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A Study of Land Use Planning Practices and the Relationship Between Population Distribution and Transportation Infrastructure in Kathmandu, Nepal.

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A study of land use planning practices, and the relationship between population distribution and transportation infrastructure in Kathmandu, Nepal.

A thesis submitted in partial fulfillment of the requirements for the Master of Urban and Regional Planning degree at Virginia Commonwealth University.

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Abstract

A STUDY OF LAND USE PLANNING PRACTICES AND THE RELATIONSHIP BETWEEN POPULATION DISTRIBUTION AND TRANSPORTATION INFRASTRUCTURE IN KATHMANDU, NEPAL

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A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Urban and Regional Planning at Virginia Commonwealth University.

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This particular paper is meant to investigate planning in Kathmandu, Nepal specifically land use planning practices and the implications on the transportation network(s). Very early on in the research including existing land use (if any), and current transportation networks, it was clear that investigations must be made into the political and planning situation leading up to the modern era in Nepal. The overview of past political events is necessary to explain current planning trends and techniques, and also the mindset of the people of Kathmandu towards planning.

Of course universal planning truths can be applied in various international contexts, but each location and situation has to be approached with a fresh perspective. Where hard planning process is lacking often times planning theory can help to fill in some of the gaps. Both qualitative factors and quantitative data are presented and analyzed to show the current planning and transportation situation in Kathmandu.

Figure 1 Partial Kathmandu Aerial *March 2009 Walter Suwal*

CHAPTER 1 Introduction

Nepal is a landlocked nation in the middle of Asia north of India and south of China. Mount Everest rests inside its borders. The most recent population statistics (2008) have the population of Nepal at 26.9 million. The capital city of Kathmandu is home to roughly 600,000 residents. The greater metropolitan area (Map 1) including Kathmandu, Lalitpur, and Bhaktapur consists of over 1 million residents. Despite its rich history and beautiful scenery, Nepal is a Third World nation and is currently one of the poorest nations in the world. The 2007/2008 per capital GDP was $470 and over 30 percent (30.8%) of the population lives below the poverty line according to a Nepal living standards survey.

Table 1: Population trends in Kathmandu Nepal

Population of Kathmandu			
Year	1961	1991	2001
Total Pop	121,019	421,258	671,846

In recent years it has been the stage for political unrest, as the old monarchy system became more unpopular. The newly elected government has done away with the monarchy, and is in the process of forming a new legislative body and new constitution. Physically, Nepal is divided into 3 ecological zones: mountain, hills, and terai (flat lands). Being in the heart of the Kathmandu Valley, there is little room for outward expansion of the city, therefore with the increasing population; infill is the primary development method (Kathmandu).

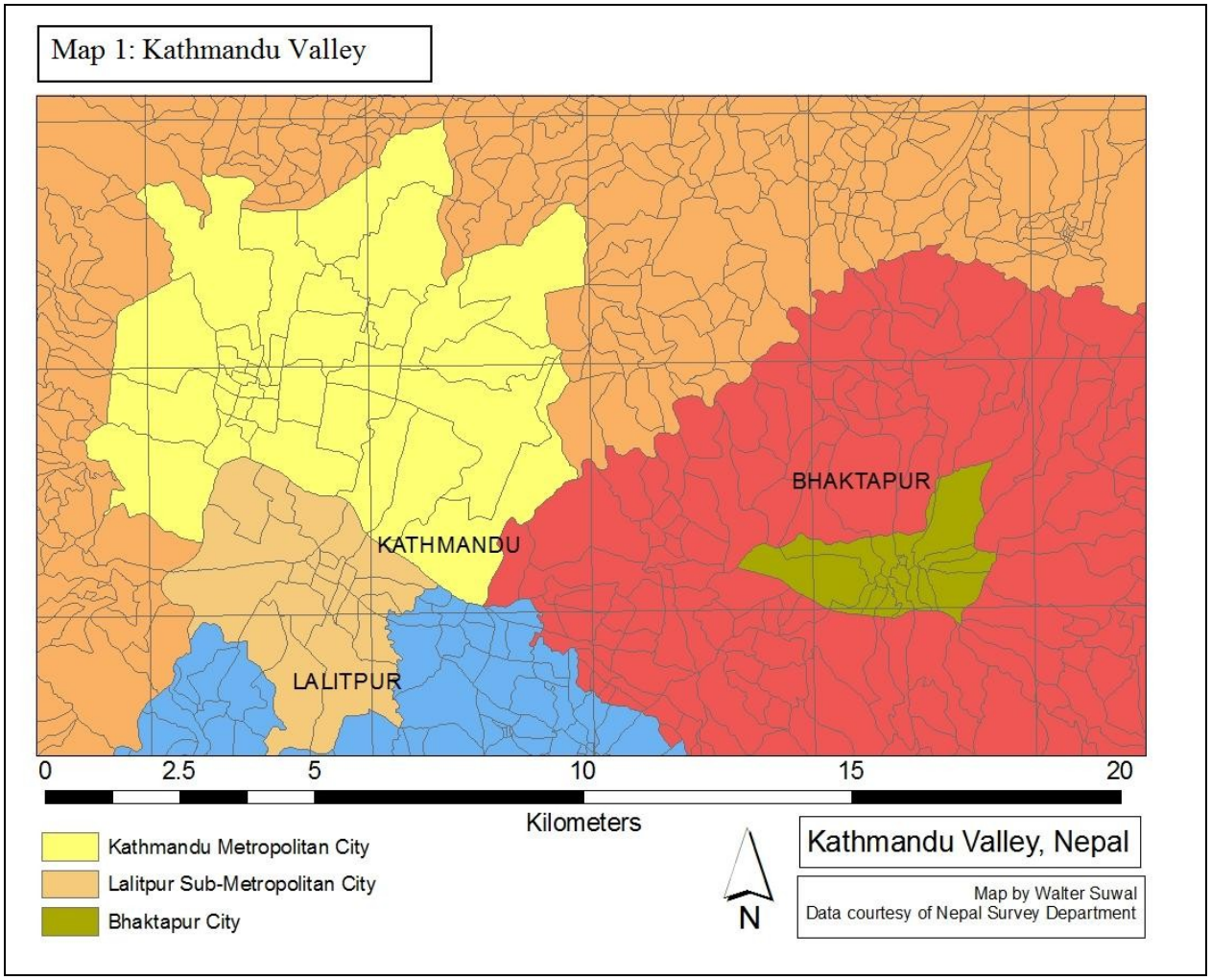
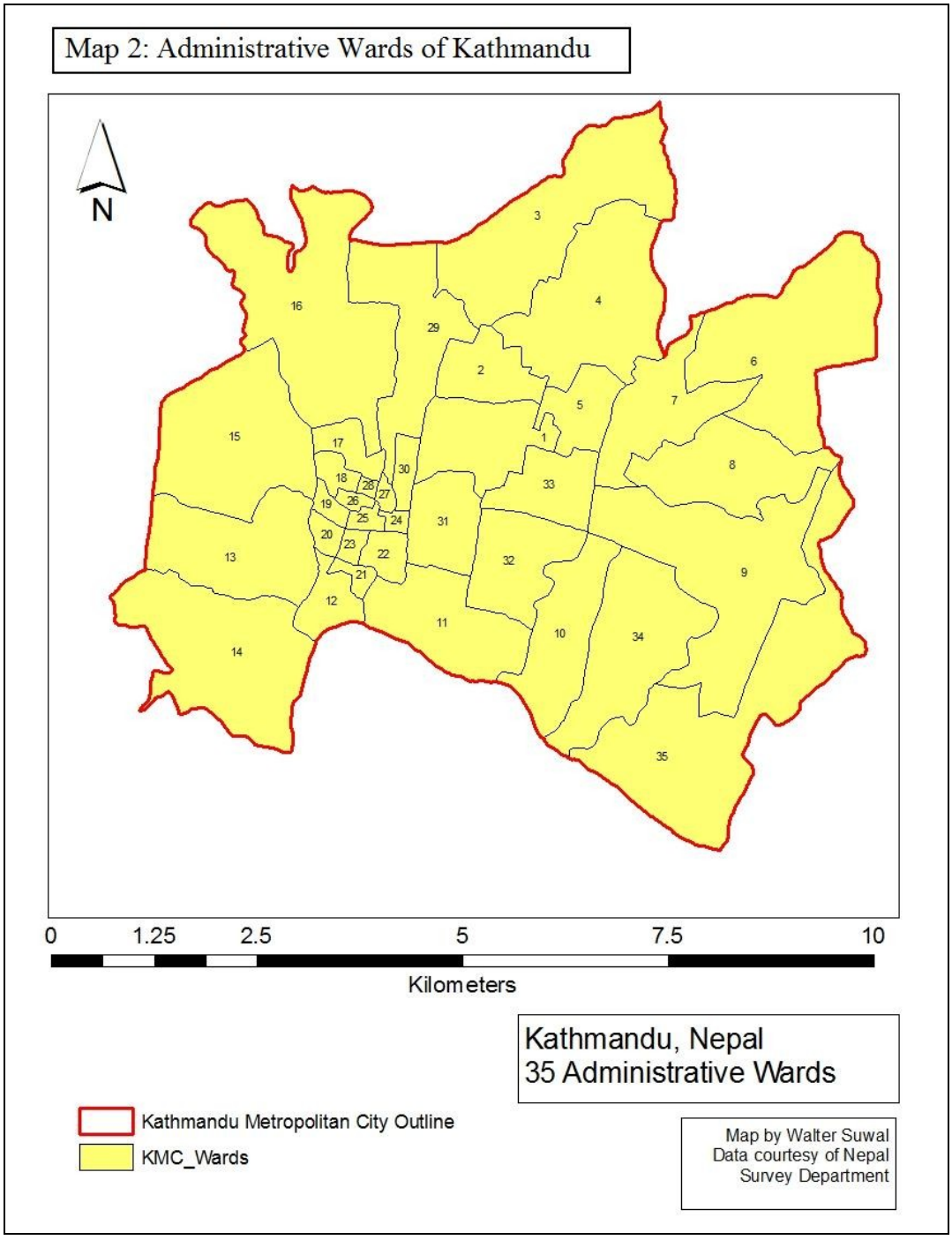


Figure 2 Bouddha Temple with mixed land use *March 2009 Walter Suwal*

The Kathmandu Metropolitan City (KMC) includes downtown Kathmandu and historic Kathmandu as well as the surrounding urban areas. Map 2 shows the 35 administrative wards inside of the Kathmandu Metropolitan City, which is comparable to our Metropolitan Statistical Areas.



1.1 Research Problem

The link between the planning process and urban infrastructure is extremely important; specifically the link between land use planning and transportation infrastructure. One measure of this link could be the relationship between population distribution and transportation infrastructure across a metropolitan area. Many cities of Nepal including Kathmandu have suffered due to lack of effective planning practices. The land use patterns and population distribution in the Kathmandu metropolitan area must be examined for its relationship with the transport network which serves as the lifeline for any modern city.

Chapter 2 of this paper will provide not only a review of relevant land use planning and transportation literature but also much needed background research into the current events of Nepal both in terms of politics and planning. In addition to providing an overview of the political and planning situation in Kathmandu, Nepal, the main objective of this paper is to show the link between land use planning and current transportation in the city. This will be investigated using several parameters including looking at accessibility of the transportation network as well as the improvement of existing conditions. Chapter 3 discusses the research methodology further as well as gives an overview of information gathered and specific data obtained. Chapter 4 includes detailed analysis of information and data in relation to the main thesis objectives.

1.2 Political State of Affairs

In terms of planning philosophy, planning can be viewed in regards to a political process. In the case of planning in America, planning can be seen as a democratic process

with varied invested interests. Planning in a contemporary democracy involves complex, differing, and often competing interests which must be balanced (Kelly and Becker Ch3).

Defining two distinct periods indicating a 'period of time' for the research and analysis was difficult but necessary. Two periods for study were designated: Pre-Modern and Modern. The Pre-Modern Era includes the early history of Nepal starting with the formation of the Kingdom of Nepal in 1768 up to and including the year 1989 A.D. The Modern Era then includes the year 1990 A.D. in which a constitutional monarchy was established up to the present Democratic Republic (2009 A.D. at the time of this writing).

The Kingdom of Nepal was established in 1768 A.D. with the first unified leadership of Nepal being under a Monarchy. The monarchy was until 1990 an absolute monarchy. In that year the first steps toward democratization began. Although it would be nearly 20 years before the monarchy officially ended. King Birendra BB Shah (1972 – 2001 A.D.) helped establish a constituent assembly in 1990 sharing some of his power with the elected assembly.

In 2001 Birendra along with the royal family was assassinated and his brother Gyanendra BB Shah (2001 – 2008 A.D.) became the last king of Nepal. Gyanendra who was not totally in favor of democratization dismissed the parliament early in his reign but abdicated in 2008 A.D. under pressures from the people of Nepal as well as the international community (Nepal 2008).

The Federal Republic of Nepal was established in 2008 A.D. with Dr Ram Baran Yadav as President and Pushpa Kamal Dahal as Prime Minister, splitting the executive

power. The legislative power comes from the newly reformed constituent assembly made of 601 elected officials (Election Commission 2008).

1.3 Planning In Nepal

With the new government still in transition, this is a good time to take a look at elements of planning, specifically land use patterns, in Kathmandu (Nepal News). In the case of planning in Kathmandu, the planning process has been until recently lacking the democratic government, which would propel the process. In Kathmandu with the pre-modern era, traditionally, there was little collaboration involved in decision making across the board especially urban planning and land use planning. This is evidenced by the fact that both local and regional land use and development plans do exist but implementation is very slow and often drawn-out.

Information regarding planning in Nepal before 1990 was a little hard to come by. However viable information was collected as to the general planning environment. Shortly after gaining entry into the United Nations in 1955, Nepal began receiving increased foreign aid both advisory (mainly in the drafting of official government documents) and financially. In the 1960's the planning environment in Nepal was one of optimism for the future. In 1969 a document was published entitled "The Physical Development Plan for the Kathmandu Valley." As the introduction to the document states, it was the joint effort of Nepal and its UN friends. The document itself is quite informative, reporting current conditions, as well as actual plans and recommendations for the Kathmandu Valley (Pandey 1969).

Some of the objectives of the document were historical preservation, reducing congestion in cities, urban renewal, and the production of a land use map. One of the recommendations "proposed development of Kathmandu-Patan urban complex," (Panday 1969) was the foundation for the Kathmandu Metropolitan City and Lalitpur Sub-Metropolitan City. Unfortunately most of the recommendations in the document were never implemented as they could not get political steam. However this document (the first and only of its kind as far as this research is concerned) sparked the development of a sort of plan that is to be updated every 5 years. Of course without implementation, these types of plans are of little use to planners.

Figure 3 Downtown temple with urban development *March 2009 Walter Suwal*

CHAPTER 2 Background and Literature Review

Land use planning must strive to make the most efficient use of the land applicable to any given situation. Generally, land use planning involves how the "land" is used both in terms of a resource and a service to the population. As a resource the land can be used in an agricultural sense or in a more varied market sense; as a service the land allows a population to dwell and conduct business as well as a means for the population to travel from dwelling to business and leisure.

2 .1 Land Use Planning and Transportation

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. Conversely existing transportation infrastructure can lead to increased development where the transportation networks currently exist (Berke et al 2006). 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

While the strength of the land use – transportation link is sometimes debated, it does exist and can be seen in countless cities both in the U.S. and around the world. Several case studies and relevant international policy documents were reviewed for background research.

In following with the two way linkages, Levy says that not only does the land use shape the demand for transportation, but also that the provision of roads alters the intensity of land uses. He uses the example of the US highway system in which the system was designed to ease movement of people between urban centers across the country. The author goes on to explain that the highways as they are today, have served to alter these same urban centers (Levy 2006).

The balance between supply and demand of land for development can be maintained by certain planning support systems. In order to use planning support systems efficiently, underlying demographic dynamics must be studied and modeled. As far as land use planning, the population can be said to represent the 'community' in terms of land uses. Fundamental to land use planning are population indicators and forecasts which are used to estimate the demand for individual land uses. Land needed for transportation infrastructure can then be based on these land use needs. The spatial distribution of a population is essential to plan for both community facilities and also urban infrastructure (Berke et al 2006).

The world development report of 1999/2000 suggests that the issues stemming from increased transportation including congestion, pollution and limited mobility of the poor "require urban governments to optimize land use, manage traffic and demand for

transportation…" It goes on to say that integrated land use and transportation policy is extremely important in making cities livable. It also recognizes the difficulties of many developing countries in coordinating transportation and land use policies due to political difficulties (World Bank 1999).

Levy agrees with the conception that at the municipal level, the coordination between land use planning and transportation is easiest due to factors such as the number of people being smaller and less bureaucracy. Furthermore, the notion is presented that transportation planning is one of the most mathematically justified areas of planning. This follows along with the area of population distribution and its mathematical basis. For his part, Levy also brings up a good point about populations. Showing the distinction between the western world and the third world, he explains that, in many Third World nations population increases have been and are still happening. These population booms can occur in urban areas since they are still developing and growing. Also the rural populations are also a factor when rural to urban migration is concerned (Levy 2006).

In terms of urbanization and the developing world, the world development report of 2008/2009 suggests that one of the hallmarks of urbanization is the transfer from predominantly agricultural land use patterns to patterns including private land ownership. It also says that once population and density is rising that "land regulation and planning can ensure the efficient coordination of different land uses." In the same article a section titled "Institutions and Infrastructure Must Evolve Continually," makes clear that as nations develop, the institutions governing land use must adapt to the more complex transportation networks. Moreover this article proposes a few recommendations in order

to facilitate 'demand management and public transportation' to promote development especially at controlled densities. The recommendations include: improving transport options, managing land use, and launching general policies and programs. These recommendation or instruments show that when planning in any context the factors of transportation and land use planning must be included (World Bank 2008).

Having integrated land use and transportation policies is important because only having land use policies will not effectively plan for how people get to where they want to go, and having just transportation policies will not plan for where the settlements and densities will occur. Only with a balanced land use and transportation policy will it be possible to plan an efficient and controlled urban area. An urban growth report gives an overview of some of the international development trends around the world. Of particular note is one section regarding "South Asia." The report asserts that during urbanization and reformation of land use patterns, South Asia, along with South East Asia continues to improve modes of transportation which help to blur the line between agricultural and rural land use. This is an important trend to note as the increase of urbanization is dictating that transportation infrastructure also must advance (Cohen 2004).

In relation to urban and rural areas becoming integrated, the idea of primacy also comes into play. The *Urban Geography* textbook does a great job at defining primacy. The issue of primacy involves "intense urbanization focused on a single [large] city which provides the fuel that enables that city to grow into a megacity." The 'primate city' dominates many third world nations especially in South Asia. The existence of the so

called primate city is not an issue in and of itself, only a situational imperative to these areas (Kaplan et al 2004).

Primacy includes both population size as well as cultural and political dominance. In terms of land use planning, the size and implications of the potential primate city are hard to predict. This may mean that land uses and transportation networks while related may not be as integrated due to the fact that they have to play catch-up with each other. Since the primate city serves a large given area, planning importance is given to the city center or urban core and urban growth trends may be neglected. These urban growth trends can be used to predict where and to what extent a primate city include the need for land use policies and transportation infrastructure.

In order to properly link the literature with the real world and to provide an example of some of the trends and planning practices presented, several case studies were examined as to their relevance to the relationships and linkages presented. Two case studies are examined below, the case of Curitiba Brazil and the case of Singapore. The case of Kathmandu, Nepal will be examined in greater detail following this section.

- In the city of Curitiba, Brazil the past half century has led to great strides in terms of integrating land use policies with transportation policies. The area specific strategy involved using two structural north south transport arteries in hopes to alleviate urban sprawl conditions. In Curitiba the combination of transportation oriented planning with pedestrian and environmental planning was key to

controlling the urban growth (Rabinovitch 1996). The effectiveness of the strategy can be seen in two distinct ways:

  - Arterial corridors were identified using existing transportation networks, which served as guidelines to direct transportation as well as settlement
  - The policies also took advantage of the transportation networks in order to "integrate rather than isolate" residential land uses

- Singapore on its own is a unique entity in the world. It is one of the few places of earth which is both a city and a nation. The city-state of Singapore has employed some innovative strategies into their transportation planning system. One such strategy is using electronic road pricing schemes as a mechanism for congestion pricing. Although the strategy has been successful there since the transportation network may not be as varied, obstacles can be foreseen in other global cities (Toh et al 1997). Some of these obstacles may be:
  - Drivers may go out of their way to dodge the congestion times creating congestion in new areas
  - Drivers may be more likely to take alternate paths or cut through residential areas making them more dangerous to pedestrians
  - The infrastructure cost would most likely be far greater than in a smaller nation such as Singapore

Having separate land use and transportation planning will only serve to reinforce past development trends instead of looking for and strengthening emerging trends. As previously stated difficulties can exist in coordinating land use policies with transportation due to politics; furthermore, different authority levels and jurisdictions may get in the ways

of integrated policies. Transportation needs can be derived from the need of the people to access various destinations around the urban area. A function of the land use system is the all important accessibility. Berke sums it up best, "thus according to an accessibility view of transportation planning, areas that are more accessible will encourage more livable, sustainable activity patterns than less accessible areas (Berke et al 2006)."

2.2 Case Study: Nepal

The previous two case studies are good examples of some of the planning practices and trends found throughout the world. Their relevance to the global planning literature is not in question. A great many things can be learned from these cases including the "integrate rather than isolate philosophy," the identification of growth corridors, and in the case of Singapore, the complexities of the primate city. These lessons and the points from the literature review warrant a look at a very unique case in the global stage: Nepal.

2.2.1 Regime Change

This includes the differences between the regimes and their attitudes towards land use planning as well as planning in general. This is of course keeping in mind that the current government is still in transition at present time.

Planning during the absolute monarchy years was of a sublime nature. With the help of the U.N. Nepal was able to publish "The Physical Development Plan for the Kathmandu Valley," in 1969. The plan itself is an impressive undertaking especially for the time frame and for Nepal being a Third World nation (Panday 1969).

Surprisingly the document is very well written and contains great detail throughout. In addition to background and current conditions of the Kathmandu Valley, the document covers in detail recommendations and implementation. The implementation strategy includes the acknowledgement of a need for special governmental agencies as well as recognizes the importance of legal requirements to enable the plan recommendations. The implementation even includes some very basic land use and zoning regulations. The plan document calls for three zones: A, B, C. Zone A would be the city center, Zone B would be the fringe areas, and Zone C would be designated for new settlements (Pandey 1969).

The information (from both observations and conversations) suggests that the majority of the recommendations and implementation programs never happened due to both economic and political reasons. The power of the absolute monarchy stifled the democratic processes that were needed for these planning changes to happen. Other than the local 5-year plans, a document of this magnitude was never again produced but the government "is in progress of evaluating and crafting" another type of regional plan, said Suresh Shrestha of the Survey Department of Nepal (Appedndix A).

The new republic government of course is still in transition after less than a year so there is hope that new and innovative ideas are on the horizon. In this new modern era, more of an emphasis on planning as a technical discipline is evidenced by the increased use of GIS applications. This is exemplified via the representation of Nepal at international GIS conferences including the 2004 ESRI International Users Conference (Pradhan 2004).

Talking to the planners both local and federal, the general consensus is that while the planning methods have become more technical and more regional, the political

influence of planning has not increased that much in recent years. Tribhuvan Pradhan, GIS manager of the Kathmandu Metropolitan City, is hopeful but says that "most decision makers [politicians] do not fully understand the field of planning and GIS." Even the National Planning Commission is made up of politicians often with antiquated ways of thinking. The National Planning Commission is one of few planning related agencies from the Pre-Modern Era. While its longevity boasts a successful organization, its political power outweighs its advisory agency status. Nevertheless planning in Kathmandu can only get to be more progressive with the new democratic government.

2.2.2 Planning Environment

Land use planning must be defined as it pertains to Kathmandu, Nepal, Another point of interest is the inclusion/exclusion of the public in planning and decision making.

As is the case around the globe, planning, specifically land use planning, has seemingly been marginalized. Planning has so many facets that it is hard to set out an education path strictly for planning without specialization. In Nepal there is no "planning" curriculum at all and therefore planning is very much an interdisciplinary field.

During the old absolute monarchy regime land use planning was distinguished by its 'Agricultural' versus 'non-Agricultural' uses. This makes sense due to the fact that during the Pre-Modern era, farming and cultivation was the main industry and livelihood all across the valley. Both local and regional farming practices dominated the expansive fertile land. While recent history suggests that commerce and trade and even tourism have

become the main economic activities in Kathmandu, agriculture is still very important to people even in urban areas.

In the new modern era more and more people are recognizing the need for land use planning with urban overcrowding and haphazard development. Also with the increase in tourism, people in Nepal have taken an increased focus on environmental issues and preservation. The Land Use Planning Project was launched in 2000 as a means to ensure both agriculture and environmental sustainability in the nation and especially in the Kathmandu Valley (Prasad 2001). Land use planning is more commonly applied to urban situations, but since agriculture and the natural environment are so closely tied to the urban environment the role of the Land Use Planning Project taking on seemingly rural tasks is not out of the ordinary.

While many of the current planners of Kathmandu and Nepal have had to go outside of Nepal to receive their education, an increased emphasis on geography and planning is being seen in the top Kathmandu Universities according to an interview with Indra Manandhar former professor of Geography at Tribhuvan University. As mentioned earlier the new planners of today are working very hard to get information to the public. This can be done through GIS applications and via the web, but people with advanced technological knowledge are needed for implementation (Appendix A).

The current planning environment in Kathmandu is one of realism. Most of the current administration views the recent political progress as a step in the right direction towards progress in the field of planning. With the increased use of GIS for land use and other planning aspects, Nepal and the city of Kathmandu in particular are vying not to be

left behind as evidenced by the National Geographic Information Infrastructure Project (Figure 4) which is well under way in mapping both infrastructure and land uses in Nepal. On the local level the Kathmandu Valley Mapping Project is working on digitally mapping the entire Kathmandu Valley and having those maps available to various institutions across the city (see Table 2 below).

Table 2: Government Agencies and Service Projects

Government Agency / Project	Level	Main Purpose
National Planning Commission	National Gov't	Advisory body for Development Planning
Ministry of Physical Planning and Works	National Gov't	Infrastructure Development
National Geographic Information Infrastructure Project (NGIIP)	National Gov't	Digitally mapping the entire nation of Nepal
Central Land Use Planning Project	National Gov't	Help achieve agricultural sustainability
Kathmandu Metropolitan City Office	Local Gov't	Planning Administration for KMC
Kathmandu Valley Mapping Project	Local Gov't	Producing a publicly available atlas for the Kathmandu Valley

Figure 4 NGIIP Office *March 2009 Walter Suwal*

Figure 5 HIGH DENSITY RESIDENTIAL DEVELOPMENT; private land ownership and few buildings regulations means people will build as tall as they can afford *MARCH 2009 WALTER SUWAL*

2.2.3 Existing Land Use

Simply, this component deals with the general conditions of buildings and infrastructure, as well as a description of land uses. Specific types of land uses are presented, as well as general classifications.

One of the only 'Current Land Use' maps for Kathmandu in existence is the one shown as Map 3 maintained by the Kathmandu Metropolitan City Office. Table 3 also from the KMC shows the distribution of existing land uses. While not directly joined to the land use map, this information is vital in understanding the configuration of Kathmandu.

Map 3: Existing Land Use Map (Kathmandu Metropolitan City).

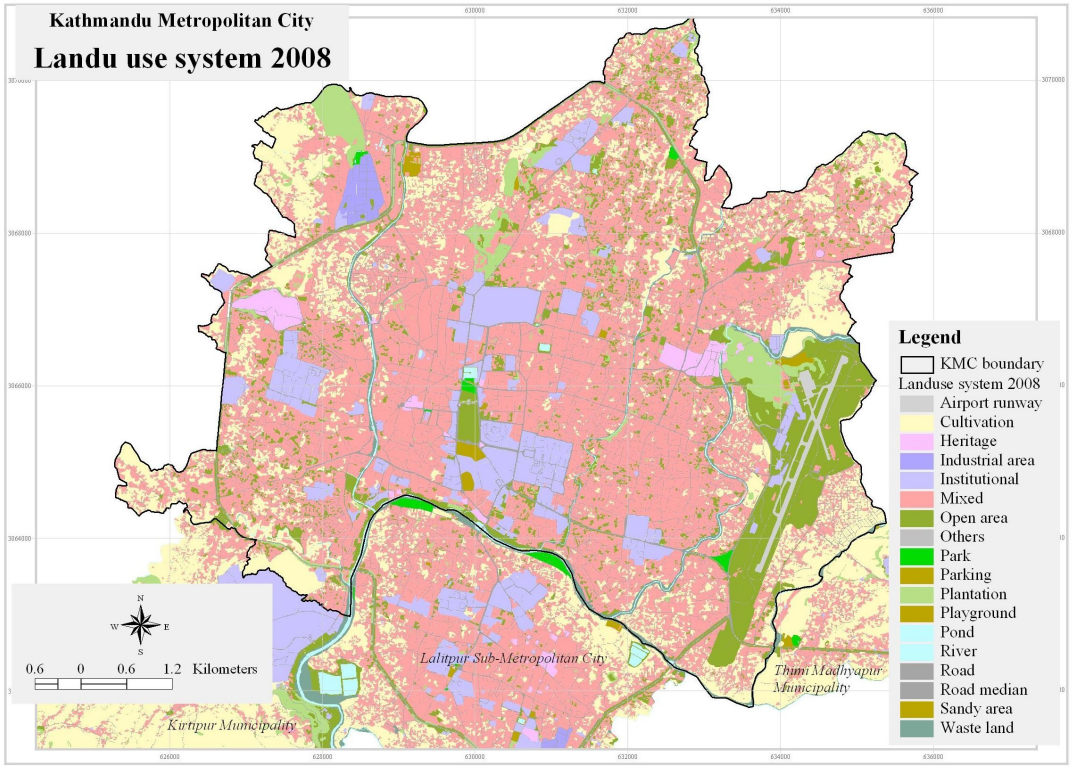


Table 3: Existing land uses (as defined by KMC)

Residential (High density)	8%
Residential (Medium density)	35%
Residential (Low density)	10%
Commercial	4%
Institutional	8%
Industrial	1%
Open spaces	6%
Utilities	1%
Airport	3%
Road	3%
Water bodies	1%
Agriculture	18%
Others	2%
Total	100%

Both the past and current Land Use Classifications are very specific with several levels of classification; a sample of each era is shown in table 4 below.

Table 4: Land Use Classifications for Historical Analysis

Sample Land Use Reclassification	
Pre-Modern	Modern
Agriculture	Cultivation
Forest	Heritage
Special Purpose	Industrial
Rural Settlements	Institutional
Urban Settlements	Mixed Use
	Open Area
	Wasteland

For the ease of analysis, general land use categories were identified and the era-specific classifications were aggregated into four land uses: residential, commercial, industrial, and agricultural.

In the Pre-Modern Era Residential areas were compact but structurally not as dense as the modern urban city. Logically less people as a whole meant more compact settlements would be the most efficient in terms of resources and economy. The Industrial uses were primarily limited to logging, herb collection and textiles such as jute (burlap) because heavy machinery and equipment was too expensive. The commercial uses would have included mostly local markets as fresh goods were not able to be moved successfully across long distances. Agricultural uses were widespread as localities depended heavily on local markets for their daily food needs (Pandey 1969).

2.2.4 Evolution of Transportation Systems

Since its existence was made known to the world, Nepal has remained an isolated nation due to its geography and religious beliefs. It has never been conquered by an outside force, never been occupied or colonized, and has remained neutral (with the exception of the Gurkha soldiers contracted to the British Army during World War II) in most of the modern world conflicts of the past century.

As far as geography, Nepal lies in the heart of the Himalayan Mountains in central Asia. Due to the range and heights of the mountains surrounding it, few armies and travelers for that matter even knew of its existence or were logistically able to explore or invade. In terms of religion Nepal until recently was the only Hindu Kingdom in the World, this made it difficult for immigration into the nation for residency. Of course with the world's highest peak in the country, many the seasoned traveler or explorer would venture into the valleys of Katmandu.

Figure 4 SAMPLE ROADWAY IN NEPAL © *MINISTRY OF PLANNING AND WORKS*

The transportation system in Nepal and the city of Kathmandu is not unlike similar networks in developing countries. The current road network system for most of Nepal including urban and rural areas has evolved over the past few centuries. Beginning in ancient times of tribes and remote villages, many of which still exist today, caravan and trading routes were a crucial part of everyday life in Nepal.

Beginning at a time of the most basic level of communication and transportation, caravans were necessary to obtain goods and services that each particular village needed to function but could not necessarily produce themselves. These trips were made as often as needed but as seldom as possible due to the logistics of the trip and danger involved with crossing a rural and wild mountainous countryside. Several documentaries and movies have been made on the caravans of Nepal. One such movie *Himalaya* directed by Eric Valli, was nominated for an academy award in 2000.

Unlike many nations in the west, Nepal and the city of Kathmandu had to build themselves from the ground up without the comforts of a benefactor. The evolution of transportation in Katmandu has progressed, but at a slower rate than other similar developing nations.

Figure 5 URBAN INFRASTRUCTURE WITH TRAFFIC *MARCH 2009 WALTER SUWAL*

CHAPTER 3 Methodology

From the background research and literature review in chapter 2, it is clear that the planning environment while having a somewhat solid foundation is still in the formation stages. Information collected before the field work was analyzed and compared to the data collected during the trip to Kathmandu, including GIS data and hard copy topographic maps. As well, qualitative information from the initial research was assimilated with the data collected during field work.

3.1 Research Focus

The focus of this paper is looking at both the current and former land use practices and the relationship with the transportation infrastructure in Kathmandu, Nepal. The general hypothesis proposed by this paper is that the land use planning practices and patterns which have been followed by the Nation of Nepal and city of Kathmandu over both the pre-modern and modern eras have not led to the development of an accessible transportation network for the metropolitan population. In following with the initial thesis objectives, the accessibility of the transportation network as well as the transportation infrastructure are to be addressed through analysis. These objectives are addressed through the relationship between the population distribution and the transportation infrastructure in Kathmandu, Nepal.

3.2 Preliminary and Primary Research

Due to the nature of this project the initial data collection relied partially on web based research, including websites of government agencies and NGOs in Nepal. From these websites information was gathered regarding the existing conditions and infrastructure of the area. Also a literature review was conducted of online journals, as well as governmental documents and official reports regarding planning efforts both past and present in Nepal.

In addition to the initial data collection and literature review, a trip to Katmandu was necessary for field work and primary research. This trip to Kathmandu was invaluable in the research process, and allowed the author to make first hand observations into a world very few have ventured. General inquiries were made concerning common planning laws and legislation including types of current and past land uses in Kathmandu as well as any zoning ordinances (or the like) that are in effect or have ever been in effect. The general planning environment was also a topic of concern during initