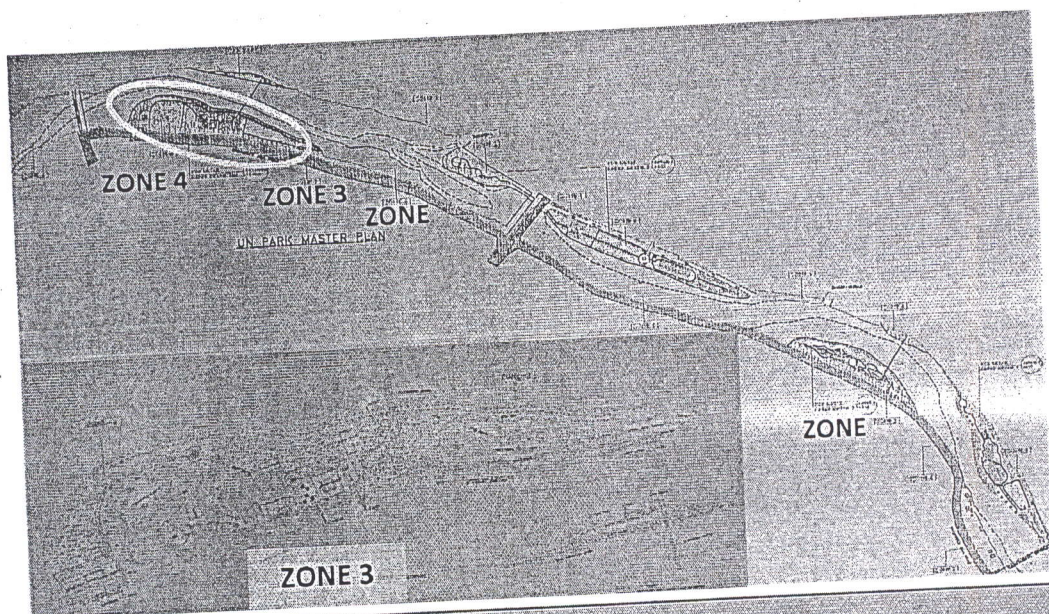


Figure 19: Master Plan of UN Park  
Source: UN Park Development Committee, 2052 B.S., Anamnagar

### 3.3.4. Bagmati Area Physical Infrastructure Development Project (BAPID Project) - Package 5

Project Status: Initial Stage- Tender awarding stage; Project construction is slated to begin in January 2013 and end by mid of 2015.

The High Powered Committee for Integrated Development of Bagmati Civilization (HPCIDBC) under the BAPID Projects' Package 5 involves development in the area from Shankhamul Bagmati Bridge all the way up to the Balkhu Bridge in both Lalitpur and Kathmandu sides of the river corridor. Development works will involve:

- Municipal Trunk Sewer

- Green Belt
- River Training Works
- Metallic Road with Asphalt Covering

In order to curb further environmental degradation of the Bagmati River and adjoining area as well as to restore the condition of the once pristine Bagmati River, the Government formed a High Committee for implementation and monitoring of the Bagmati Area Sewerage Construction Rehabilitation Project (BASP) in 1995 A.D.

**Project Description:** The Bagmati Area Physical Infrastructure Development Project (BAPIDP) is divided into different sections from Sundarijal to Balkhu section into five packages. BASP has already laid down trunk sewer along the left and right bank of the Bagmati River from Gokarna to Tamraganga, which carries the sewage upto the Guheshwori Waste Water Treatment Plant. The treated waste water is discharged in to the Bagmati River through Tamraganga- tilganga sewer tunnel bypassing the Aryaghat area. Works of laying sewers along both banks of the River from Tilganga to Shankhamul section are under progress.

The present package 5 involves construction of metallic road with asphalt concreting from along the stretch from Shankhamul Bagmati Bridge to Thapathali bagmati Bridge (1.2 km), Thapathali Bagmati Bridge to Kalopool(Teku Ghat) about 800m and Kalopool to Balkhu Bagmati Bridge (750m). It also involves construction of trunk sewers, sewer appurtenances, siphons, weir, green belt, river training works, piling works etc. The project will maintain a minimum of 30m river width, 12m greenery and a uniform road width of 8m throughout wherever possible.

#### Project Objectives:

- ✓ To improve the overall environment of Bagmati – the project will help 'channelize' the directly discharged sewage and so helps in preventing further pollution of the river.
- ✓ Trunk sewers help in decreasing sewer sections and so is cost efficient
- ✓ At least maintain a minimum flow
- ✓ Maintain water quality that is adequate to sustain aquatic life.

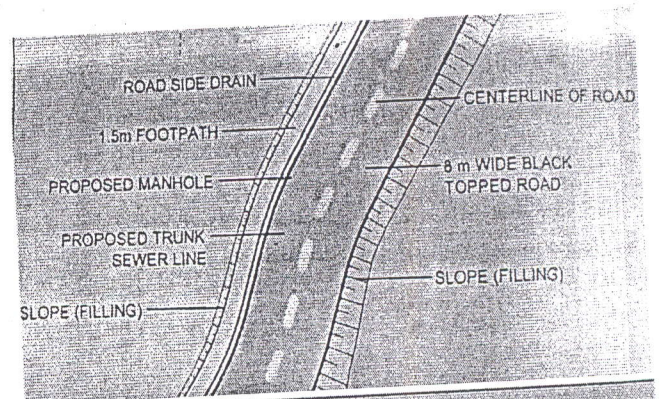


Figure 20: Package 5  
Source: BDA, Kamaladi

- ✓ The road and greenery will help to protect the river banks, prevents further encroachment

(Source: HPCIDBC, Guheshwori, interview with Bahrat Man KC, Deputy Project Manager and Ram Kumar Shrestha, project engineer, and BDA Consultancy, Kamladi; Triratna Shakyar Engineer, Madan Chitrakar)

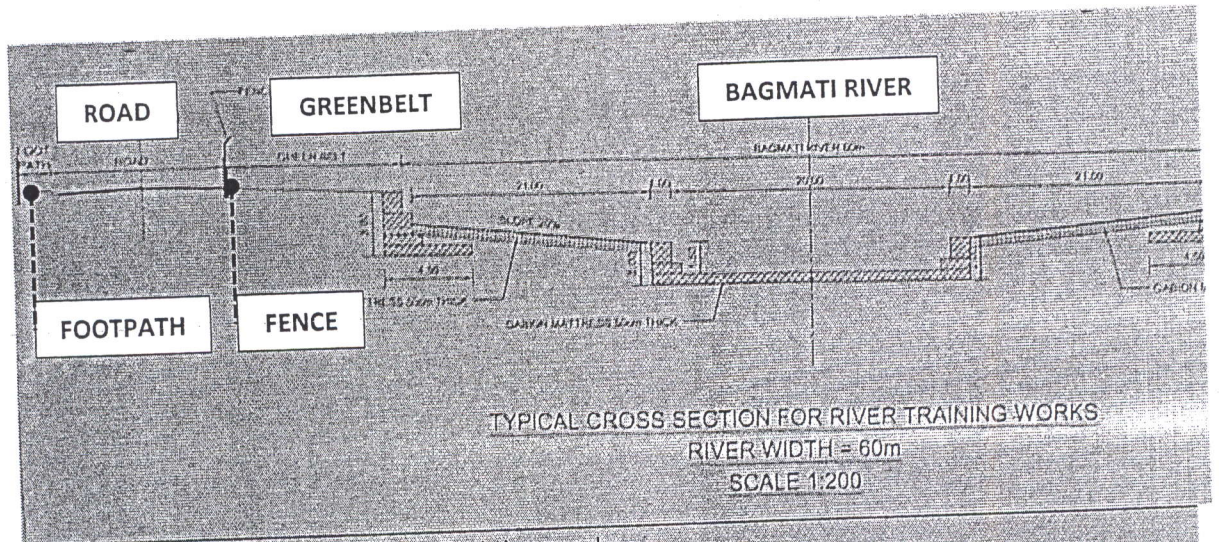


Figure 21: Cross section for River Training works  
(Source: BDA, Kamladi)

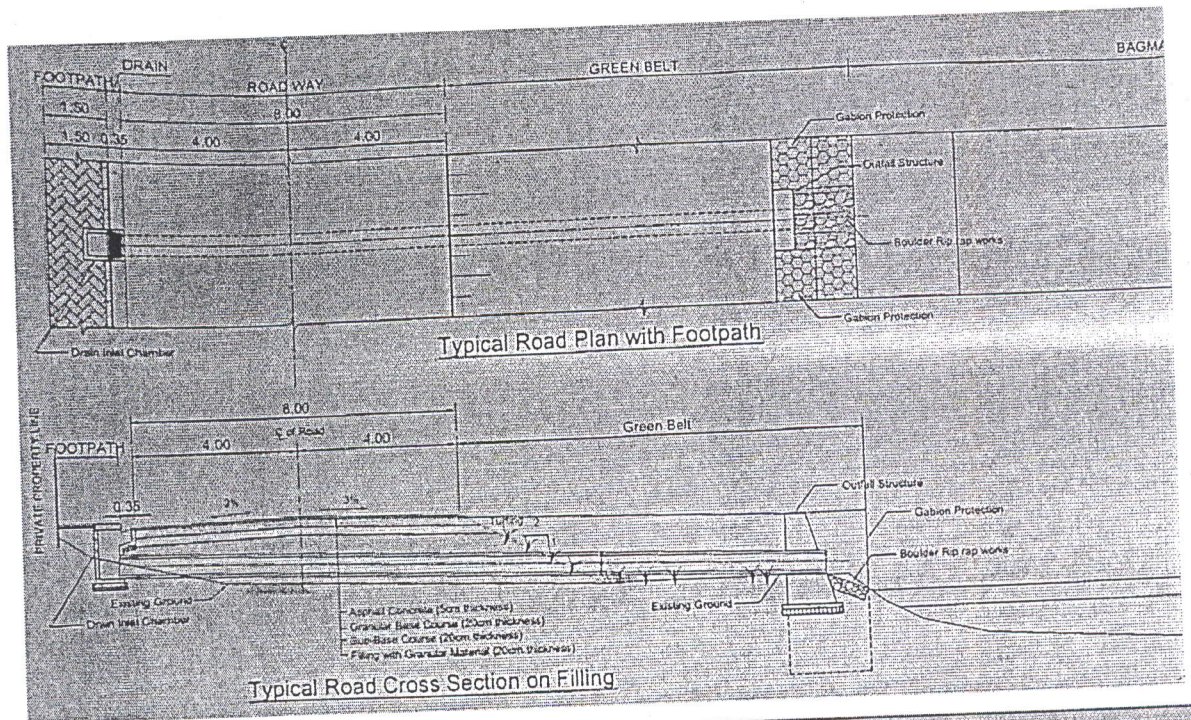


Figure 22: Typical road plan and cross-section with footpath, drains, greenbelt  
(Source: BDA, Kamladi)

### 3.4. TRANSPORTATION SCENARIO OF THE STUDY AREA

Jwagal-Balkhu Road (Bagmati Corridor): Length 3.45km, 2 lane

Road was opened by local people. Government had given priority to open and upgrade to two lane blacktop road from the fiscal year 2063/064 under Urban Road Program through Budget Niti & Karyakram. The road section under Niti Karyakram was Bagmati corridor Tilganga- Manohara- Balkhu section. The road is upgraded to 2 lanes Black top. (Source: Department of Roads, Lalitpur)

#### 3.4.1. History of the Bagmati River Corridor Road (Jwagal-Balkhu section)

*(Source: From interview with a local key informant, who has been a resident of the area since ancestor's times and who is also actively involved in the ward: Mr. Dhruva Lal Tandukar (resident of ward no. 1), Social worker, former ward executive and chairman of Lalitpur National Consumer Forum)*

Earlier the river's edge reached up to Prashain ghat, which in the present day is next to the main corridor road. In about 30-40 years the river has drastically narrowed. The Bagmati River Corridor Road some 15-20 years earlier did not exist and what existed in its place was a small 3-4 feet wide dirt road or 'kulo'. The area comprised basically of agricultural fields and very little households, and there were ghats nearby. So, basically it was not a very safe place as it was not very accessible nor was any sort of development taking place.

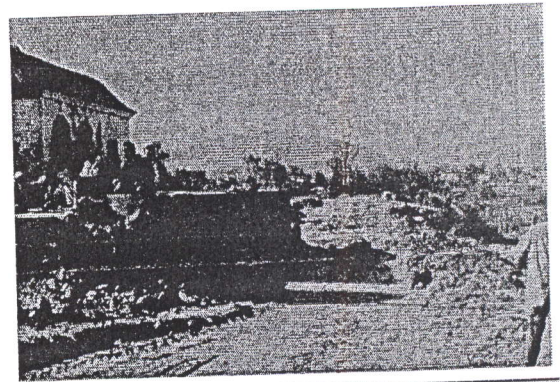


Figure 23: Prashain Ghat in 2052 B.S.  
(Source: Ward 1 office)

In 2052 B.S. the UN Park Development Committee acquired around 1576 ropanis of Government land (Bagmati flood plains) on either side (Lalitpur and Kathmandu) of the Bagmati River, extending all the way from Shankhamul to Teku Dovan for development and efforts at river preservation. From that land they left 20 m for road development.

It was in 2054 B.S. that the locals and ward members of ward 1 initiated for road construction. Due to the existence of slaughter houses on the river banks, wastes from such practice were thrown into the river. In order to put an end to those practices and also since the concept of the east-west Bagmati Corridor road proposed by JICA meant that private property would be acquired for road construction, the locals of wards instead initiated and

shifted the construction of roads towards the riverside. They claim to have donated 2m each of their private property for the road.

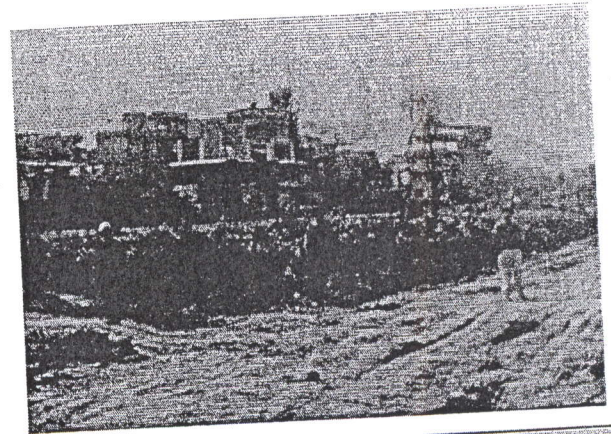


Figure 24: Bagmati River Corridor Road in 2054 B.S.  
(Source: Lalitpur ward 1, ward office)

A total of 150m stretch of the area was cleared for a 14 feet wide road. In 2055/56 B.S., the stretch of road was constructed from Thapathali pool to the present Sankata Bridge. Here, solid waste was dumped on the river banks and covered with earth on top and was leveled using a bulldozer. In the case of ward no. 2 the area up to Teku/Kalo pul was leveled for road and similarly in the case of ward no. 10 – Thapathali to Jwagal bridge stretch was leveled and the road opened.

Upgrading of the road to 2 lane blacktop road began in 2063/64 B.S. The total width of this 2 lane road is 15m as proposed in JICA report. However at present, the road width is not uniform and differs and the road has not even been completed as there are no sidewalks. The carriageway of 8m is also not consistent. Future plans from the JICA study include expanding the road to 30-32m width and making it a 4 lane road. Also currently plans prepared by High power Committee (HPCIDBC) i.e.

Package 5 is being drafted which includes uniform road width throughout the stretch. However, a 4 lane road may not be possible or feasible for many reasons, namely because lots of property will have to be acquired and buildings demolished. The road if expanded would reach up to the wall of Advanced Engineering College Building.

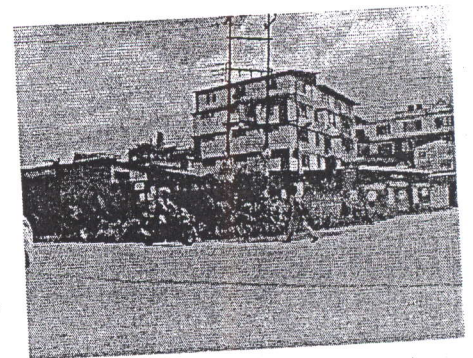


Fig: Advanced Engineering College

### 3.4.2. Bridges in the Study Area

Bridges are important in that their basic function is to bridge gaps. They serve as links between different places thereby shortening the distance or gap, thus also reducing the time for travel. They have direct and long term implications and impacts on land use, traffic volume, commercial and institutional values etc. The bridges of the study area provide a direct link between Lalitpur and Kathmandu providing access above the Bagmati River.

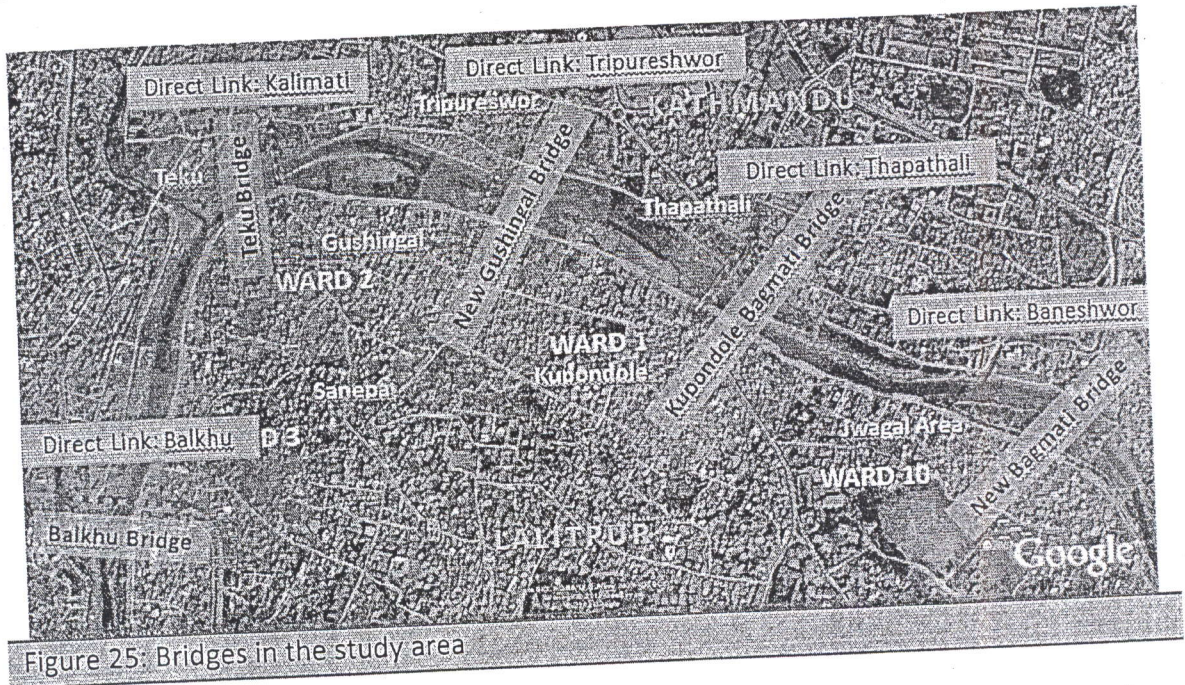


Figure 25: Bridges in the study area

There are five bridges in the study area. Two are new bridges that have recently been constructed whereas the remaining three are quite old. The new bridges are the new Bagmati Bridge at Jwagal and the Sankata Bridge at Gushingal.

#### i. The Kupondole-Thapathali Bridge:

This bridge provides direct link between Kupondole and Thapathali. It is a long span bridge. The history of the Kupondole-Thapathali Bridge is very old. It has served as a major route to connect the cities of Patan and Kathmandu and has helped strengthen social, cultural and economic activities between these two cities. There have been different types of bridges constructed in different time periods. Initially there was a wooden log bridge prior to the Rana regime. But later on in the Rana times a steel suspension bridge was constructed. This suspension bridge collapsed in the earthquake of 1935 A.D., but it was rebuilt. A motor able bridge was constructed alongside the suspension bridge in 1935 A.D. Improvements to the motor able was done in 1968 A.D. under the cooperation of the Indian Government. It was further improved in 1981 A.D.

The two lanes RCC steel plate Girds Bridge was constructed under the Nepal India Cooperation in 1981 A.D. to replace the existing one lane motor able bridge. Its total length was 184.19 m and width of carriage way is 6.5m(source: Road Div., Lalitpur). Later another 2 lane motor able concrete bridge was added alongside the existing bridge under the Nepal-Japan cooperation in 1996 A.D. Its length is 190m.

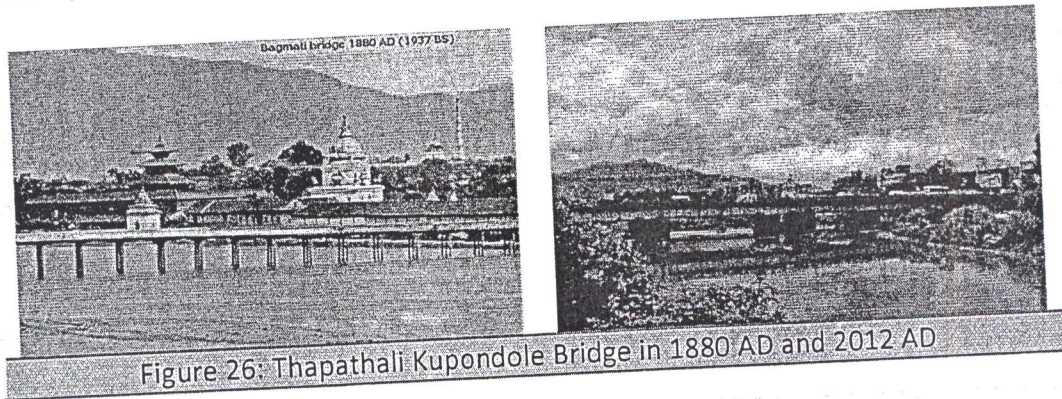


Figure 26: Thapathali-Kupondole Bridge in 1880 AD and 2012 AD

ii. **The Teku Bridge (kalo Pool):**

This bridge provides a direct link to Teku, Kalimati area from gushingal. There is an RCC bridge which is 2 lane and with total carriage width of 5.5m and total length of the bridge is 134.30m (Source: Road Div., lalitpur). This bridge was constructed in 1990's AD. Alongside this bridge is an old suspension bridge dating back to the 1960's AD. It is meant only for people and one person may pass at a time.

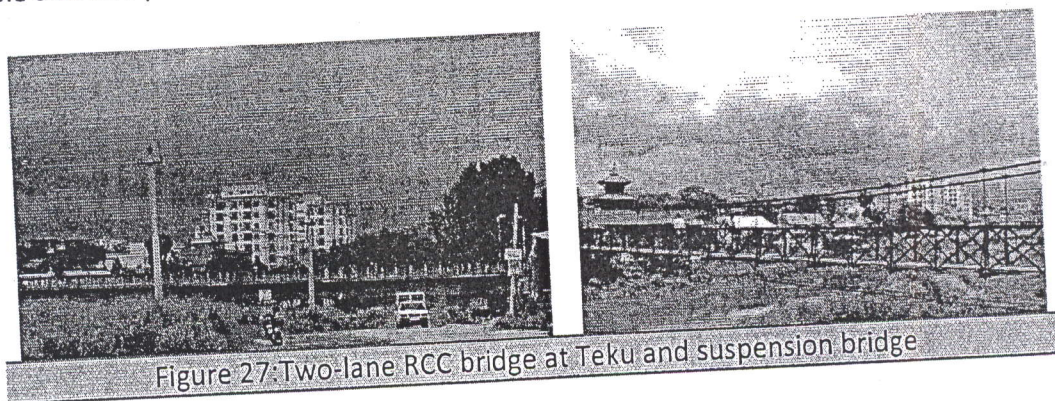


Figure 27: Two-lane RCC bridge at Teku and suspension bridge

iii. **Sanepa Bridge (Balkhu Pool):**

This bridge provides direct link between Sanepa and Balkhu. It is a long span RCC 4-lane bridge with carriageway width of 10m and total length of 128m (source: Road Div., Lalitpur). It was constructed in the 1980's AD.



Figure 28: Sanepa Bridge (Balkhu)

#### iv. New Bagmati Bridge (Jwagal):

This bridge provides a direct link from Jwagal to Buddhanagar, Babarmahal. It is a 2-lane bridge of length 50.10m and width 11.7m. It was constructed by the Road Division Office, Lalitpur. Construction started in 2066 Falgun and expected completion was in 2067 Asar but due to delays it has still not been completed. The total cost of the project amounted to NRs. 3Crore. (Source: Road Div. Office, Lalitpur). There is a pedestrian bridge inside the compounds of UN park in Jwagal. This is a metal bridge and it connects the area to Buddhanagar as well. This was constructed under the UN Park Project.

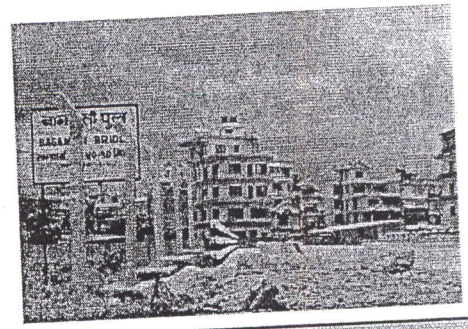


Figure 29: New Bagmati Bridge (Jwagal)

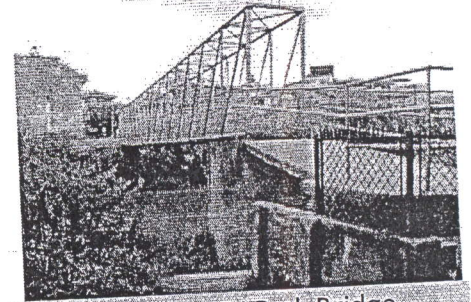


Figure 30: UN Park Bridge

#### v. Sankata Bridge (Gushingal):

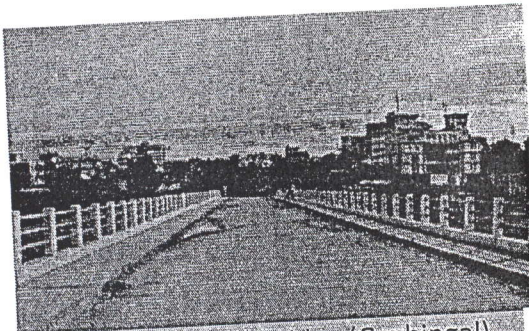


Figure 31: Sankata Bridge (Gushingal)

This bridge provides a direct link from Gushingal, Kupondole to Tripureswor. On an average it takes about 6-8 minutes' walk to reach Tripureswor chowk. The length of this bridge is 85m and width 11.7m and it is being constructed by the Road division Office, Lalitpur. Construction began in 2064 Poush with expected

completion in 2064 Asar. However due to disturbances from squatters of Bagmati area, the works got delayed and was again scheduled for completion in 2067 BS. Again due to certain delays, completion target could not be met and construction got completed only this year, i.e. 2069 BS. The initial project cost was estimated at NRs. 4.75 Crores but due to delays cost also increased to Nrs 8 Crores. (Source: Road Div. Office, Lalitpur)

#### 3.4.3. Transportation Scenario of the Surroundings

The major road corridor in the surroundings of the study area is the Thapathali-Jawalakhel-Lagankhel Corridor. Construction of this road corridor had started during the Rana rule so as to link their palaces in Thapathali and Pulchowk. Similarly the tradition in Rana families of offering their palaces and lands to the new prime minister's also played a key role in road development. These offerings had to be made by the ousted prime minister to the new

(source: Rana, Diamond S, excerpt from Shrestha, S. M. 2011). The Thapathali- Jawalakhel corridor was developed as route to Godavari Botanical Gardens as an alternative shorter route.

As mentioned in the 1991 JICA report on "Urban Road Development in Kathmandu Valley", one of the benefits expected from their high priority project on improving Bagmati Transport Corridor was securing an alternate route between Kathmandu and Patan. The only route present in those days was the Thapathali- Kupondole route. So, securing of a new, reliable, alternate route was found essential not only for economic reasons but also for daily life of the people. This alternate route is the Bagmati River Corridor Road that forms the South link of inner ring road and part of a wider picture of building up the basic frame of road networks in Kathmandu Valley.

### 3.5. LAND VALUE

The land value in study area through interviews with key informants and land owners:

**In the Year 2052/53 B.S.** – Property located inland was more expensive than those situated near the river bank. Property located inland would cost as much as NRS. 1 lakh per ana and those located near the river would cost around NRS. 80,000 per ana.

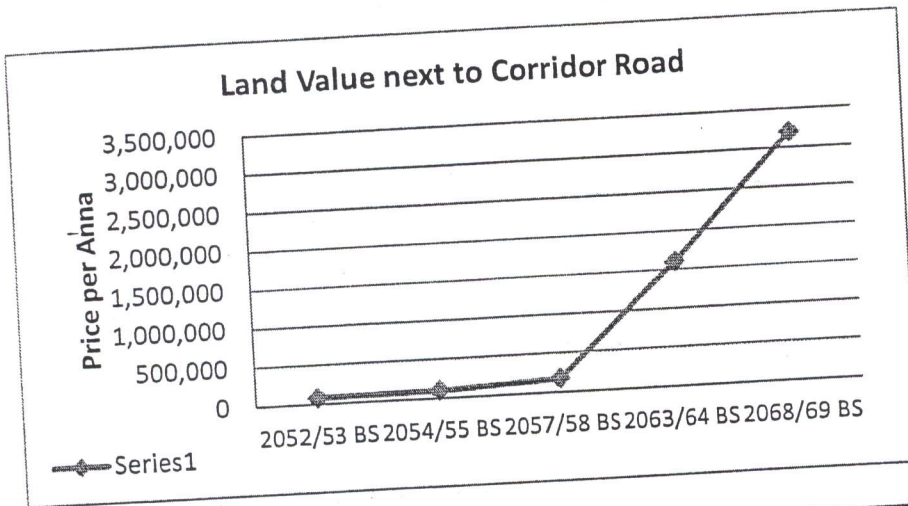
Even after the construction of roads, (around **2054/55 B.S.**), the value of properties didn't rise by much. Property located near the river would cost around NRS. 1 lakh per ana. After gravelling of the road in **2057/58 B.S.**, the land value increased slightly. Property inland and near the river would now cost NRS. 1.75 lakh and NRS. 1.25 lakh respectively.

By the year **2060 B.S.**, there was a significant drop in the agriculture land. In Kupondole area, agriculture land could be found only up to 60-70m inside from the corridor road. In Gushingal area, agriculture land – 100m inside road (up to Shanti Bihar).

After the Maoists signed the peace treaty, the land valued witnessed a sudden and drastic increase. After the black topping of road in **2063/64 B.S.**, land value increased dramatically. 1 ana of land would cost as much as NRS. 16 lakh.

**In the present year 2069 B.S.** – The value of property situated roadside is around NRS. 30-35 lakh per ana at present. That of property located on the secondary road is around NRS. 20-22 lakh per ana. Those accessible by alleys cost NRS. 15-17 lakh per ana. However, the

value of properties located in the stretch from Sankata bridge to Kalo pul is lesser. The value of property situated roadside is around NRS. 22 lakh per ana.



Year	Land Value NRs/Anna
2052/53 BS	80,000
2054/55 BS	100,000
2057/58 BS	175,000
2063/64 BS	1,600,000
2068/69 BS	3,200,000

Table 16: Land Value in Study Area (2052-69 BS)

Chart 1: Land Value in Study area before and after the road

### 3.5.1. Land Value in the Surrounding areas:

Table 17: Minimum Land Values (NRs. in '000')

Year B.S.	Major Corridor		Kupondole to Patan		Kupondole to Sanepa	
	Govt.	Market	Govt.	Market	Govt.	Market
2047/48	2,000	6,400	1,200	4,000	700	4,800
2054/55	3,036	9,600	1,897	5,000	1,012	8,000
2061/62	6,500	9,600	4,200	8,400	2,400	8,000
2064/65	11,000	1,60,000	6,400	128,000	3,700	10,000
2067/68	22,000	2,40,000	10,000	1,60,000	6,600	12,000

Source: Minimum Land Value Books, DLRO, Lalitpur

The minimum market values differ vastly from the minimum government value. This difference is more than ten times the government value. However, from the above chart we can see that the price per ana of land in present context in the study area is what the minimum Government price per ana of land in the major kupondole to Jawalakhel corridor was more than a decade ago. Taking the case of Kupondole to Patan access, the govt. price of 2061/62 (8 years before) coincides with the present study area market value and that of kupondole to Sanepa, govt. value of 2064/65 (5 years before) coincides.

With further plans for the development of better roads the market price in the study area is bound to increase and may at some point exceed that of the other inner roads.

## CHAPTER IV: LAND USE CHANGE ANALYSIS

Land use change analysis over 4 decades is carried out, analyzing the study area in the years 1965 A.D, 1987 A.D., 1998 A.D and 2012 A.D.

### 4.1. LAND USE CHANGE ANALYSIS OF 1965 AD / 2022 BS

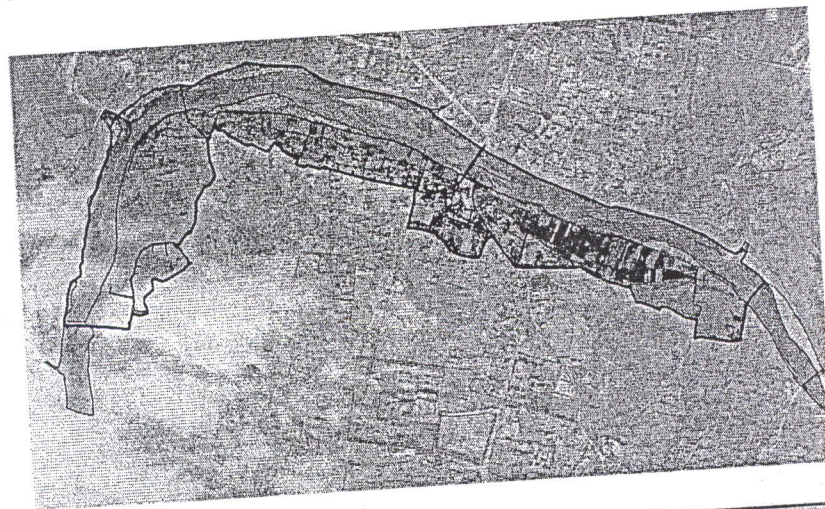


Figure 32: Aerial Image of Study Area in 1965 AD

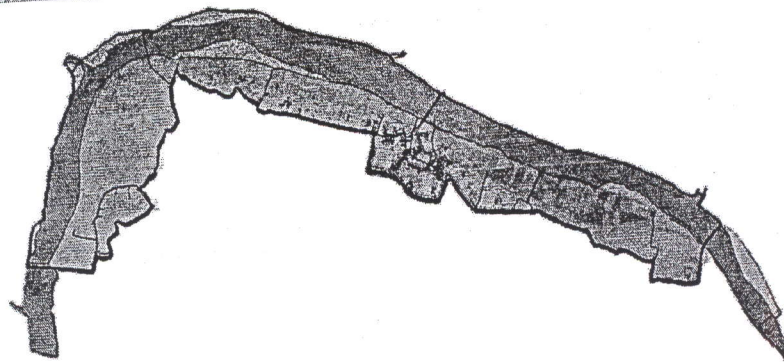


Figure 33: Digitized image of study area – 1965 AD

Total % of Metalled (Black-topped) Road	Total % of Un-metalled Road	Total Built – Up Area in %	Total cultivated land/open spaces in %
1%	2.1%	2%	95%

Source: Digitization in AUTOCAD

#### A. Land Use:

From the figure we can notice that agricultural land dominates whether in the form of cultivation land or open areas/fields. It is clear from the table that cultivated land/ open spaces amount to 95% of the study area. This is comparatively a very large percentage of total land use. Catchment area of ground water recharge was significantly high due to less built form. Further the built up area accounts to only 2% suggesting that these built forms

were mostly residences belonging to those involved in farming occupation i.e. predominantly the Newar community of Tandukars, Byanjankars and Maharjans. Built forms were also found in small proportions and clusters around road networks, especially near the Thapathali-Kupondole Bridge area. This settlement also comprised of the Newar Community of Amatya caste group. Mixed residential buildings were very less.

### B. Road Network

The Main road i.e. the Thapathali-Pulchowk road is about 10m wide with blacktopped and this amounts to only 1%. This is the only black-topped road in the study area. From this road there is a secondary and tertiary road of widths 5m and 3m respectively. This is in kupondole area. Besides these roads, the rest of the roads in the area are basically dirt roads of varying widths of mostly 2m, which leads to either residences or the cultivated fields and the river. These roads amount to 2.1% of the total study area. There is no form of road or path along the river banks. Most of the roads were directly connected to the river-for the access to farmland and for performing daily sacred activities.

### C. Bagmati River/ River front in 1965 A.D.

Total River Area (km <sup>2</sup> )	Maximum River Width	Minimum River Width	% Change
0.49 km <sup>2</sup>	175m	63m	-

Source: Digitization in AUTOCAD

The aerial image of the Bagmati River in the 1960's reveals the true image and original state of the river. The maximum width of the river was found to be 175 m whereas the minimum 63m in the study area. Lots of wide flood plains and sand beds can also be seen in the image. There is also mention in the Physical Development Plan for Kathmandu Valley, 1969, that "the rivers have meandering courses and in some areas wide flood plains caused by the relatively flat topography of the Valley and its soft, deep sedimentary deposits." Traditionally the land-use adjoining the riverfront consisted of stone stepped embankments for cremations, ritual bathing, temple complexes and agricultural land. The river front area was used as farmland and also for religious purposes- many ghats were located there. The quality of the water was also good so people used to perform their sacred activities and even aquatic life was possible. This river being one of the most sacred and holy river for the Hindus had lots of religious uses in those days. The Ghat near the Bahari pith was functioning; there was the Rajtirtha area and Ghat, the prashain Ghat which were all in use.

4. 2. LAND USE CHANGE ANALYSIS OF 1987 AD/ 2044 BS



Figure 34: Aerial Image of study area in 1987 AD

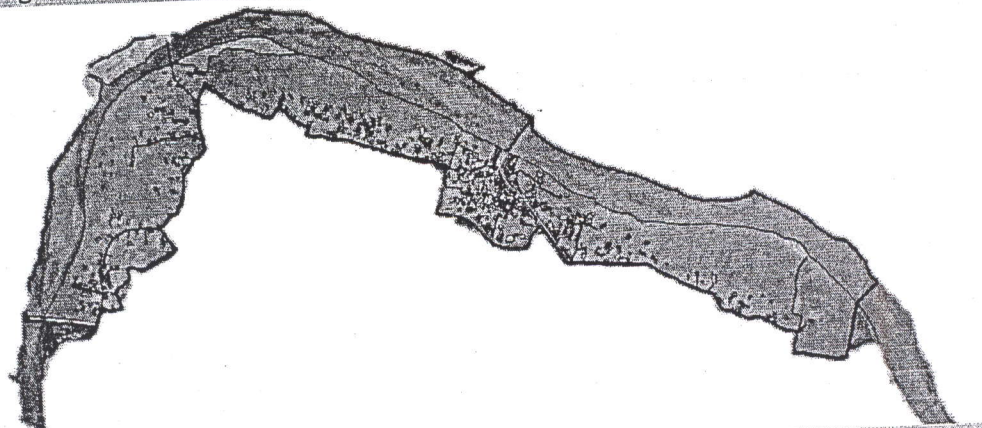


Figure 35: Digitized image of study area - 1987 AD

Land Use and Road Network in 1987 A.D.

Table 20 : Land Use Change Analysis of 1987 AD

Total % of Metalled (Black-topped) Road	Total % of Unmetalled Road	Total Built -Up Area in %	Total cultivated land/open spaces in %
1.3%	2.3%	8%	88%

Source: Digitization in AUTOCAD

A. LAND USE (1987)

By this time, built up area had started to increase with built forms developing near to the road networks i.e. near the periphery of the study area. Since these developments are occurring around road networks, it is assumed that development of a mixed residential/commercial type has started. Still quite dense settlements could be found at a distance of 100 m from the edge of the river, especially in kupondole area. Catchment area for ground water recharge was decreasing gradually. Settlements was getting denser in areas near to the Thapathali-Kupondole bridge and road. So, we may assume that the

development of this road has led to increase in built up area. However the land close to the river and river banks were still being used for agricultural purposes. 88% of the study area land is Agricultural land/open space but this has decreased by 7% compared to 1965 A.D., whereas built-up area has increased by 6% compared to 1965 A.D., amounting to 8% of the study area. Scattered built form started to develop in the agricultural land and there is decrease in the number of trees.

### B. ROAD NETWORK 1987

The width of the main road has increased and is 21m wide with blacktopping, whereas secondary roads and tertiary roads with 5m and 3m respectively. A slight increase in the percentage area of roads is seen. Metalled roads amount to 1.3%, slight increase of 0.3% from 1965 and unmetalled roads are 2.3%, also a slight increase from 1965 A.D. Even though there is only a slight increase in roads in the study area, roads were developing in the surrounding areas. The reason for this slight increase is because the main purpose of the land was still for agricultural use.

### C. BAGMATI RIVER/ RIVER FRONT IN 1987 A.D.

Table 21: State of Bagmati River of study area in 1987 AD

Total River Area (km <sup>2</sup> )	Maximum River Width	Minimum River Width	% decrease in area
0.42 km <sup>2</sup>	175m	34m	14%

Source: Digitization in AUTOCAD

The minimum width of the rivers had decreased in the last two decades. The amount of sand beds also seemed to have been reduced. The decrease in the river's area in the last decades was by 14%. However, the quality of water and aquatic life was not so changed. People still used to perform their sacred activities. Ghats near the Barahi pith and Rajtirtha were still functioning. Few Settlements started to grow in the agricultural lands of the river bank, especially near the Thapathali-Kupondole Bridge and dense settlements could be found at a distance of 100m from river's edge, especially in Kupondole area. Cultural elements like pati, ghats and sattal were still functioning.

4.3. LAND USE CHANGE ANALYSIS OF 1998 AD/ 2055 BS



Figure 36: Aerial image of study area in 1998 AD

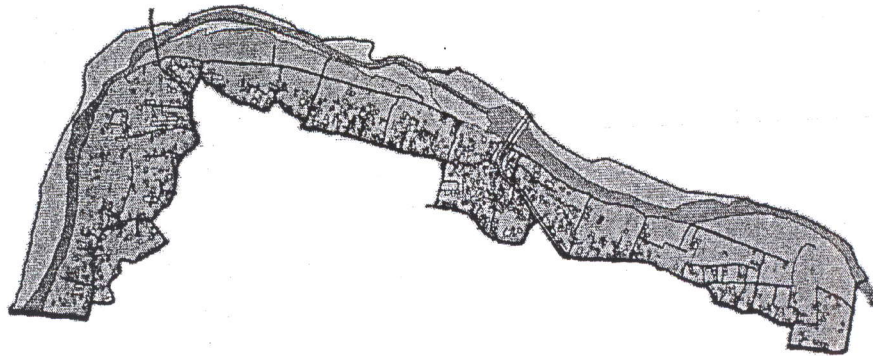


Figure 37: Digitized image of study area -1998 AD

Land Use and Road Network in 1998 A.D.

Table 22: Land Use Change Analysis of 1998 AD

Total % of Metalled (Black-topped) Road	Total % of Unmetalled Road	Total Built -Up Area in %	Total cultivated land/open spaces in %
4%	2.8%	14.86%	78.2%

Source: Digitization in AUTOCAD

A. LAND USE (1998)

Built up area was increasing and densification was occurring. There was rapid conversion of agricultural land for construction purposes. The catchment area for ground water recharge was also decreasing. There was well marked division of agricultural land by clear 3m-4m wide roads in some areas. Settlements had started emerging on either side of the roads. The built up area had increased by around 7% in the last decade from 1987 A.D. Total built-up area formed around 15%, whereas agricultural land/open space had decreased by 10% and now accounted to 78% of the total area.

Encroachment of the river banks could be seen with settlements emerging as close as 30m from the river's edge. However the land closest to the river and river banks were still being used for agricultural purposes. Scattered built forms had grown into quite dense settlements and there was further decrease in the number of trees. Heterogeneous societies had emerged during this time with people gradually shifting occupation and selling the agricultural land. Besides, the rate of migration had also increased.

### B. ROAD NETWORK 1998

The number and length of roads had increased. Roads were developed and metalled (blacktopped) roads had increased by as much as 3% in the last decade. Metalled roads comprised 4% whereas unmetalled roads 2.8%. The primary road was 21m wide and secondary and tertiary roads 5m and 3m respectively, whereas the unmetalled roads' width varied from 1m to 4m. Clear and distinct unmetalled roads divided the agricultural land. A dirt road/path had formed along the bagmati river banks in jwagal area and kupondole area; it was the formation of the Bagmati Corridor Link Road.

### C. BAGMATI RIVER/ RIVER FRONT IN 1998 A.D.

Table 23: State of Bagmati River of Study Area in 1998 AD

Total River Area (km <sup>2</sup> )	Maximum River Width	Minimum River Width	% decrease in area
0.28 km <sup>2</sup>	102m	19m	32%

Source: Digitization in AUTOCAD

The river area had now decreased tremendously by 32% in the last decade. The river width had decreased as well and the minimum width now was around 19m whereas the maximum 102m. Large amounts of sand extraction due to increase in demand for construction materials had resulted in depletion of sand beds and river deepening and narrowing. Encroachment of the river banks has increased.

Besides this, the quality of water had degraded tremendously and the original function of the river as a drainage system has been converted into one for carrying mainly sewage. Open drains discharge sewage and wastes directly into the river. Hardly any form of aquatic life can be found to survive in such conditions. The pollution level has increased. Solid wastes are also dumped along the river banks.

With decreasing river width and increase in land area in between the Ghats and the river, the religious function had slowly begun to fade. The cremation sites are no longer being

used. The one in Barahi has shifted to Shankhamul due to the Bagmati road corridor development. So, basically the function and role of this once holy river in the daily lives of the people is slowly fading and losing its value.

**4. 4. LAND USE CHANGE ANALYSIS OF 2012 AD / 2069 BS**

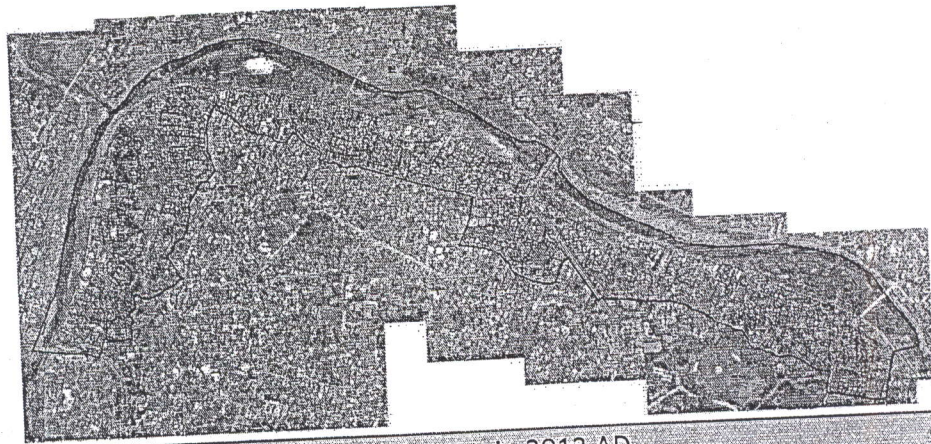


Figure 38: Aerial Image of study area in 2012 AD

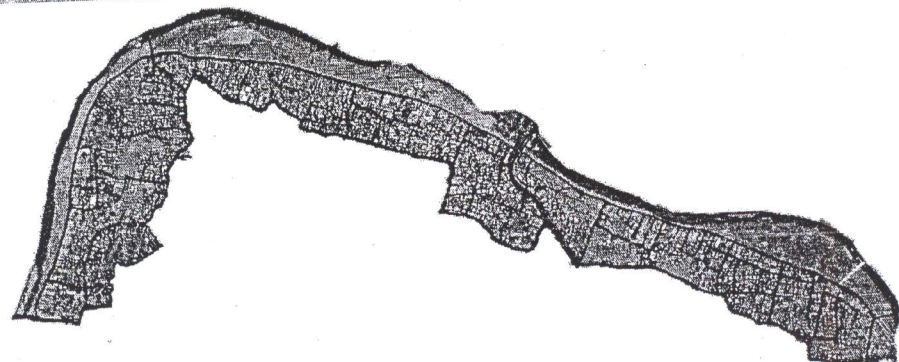


Figure 39: Digitized image of study area- 2012 AD

**Land Use and Road Network in 2012 A.D.**

Table 24: Land Use CHange Analysis of 2012 AD

Total % of Metalled (Black-topped) Road	Total % of Unmetalled Road	Total Built –Up Area in %	Total cultivated land/open spaces in %
9.4%	1.6%	25%	63%

Source: Digitization in AUTOCAD

**A. LAND USE (2012)**

Almost all of the vacant land has been filled up with built structures, with hardly any land used for agricultural purposes. The only open/cultivated space that can be seen in the study area lies next to the river on the river banks. Built form around road networks are getting denser with increased inclination towards commercialization, especially along the Bagmati Road Corridor. Thus, built form along the urban fringe of Patan city has gotten denser.

The Development of new roads also leads to the reduction of open spaces. As more development started, Settlements were crowded along major roads and junctions. Built up area accounts to 25% of the total study area and this has increased by around 10% in the last decade; whereas the cultivation/open spaces has decreased by 15% accounting to 63% at present of the study area.

### B. ROAD NETWORK (2012)

The road network in the area has increased. The main road i.e. the Thapathali- Kupondole Road is about 21m with blacktopped. The Bagmati River Corridor Road is 8m wide and is blacktopped; whereas the secondary roads and tertiary roads with 5m and 3m respectively. The percentage area of black topped roads has increased by around 5.4% in the last decade and amounts to 9.4%. Unmetalled roads amount to 1.6 % and their widths vary.

Prominent buildings, offices and institutions are emerging along the Corridor Road and this may be attributed to ease of access and opportunities for development of land. Commercialization has not only been limited to this corridor but its impacts can be seen 100m -200m inside as well. Development of Bagmati corridor is still an on-going process. Much more open spaces are converted into road networks. Drainage and sewerage lines are passed along the road networks.

### C. BAGMATI RIVER/RIVER FRONT IN 2012 A.D

Total River Area (km <sup>2</sup> )	Maximum River Width	Minimum River Width	% decrease in area
0.10 km <sup>2</sup>	93m	11m	64%

Source: Digitization in AUTOCAD

The width of the Bagmati River has decreased considerably over the years. From the chart above it can be seen that in the last decade the decrease in percentage area is the highest accounting to 64% decrease. All that is left of the river now is a narrow, deep, polluted river. The river width had decreased as well and the minimum width now is around 11m whereas the maximum 93m. The shrinking width of the Bagmati may result in river bed erosion which is harmful for the foundation of the bridges. The sand extracted over the years for different purposes has deteriorated the situation even more. However, there is no sand mining occurring since the last decade.

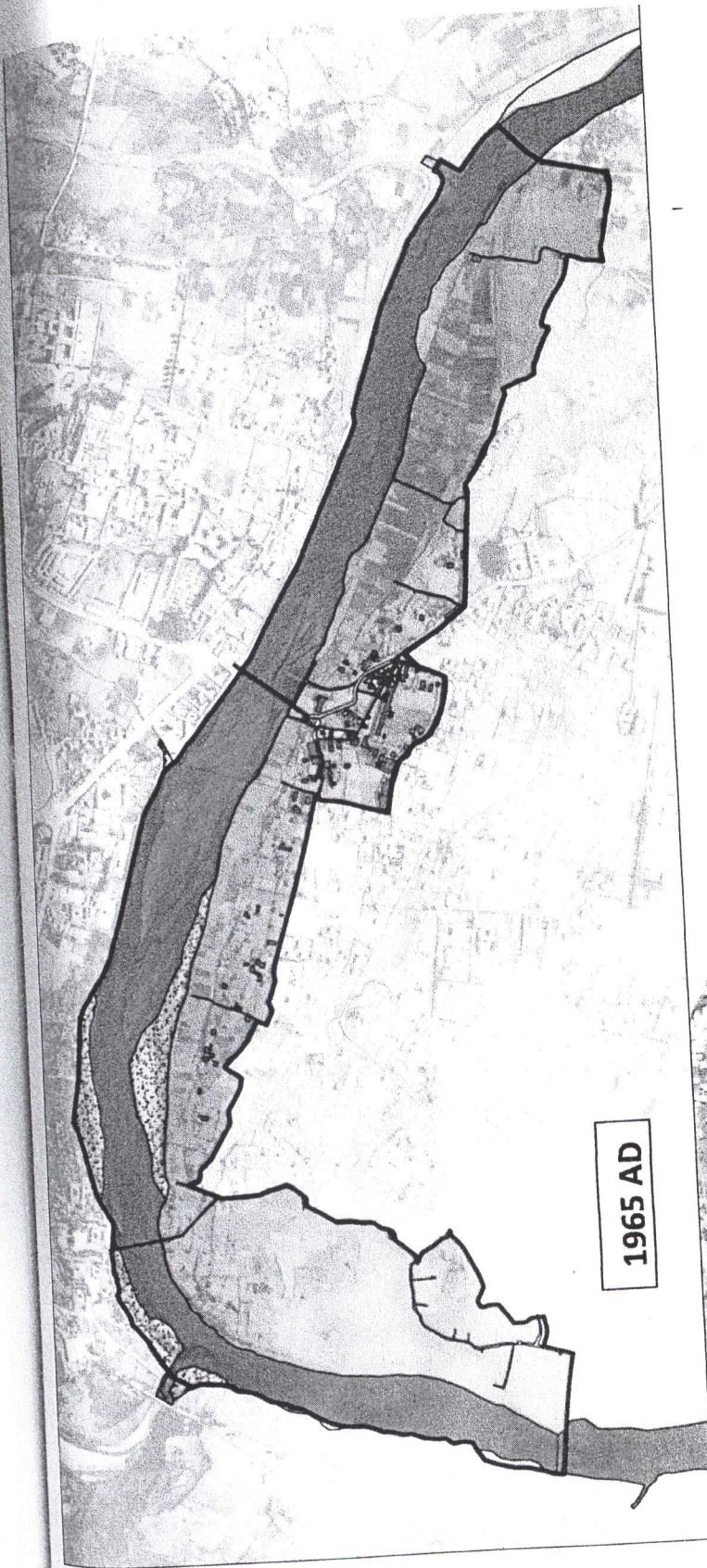
The River Environment is getting worse day by day as it is used as dumping site and most of the sewer lines are connected to the river. No aquatic life can be seen today with the BOD level of the river extremely high and this stretch classified as the most polluted. New religious built form like Gurudwara has emerged. Cultural and religious elements are deteriorating in function as well as form. The Barahi cremation site was used upto 1999, but shifted to sankhamul after Bagmati road corridor development. Even the Rajtirtha cremation site is visited only for the twmples and the holy water.

With the development of the Bagmati River Corridor road along the banks of the river, almost all river fronts next on the other side of the road is converted into built form so no more agricultural land. However open space/ cultivated land can be found only on what remains of the river banks between the river and the road. Temporary structures, buildings, commercial activities and offices can be found to encroach the river banks. The other side of the road constitutes the built-up areas. New built forms like high rise apartments and institutions and offices are being developed.

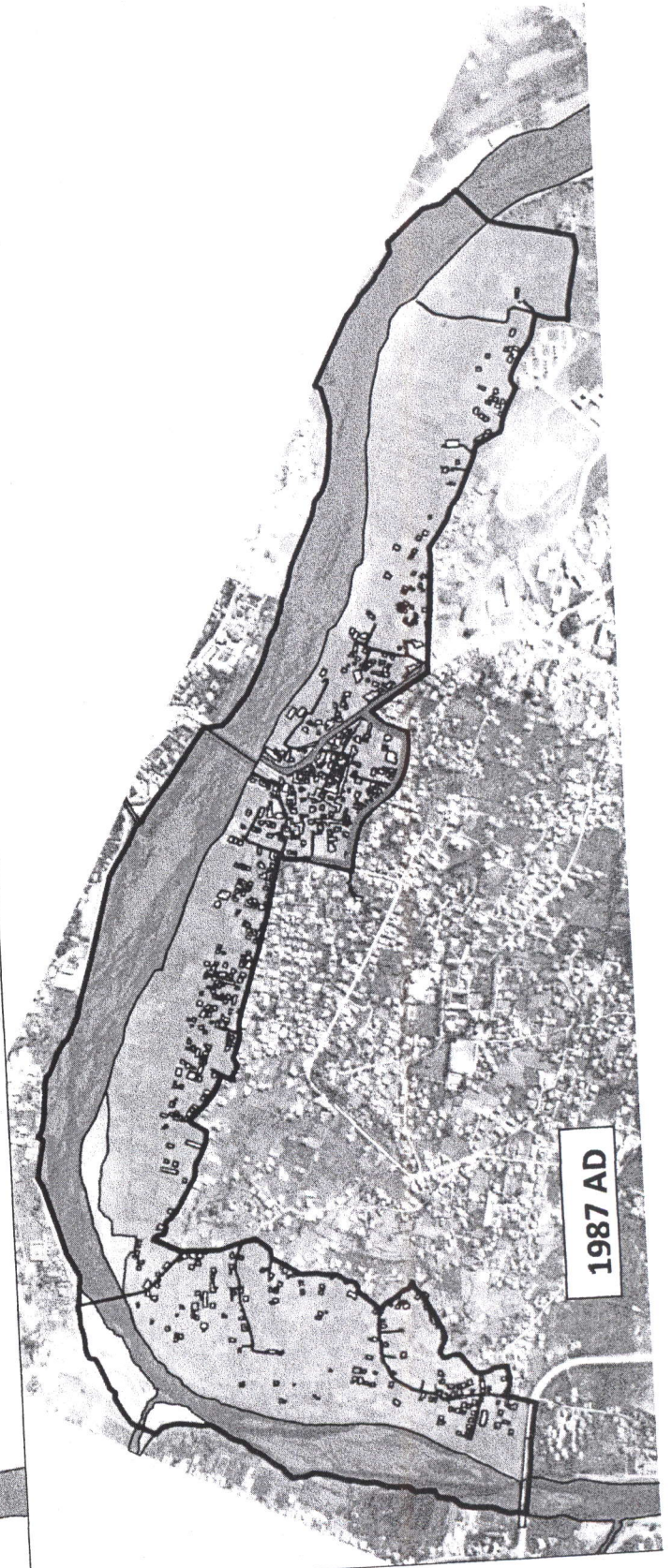
#### 4.5. SUMMARY OF CHANGE ANALYSIS FROM 1965A.D. -2012 A.D.

	1965 AD	1987 AD	1998 AD	2012 AD
Total % of Metalled (Black-topped) Road	1	1.3	4	9.4
Total % of Unmetalled Road	2.1	2.3	2.8	1.6
Total Built-Up Area in %	2	8	14.86	25
Total cultivated land/open spaces in %	95	88	78.2	63
% decrease in river area	-	14	32	64

Source: Digitization in AUTOCAD



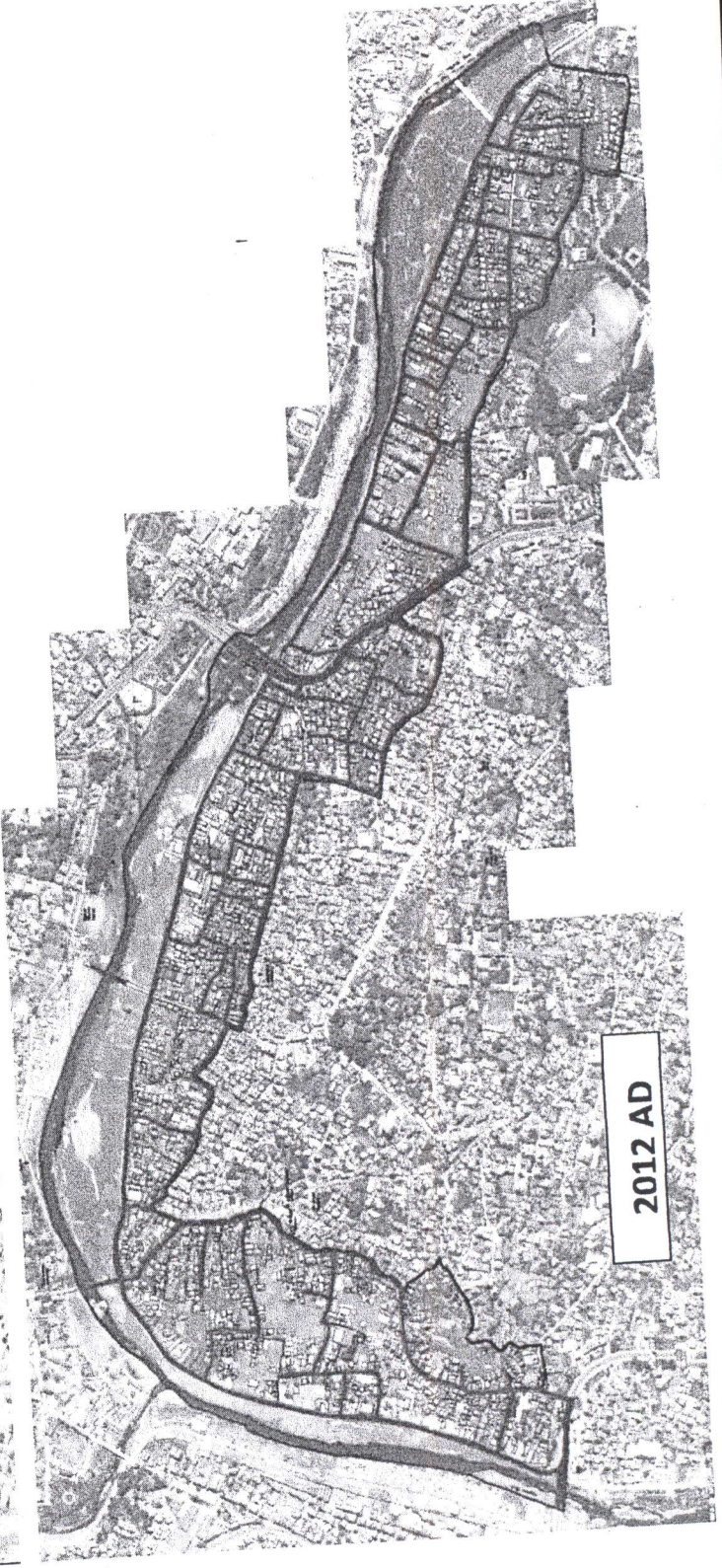
1965 AD



1987 AD



1998 AD



2012 AD

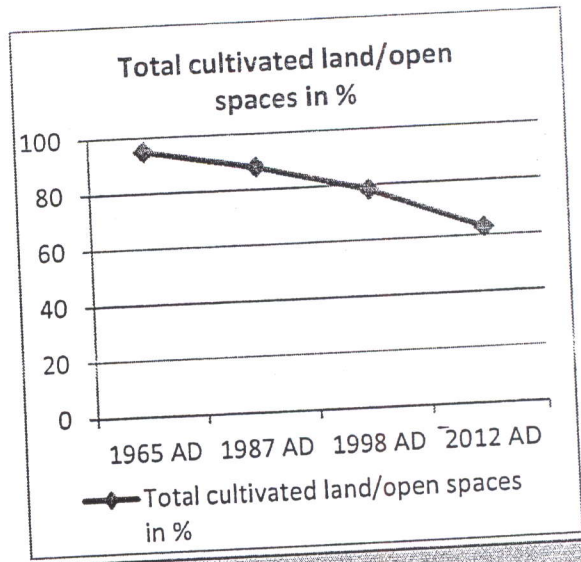
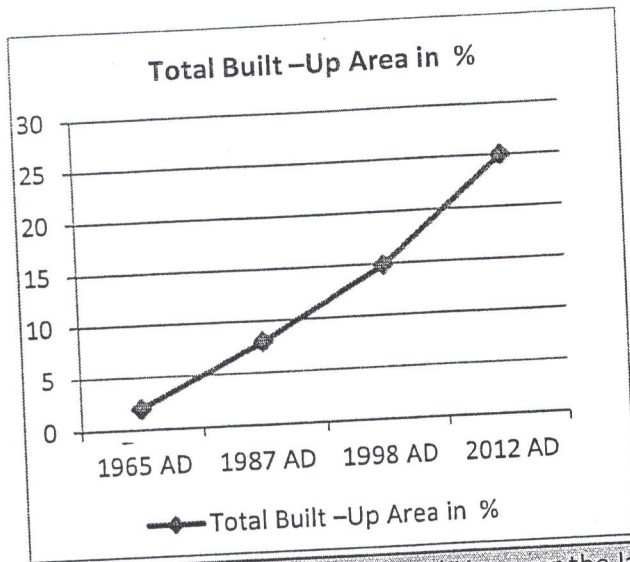


Chart 2: Change Scenario of Land Use over the last four decades

From both the charts, what are most noticeable are the increasing and decreasing trends. Built-up area has been increasing whereas open spaces have been decreasing over the past four decades. The study area up till the 1980's was primarily an agricultural land, but from late 1980's onwards the effects of urbanization has resulted in increase in built up areas and decrease in open spaces and agricultural lands. Impervious surface increased resulting in low ground water recharge.

With shifting of occupations and increasing rate of migration land had become a scarce commodity and asset. Thus, the use of land shifted. In the present context besides few areas along the river banks, no more land can be seen used for cultivation. Rather due to development of the Bagmati Road Corridor, the use is shifting toward commercialization.

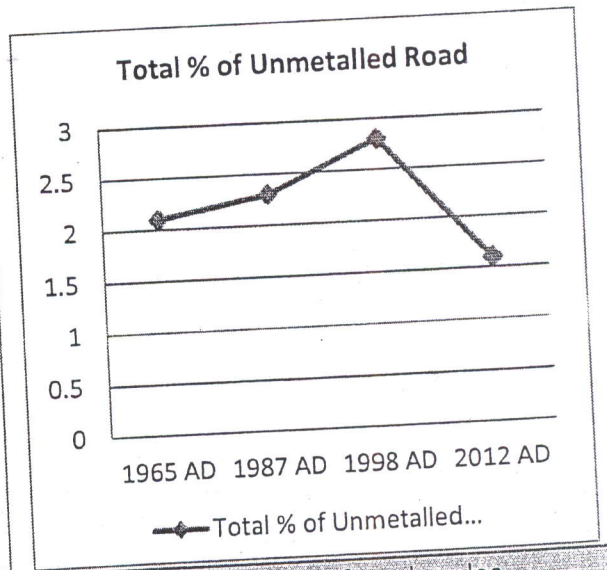
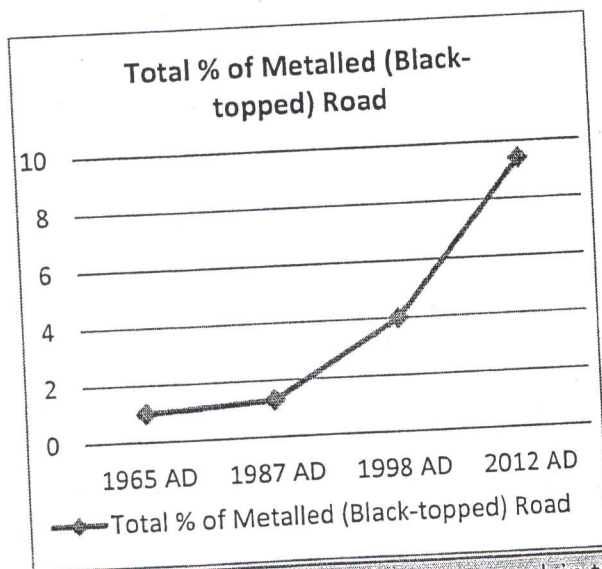


Chart 3: Change scenario of road network in the study area over the last four decades

From the chart 3 we can see that up till 1990's there was not much blacktopping of the roads. This is attributed to the reason that the area was primarily used for agriculture. But

from 1990 to 2000 A.D roads had begun developing and so were blacktopping done. From 2000 A.D onwards what can be seen is that there has been a sharp rise in the percentage of road areas blacktopped, whereas a fall in the number of unmetalled roads. This indicates that development has been taking place whereby previous dirt roads are being converted into black topped roads for better urban environments. However, open spaces and river banks have encroached.

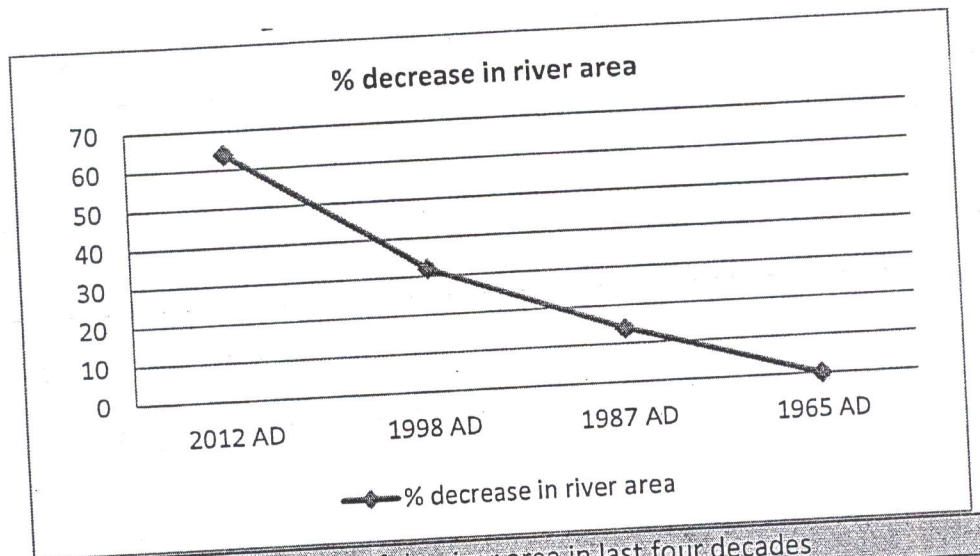


Chart 4: Change Scenario of the river area in last four decades

Urbanization has taken its toll and its impacts have had serious consequences directly on the river environment. The chart 4 clearly shows that the river area has been decreasing and this indicates narrowing of the river forming a channel with loss of flood plains and encroachment of river banks. Not only that, but the environment of the river has deteriorated to a point which has caused maximum damage, with this stretch falling under the most polluted category. What remains of the once pristine holy river, is a river in the form of a channel carrying sewage and wastes.

#### 4.6. DRAINAGE AND SEWERAGE

*In the Past:* Taking the scenario of Lalitpur as a whole, due to the natural gradient of the land and large areas devoted for agricultural purposes, the rainfall was transformed quickly into stream flow that infiltrates the ground and over time joins the nearest tributaries which results more or less in constant stream flow. Later, during the Rana era, large brick tunnels (Rana era drains) were constructed for Storm Water Drainage. The drains were laid in the center of the road. Most of the drains were open and followed the ridges of the contour and those along the roads were covered. There were low number of sewer lines and the size of the drains was big enough for a man to fit in. The drain water was used by the low lying agro land.

*In the Present Times:* the trend has changed. With more surface coverage by roads, pavements, buildings etc. the cumulative effects of straightening tributaries or paving over more land upstream lowered the permeability of the watershed, and often dumps an unnatural volume of storm runoff water into the system. This results in more erosion and other impacts. With decreasing vegetation downstream, there is minimum filtration of the impurities of storm run-off and so what happens on the high ground ultimately affects the river below. Ground water quality is also affected. Healthy, slower-moving drainage systems with vegetated stream edges and wetlands can help absorb some contaminants. However, the major problem here is the depletion of permeable watersheds- cultivated lands, green patches and direct discharge of untreated sewerage into the river.

Drainage has been neglected over the years and its manifestations can be seen to this day. Road side drains have seldom been designed in relation to the local catchment and so consequently localized flooding frequently occurs. In other instances localized flooding occurs due to lack of maintenance and cleaning and in some cases due to absolute lack of drains in the area. Until a couple of years back, it was mandatory for newly built houses to have their own septic tank. But later on so called 'dhals' were built in different wards with the help of local authorities and all the sewerage of the houses were joined to these 'dhals' which ultimately discharges into Bagmati.

There is no sole line agency to take responsibility and so most of the time sewerage is planned by the communities in the ward, or through 40/60 finance schemes through public participation where the government provides 40% and the members of the community 60% for the construction costs. Not only this, there is no fixed design criteria or limit to the

number of sewage line connections that are made in a particular area as told by an engineer at Sewerage section at Jawalakhel. This is how the sewerage system in Kathmandu Valley is being planned or rather unplanned.

Table 27: Drainage System over the years in ward 1 & 10

Pipe type	(1950-1970)	(1970-1990)	(1990-2010)
Earthen pipe	85	52	-
Polythene pipe	5	25	30
Hume pipe (90cm)		3	5
Hume pipe (45cm)	5	10	12
Hume pipe(30cm)	2	5	24
Hume pipe(15cm)	3	5	29

All datas are in %, Source: Ward profile – Taken from Planning Studio III of 2066 batch

Table 28: Storm Water drainage system of wards

S.N	Description	(1950-1970)	(1970-1990)	(1990-2010)
1	Open drainage	70	35	5
2	Surface drainage	25	45	55
3	Storm water Pipe	5	20	40

All datas are in %, Source: Ward profile – Taken from Planning Studio III of 2066 batch

**4.6.1. In the case of the study area**

The study area in the past was an agricultural area with 95% of the land used for that purpose. The area remained predominantly an agricultural area up till the 1990's, where in 1998 A.D around 75% of the land was still used for cultivation. It is only in the last 15 years that rapid urbanization has taken place and now open space and cultivation land has drastically decreased and built -up area dramatically increased.

So, in the past there was a high level of ground water recharge. Drainage and storm water run-off followed the natural topography and ultimately flowed into the river, where most were soaked up by the land itself due to the pervious nature of the soil and due to minimal surface sealing.

It is from the 1990's onwards that built up area and road networks have increased considerably contributing to vast surface sealing. This has resulted in decreasing permeability of the watershed area itself- the study area. As a result, the development

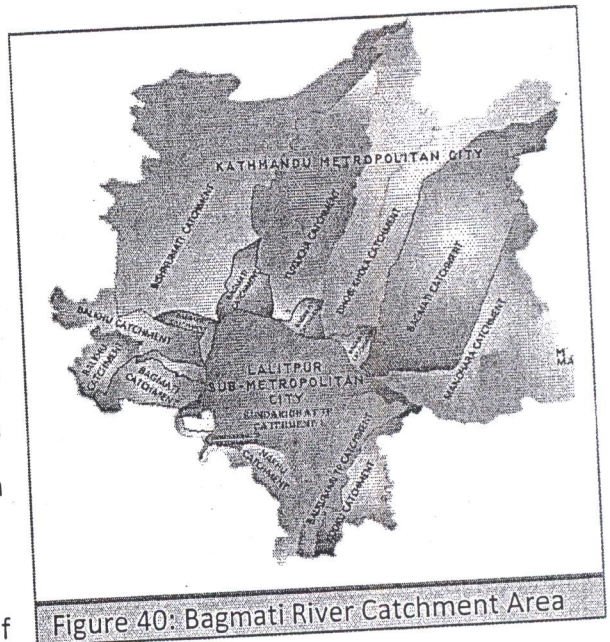


Figure 40: Bagmati River Catchment Area

practices taking place in the watershed impacts not only the ground water quality but also the runoff entering the river as most surface run offs are contaminated. Ground water quality is also affected. Even air pollution can affect water quality when airborne contaminants enter runoff water. So, the high numbers of vehicles plying the corridor road give off emissions which contribute to air pollution and since the road is situated in close proximity, it further aggravates the situation.

But the most serious reason for contamination is the direct discharge of untreated sewage. Most of the houses during in early times had septic tanks. So, it is seen that in the 60's, 70's, and 80's and even up to the early 90's that the state of the Bagmati River was quite good, it is only after the rapid urbanization that the river had started to deteriorate.

#### 4.6.2. Current Situation of Drainage & Sewerage in the Study Area



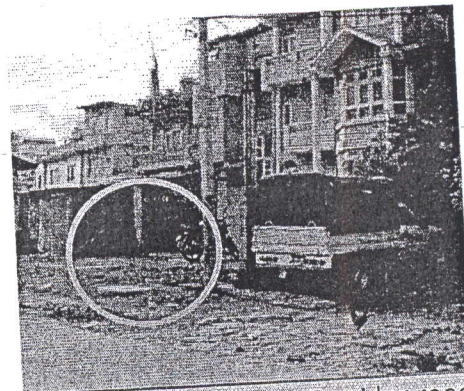
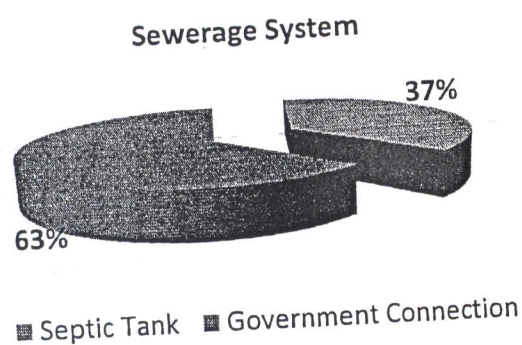
Figure 41: Overall drainage and sewerage scenario of the study area  
Source: position of manhole and sewer outlets- HPCIDBC

Being a concentrated settlement, a considerable number of sewerage outlets throughout the stretch can be found. The existing sewerage system development has not been scientifically designed nor is it systematic and lying of sewers has been done in a haphazard way.

As mentioned before, the community members are mostly responsible for the connection of sewerage lines from the respective houses to a main sewer or 'dhals' which lies in the center of the road. From this, these main 'dhals' then connect to sewer outfalls that directly

discharge into the adjoining Bagmati River. Even the sizes for the sewage connection differs; the main connection or 'dhal' ranges from 8" dia to 1200 mm and the individual sewer lines size may be 6" to 8" in diameter. Sometimes rain water pipes and other connections are made to the main 'dhals' also.

It was found from the questionnaire survey that 37% of the buildings surveyed had septic tank whereas the remaining 63% was connected to the main sewer line which discharges directly into the Bagmati River without any treatment. Even though some houses had provision of septic tank, most were not in use. Thus, this has considerably contributed in degradation of the river.



**Chart 5: Sewerage system in study area**

**Figure 42: Manhole near Corridor road**

With gradual increase in settlement, natural drainage is covered by a concrete layer of road. The road promotes access to the area thereby further opening up the area to development, but on the contrary it is surface sealing with impervious layer. Increase in built up area together with road networks has contributed to decrease in ground water recharge and so decrease in ground water and drying up of wells.

There are no covered drains in the study area, but there are slight surface drains at the sides of roads in certain areas. The slopes of the roads are maintained so as to drain off the storm water into the river. However in certain sections the slope hasn't even been designed properly or due to certain obstructions, the storm water drains into the residential areas resulting in water logging and huge puddles of water on the roads especially during the monsoons. These large pools of water can usually be seen flooding the road under the bridges up till last year but not this monsoon season. In some sections what could be seen were manhole covers removed so as to allow the storm water to drain off into it. This could be seen in the roads under the bridges such as under Kupondole- Thapathali Bridge. This at times has also resulted in overflowing of the foul sewage water and surface water onto the roads.

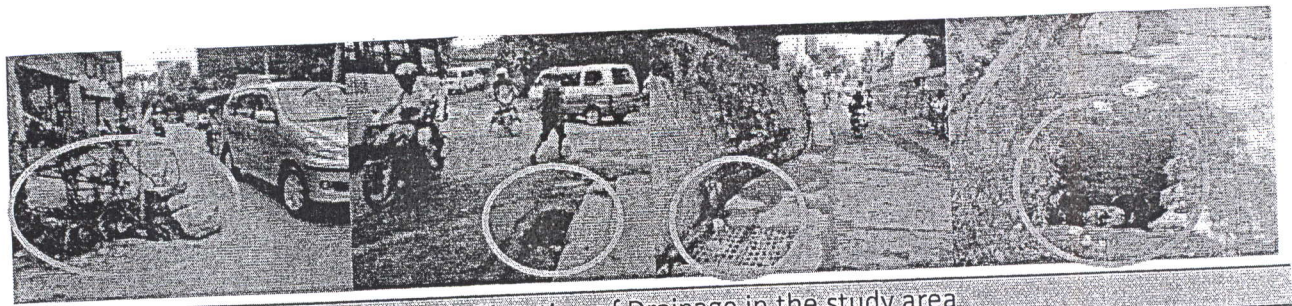


Figure 43: Situation of Drainage in the study area

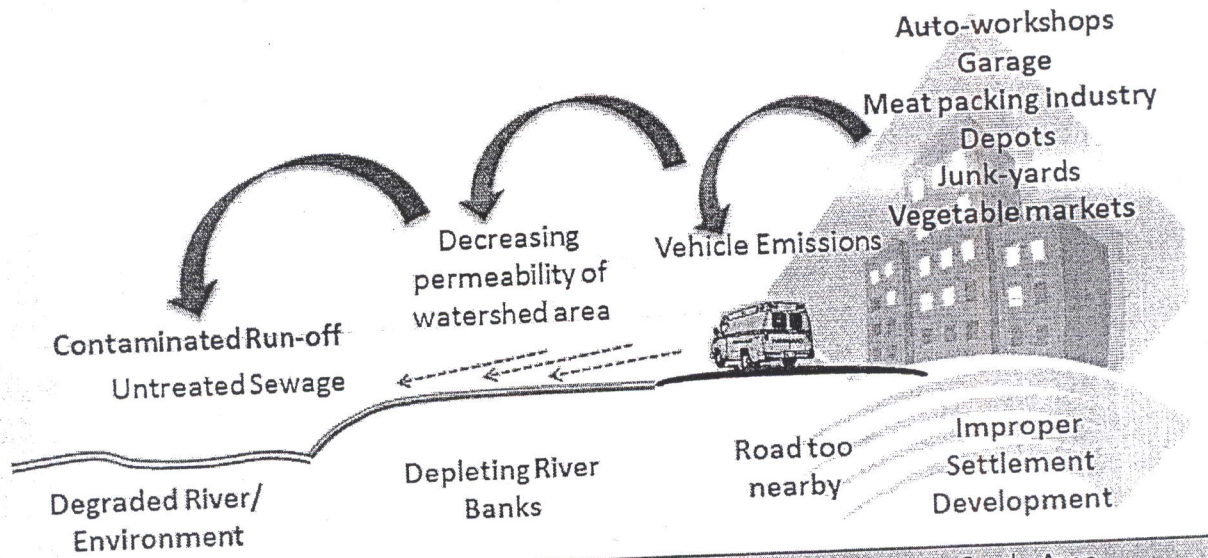


Figure 44: Diagrammatic representation of Natural Drainage Situation in Study Area

The above figure 87 is a diagrammatic representation summarizing the natural system of drainage and the problems associated with it that result in contaminated run off which is also one of the reasons for pollution of river water besides discharge of untreated sewage being the major cause.

#### 4.7. SOCIAL ASPECT

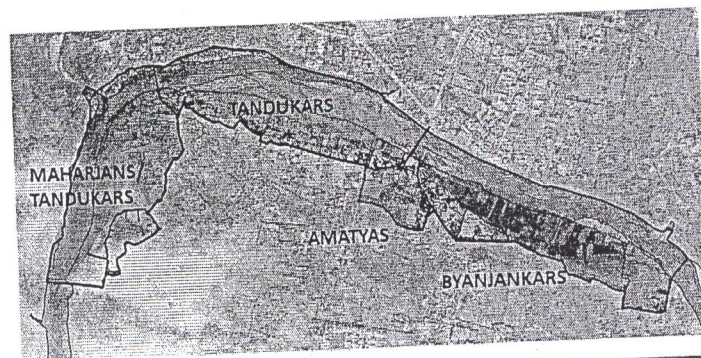


Figure 45: Social aspect of study area in history

Since the study area was dominated by agricultural use we find that the original inhabitants of the area were those whose occupation was farming. Majority of the original inhabitants

belonged to various sub-castes of the Newari caste. The area between Kupondole to Rajtirtha was dominated by Tandukars (from river boundary till 200m inside). Similarly, the Kupondole-Jwagal area had majority of Byanjankars. The Teku-Balkhu area had majority of Maharjans and Tandukars. The areas a little further from the river banks around Hanumanthan had Amatyas. Later on Chettris and Ranas could be found. However, in the present day scenario even though the Newar community still dominates we find a mix cultural society due to high number of in-migration.

#### 4.8. CULTURAL ASPECT

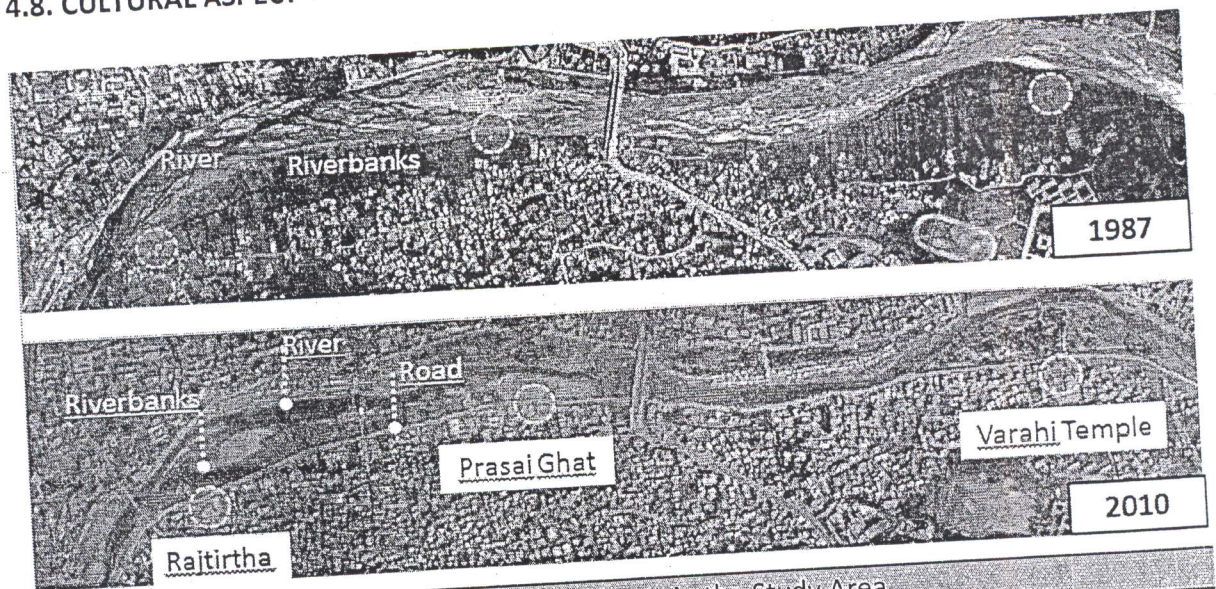


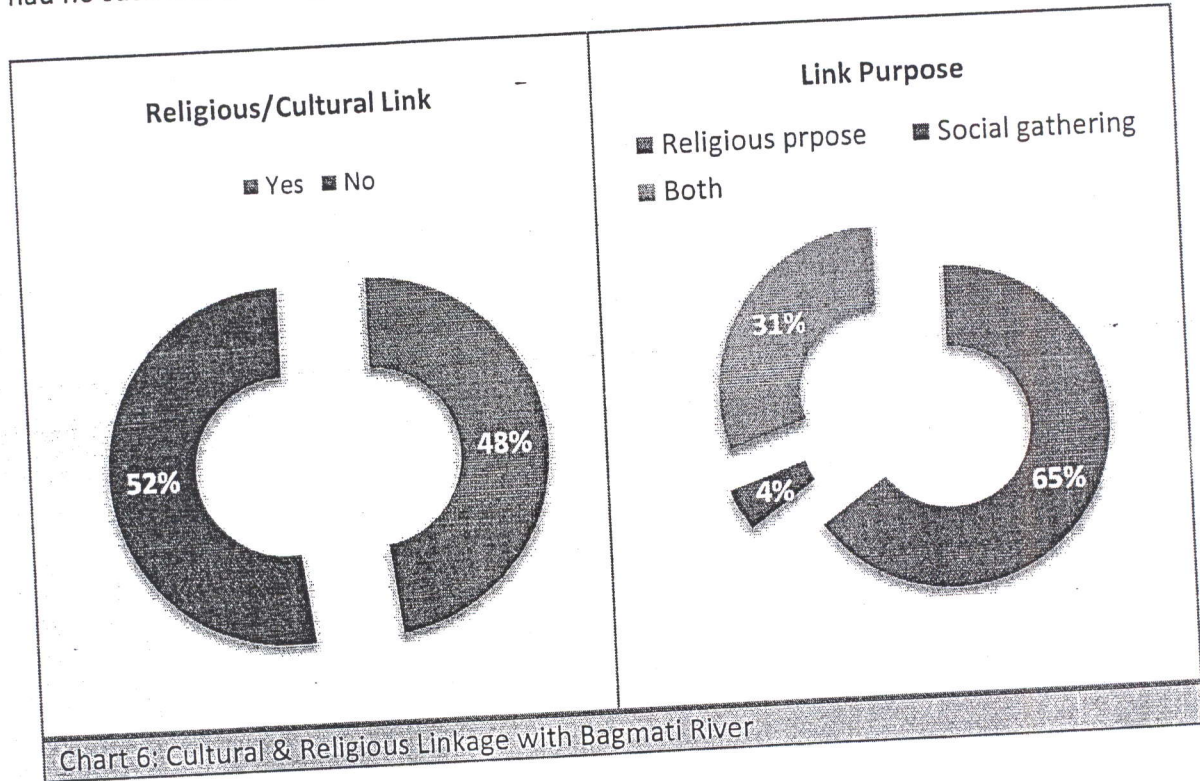
Figure 46: Changing Religious and Cultural Aspects in the Study Area

#### Changes in the religious and cultural aspects:

Earlier the religious structures were situated along the river banks serving the primary function of funeral sites, there were large agricultural land in the surroundings. However now, due to urbanization and development, the construction of roads, densification in built-up areas and increase in migration resulting in heterogeneous societies, these religious structures have lost their cultural value to a great extent. The degradation of the river has resulted in the decrease in the religious and cultural practices, decreasing its value as well.

At present, due to the shift in the river course over the years, the religious structures are found situated next to the Bagmati River Corridor Road and are no longer used as funeral sites. They are surrounded by dense settlements and park, road have developed between these structures and the river.

From the questionnaire survey carried out it was found that 48% of the respondents stated that they had religious/cultural link with the Bagmati River. Out of these 65% said it was for religious purposes like 'sharadha', pujas etc. 4% said it was for social purposes and 31% said both. These included new festivals such as 'chhatt' that was celebrated on the banks of Bagmati River recently and festivals like holi. 48% of the respondents however said that they had no such link with Bagmati River.



So, what can be seen in the study area is that even though the cultural values have decreased, the religious importance of these monuments is still intact to a certain degree.

The cultural practices of earlier times are not possible now due to changes in land use, rising land values, expenses and their unfeasible nature. However preservation of these religious monuments, preserving their values and heritage are important. This can be achieved through environmental improvement and preservation, conserving the Bagmati River, conserving its confluence points as maximum religious structures of immense heritage value are situated at these junctions.

## CHAPTER V: EXISTING SITUATION ANALYSIS OF STUDY AREA

Existing situation analysis has been carried out through:

- Visual observation analysis and
- Questionnaire survey of a small purposive sample

Both visual observation and the questionnaire survey was carried out along the 3.4 km stretch of the corridor road and up to a depth of 50m within from the road and on the other side observations of the area between the river and road were made. For simplification and clarity, these observations were made individually for the individual sections.

### 5.1. VISUAL OBSERVATIONS

#### 5. 1. 1. Visual Observations/ Section 1: (New Bagmati Bridge to Thapathali-Kupondole Bridge)

Ward: 10

##### A. LAND USE

Agricultural Land	Commercial	Institutional	Residential	Open Spaces	Encroachment of River Banks
None	Yes	Yes	Yes	Yes	No

##### B. INFRASTRUCTURE

**Main Road:** The main is not in a good condition, the width is not uniform and quite small for it to be a two lane road. There are numerous potholes in some areas, some of which are quite deep and results in water logging. Huge pools of water are found a little further near Un Park gate on way to Shankhamul.

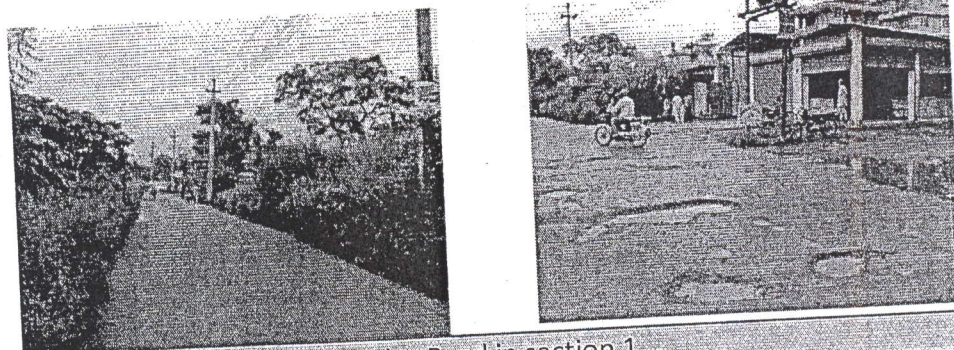


Figure 47: Condition of Corridor Road in section 1

**Secondary roads:** These form the access to residential areas. Some are Blacktopped and in good condition (plotting area), whereas others haven't been black topped. The width of secondary access varies from 4m to 6m.



Figure 48: Secondary access roads of section 1

**Drainage:** Due to uneven slope of the road and dumping of construction materials on the river banks, it was found that surface water drained to the residential areas in certain places rather than flowing into the river. There are neither covered drains nor surface drains in the residential areas but presence of covered drain near the thapathali-kupondole bridge.



Figure 49: Water logging in the roads

### C. SOCIO-ECONOMIC

#### **Type of development along road corridor: Building use**

Mostly residential buildings could be found with maximum having ground floor use as commercial and some having offices, institutions. A few auto workshops and depots could be found. High rise structures like an apartment, office complex, a bar council could be found along the corridor.

#### **Building heights along road corridor:**

Ranging from 1 story to 7 ½ story.

**FAR Utilization:** This section falls under Planned Residential Sub-Zone and the FAR specified is FAR=2 for residences and FAR=3 for commercial purposes. Here majority of the buildings are of 2.5 to 3.5 stories with majority of road side plot sizes between 4 to 5 annas.

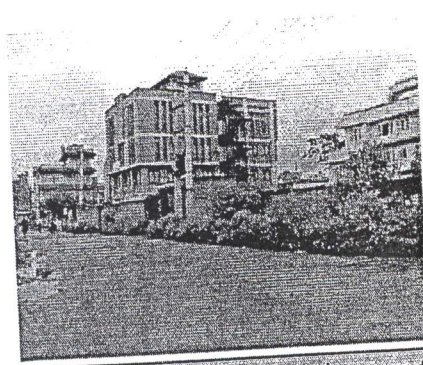


Figure 50: High rise development along corridor of section 1



Figure 51: Mix-use development along the corridor road of section 1

#### D. CULTURAL & RELIGIOUS STRUCTURES

##### Dhanwantari Barahi Temple

Comprises of main temple inside the complex, main building, pati, dabali, 2 small shrines of shiva and Bishnu on the dabali, 5 minor temples and shrines inside the complex.

**Significance:** A few small new shrines constructed and dedicated by people in the name of their departed parents and loved ones.

**Existing State:** In good condition, well maintained.

**Use:** Youth club, yoga center, people use the pati for resting, gathering, the dabali or stone platform is used for socializing. Particularly in the morning hours a small tea shop can be seen there, people socialize and gather there after exercise in UN park.

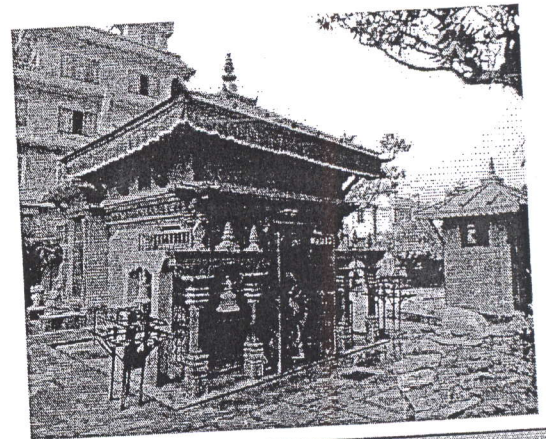


Figure 52: The main Barahi temple

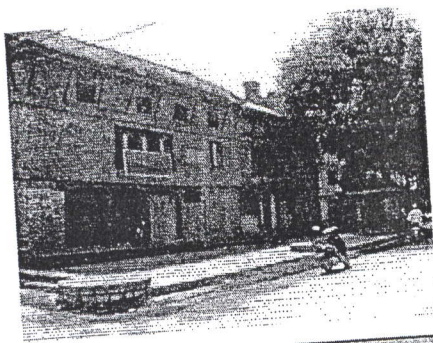


Figure 53: Sattal area of Barahi Complex

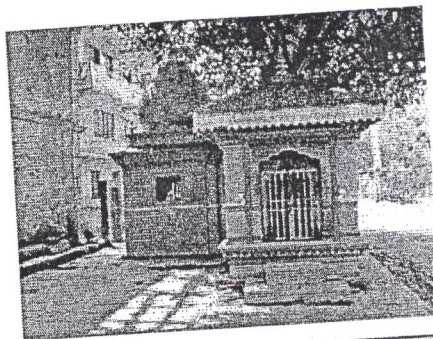


Figure 54: Small religious temples on the Dabali

**History:** During the lichhavi period the image of barahi came to the area being swept away by bagmati. Established as a temple by the maskey family and became renowned as one of the astamatrikas and 12 piths. Due to the volume of river in the past, the barahi was worshipped only during winter months when river level was low. The area of the dhanwantari barahi limited to 10 annas. During the land -adjustment program by the town development committee the area of the temple was increased to 1 ropani. The idol of barahi was stolen two times at 2009 and 2024, which was replaced both times by the byanjankar family. In past, there used to be a pati besides the temple, which was destroyed and was renovated by the Byanjankar family.

#### Cultural Aspects:

- One of the astamatrika of Patan town.
- Based on Dhawantari means "god of medicine"
- The temple complex with the temple of Barahi temple worshipped mainly by Maskey community but also by local people of that area.
- Also by using the sattal area of Barahi complex by a club and as a yoga center, it has changed the settlement pattern from residential to a mixed commercial use pattern.

#### E. ENVIRONMENTAL

**River's condition:** Due to monsoons the river flow is quite good and there is no foul smell. The river in this section looks cleaner compared to the other sections. River edges comprise of natural vegetative growth.

**Floodplains:** 125m maximum in UN Park, 86m max in other areas besides the park (source: 2010 survey by BDA, Kamladi)

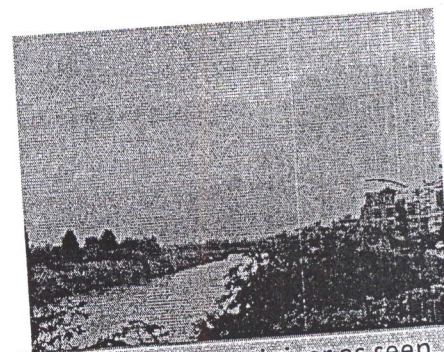


Figure 55: Bagmati river as seen from Kupondole Bridge

### Use of River Banks:

UN Park and KUKL in its premises make up the river bank areas of this section. Other than that small portions along the roadside comprise of outgrown vegetation and serves as a place to dump construction material wastes.

**Solid Waste Disposal:** Can be seen in small sections scattered. However there is no significant amount.

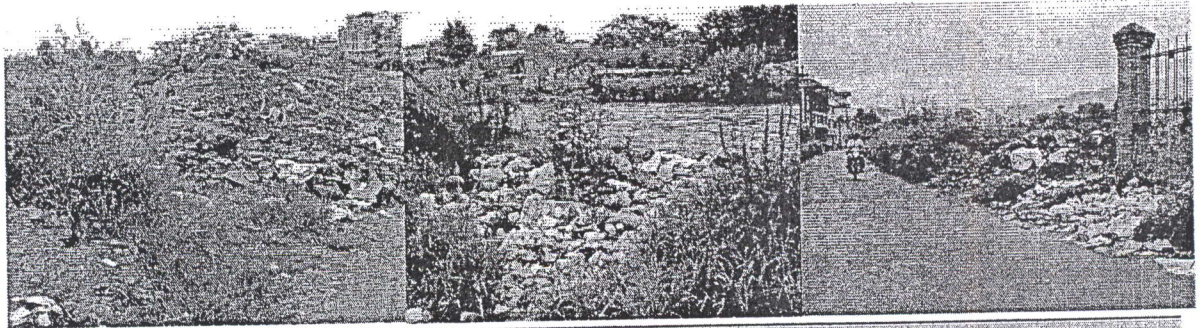


Figure 56: Dumping of garbage and construction wastes along the banks & road sides

### UN Park- Existing Condition:

- KUKL Office- water tanks, storage, treatment plant in its premises
- Suspension Bridge for pedestrians leading to Buddhanagar
- Paved footpaths for walking
- Trees, bushes, flowers
- Statue
- Concrete seatings
- Pavillions
- Overgrown vegetation and trees, not well maintained, despite of dustbins littering can be seen. People usually come in the mornings for exercise purposes like walking, jogging, yoga, badminton etc. In the afternoons and evenings the number of people visiting decreases. Stray dogs and cows can also be seen.

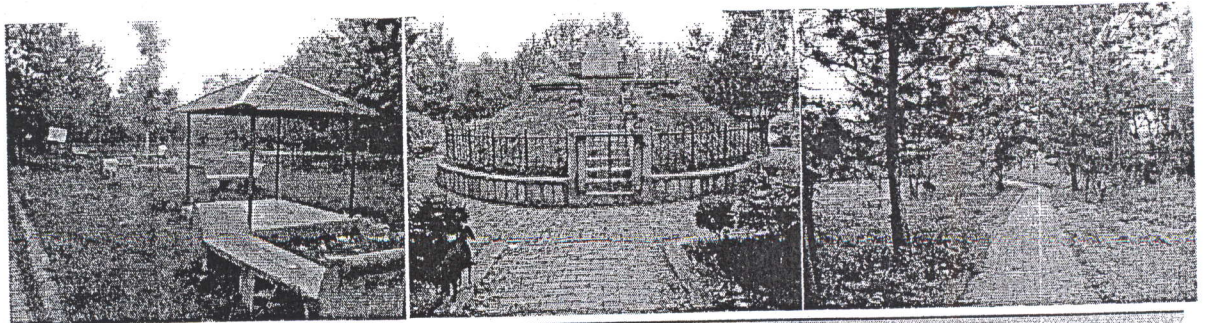


Figure 57: Elements in the UN Park

**List of Significant Buildings along the corridor**

Nepal Council of Arbitration (NEPCA)	Tarai Madhesh Loktantric Party
Rio Apartment	Institute for Career Developemnt (ICD)
Digbijay Complex	Conception Interior Pvt. Ltd.
River saving and credit cooperation	Prashuti griha Hospital quarters
Multi International Trade Market (P) Ltd.	PSI Nepal office
United World Technical Training Center (UWTTC)	

**5.1.2. Visual Observations/ Section 2: (Thapathali-Kupondole Bridge to Sankata Bridge)**

Ward: 1, 10

**A. LAND USE**

Agricultural Land	Commercial	Institutional	Residential	Open Spaces	Encroachment of River Banks
Yes	Yes	Yes	Yes	Yes	Yes

**B. INFRASTRUCTURE**

**Main Road** is blacktopped and in satisfactory condition, though water logging can be seen in certain places. This section of the corridor road is wider compared to that of section 1. Its carriage width is 8m but this may not be uniform throughout.

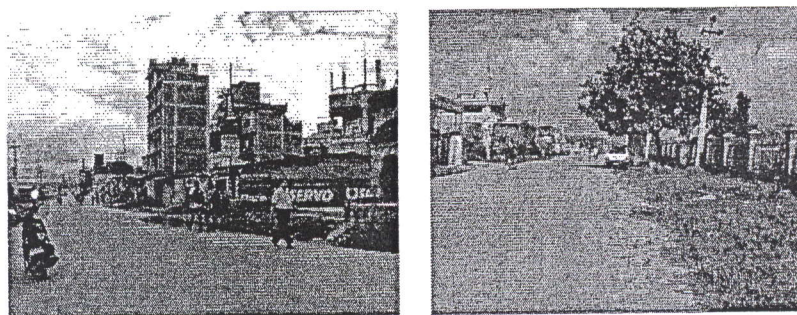


Figure 58: Bagmati River Corridor of section 2

**Secondary Roads:** Access to mixed use development areas. Black topped as well as dirt roads of 4m and 6m widths. These roads connect to 8m wide road from Hanumanthan.

**Drainage:** Due to improper slope of roads we can see water logging in certain portions. There is absence of any covered or surface drains in the corridor road. Man holes may be found all along the roads. Roads that are being upgraded under GLD will have surface drains

on either side. In certain places manhole covers can be seen removed to allow the surface run off to pass.

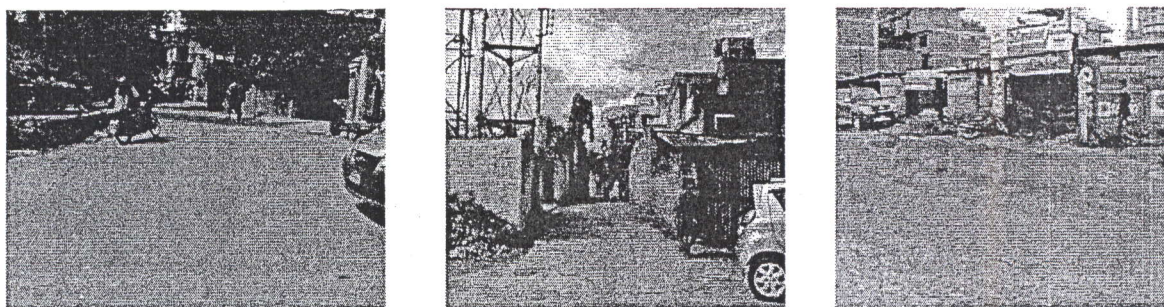


Figure 59: Secondary access roads of section 2; water logging

### C. SOCIO-ECONOMIC

#### Type of development along road corridor: Building use

Mostly commercial and institutional development can be seen along the road corridor. Commercial development comprising mainly of auto workshops, service centers, depots, godowns and institutional development comprising of colleges- major are - Advanced engineering college, Nightingale nursing college, KIHM college. A church- nawajeevan church was also seen. Besides these, a Diabetes and Thyroid health clinic, some new constructions, a furniture godown and small tea shops and a few residences.

Near the main Kupondole-Thapathali Bridge vegetable and meat vendors sell their goods from temporary sheds on either side of the road. A local club- 'Friend's Club' provides these spaces for a minimal rate of Rs.300/month. These vendors are not locals but mostly from some other places like banglamukhi and other places in Patan.

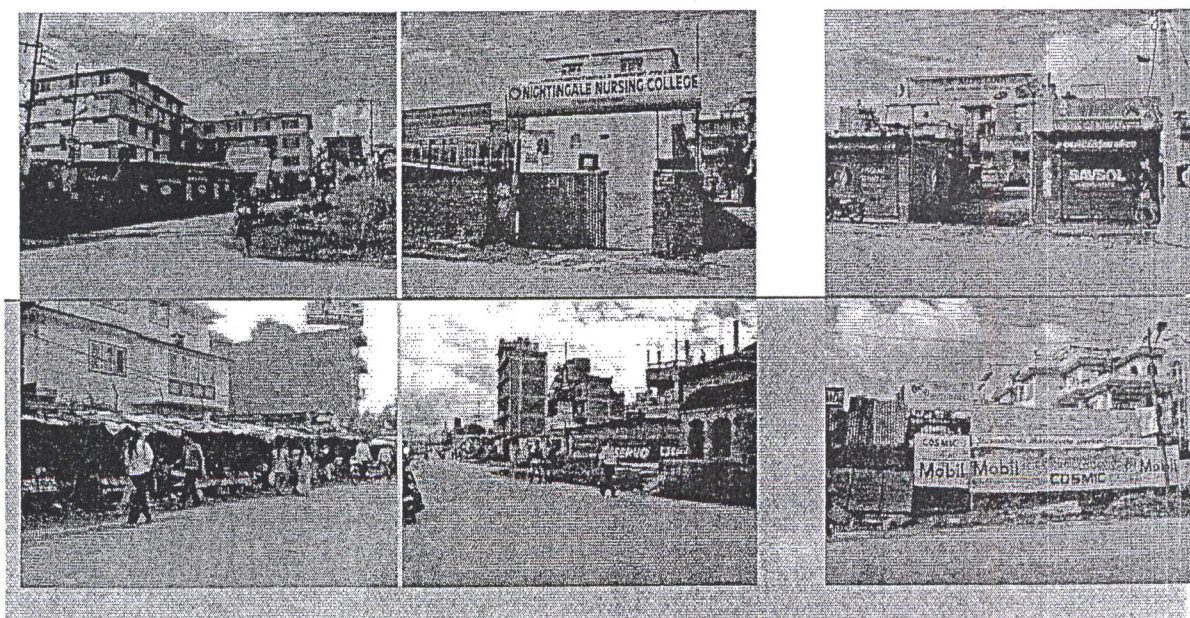


Figure 60: Existing development along the Corridor Road of Section 2

**Type of development 50m within road corridor: Building use**

Mostly Commercial development:

Ward office of ward 10, local club offices, restaurants, bakeries, grocery shops, electrical shops, architectural firm- Creative Consultancy, Training and educational institutes, office complexes, a range of schools- Nightingale, Nagarjuna School, Rupak Memorial, UCMAS, Elsic, Student hostels, small tailoring shops, boutiques etc. Mostly what can be seen are residential buildings having commercial use in the ground floors. There are also religious structures such as the Hanumansthan and Ganesh Mandir, The Gurudwara.

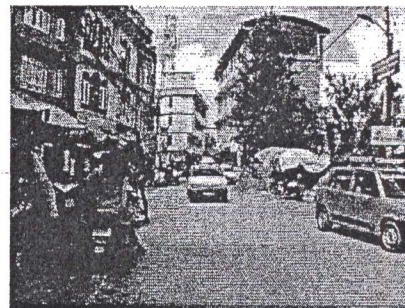


Figure 61: Development trends within 50-100m within COrridor Road

**Building heights along road corridor:**

Temporary and permanent structures, ranging from 1 storey to 5 ½ story

**FAR Utilization:** This section falls under the Dense Mixed Residential Sub-Zone category. Here the majority of buildings are of mixed use and of 3.5-4.5 stories. Specified FAR for residences is FAR=2.5, for commercial FAR=2 and schools FAR=1.5.

**D. CULTURAL & RELIGIOUS STRUCTURES****Prashain Ghat**

**Significance:** Once used to be a funeral site. Also signifies that the river once used to flow till there but has narrowed now.

**Existing State:** It's abandoned and not maintained

**Use:** No particular use.

**Nawajeevan Church :** Situated along the main road. It is one of the later additions and is fully functionaing.

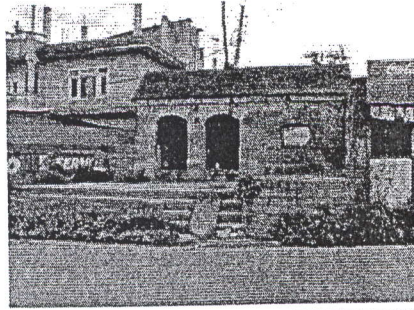


Figure 62: Prashain Ghat

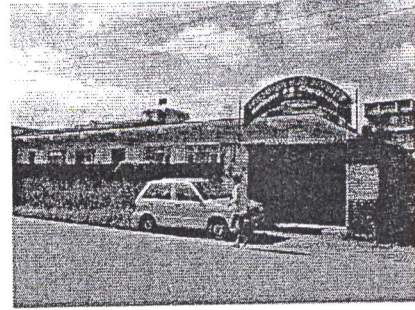


Figure 63: Nawajeevan Church

### E. ENVIRONMENTAL

**River's condition:** Due to monsoons the river flow is quite good and there is no smell. It looks cleaner compared to the other sections. River edges comprise of natural vegetative growth.

**Floodplains:** Max. Width of 92m and min of 57m (source: 2010 A.D survey by BDA, Kamaladi)

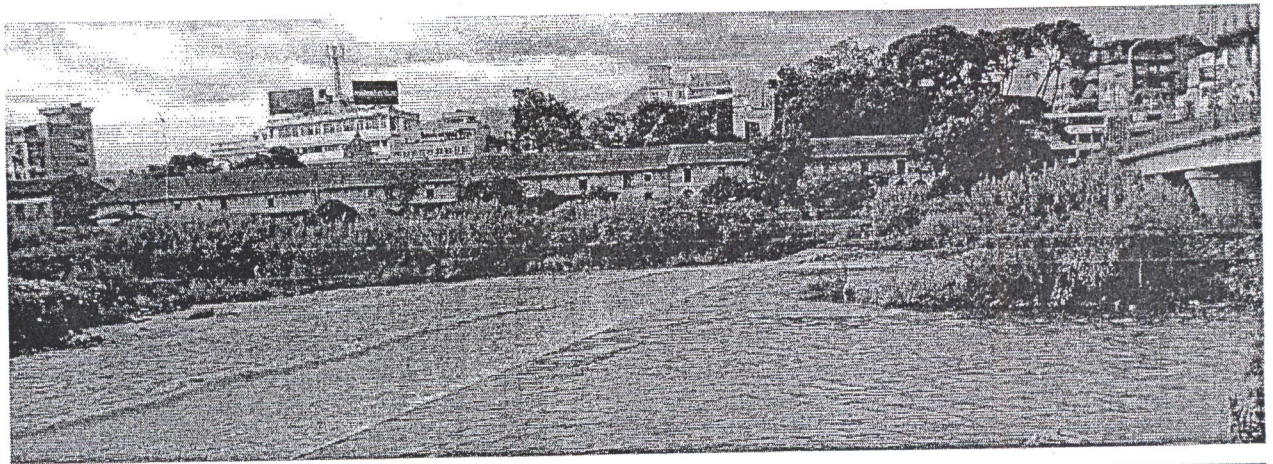


Figure 64: Bagmati River near Thapathali-Kupondole Bridge of section 2

#### **USE OF RIVER BANKS:**

The river banks are being used for various purposes ranging from agricultural use to play fields where people have football matches, play, etc. The locals use some portions of the land for agricultural use where crops like corn, rice, vegetable are being grown. Most of the river bank spaces could be seen with overgrown vegetation and trees and seemed unmaintained. The open field was being used for various purposes besides as a play field. People could be seen doing household chores there such as washing, bathing, drying clothes. These people were usually the squatters residing on the other side of the bank. A long stretch of open space situated next to the main bridge i.e. the Kupondole Bridge has an entrance gate. It is used for trial practice by vehicles and public gatherings, religious gatherings are held there.

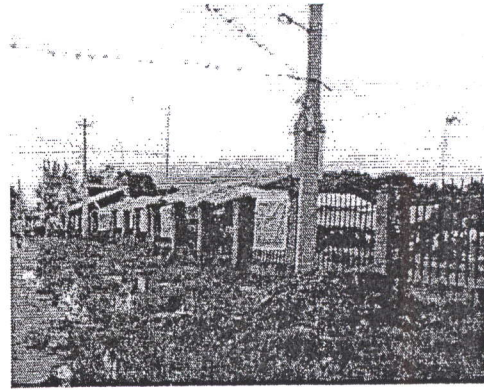
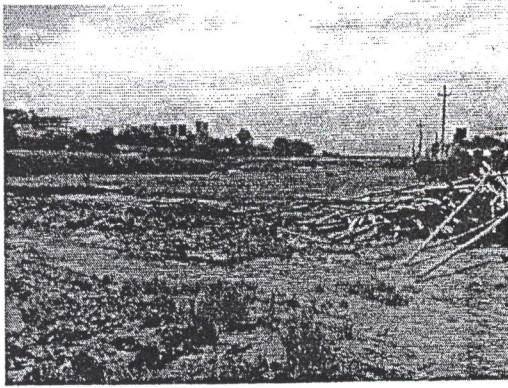


Figure 65: The open space next to the river used for various purposes

A public tap is situated next to the new Sankata Bridge on the river banks where people were seen bathing, washing. The level of the river was the same as the platform of the tap area. A junk yard is also present behind the public tap area.

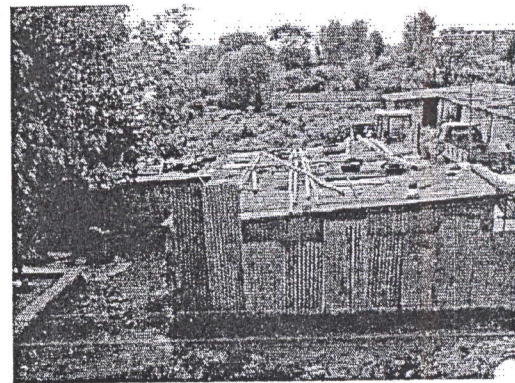
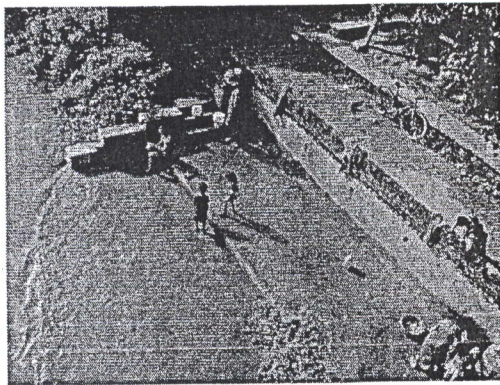


Figure 66: Public tap on the river banks

Figure 67: Illegal construction & occupation

The ward office of ward 1 is also situated next to the main road on the river bank area. It also houses a dental clinic and Nepal Diabetes Association. Next to this building is the WEPCO (Women Environment Protection Committee) office building premises. WEPCO collects and recycles the solid wastes collected from various neighboring wards. The organic waste is converted into fertilizers and sold. It is all done in this compound. A driving Institute- Ability Driving School is also situated next to the ward office.

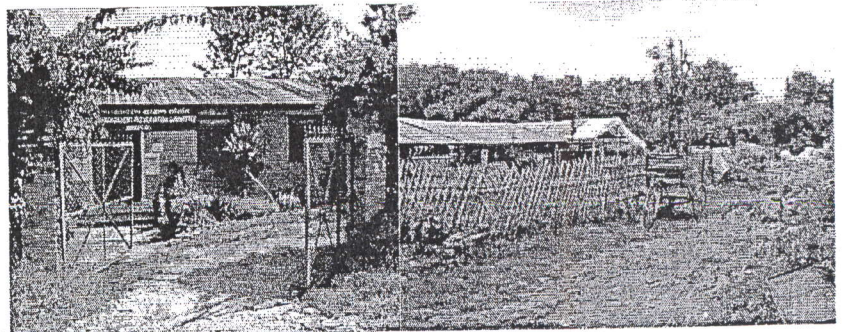
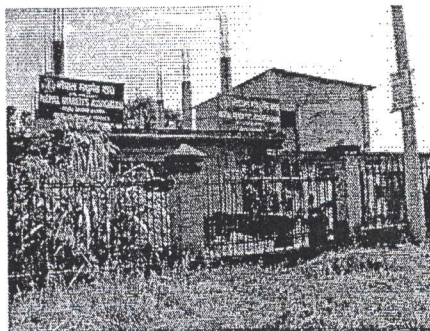
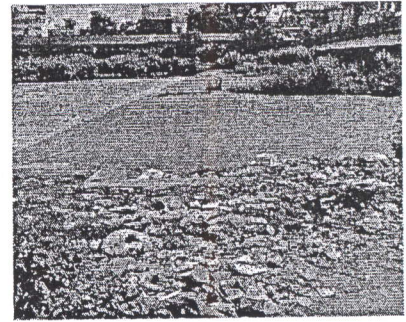


Figure 68: Ward office of ward 1

Figure 69: WEPCO Premises

**Solid Waste Disposal:** Can be seen in small sections scattered especially in the public open spaces next to the road near the main Bridge. Otherwise, the rest of the road stretch seems relatively free from wastes in this section.



**Pollution Level:** Moderate

**List of Prominent Buildings along the Main Road Corridor**

Figure 70: Solid waste disposal- section2

Bajaj Service Center	WEPCO
Advanced Engineering College	Ward Office of Ward 1
Nightingale Nursing College	NS Auto Center Pvt. Ltd.
Nawajeevan Church	Diabetes, Thyroid and Endocrinology Care Center
Kathmandu Institute of Hospitality Management	

**5.1.3. Visual Observations/Section 3: (Sankata Bridge to Kalo Pool)**

Ward: 2

**A. LAND USE**

Agricultural Land	Commercial	Institutional	Residential	Open Spaces	Encroachment of River Banks
Yes	Yes	No	Yes	Yes	Yes

**B. INFRASTRUCTURE**

**Road:** Primary road and secondary Road

**Main Road** is blacktopped and in satisfactory condition, though water logging can be seen in certain places. Width is not uniform throughout.

**Secondary roads:** access to mixed use residential areas. Some roads are blacktopped but have numerous potholes whereas most are dirt roads. Width varies from 4m to 6m.

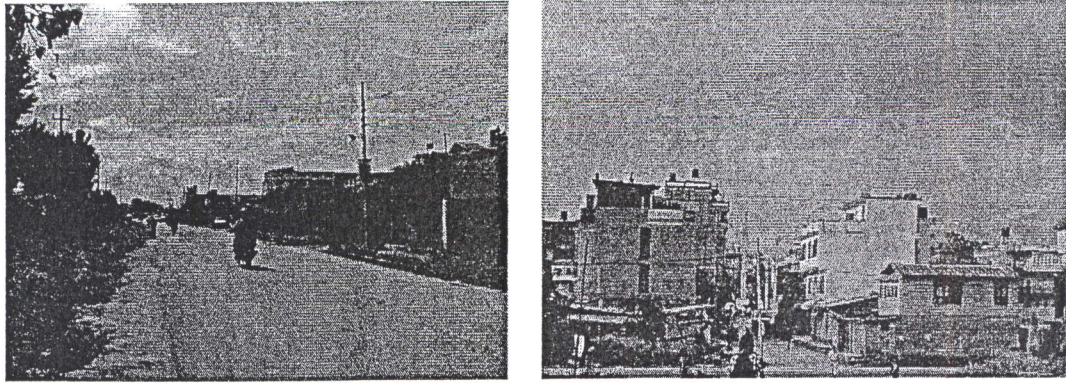


Figure 71: The main Corridor Roads & secondary roads of section 3

**Drainage:** Neither covered nor open surface drains found in this section. The gradient of the road at present is such that it slopes slightly towards the river bank areas and open space where the surface run off flows over green fields and pervious layers and ultimately towards the river.

### C. SOCIO-ECONOMIC

#### **Type of development along road corridor: Building use**

Very few residences can be seen along the corridor, mostly temporary structures housing auto workshops, metal works, junk yards, scrap- metal works, service centers and godowns. Besides these there are also small shops, hardware stores. Most of the residences can be seen at a distance of 20m from the corridor road.



Figure 72: Type of development along the road corridor of section 3

#### **Type of development 50m within road corridor: Building use**

Mixed use development with residential use and commercial uses mostly on the ground floor.

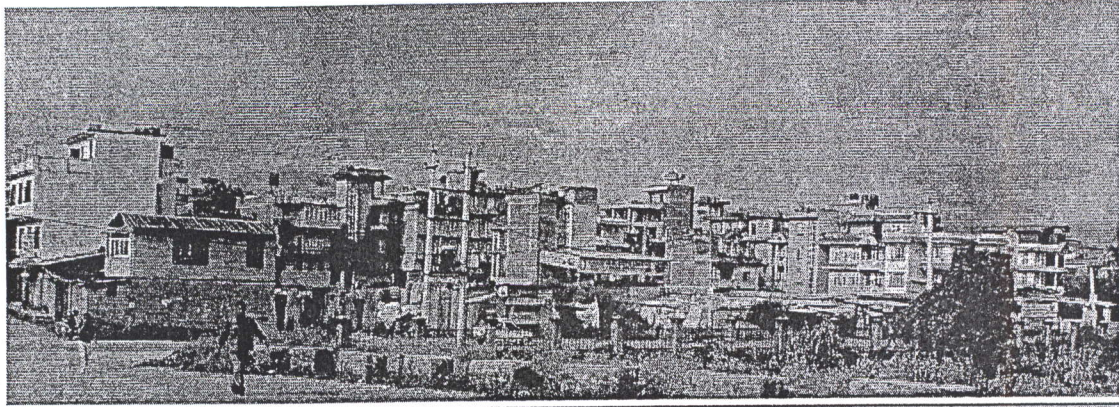


Figure 73: Developments within 50m from road corridor-section 3

**Building heights along road corridor:** Mostly Temporary structures, ranging from 1 to 2 story height .Few residences ranging from 2-5 story height

**FAR Utilization:** This section falls under the Other Mixed Residential Sub-Zone category. Here the majority of buildings along the corridor road are of temporary nature comprising mostly of motorcycle repair workshops. Specified FAR for residences is FAR=1.75, for commercial FAR=2.

#### D. CULTURAL & RELIGIOUS STRUCTURES

##### **Rajtirtha**

**Significance:** Originally a ghat area for the Raj family up till a few decades age but no longer used as a ghat due to the significant narrowing of the river and increase in distance from its banks.

It is also significant for the water that is found there in a well or 'kunda' which is believed to cure illnesses such as gastric, stomach pains, cuts and wounds. There are various other smaller shrines and temples in its premises such as the Ram Mandir (1986 AD), Satyanarayan Mandir, Hanuman mandir (Panchamukhi), ganesh, shiva lingas etc.

**Existing State:** It is well maintained by the priests there and some local clubs. There are new additions such as a hall or pati space (built in 2058 BS) that is used for functions, small gatherings etc., selling of medicinal herbs ('jadi butti') and a room provided for 'kriya' purposes.

**Use:** It is being used as a religious landmark. People from all over the Kathmandu Valley visit the place for the valuable water believed to cure illnesses. 'Bhajans' or holy prayers are being organized every month and the 'kriya ghar' is used occasionally. The new 'pati' has multi-functional use.

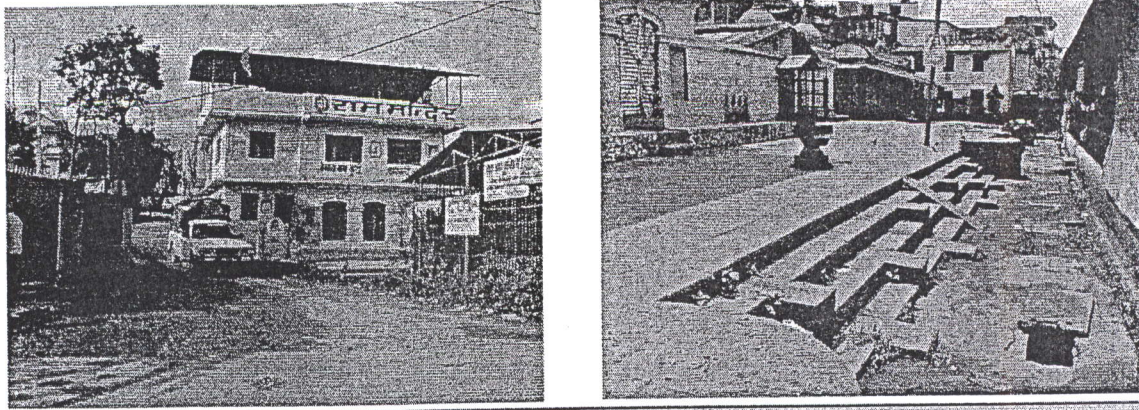


Figure 74: Rajtirtha Premises; Ram Mandir

### E. ENVIRONMENTAL

**River's condition:** Due to monsoons the river flow is quite good and there is no smell. It looks cleaner compared to the other sections. River edges comprise of natural vegetative growth. However solid wastes can be seen disposed on the banks where the squatter settlement is found, i.e. on the other side of the river bank. **Floodplains:** Maximum width of 137m at the football field (*source: 2010A.D survey by BDA, Kamaladi*)

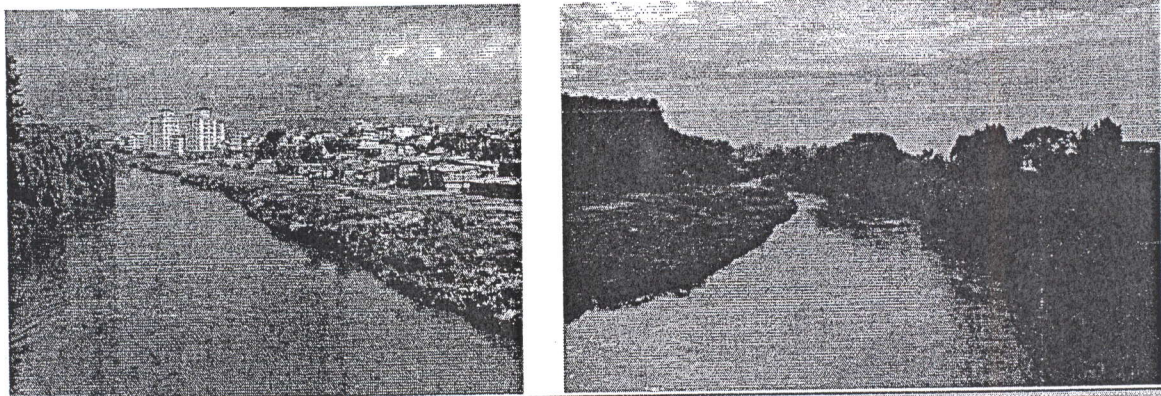


Figure 75: The Bagmati River as seen from Sankata Bridge

#### **USE OF RIVER BANKS:**

The river banks are being used for various purposes ranging from agricultural use to play fields where people have football matches, play, etc. The open field was being used for various purposes besides as a play field. People could be seen doing household chores there such as washing, bathing, drying clothes. These people were usually the squatters residing on the other side of the bank.



Figure 76: Domestic chores being carried out in the open spaces of the river banks

A small park called the Rajtirtha Park is situated there. There is a small tennis court and seating area. It is usually used in the early mornings where people come to play tennis and for exercise. However it is not well maintained and overgrown vegetation and trees are found there.

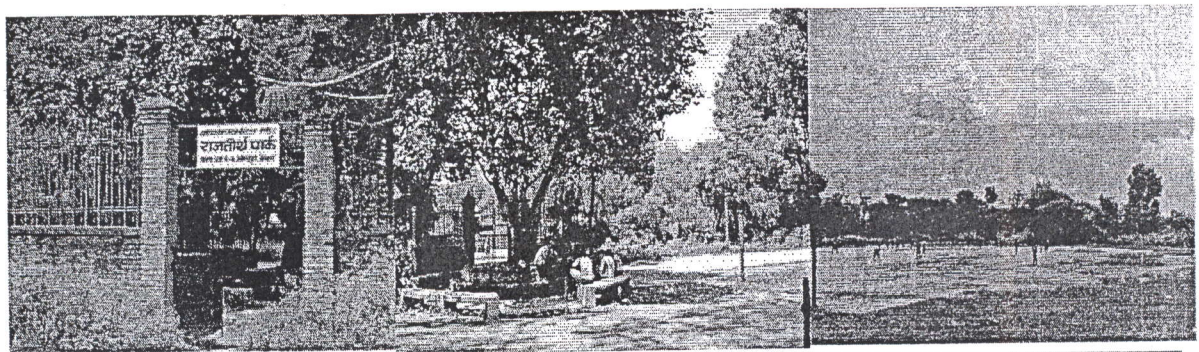


Figure 77: The open spaces used as parks and for recreational purposes

Some portions of the open spaces are being used for agricultural purposes and certain temporary constructions like sheds can be found scattered. The locals use some portions of the land for agricultural use where crops like corn, rice, vegetable were being grown. Most of the river bank spaces could be seen with overgrown vegetation and trees and seemed unmaintained.



Figure 78: Temporary sheds encroaching; flood plains used for cultivation purposes

**Solid Waste Disposal:** Can be seen in small sections scattered especially in front of the entrance to these public open spaces next to the road.

**Pollution Level:** Low, lots of greeneries are found in this section.

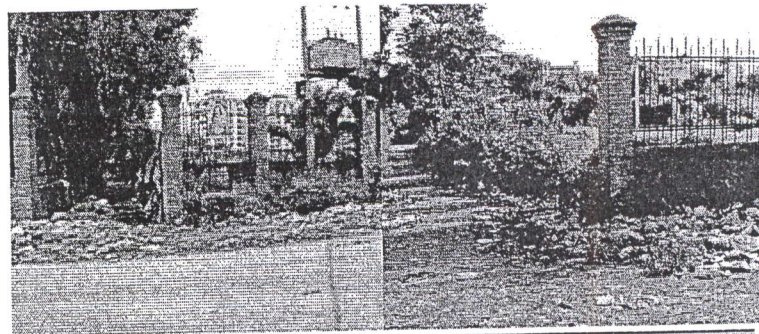


Figure 79: Disposal of garbage and wastes at entrances to public spaces

**5.1.4. Visual Observations/ Section 4: (From Kalopool in Teku to Sanepa Pool/ Balkhu Bridge)**

Ward: 2

**A. LAND USE**

Agricultural Land	Commercial	Institutional	Residential	Open Spaces	Encroachment of River Banks
No	Yes	Yes	Yes	Yes	Yes

**B. INFRASTRUCTURE**

The Main Corridor Road is in a bad condition, there are potholes in certain sections, blacktopping is done only in certain areas. The road is very muddy with water puddles in most sections.

Secondary access is to mainly residential areas and mixed use developments. These roads are mostly around 4m wide.

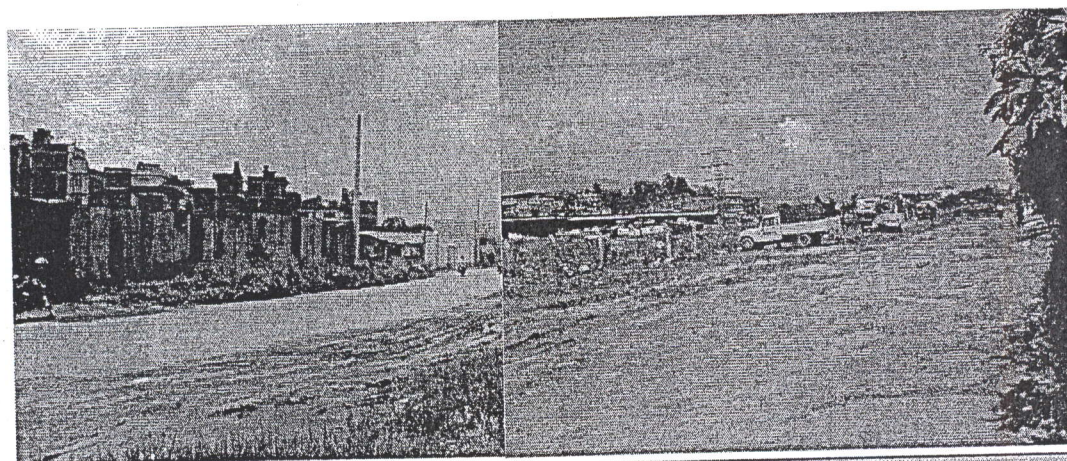


Figure 80: The main corridor road of section 4

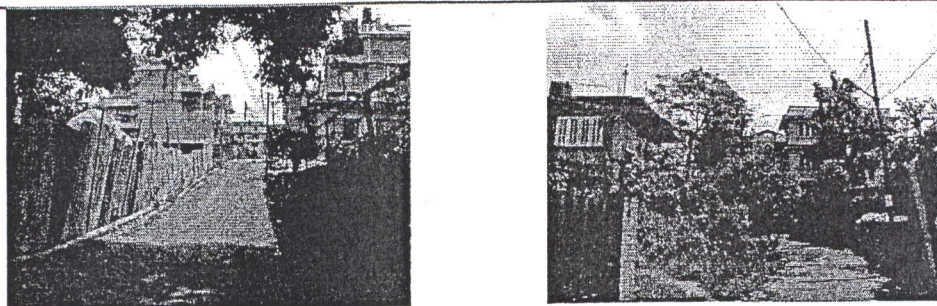


Figure 81: Secondary access roads to various residential & mixed use developments

-**Drainage:** Exposed Sewerage outlets that open directly into the Bagmati River (both Lalitpur & Kathmandu side).

There are no covered drains nor are there surface drains for surface run off.

### C. SOCIO-ECONOMIC

**Type of development along road corridor: Building use**

No residential buildings found all along the road corridor in this segment. Mostly vehicle workshops, metal works, iron works, junk yards, a meat packing industry, sand, construction material storage go-downs , depots.

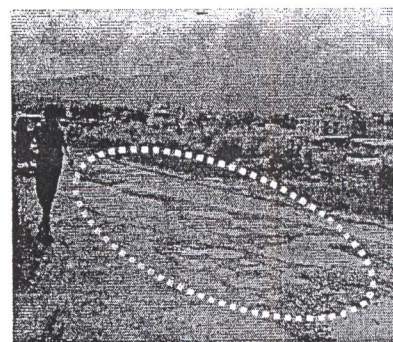


Figure 82: Numerous potholes along the road of section 4

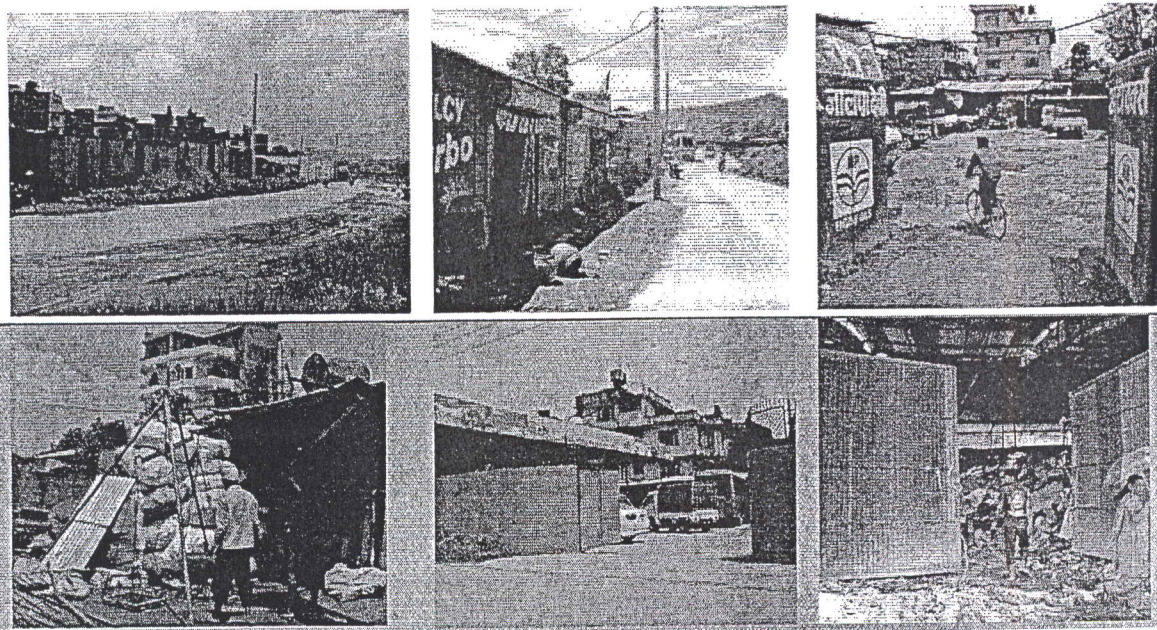


Figure 83: Type of development along the corridor of section 4

**Within 100 m from main road:**

Residential buildings found after 100m, a college also was present (150m from main road)

Offices, flex printing etc.

**Building heights along road corridor:** Mostly temporary structures- Tin sheets, sheds, few permanent 1-2 story height along the corridor

**FAR Utilization:** This section falls under the Other Mixed Residential Sub-Zone category. Here the majority of buildings along the corridor road are of temporary nature comprising mostly of motorcycle repair workshops, garages and storage for construction materials. Specified FAR for residences is FAR=1.75, for commercial FAR=2.

**D. CULTURAL & RELIGIOUS STRUCTURES- None**

**E. ENVIRONMENTAL**

**River's condition:** Bishnumati River mixes with the main Bagmati River and so river width quite wide after that. Open sewers discharging wastes directly into the river are found at certain intervals all along the banks. Sewer outlets directly open into the river causing river water pollution. The main trunk river of Bagmati from Sankhamul to Teku and downstream has very high volume of raw sewage mixed into it especially as it passes through core city area.

**Flood plains:** maximum width of 32m only (*Source: 2010 survey conducted by BDA, kamladi*)

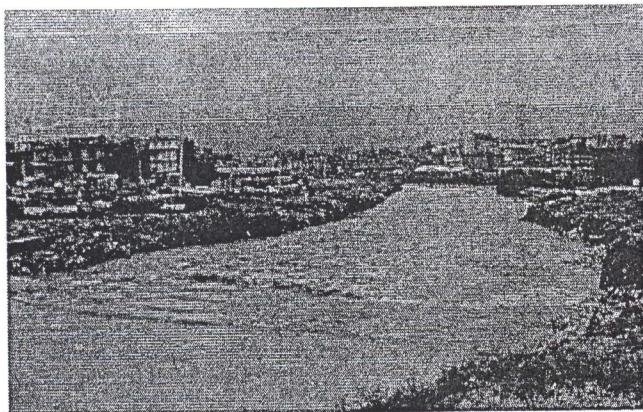


Figure 84: The Bagmati River as seen from Kalopool in Teku

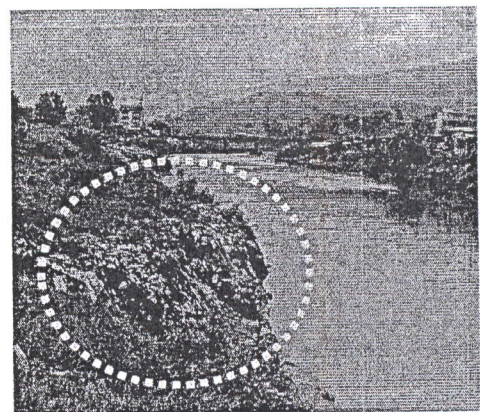


Figure 85: river bed erosion due to inorganic wastes-plastics

**USE OF RIVER BANKS:**

River banks are in worse condition due to the long period of solid waste disposal on the banks. Non-degradable wastes like plastics can be seen to a considerable depth. River banks are in state of erosion. A certain portion of the bank is being used for parking of pick-up trucks. Solid waste disposal in that strip has been stopped. There is also a park that provides some form of greenery to the otherwise degraded river banks.

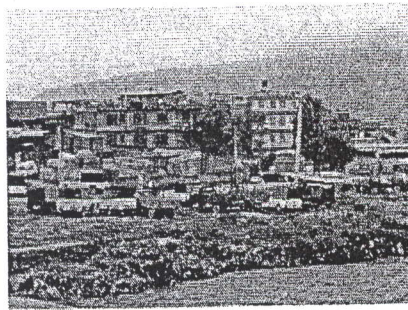


Figure 86: River bank used as parking for pick-ups



Figure 87: Garbage disposal site

**Solid Waste Disposal:** Disposed in river bank area between the Kalo Pool and Shahid Park and also all along the banks after the park and near Balkhu Pool (Sanepa). Collected wastes disposed by collectors in Thelas and small pick-ups cars. Also construction wastes could be seen deposited there.

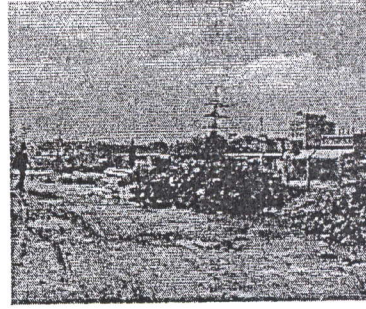


Figure 88: Garbage and construction material disposal on the river banks- section 4

**Shahid Smarak Park:** Initiation of Locals in support with the Municipality, constructed this park on the river banks. It is supposed to extend from Kalo pool all the way up to Balkhu Pool (Sanepa Pool). At present the park occupies only a certain portion. Now, looked after by a local club- 'Riverside Youth Club'. The main reason was - Dumping site- to stop dumping in the area. Squatters started occupying the banks, so after their removal, this park was constructed as told by the club's president Balram Subedi.

#### Works by the club:

Improving the environment by planting trees, greeneries, also organize a cleaning up of the river banks from Teku pool to Balkhu pool every month. Put up awareness boards at certain places along the road corridor.

**Pollution Level:** High

- Solid waste disposal along the banks
- Foul smell as a result of dumping and also foul smell near the meat packing industry.

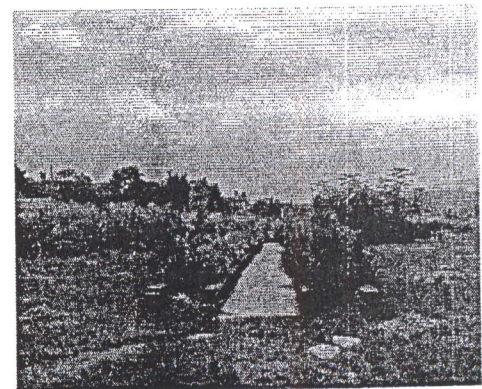


Figure 89: Shahid Smarak Park

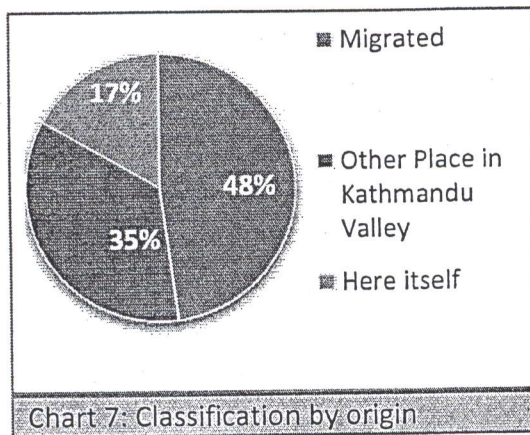
### 5.5. QUESTIONNAIRE SURVEY

Questionnaire survey was conducted along the 3.4 km stretch of the Bagmati River Corridor Road, within 50m from the edge of the river corridor road covering all the four sections all the way from the new Bagmati Bridge in Jwagal upto the Sanepa Bridge in balkhu. Around 65-70 buildings were surveyed and maximum along the road corridor.

*The purpose of this survey was to gather qualitative data and people's perceptions on various issues.*

#### 5.5.1. Socio-Cultural and Socio-Economic Data

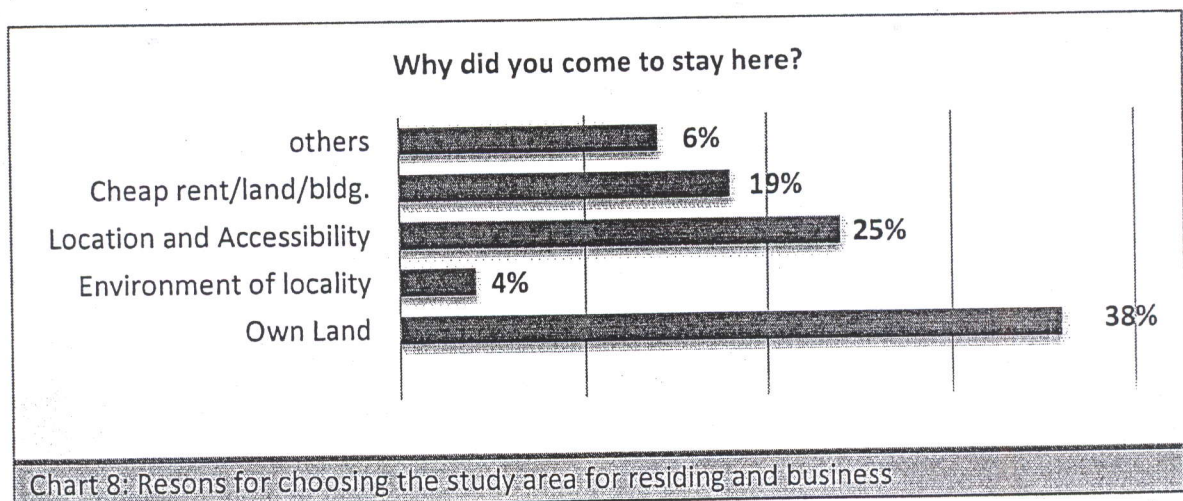
##### a) Classification by Origin



From the sample survey carried out, it was found that only 17% of the population is originally from there whereas total of 83% are migrated. Of the total migrated, 48% are originally from out of the valley and 35% are originally from some other place in the Valley.

This large number of migrated population can be attributed to the fact that earlier the area was

primarily for agricultural use. However over the years, development has resulted in shifting of occupation and growing demand for land.



Since the study area was previously agricultural land that has now been converted for other uses due to the process of urbanization, it was found from the survey that a considerable majority of the respondents are not original inhabitants of the area. So, the reason for their coming to this area was primarily because they owned land in the area. 38% of the

respondents said that it was because they owned land, 25% because of its location and accessibility, and 19% because of the cheap rent / land whereas only 4% said because of the environment of the locality. The 4% were basically respondents from section 1 i.e. Jwagal town planning area. With the construction of the Bagmati river corridor road, together with ease of access, it has opened up areas to development opportunities.

**b) Caste Composition**

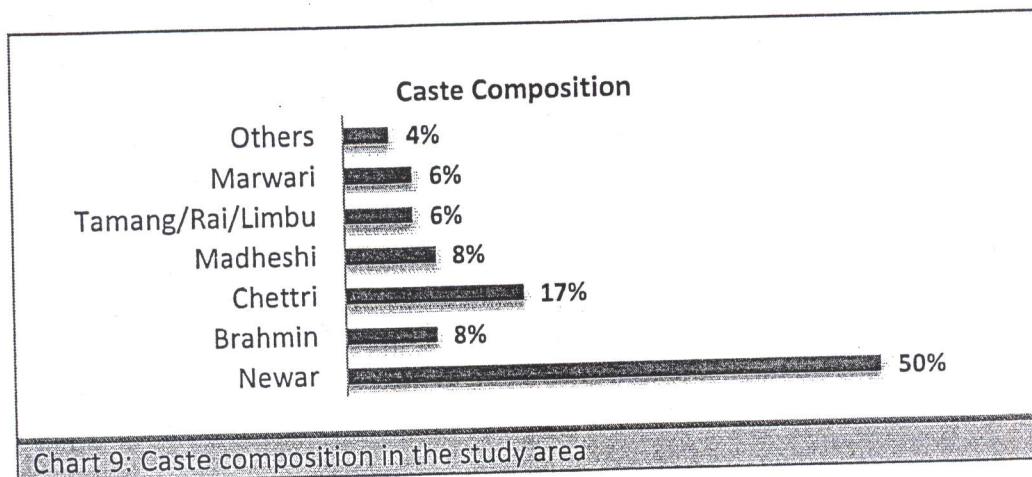


Chart 9: Caste composition in the study area

From the sample survey it was found that Newars are the majority caste accounting to 50%, followed by Chettris(17%) and Brahmins (8%). Newars are the indigenous inhabitants of that area, especially those belonging to the farming profession. However now as seen by the large percentage of migrants, people belonging to different castes besides Newari caste can be seen inhabiting the areas. A heterogeneous society has begun to form in the present day.

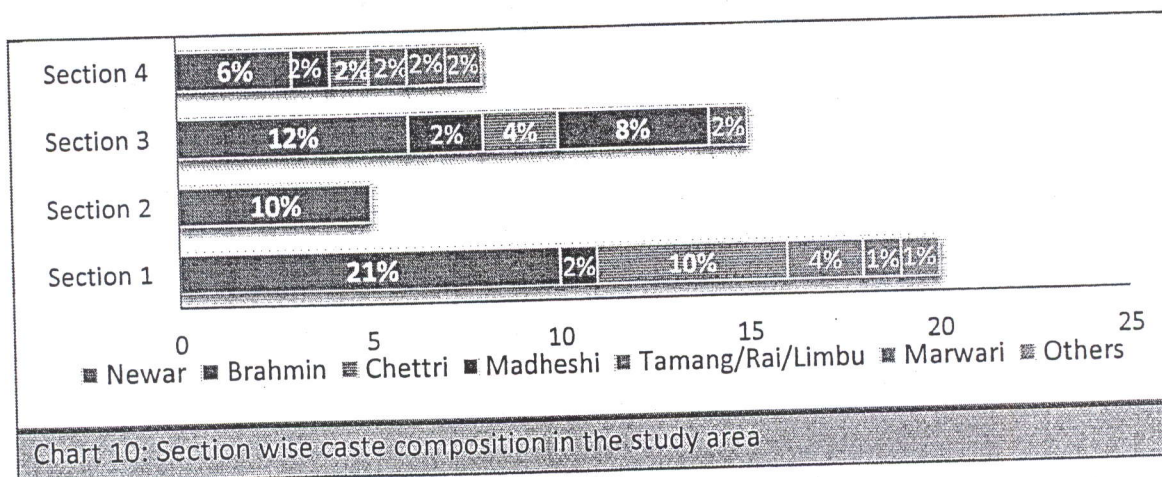
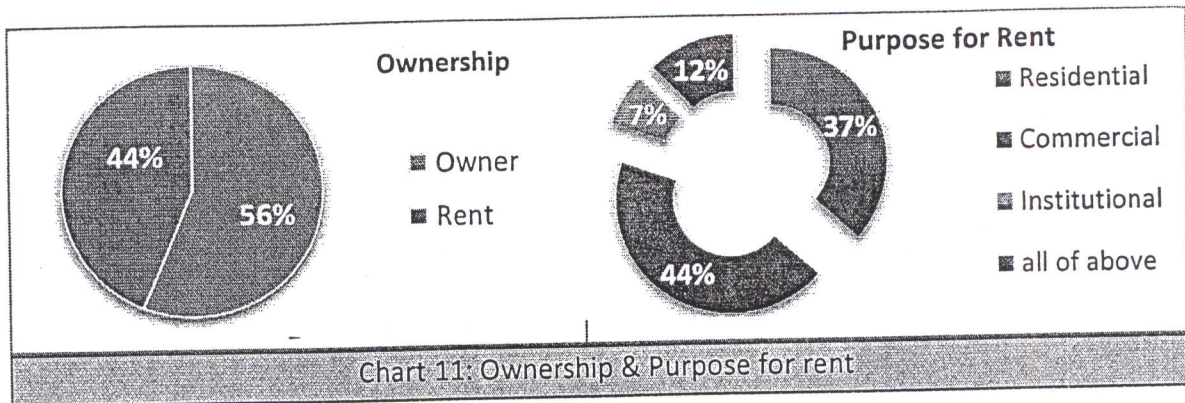


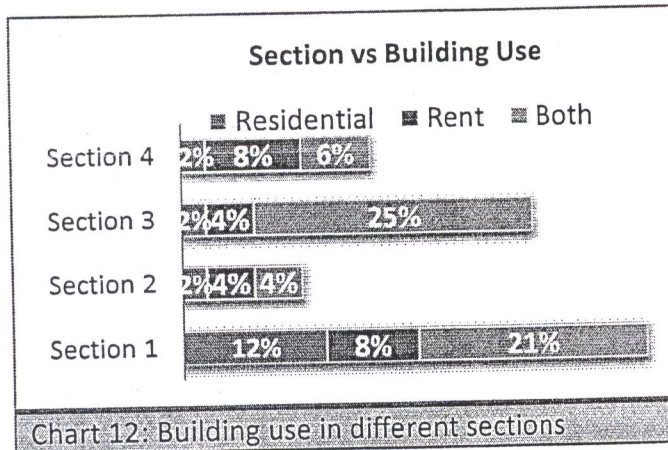
Chart 10: Section wise caste composition in the study area

From the above chart it is observed that the Newar population is found to dominate in all the four sections of the study area. Section 1 had significant population belonging to the Chhettri caste (10%), whereas in section 3 Madheshi castes (8%) are quite significant after Newar population.

c) Resident Type



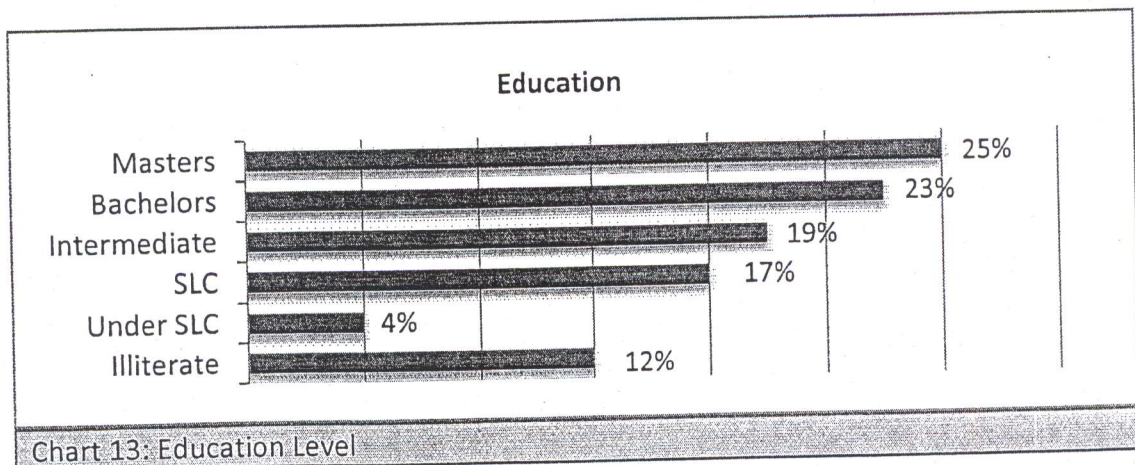
From the survey it was found that 56% of the people residing were owners of the buildings, whereas the 44% were tenants and had rented for various purposes. The purpose for renting varied from residential use to commercial use, of which 44% was rented for commercial use, followed by 37% for residential purposes, 7% institutional whereas 12% for all of the above uses. So, in the study area it was found that commercial use dominated, especially along the road corridor with a total of 56% buildings/land rented/used for that purpose.



It was also found that in all the four sections buildings with both types of uses i.e. residential and rent dominated with maximum numbers seen in section 3 and 1. Also in sections 1 and 4 buildings with only rental use comprised 8% each. So basically section 1 is a residential area

but along the road corridors commercial development is occurring.

d) Education



The education scenario in the surveyed area shows that 84% of the population surveyed has studied till SLC level or above. Out of which 25% have completed masters, 23% Bachelors, 19% Intermediate level and 17% till SLC. Under SLC and illiterate population accounts to about 16% of the total surveyed population. Hence, the education level varies from masters to secondary level.

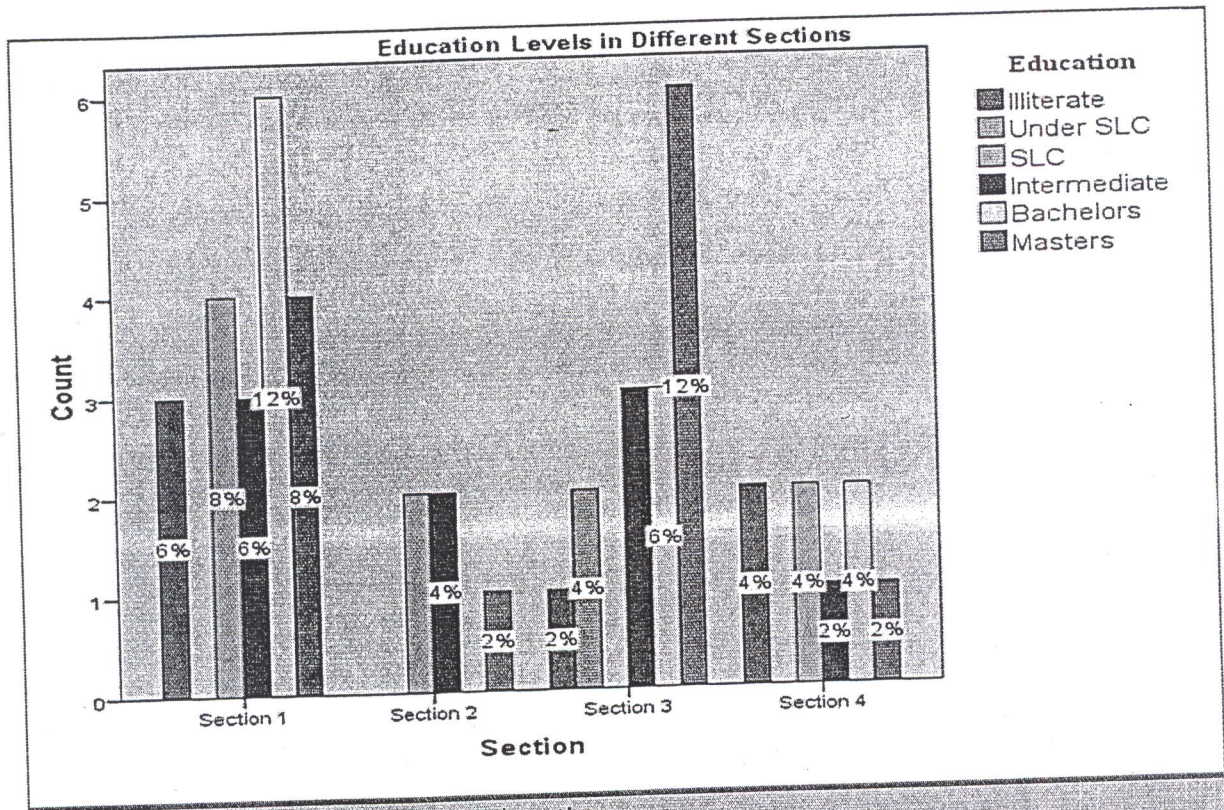


Chart 14: Cross-Tab of education and section

Upon comparing the education scenario of the respondents belonging to the different sections, it was found that section 1 and section 3 had the most number of respondents in bachelors and masters level.

e) Occupation

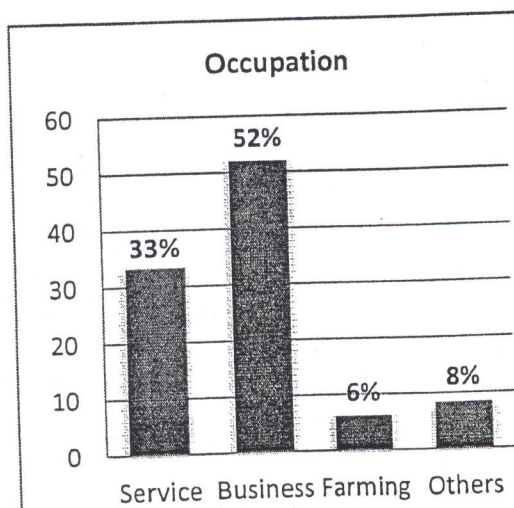


Chart 15: Occupation

According to the sample survey done in the site it is observed that most of people have changed their occupation at present. More than half are involved in business and this can be attributed to ease of access due to the development of roads. About 52% of people were engaged in business, 6% in agriculture, 33% in service and 8% in others. For the original inhabitants of the area, their primary occupation of agriculture has shifted with the selling of their land and most are basically involved

in businesses.

5.5.2. Physical Data

Plot Sizes

From the survey it was found that majority of the plots mostly along the road corridor was of 4 and 5 annas in area (54%). Whereas only 4% was above 1 ropani.

This 4% comprised mainly of auto workshops, depots and was in Balkhu area i.e. belonged to section 4 of the study area.

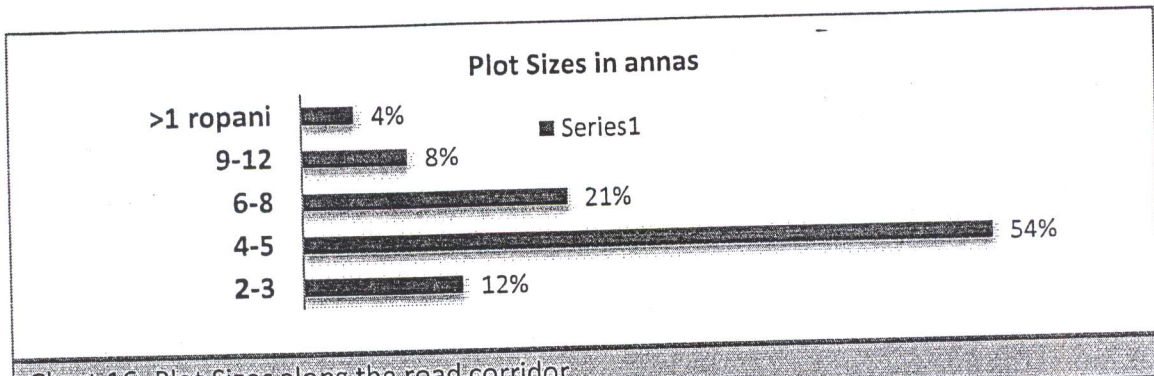


Chart 16: Plot Sizes along the road corridor

From the cross tabulation it was found that the majority of the people of migrated origin(48%) had plot sizes of 4-5 annas in the study area.

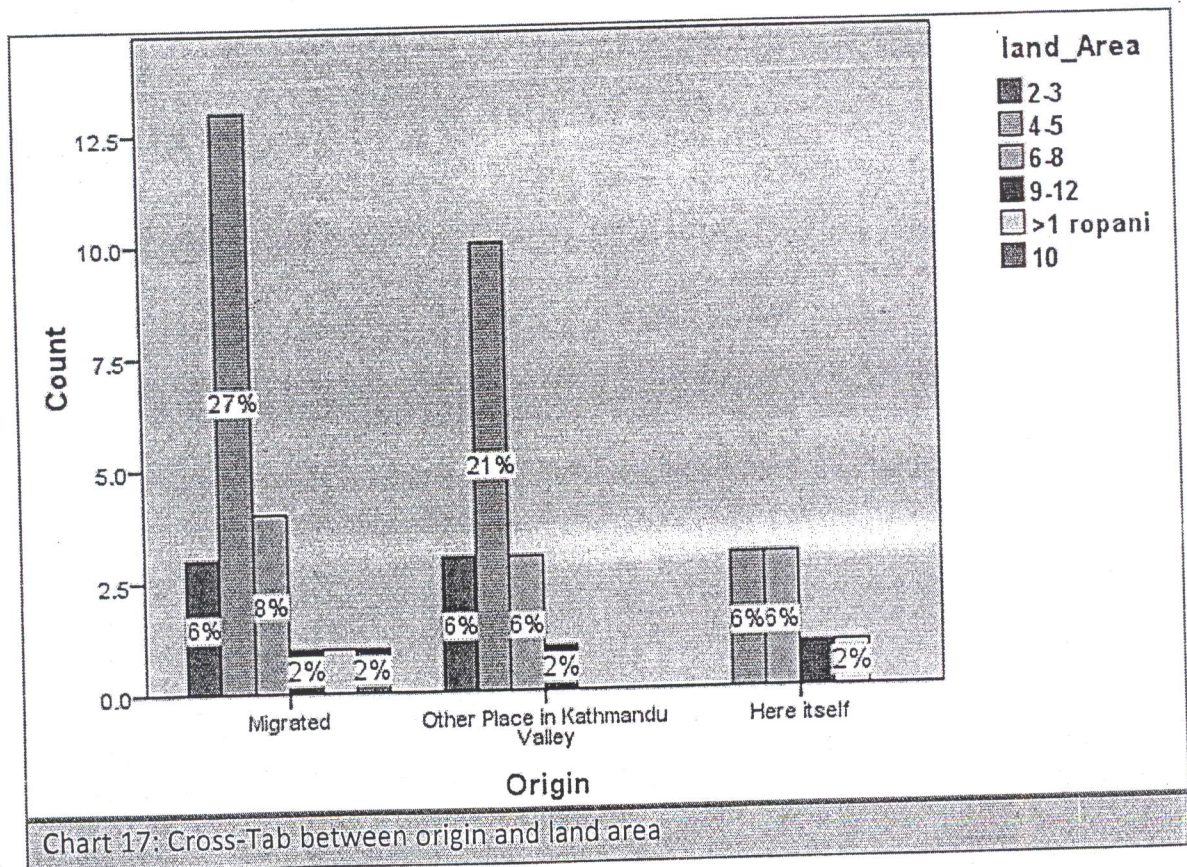
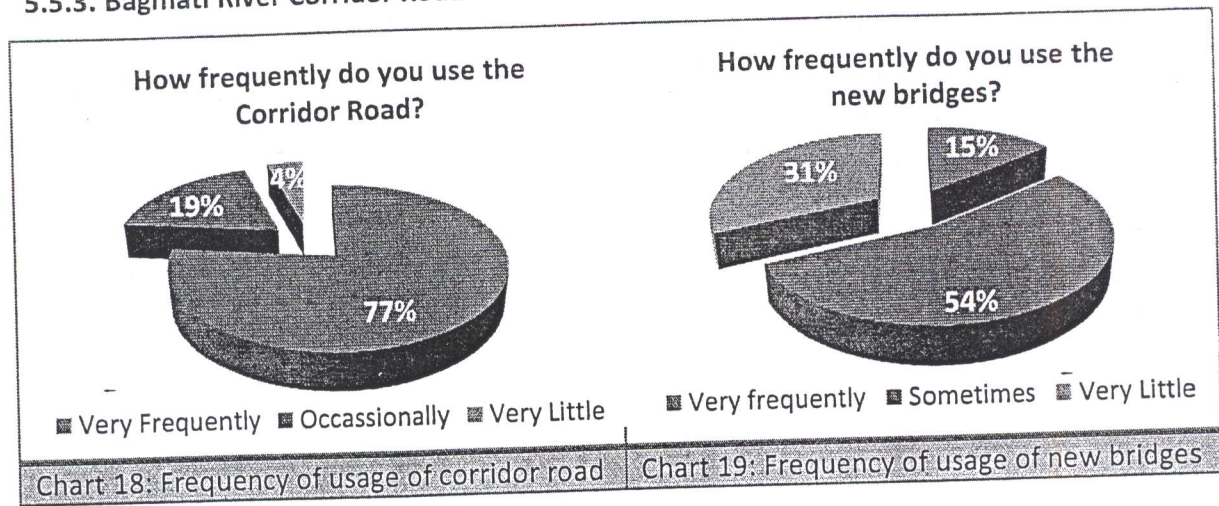
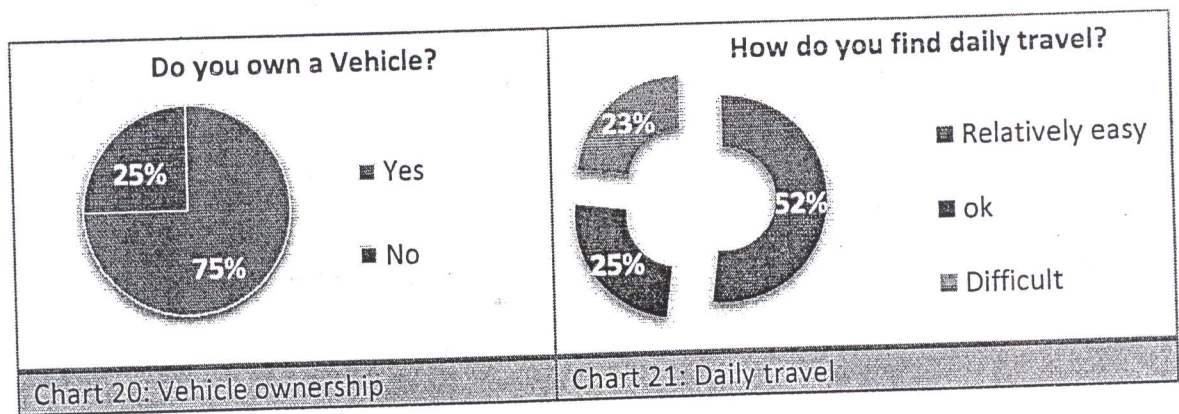


Chart 17: Cross-Tab between origin and land area

### 5.5.3. Bagmati River Corridor Road



It was found from the survey that 77% of the respondents frequently used the Bagmati River Corridor Road for travel purposes, 19% used it occasionally whereas only 4% hardly used this road for travel. Similarly, only 15% of the respondents frequently use the new bridges i.e. the new Bagmati Bridge and the Sankata Bridge, 31% occasionally whereas 54% hardly ever use it. This large number may be attributed to the fact that the bridges are relatively new only recently being constructed and so the adjacent road constructions have not been completed. So, most of the people stated this as the reason.



From the survey it was found that 75% of the respondents owned some type of vehicle (60% motorcycle, 8% car, 15% both) and 25% owned none. On asking how they found daily travel to and fro from the area 52% of the respondents found travelling using this corridor road relatively easy, 25% found it ok whereas 23% of the respondents found it difficult. The reasons for each of the answers were common. For those who found it easy, the reason ranged from less traffic jams, shorter route and less time consuming. For those who found it difficult, the reasons were speeding, incomplete roads, potholes, no proper footpaths for pedestrians and no public transportation service.

From the cross tabulation of vehicle ownership with daily travel, it was seen that people with vehicles (car, motorcycle) found travelling through the corridor road relatively easier than people who didn't own any type of vehicle. This is because there are no footpaths for pedestrians and so the roads are unsafe for walking.

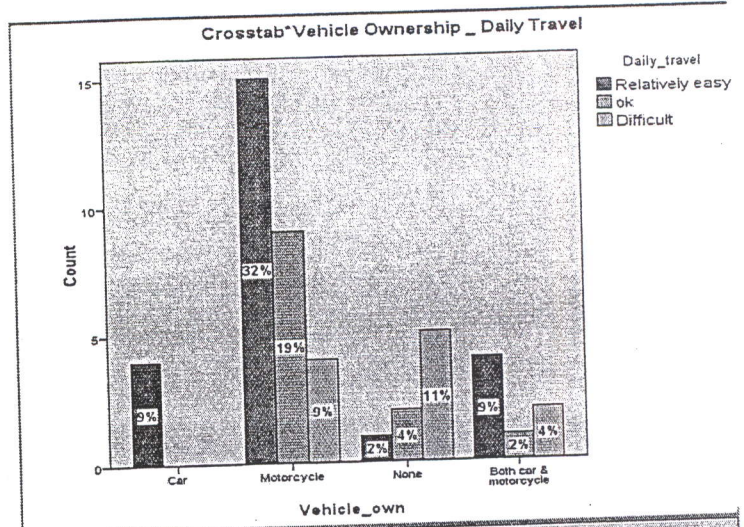


Chart 22: Cross-tab of vehicle ownership & daily travel

5.5.4. Satisfaction with the following:

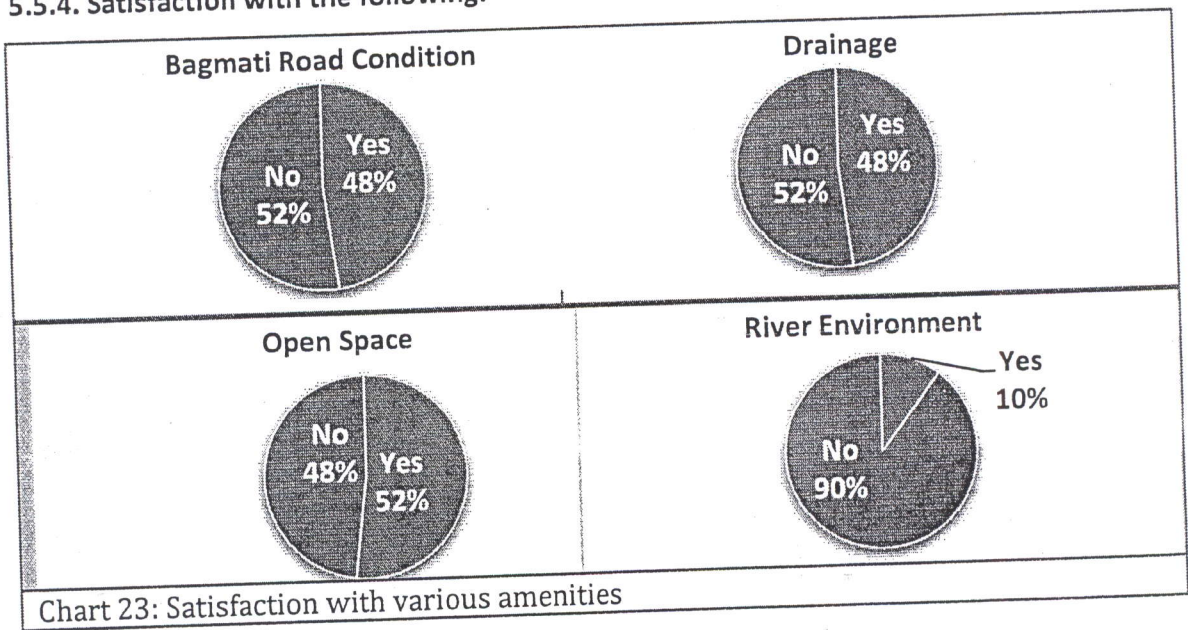


Chart 23: Satisfaction with various amenities

5.5.5. Solid Waste Disposal

From the survey it was found that majority (54%) of the respondents had house to house collection for disposing their solid waste. 15% disposed it in their own compound, 12% in municipality container, and 19% dumped it on the streets or riversides. In section 1, 2 and 3, an organization called WEPCO (Women Environment Preservation Committee) collected solid wastes from house to house for a

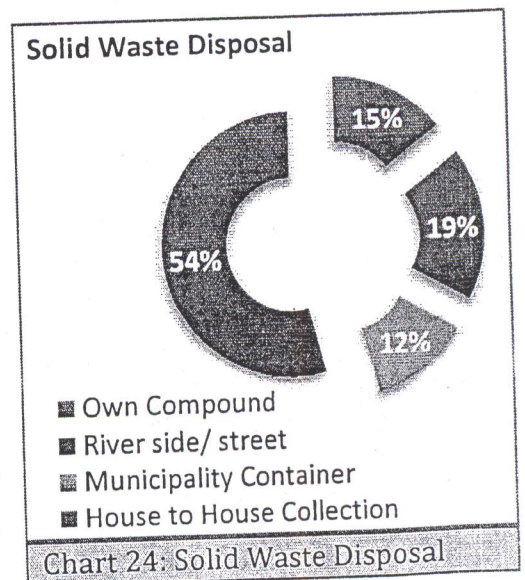
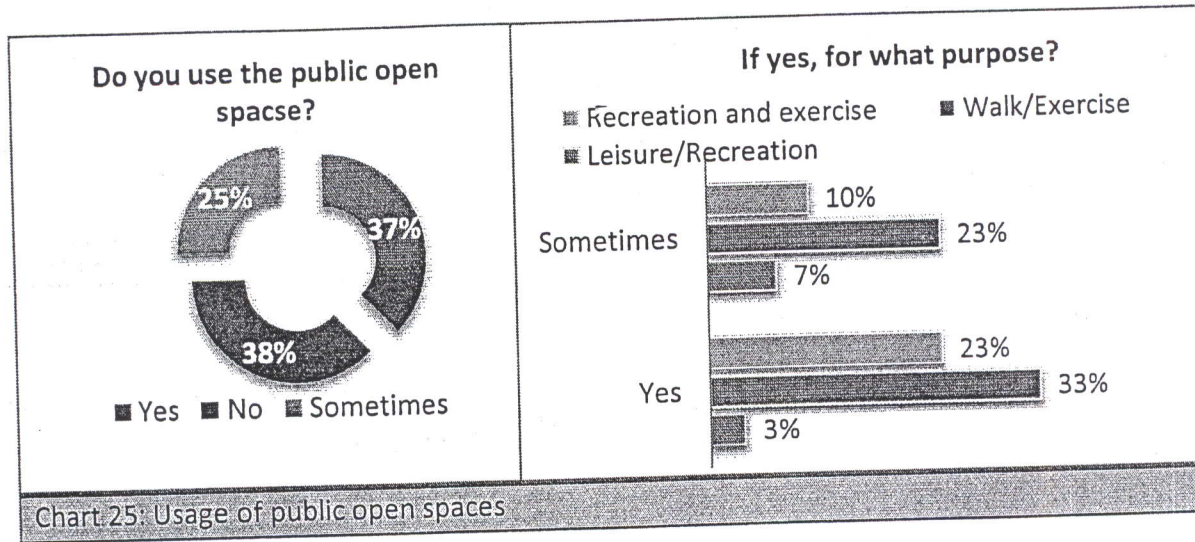


Chart 24: Solid Waste Disposal

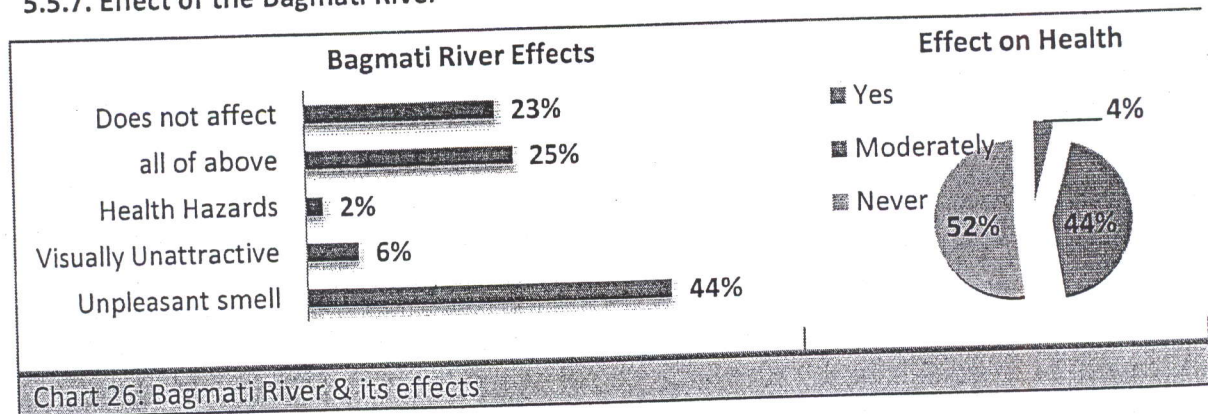
monthly charge and recycled, reused or sold the wastes in the form of fertilizers. Even though such organizations are present dumping of wastes along the streets are common sights in all the four sections of the study area. The extreme case of this can be seen in section 4 i.e. Balkhu as the dumping site is situated there along the river banks.

### 5.5.6. Open Space Usage



From the survey it was found that 37% of the respondents used the public open spaces regularly, 25% used the spaces sometimes, whereas 38% did not use these spaces. From the cross tab of those that visited these spaces the main purpose for their visit was for walking and exercise (total of 56%). So, the reason for the large number of respondents using these spaces for primarily exercise purposes only may be because of the existing ill-maintained condition and also lack of recreational facilities in these spaces.

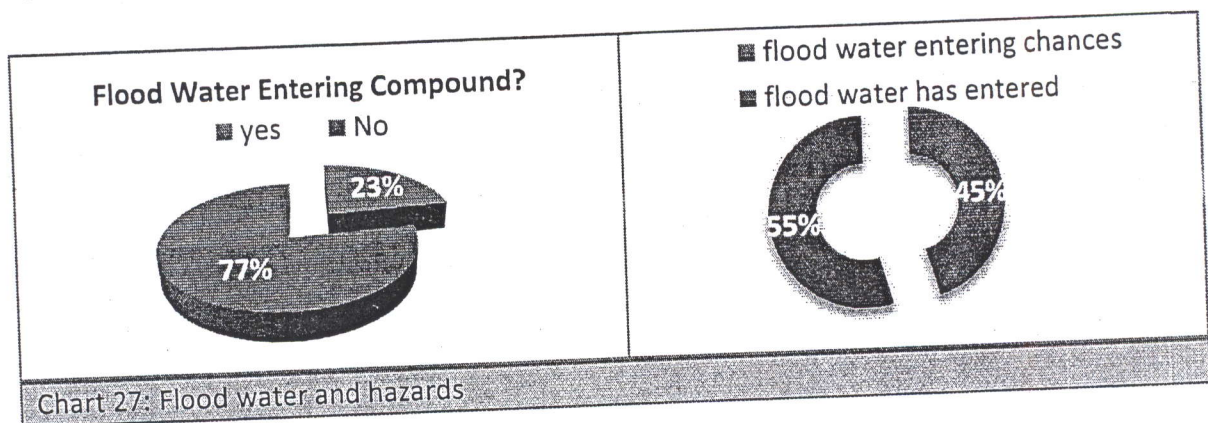
### 5.5.7. Effect of the Bagmati River



In questionnaire survey the respondents were asked to choose what effect the Bagmati river's condition was having in their area and 44% responded by saying unpleasant smell. In some areas this usually was not all year round but during certain months, but in other places, especially in Teku, Balkhu area the unpleasant smell was yearlong. This is further

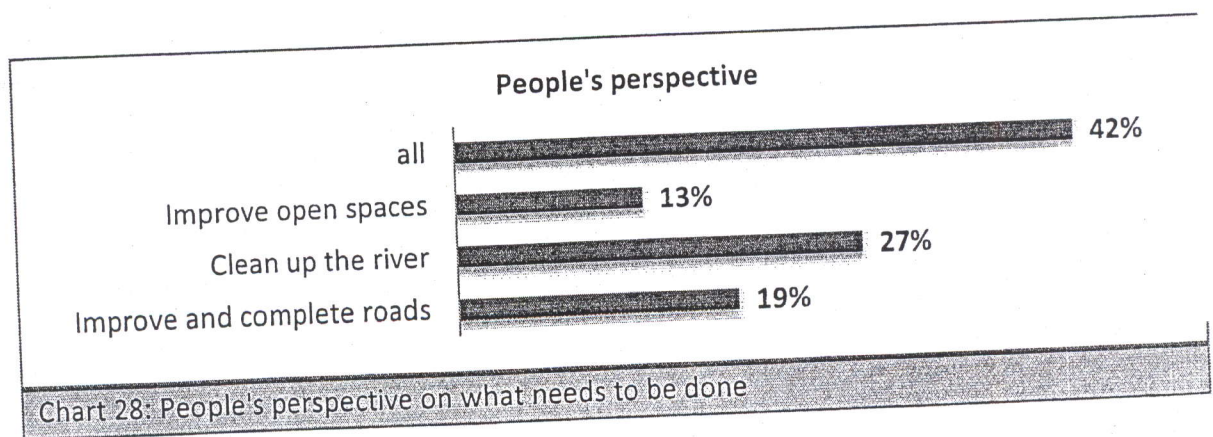
worsened due to the dumping site in balkhu. 6% thought it was visually unattractive and degraded the value of the area whereas only 2% thought it posed a health hazard. 25% of the respondents thought that the existing state of the river had all of the above effects and surprisingly 23% were of the view that the state of the river does not affect their area. Those who were of this view, belonged to areas that were a little inside from the road and in areas like Jwagal where the Un Park serves as a buffer from the river.

It was also found that only 4% of the respondents' health had been affected by the River's condition. 44% said that their health had been moderately affected and 52% had never been affected. Those that were moderately affected mainly stated headaches due to the smell and that this condition may affect seriously in the long run.



77% of the respondents said that their compound had never been affected by flood waters, whereas 23% of the respondent's compound had been affected by flood waters in the last 10 years. Of these more than half mentioned that flood water had entered, whereas the remaining stated that there were chances of water entering. Usually it was seen that these were the respondents whose buildings and compounds were situated in areas close to rivers with very little flood plains.

#### 5.5.8. People's Perspective on what needs to be done in the area for its improvement



In the survey, respondents were asked to give their views on what needs to be done for the improvement of their area and it was found that 27% were of the view that the river should be cleaned, 19% responded that the corridor road should be improved and completed with drains and footpaths and 13% were of the view that the open spaces should be improved upon. 42% felt that all of the above improvements were necessary in their area.

From the chart below it can be seen that education level also has impact on the perspective and needs of a person and so noticeably most of the respondents with education above SLC were seen to suggest all of the improvements as necessary whereas majority of the respondents with little or no education felt that the river should be cleaned.

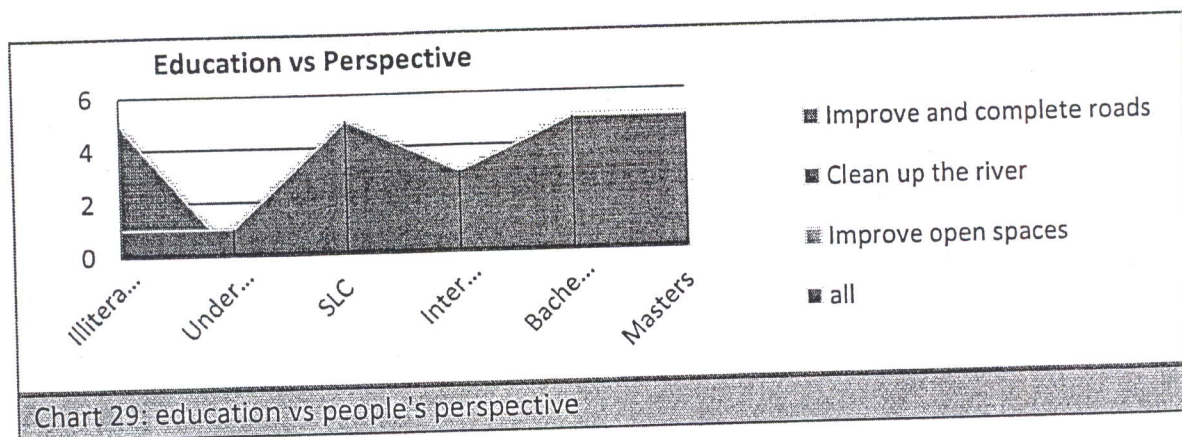


Chart 29: education vs people's perspective

From the chart below, it is seen that suggestions for all of the improvements are maximum in section 1 and section 4. Whereas in section 2 and section 3 suggestions for cleaning up the river is more compared to the other suggestions. The reason for this may be because both these sections have major bridges crossing and the surrounding areas are highly commercialized comparatively. Section 2 is Kupondole area and unpleasant smell from the river is common during the dry months. Also the main Kupondole-Thapathali bridge is situated here and so when passing people get a clear view of the river's condition. Section 3 is gusingal area which has Teku Bridge nearby. This area from the bridge upto Balkhu is really polluted and also visually not pleasing.

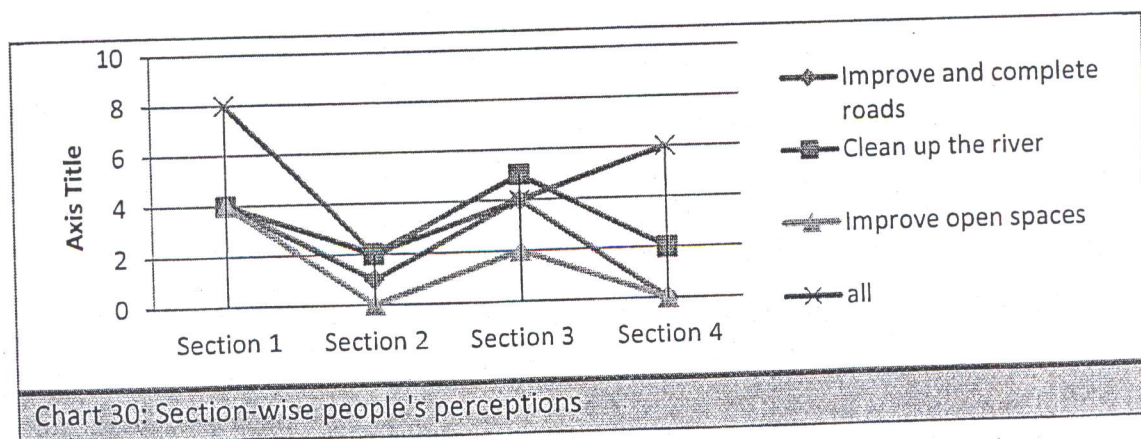


Chart 30: Section-wise people's perceptions

## CHAPTER VI: IDENTIFICATION OF PROBLEMS AND ISSUES

### 6.1. Summary of Findings

Physical Impact	Socio-Economic impact	Socio-cultural Impact	Environment
Encroachment of Public land like river banks	Increasing Land value	Migration resulting in heterogeneous society	Degradation of the River banks
Change in Land Use	Change in occupation	Decreasing religious and cultural significance of the river	Degradation of the river environment
Loss of agricultural land and open spaces	Migration		
Changing Streetscapes, Haphazard development	Commercialization and Institutionalization	Emerging new religious and cultural practices due to heterogeneous society	

### 6.2. Change Analysis: Changes brought about by the Bagmati River Corridor Road on the Land use

The study area was originally a part of the Bagmati River and its banks. The land was primarily used only for cultivation. There were hardly any residences or built up areas and the roads, besides the main Thapathali-Jawalakhel corridor, were all dirt roads. 95% of the area was only cultivated land/open spaces in the 1960's and 1970's A.D. The area was more important from a religious and cultural perspective. There were many holy temples and ghats or funeral sites constructed in this area, namely the Raj tirtha ghats, Teku ghats, Prashain ghat, ghat in Varahi, Shankhamul ghats.

From the early 1980's to late 1990's the river's width had decreased tremendously. Sand was extracted from the river beds due to the increasing demand for construction materials. This further led to the deepening and narrowing of the river. The area where once the river used to flow was now encroached for various purposes. People who started cultivating these areas claimed the land as their own.

With increasing migration rates and development pressures changes in the land use pattern occurred throughout the Valley and the study area was no exception. Development occurring in the surroundings impacted development in the study area as well. The development of the Thapathali-Jawalakhel corridor as the main trunk road for Lalitpur district formed the base for network development in the areas like Jwagal, Kupondole,

Sanepa, Gushingal. This led to changes in the intensity of uses of land on either side of the road networks. The trend that could be seen were increase in built up areas near road networks. With increase in access to the inner areas, the built up area also started to increase simultaneously and so more and more cultivated land were being converted for other uses such as residential, commercial purposes. People started changing their occupation and the land once used for agriculture was in demand. Rising demand for affordable land and change in occupation together with development pressures resulted in land use change.

The initialization of the Bagmati River Corridor Road by JICA in the early 90's was an outcome of the need for providing an alternate route linking Patan to Kathmandu besides the existing Kupondole Bridge and the Thapathali-Jawalakhel Corridor. It formed the south link in the Inner Ring Road concept and was necessary as a long term goal for relieving traffic congestion and for building up the basic frame of urban road network in the valley. With its construction along the banks of the Bagmati River in the 1990's, not only had the land use pattern changed, but the land value had changed considerably as well. By late 2000 A.D, the land use had changed from residential to mixed type of use inclining more towards commercialization and the land value has almost doubled.

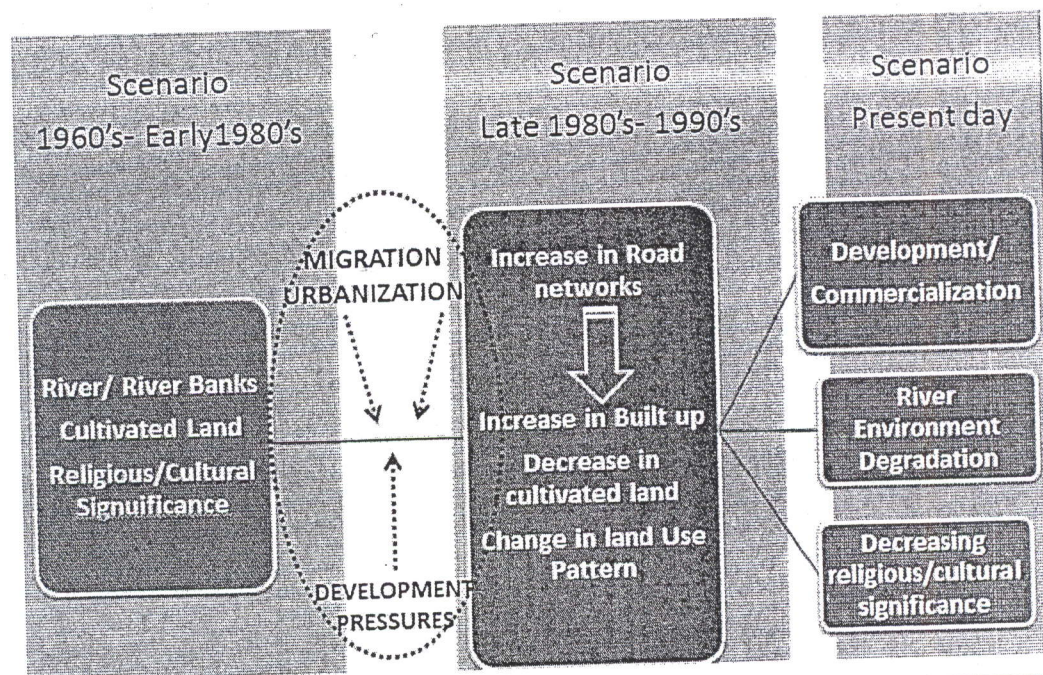


Figure 90: Scenario of land use & infrastructure development of study area

### 6.2.1. Positive Effects

Development of the Bagmati River Corridor Road has opened up the study area for development and provided economic opportunities. Increase in land value not only along

the main corridor road but also in the adjoining areas along secondary road networks as well. Residential, commercial and institutional developments, with gradual conversion of residential areas to mixed use developments have been occurring. An inclination towards commercial development and institutional development along the main corridor road can be seen with a number of colleges and office buildings emerging especially in Jwagal and Kupondole areas.

The corridor road has to some extent provided relief from traffic congestion and has reduced travelling distance and time. The new bridges directly connect Tripureswor and Buddha Nagar areas with Kupondole. Thus, the corridor road offers an alternate route from the main road in reaching different destinations.

### **6.2.2. Negative Effects**

Development of the Corridor Road has led to increase in commercial activities and increase in concentrations in the study area. This in turn have its impacts such as increase in waste generation and increase in pollution levels. Increase in the mix land use along the corridor road networks and their junctions has led to haphazard constructions and unplanned developments as there is lack of legal provisions.

Encroachment of the river banks next to the road for commercial activities can be seen. In most sections, there are hardly any land to act as buffer between the road and the river. In places where land is present, encroachment has occurred. Some encroachments are beneficial such as parks, but most detrimental to the river environment and overall development of the area and well-being of the residents. For example river banks especially in Balkhu have been converted into a dumping site for solid wastes, household garbage, etc. The river banks are also being used as truck yards and parking for pick-ups.

There has been tremendous conversion of agricultural land and flood plains for development purposes as a result of rapid urbanization and improper planning. The increase in road networks has resulted in increase in surface sealing and loss of greeneries and catchment areas for ground water recharge. This hampers the river environment and may be the cause for decreasing river flow and decrease in ground water table.

The increase in traffic as a result of this road corridor has formed a sort of barrier between the river and the religious monuments that are situated on its banks. The use of the land has changed and so, the original function of these areas as ghats or funeral sites can no longer occur and besides the religious significance of the river has also declined gradually as a result

to the degradation of the river environment. There has been loss of ecological and cultural elements and spaces like trees and patis.

Incomplete and improper development of the Corridor Road has also posed difficulties to pedestrians and residents of the adjoining residential areas as there are no footpaths. The vehicle speed is also high but the road width is not sufficient for two-way traffic and pedestrian flow. The road is also not suited for large and heavy vehicular traffic. So, the Bagmati Corridor road is unsafe for pedestrians and school children alike.

### **6.3. Change Analysis: Development trends of the Bagmati River Banks and flood plains**

Up till the late 1980's the Bagmati River was wide and had vast flood plains. The level of water was also very high and the flow was good. As the river began to narrow as a result of excessive sand extraction from the river beds, land once part of the river was now exposed, open and easily accessible to people. These exposed lands started being encroached upon. Initially, they were used for agricultural purposes. Religious monuments, funeral sites were constructed and encroaching the river banks. As time passed the purpose for encroachment also varied. Initially construction of religious structures was for public benefit and as a part of a cultural tradition. But later on, the purpose for encroachment changed and was done for personal benefits by public and private agencies.

Furthermore, political changes, development pressures, increase in land value and fertile lands played a positive role in increasing encroachment of the river banks. Encroachment of land by squatters is a serious issue and can be seen along the banks of the Bagmati River in Thapathali, Shankhamul, Jwagal. Public office buildings like that of ward offices have been found on river banks e.g. ward 1 of LSMC, private offices and organizations such as WEPCO, parks like UN park, dumping sites, garages etc.

Encroachment of the river banks occurs because there was no clear and proper demarcation of river's property due to changes in the river course. So the problem is that of 'crisis of a commons'. There are numerous agencies working for the improvement of Bagmati but no sole autonomous body to look after the overall welfare of the River and its flood plains.

#### **6.3.1. Positive Trends**

The flood plains of the Bagmati River from Shankhamul to Teku Dovan have been designated as UN park property. The Un Park has plans to develop these lands keeping in mind

protection to the river environment. These parks play a vital role in maintaining greenery in the study area and in the future may be developed for recreational and income generating activities but without hampering the river environment. At present even though these parks are not well maintained they provide an open green space for recreational activities like sports and mainly for exercise and walking to the residents. A park is found in the river banks of Balkhu also which was developed in order to prevent further dumping in the areas and to maintain greeneries. These parks are fenced and so prevent squatters or other bodies from encroaching on the lands.

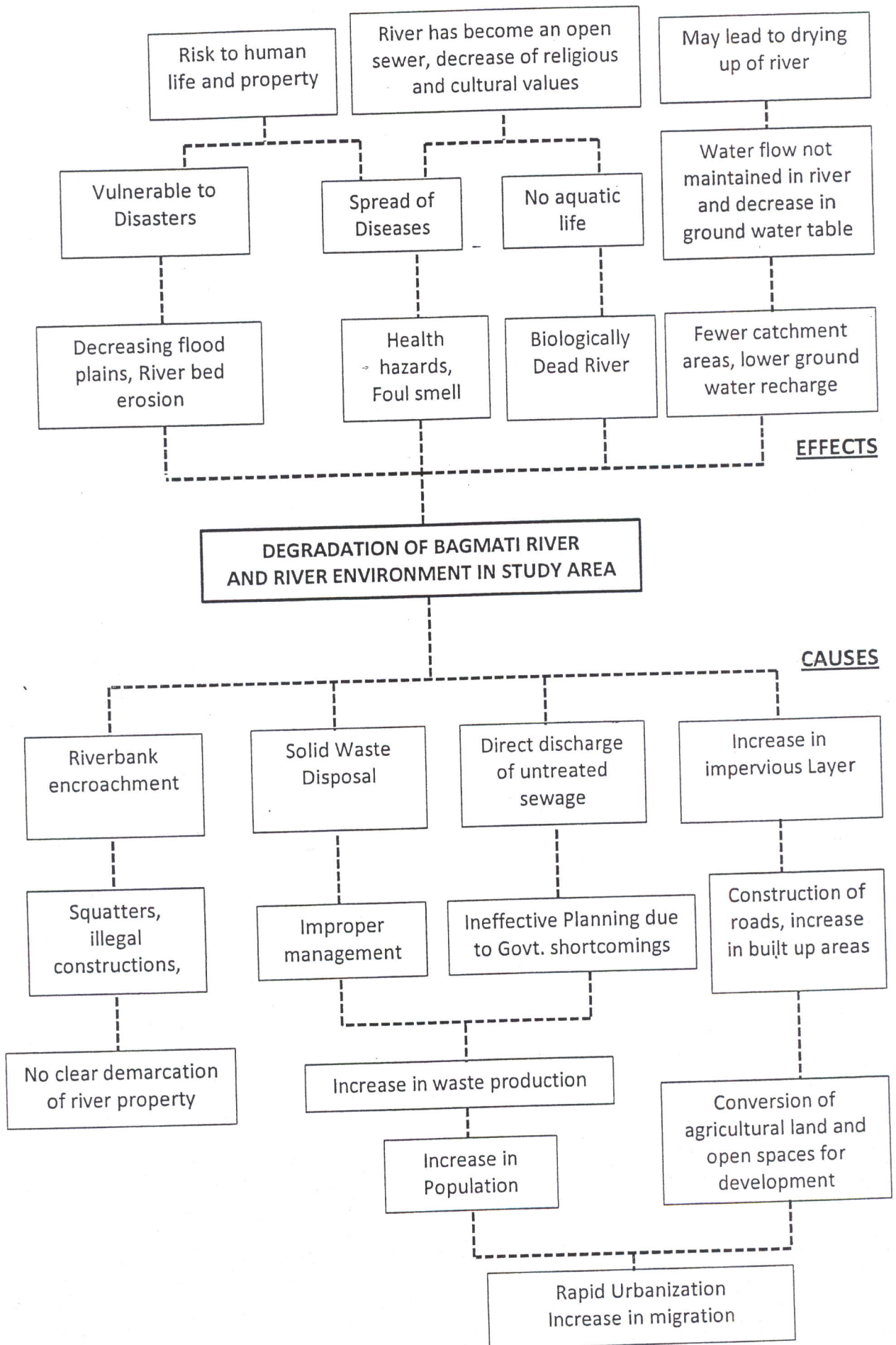
### 6.3.2. Negative Trends

The major effect of encroachment is the loss of wet lands and flood plains. River banks even though they were encroached for agricultural purposes had positive effects in that the roots of trees and vegetation retained water for a period of 2-3 months and after that period the water is slowly discharged. This process helps in maintaining water level and continuous flow of the rivers. But due to decrease in agricultural lands and trees, this process is not maintained and so in monsoons and during heavy rainfall there is high run off capacity through the drains or surfaces and this result in instant floods raising the level of river water only during that period, whereas the rest of the months are dry. Surface sealing of the ground through various construction works such as; roads, footpaths, walkways, buildings results in decrease in catchment areas during surface run-off and so decrease in the quantity of ground water recharge.

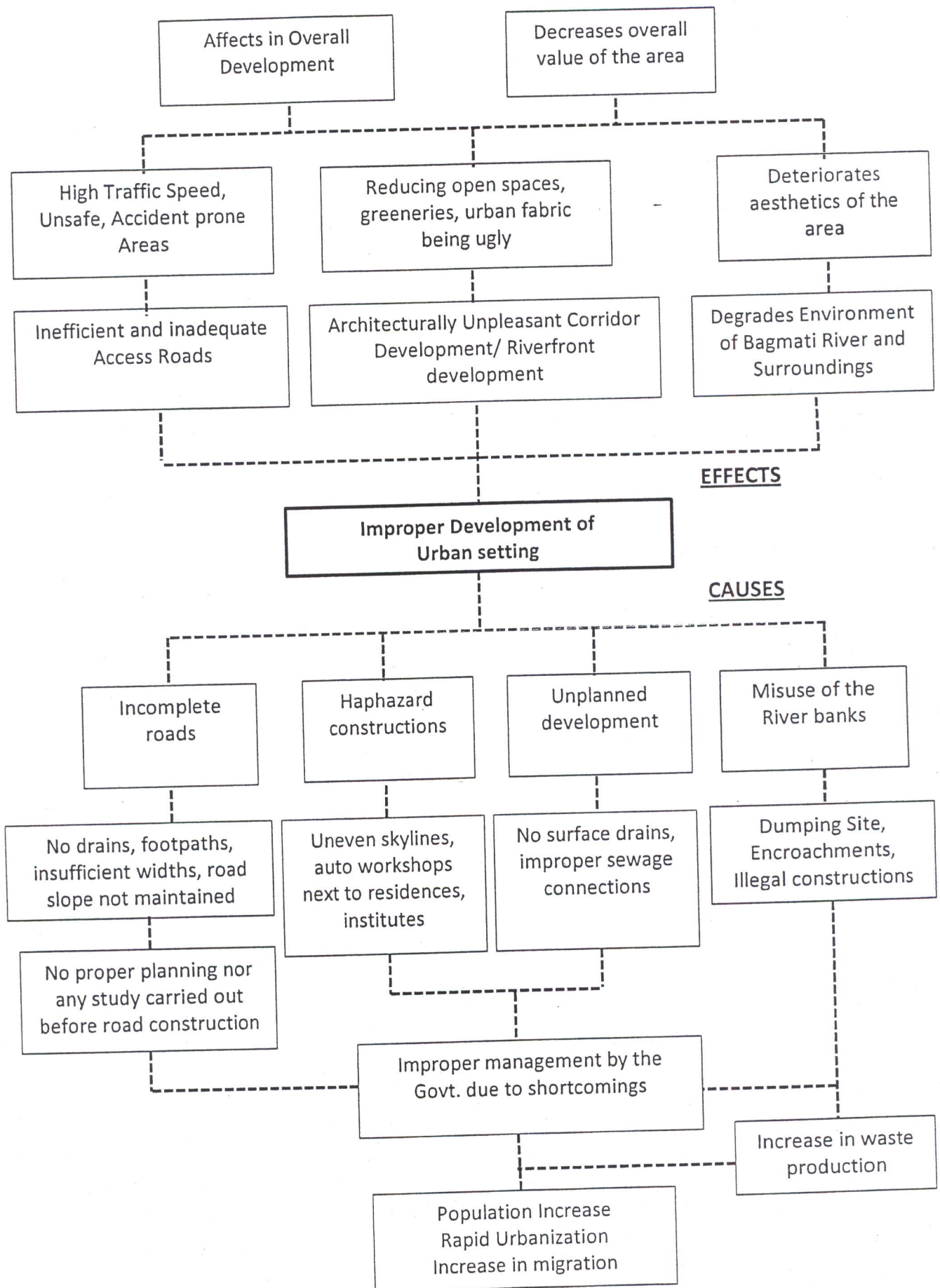
The construction of the corridor road was done on the river's land leaving a setback of minimum 20m from the river's edge. However, this has not been maintained throughout and so in certain areas there is absence of flood plains or negligible amount of flood plains. Besides this dumping of solid wastes on the banks is another major issue which has degraded the river environment considerably, posed serious health hazards and the non-degradable wastes like plastics have increased the dangers of river bank erosions.

Squatter settlements are another major issue. Although there are no settlements in the study area, there are present in the adjoining banks such as in Thapathali and Jwagal. Their sewage is discharged directly into the river and practice of open defecation is prevalent. They have no basic infrastructure and services so misuse of the land and river occurs.

6.4. Major Problem Identification: Degradation of Bagmati River and River Environment



6.5. Major Problem Identification: Improper Development of the Urban Setting



### 6.6. Major Problem Identification: Proximity of the Corridor Road to the Bagmati River

The construction of the Bagmati River Corridor Road has had a vital role in the overall development of the study area. The development of this corridor road in the particular area was an inevitable process as rapid development and urbanization had been occurring in the surrounding areas for a long time and these development pressures and road networks allowed for areas in their vicinity to develop as well. So, the Corridor Road was indeed a necessity.

However, this is a clear case of improper implementation and external pressures affecting overall decision. JICA in their study of Kathmandu Valley Urban Development 1991-1993A.D Report had proposed this road network and initialized the concept of an inner ring road as an overall factor for the development of urban road network of Kathmandu in the long run. But it was found that a lot of land and property that originally was part of the river area but later belonging to the inhabitants were included in the concept. Upon realizing that their land would be acquired for this purpose, the concerned authorities came under the pressure of the locals and so the road was shifted towards the river side. This resulted in reduction and loss of flood plains in many areas along the stretch of the river. Improper planning, minimum stakeholder participation and lack of involvement of the community in the conceptualization of the plans for development may be the reason behind alterations to the original concept.

This decision on the part of the concerned authorities, to shift the road towards the river has had its consequences of which the major has been the effect on the environment of the river and its surroundings. Even though the road was constructed leaving a minimum of 20m from the river's edge, this has not been maintained in majority areas throughout the stretch.

In many places such as in certain areas of Jwagal, Balkhu and even Kupondole there seems to be absolutely no river banks. The edge of the river forms the edge of the road with a strip of green vegetation in between in these areas. So, there are basically no flood plains or green patches as catchment areas for rainwater run-off. These have negative implication in the long-term such as flash-floods in monsoons whereas the rest of the time the river remains dry. The flow of the river is also not maintained. Besides reduction in ecological patches negatively affect the environment.

With the road corridor so nearby, encroachment on the river banks is inevitable if not checked. The road provides easy access and promotes commercialization. River banks next

to roads provide lucrative areas for establishing small businesses. In most areas junk yards, scrap metal works, auto shops, parking areas for heavy vehicles and so on could be found. Even if squatters were not found in the study area they are squatting on the river banks of the Bagmati and also contribute to river pollution. These types of uses hampers the environment as the wastes generated are usually dumped into the river. The dumping of garbage results in foul smell and also risk of diseases. It decreases the aesthetic value of an area thereby degrading the value of land. So, land when not demarcated becomes prime areas for encroachments. Pollution from vehicles also affects the environment and this type of pollution is a major problem in the Valley. Pollution from heavy vehicles is of major concern as well. Their emissions contribute to air pollution, hence affecting health and well-being of the residents.

Increase in access results from roads thereby opening up of areas to further development. The Corridor Road has led to increase in commercialization, new developments and constructions in the study area when compared to before and with each passing year the intensity of growth and construction works increase. Most of the commercialization is situated along the road corridor. The road corridor development so promotes commercialization in that area and so also leads to decrease in agricultural and cultivated areas. Increase in land value is a factor in this. Land becomes a valuable commodity, an asset. This discourages agricultural use of land; thereby promoting other more lucrative uses.

When the road is located so near to the river, the river environment, thus gets affected by the urbanization and development process and this is usually in a negative light. Dumping of wastes and mismanagement of the river banks can be seen occurring, leading to degradation of use of the riverside lands which in turn have negative consequences to the river environment and on a whole the environment of the surrounding areas as well, thus affecting overall development.

So, it can be said that the Bagmati River Corridor Road and its situated on the river banks has negatively impacted the environment of the Bagmati River and so impacting its surroundings as well. Thus, the hypothesis that *'Urban roads when situated too close to river corridors can have more negative consequences in terms of environment, particularly the river system'*, stands true.

## CHAPTER VII: CONCLUSIONS AND RECOMMENDATIONS

### 7.1. CONCLUSIONS

Rivers have historically been at the heart of many cities; so is the Bagmati River and its tributaries as it flows through highly urbanized areas of the valley, of which the study area lies at the heart. Hence, It is only obvious that urbanization will occur in these river corridor areas at an accelerated pace.

In developed countries river corridors are usually considered potentially attractive and ecologically interesting urban spaces and have become prime targets for redevelopment, offering the opportunity to create mixed use, high-density and high-quality communities. The river corridors there deliver ecological goods and services such as water resources, flood control, opportunities for recreation, well-being, aesthetic value and habitats for wildlife. However, in our case, opportunities have not been tapped due to improper planning practices and various shortcomings. The Bagmati River has become environmentally degraded as a result of this, with the worst condition prevalent in the study area i.e. from Jwagal to Balkhu section. As seen from the study ecological goods and services are limited, unsatisfactory or totally non-existent.

At present Bagmati corridor is most probably the only open space left in the city core areas of the Valley. But the degraded state of the river and its surroundings has affected not only the aesthetic value but also the economic opportunity of the land alongside the river corridor as proper development is not occurring. The open space and the river which could have been an asset to the urban areas of the city has been left neglected and polluted. But despite this, provided proper actions are taken in time, the River Corridor of the study area still offers lots of opportunities for development regardless of the prevalent threats and weaknesses. With proper planning and efficient implementation strategies this prevalent scenario can be changed for the better. For this the river should not be looked at in isolation as there are significant gains in terms of social, economic and environmental to be made through efficient planning and interventions in these urban river corridors. The issues therefore, should be tackled holistically by treating the river and its urban setting (the Bagmati River Corridor Road and the settlements) as a system.

As we have seen that the environmental conditions in the river corridor are serious as a result of mainly infrastructure deficiency, it is necessary that in future plans trunk sewers be laid simultaneously in river corridor road constructions. Also, river corridor roads should be

specifically planned in close collaboration with Land Use and Environmental strategies and even though this has already been mentioned in the 1991 Urban Development Plans, unfortunately it has not been implemented effectively till date.

Thus, the policy integrating land use, road network and environment is required for sustainable development of urban river corridors. One of the other major considerations for successful implementation and outcome of proposed plans and programs is that every stakeholder like governmental agencies, local governments, non-governmental organizations and local people should actively participate and be included.

## 7.2. RECOMMENDATIONS

Based on the research, some recommendations have been put forward that should be given priority and adhered to while developing river corridor roads in the future. Specific recommendations for the study area have also been given. Recommendations have been given in the form of policies and strategies defining the areas where special mandatory rules and regulations need to be adopted so as to solve the problems related to future land use and for an overall sustainable development of urban river corridors.

### Recommendations 1: related to River Land Management

In Land Measurement & Survey Act of 2019 B.S. all the rivers are defined as government land and the ownership of these lands lies with government. This Act has legal status and the demarcation shown in the cadastral map of 2021 is the only legal proof of the territory of Bagmati. Hence all the strategies and plan should be based on this map. At present there is great deviation in 2021 map and present condition. This Act gives legal authority to the government to fix the Territory of Bagmati as shown in the map and other documents of survey of 2021.

Guideline of Kathmandu Valley Town Development Committee, KVTDC explicitly states that **no permanent structures can be constructed within 20m buffer area of river** in urban area as a bid to protect the environment from human encroachment, but this has not been strictly adhered to.

**River area encroachment:** River banks and flood plains should be protected at all costs as much is at stake. Not only is it necessary for improvement of river environment but also to retain the religious and cultural values associated with it as many heritages and temples are

located along the banks. Some of the possible courses of action applicable to the study area and for future river road corridor developments along riverbanks are as follows:

- Prevent encroachment by defining river boundary through fencing of the river banks and flood plains.
- Try to maintain and demarcate the river banks/ floodplains on the basis of the map and documents of the survey of 2021 BS. If necessary, re-capturing of the river territory through forceful actions.
- Strictly maintaining 20m as the minimum width of flood plains and banks.
- Not allowing any sort of road expansion onto the river banks.
- Not allowing dumping sites on the river banks.
- Improve understanding of the river environment amongst land managers, local people, agencies and visitors in order to promote interest in its management

### **Recommendations 2: related to Legal and Institutional Arrangement**

**Institutional Strengthening:** The weakness of the existing institutions and lack of co-ordination among the key institutions and their failure to plan and act proactively are major barriers to development. This situation reflects the lack of political will as well as commitment. So there is an urgent need to carefully regulate and control human activities, resource use and waste disposal in order to improve the overall environment of Bagmati which again depends upon efficient and capable institution.

*Public awareness and public pressure; critical analysis of the issues by involving all stakeholders; bold and appropriate decisions by the government; and planning and implementation by all stakeholders can ensure success.*

As such, the institutional arrangements needed must respond to the following actions:

- Protect & enhance the Bagmati River ie environment
- Preserve the cultural, religions and historical heritage
- Improve the conservation of the resource
- Prevent encroachment
- Stop the dumping of solid waste and discharge of untreated sewage and effluents into the river

### **Recommendation 3: Proper Development of Bagmati River Corridor Road**

The existing Bagmati river corridor road is incomplete and not properly constructed. Various external sources have affected the proper implementation and so construction is not as planned in JICA concept of 1993 A.D. This has negatively affected the environment of Bagmati and its surroundings.

- Develop the corridor road as a two-lane road with minimum carriage-way width of 8m, provision of cycle lane of 1.5m on either side of road, provision of sidewalks of 1.5m on either side with proper facilities and handrails if needed, and an additional 1.5m on either side for green belt development. Total 17m width of the corridor.
- Proper roadside drains on either side of the road.
- Laying of major infrastructures like trunk sewers should occur side by side with the construction of the road.
- Zebra crossings and traffic lights should be placed at certain intervals
- Necessary signage and speed breakers should be placed especially in the institutional areas.
- Public vehicles should be provided in this route, necessity of bus stops.

### **Recommendations 4: River Corridors as Greenways - Bagmati River Flood Plains and Riverbanks as Greenways**

Bagmati flood plains and river banks as green corridors are recommended as there are numerous benefits. In addition to the traditional purposes for recreational and aesthetic needs these greenways are meant to serve multipurpose functions. They may be used as a potential tool to help address a range of issues such as degradation of water quality, erosion, flood damage, habitat destruction, preservation of flood plains and agricultural lands, water quality, flood hazard reduction, historic preservation and prevention of encroachment and misuse of river's land.

**Difference between greenways and greenbelts:** It is important to note that, although greenbelts are like greenways, they are not the same. Greenbelts primarily buffer and separate. Greenways are always linear and, in addition to buffering development, urban greenways invite people (and wildlife) to travel along them (Seams, 1995).

There is thus the necessity of a combination of green belts and generation 3 or multi-objective greenways along the Bagmati Corridor and can be recommended in certain stretches like **The UN Park in Jwagal** and the **river banks in Gushingal**.

The constructed green belt along the river corridor road will be maintained by the ward office and community of the respective wards, whereas the multi-objective green way/park will be maintained by the existing UN Park Committee.

#### **Multi-objective Green Parks with Green Belts:**

##### Greenways/ Green parks:

- **Traditional as well as multi-objective functions:** River banks and flood plains of the Bagmati River from Jwagal to Balkhu may be developed as green parks providing recreational facilities together with serving multiple objectives.
- **Economically feasible, adaptive response and sustainable:** The greenways will provide a counter-balance to urbanization in an affordable way. Affordable, because linear parks and greenways require a relatively small amount of land, when compared with large non-linear open spaces, to accomplish their objectives. Also, they can be woven into the urban fabric with minimal disruption. The fact that they are an appropriate, and economically feasible, adaptive response to the effects of urbanization will help sustain these green areas.
- **Act as drainage corridors-** deal with human infrastructure needs of water quality, erosion control and flood damage reduction. Greenways may help to a certain extent in reducing erosion, preserving more natural river corridors and leaving riverside strips of vegetated, undeveloped land to buffer stream edges.
- **Help sustain threatened eco-systems:** The green parks will help preserve and maintain the natural ecology, avian habitat and help revive aquatic life
- **Offset and mitigate** the effects of crowding, automobile fumes, noise, and other ills of urbanization and offer greenery and solace for the residents of the area as well as the whole city.
- **Visual Image & Well-being:** Serve as recreational space (for example exercise area, meditation, yoga, game fields, tennis/badminton courts) and help in improving the quality of life of the residents and so enhance overall well-being.
- **Cultural and Historical Preservation:** Even though the cultural and religious practices of earlier times may not be possible or feasible anymore, these greenways can have a role

in preserving heritage value. The study area has high riverside heritage value in the form of temples, ghats, river confluences.

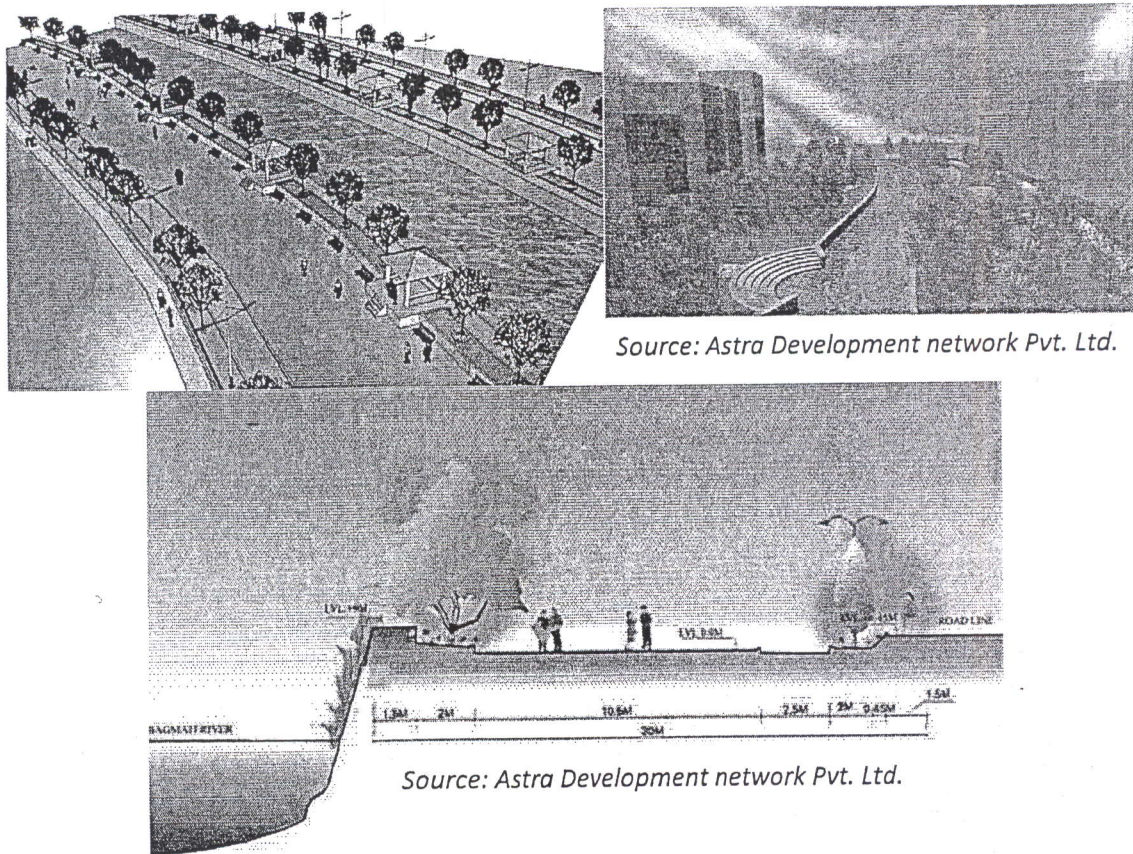
- **Educational Purpose:** These multi objective greenways can also have an educational role, since the study area has high number of institutions, colleges, schools along the corridor as well as within 200m especially in Kupondole, Sanepa and Jwagal. Greenways along the Bagmati corridor may serve as ideal outdoor classrooms providing hands-on experience that goes far beyond the textbooks. This type of learning will help in inculcating values of environmental sensitivity from a very young age onwards.

Partnerships may be formed with educational institutions and various projects may be developed where schools may adopt greenway segments, become the stewards providing a source of contributed labor (for wetland plantings and other projects) and monitoring of ecosystems. The student labor and time commitment can supplement limited public sector budgets for greenway patrol and management, and even attract private sector grants because of the dual benefits of education and environmental improvement.

*Thus, there are long-term economic benefits of preserving some natural systems as part of the urban infrastructure.*

#### **Greenbelt:**

- Greenbelts comprising of a row of perennial trees should be planted and developed all along the Bagmati River Corridor Road on either side, so as to promote a healthy and green environment, enhance the visual image of the area, screen the roads, workshops, or other unattractive features from nearby residential areas. The trees help filter out pollutants generated by traffic and other sources, and act as a buffer against noise.
- The root system of trees and vegetation will help in preventing river bank erosion
- They reduce surface run-off relative to other vegetation types because of their larger surface area, for example compared to grass or heather
- riverside trees and woodlands are an important habitat in their own right, and



Source: Astra Development network Pvt. Ltd.

Source: Astra Development network Pvt. Ltd.

Figure 91: Urban River Corridors as Green Corridors

#### Recommendation 5: River banks for urban agriculture

The existing practice of agriculture/ cultivation in some areas of the river banks like in Gushingal should actually be promoted and expanded to other areas of the banks as well.

- It helps in promoting greenery in urban area
- Prevents instant floods from occurring in monsoons and dry spell in the rest of the months as the roots of the cultivated products retain water for a period of 2-3 months and then slowly discharges it. This in a way helps maintain the river flow.
- Reduces dependency on imported vegetables and fruits
- Promotion of floriculture and horticulture as potential for income generation
- Preparing Official Plans and zoning bylaws for Urban Agricultural land for the possibility of permanent protection for food-growing spaces
- Introducing Green Purchasing Policy: emphasis on purchasing environmentally preferred products, recyclable content, and products that provide minimal impact to the environment.
- Introducing low land taxation in areas used for urban agricultural purposes so as to encourage this practice and also concept of renting out land for cultivation purposes.

### **Recommendation 6: Proper Development of the urban settlement**

**Land zoning** – The study area has been developing in a haphazard manner and so individual land use zoning is inappropriate. Almost the whole area may be classified as mixed use development where we find residential use, commercial use, institutional use, recreational use and so on. Thus, zoning may be as follows-

- Section 1 (Jwagal) and section 2 (Kupondole) - Mixed Residential with predominance of Institutional and Commercial-zone.
- Section 3 (Gushingal) and Section 4(Teku-Balkhu)- Mixed Residential with predominance of Commercial.
- Zoning of agricultural/cultivated land that needs to be preserved; environmentally sensitive areas such as landslide and flood-prone areas such as the river banks and floodplains; and public land to prevent settlement development in these areas.
- Promoting commercialization along the river corridor road through FAR regulations.

**Streamlining issuance of building permits** – by conforming to the existing planning framework, norms, and standards.

**Encouraging the planned development of settlements** –

- At appropriate locations by launching land-pooling schemes by the government; and housing development programs by the private sector.
- Establish a framework for policy decisions that anticipate the need for densification of future development patterns.
- Facilitate the preparation of new land development regulations that provide a higher standard of urban design.

### **Recommendation 7: Urban Waste Management**

Urban waste management remains unsatisfactory despite the fact that there are policy and legal frameworks and effluent standards and despite the many efforts to improve the situation. The major issues and concerns in this sector are:

- Contradictions/overlaps/duplications of authority and confusion generated by the many acts and rules
- Poor capacity – of the institutions
- Poor resource mobilization and financing capabilities

- Negligible efforts to encourage/ promote the 3Rs (reduce, reuse, and recycle)
- Inadequate/ineffective/weak compliance monitoring and enforcing mechanisms
- Lack of a long-term plan for wastewater treatment
- Poor operation and maintenance of facilities

The following are some proposed actions for improvement of waste management in the study area as well as urban areas of the Valley.

#### Related to Solid Waste Management

- **Demarcation**-To prevent the river land from solid waste dumping (municipal waste, construction materials), fencing along the whole length of the Bagmati River of the study area will work as a barrier between the waste dumper and the river.
- Dumping at Balkhu river banks should be stopped as it is adversely affecting the nearby residential area, the well-being of the inhabitants and the river environment. Dumping along the corridor road and entry to open spaces should also be prevented and for this strict action and provision of penalty in the form of fine should be given to those who disobey.
- **CBOs, NGOs, and the private sector** can play meaningful roles in solid waste management, particularly in waste collection, recycling, and operation of waste facilities.
- **Increase awareness**- Even though WEPCO is an organization active in this sector in the study area following the 3R concept, further activation of organizations and small groups (clubs) through awareness programs for reduction (by composting organic waste or changing consumption pattern), recycling and separation of waste at source is necessary.
- **Promote home composting**- attempts should be made by the government, municipalities, and NGOs to increase awareness about the benefits and methods of home composting.
- **Promotion of community based composting** practices in small or large scale depending upon coverage area and availability of area for composting.
- **Promote reuse and recycling**
- **Encourage door-to-door collection of solid waste**

- **Upgrade existing facilities for solid waste management and develop new facilities—**  
The current solid waste management facilities are inadequate and need improving. Old facilities should be renovated and new ones built in strategic locations.
- **Introducing small-scale anaerobic treatment plants in certain areas for waste management**

#### Related to Waste Water Management

- **Operate and maintain wastewater treatment plants –** Wastewater treatment plants are not in full operation, with the exception of the treatment plants at Guheshwori and Thimi. Their status should be assessed and they should be repaired if necessary. Operation and maintenance of these plants will reduce the pollution of surface water significantly.
- **Promote community wastewater treatment plants** wherever possible – Community wastewater treatment plants have potential in situations in which a few hundred households can come together and provide space to build such facility.
- **Develop decentralized wastewater treatment plants** - Previous studies on wastewater and also BAP have recommended decentralized wastewater treatment plants in Kathmandu and Lalitpur municipalities.
- **Natural treatment processes** such as Constructed Wetlands, Stabilization ponds should be promoted as compared to mechanically operated treatment plants.
- Places with surplus river banks areas should include combined solid waste treatment and waste water treatment units.
- At highly urbanized area, waste water should be diverted up to the treatment plant or collect in water tight tanks for further treatment.
- **Drainage Corridors:** address 'non-point' sources of pollution, and larger communities to develop storm water management plans addressing the quality of runoff water. This non-point effort has fostered new thinking about drainage corridors in other countries like in the US and has had a very important effect on how streams and watersheds are treated at the local level.

**Recommendation 8: Urban River Corridor Road Development in general**

- Road construction should be done maintaining a minimum of 20m distance from the river's edge.
- If required forceful actions should be used in recapturing land belonging to the river i.e. Government land
- The river banks should be demarcated by provision of fencing so as to prevent encroachment and misuse.
- The development potential of the river corridor should be synchronized with the development potential of the surrounding areas and land use and development strategies should be prepared accordingly.
- The river banks should be developed as multipurpose greenways, for details refer to recommendation 4 and page 26-28.
- At least a 1.5m wide green belt should be maintained along the total length of the road on either side.
- The river corridor road should preferably be a two-lane road with 1.5m wide footpaths on either side.
- An additional 1.5m wide lane should be provided on either side as cycle lanes.
- Necessary roadside surface drainage should be incorporated with the existing drainage systems and up gradation should be done if necessary.
- Solid waste management plan for the corridor should be identified with strict control on riverside dumping.
- Participation and involvement of all stakeholders at every stage should be carried out, community participation is vital.
- Co-ordination between the various related agencies is vital for efficient planning and development.
- Encouraging residents living adjacent to important natural corridors to emulate greenway habitat with wildlife-supporting landscaping in their own gardens can also help.

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**APPENDICES**

**QUESTIONNAIRE SURVEY FOR M.SC. URBAN PLANNING THESIS**

S.N. \_\_\_\_\_ Location \_\_\_\_\_  
 Ward \_\_\_\_\_ Date \_\_\_\_\_

- 1. Name:** \_\_\_\_\_ **House No.:** \_\_\_\_\_  
**2. Age:** \_\_\_\_\_ **3. Education:** \_\_\_\_\_  
**4. Occupation:**

Service	Business	Retired
Farming	Others	

**5. Resident Type:** Owner  Rent

**6. Where are you from originally?**

Migrated from outside Valley  some other place in Valley

**7. Land Owned (Plot Size):**

**Market Value:**

**8. Age of Building:**

**Bldg. Type/ Storey height:**

**9. Building Use by owner:**

Residential	Rent
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**If rented then purpose for rent:**

Residential	commercial	institutional	others
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**10. Why did you come to stay here?**

Own land	Environment	Near to Workplace	Cheap Rent/land/Bldg	Own community	others
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**11. Vehicle ownership:**

Car	Motorcycle	cycle	None
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**12. How do you find daily travel to and fro from the area?**

Relatively easy  OK  Difficult  why? \_\_\_\_\_

**13. How frequently do you use the bagmati river corridor road for travel?**

Very frequently	Occasionally	Very little
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14. How frequently do you use the bridges for travel?

Very frequently	Sometimes	Very little
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15. Are you satisfied with the following? [Y/N]

Bagmati Road's Condition	Drainage	Water/supply	Open Spaces	Environment of the r

16. Where are you disposing solid waste(kitchen/household garbage)?

Own Compound	River side/ street	Municipality container	House to House collect
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17. What is your sewerage system?

Septic Tank	Connection to main Govt. line	Direct connection to river	Others
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18. Do you use the open space in your area?

Yes.....Sometimes.....No.....

19. If yes, purpose?

Leisure/Recreation	Walk/exercise	Domestic work	Children's play	Social gatherings
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20. How is the state of Bagmati river affecting your area?

Unpleasant smell	Degrading value of area	Visually unattractive	Health hazards	Others
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21. Is your family health being affected by the river pollution in the last 10 years?

Yes.....Moderately.....never.....

22. Has your compound been affected by Bagmati river water during monsoons?

Yes.....No.....

23. If yes..... chances of flood water entering, flood water has entered

24. Do you have any cultural/ religious linkage with the river? Yes.....No.....

25. If yes, For what Purpose: religious/ social gathering/ Community purpose/Others  
How many times in a year?.....

26. What do you feel is lacking in the area (problems) and what can be done for further development?


**VISUAL SURVEY/ OBSERVATIONS: EXISTING SITUATION ANALYSIS**

Section:

Ward:

Date: .....

**LAND USE**

Agricultural Land

Commercial

Institutional

Residential

Open Spaces

Encroachment of River Banks

**INFRASTRUCTURE**

Road: Primary road and secondary Road

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Sewerage and Drainage:

Solid Waste Disposal:

**SOCIO-ECONOMIC**

Type of development along road corridor: Building use

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Building heights:

General Plot sizes:

Land Value along corridor

Land value a little inside

**CULTURAL & RELIGIOUS STRUCTURES**

Name:

Significance:

Existing state:

Use:

**ENVIRONMENTAL**

River's condition

Use of river banks:

Pollution Level:

Solid waste Disposal: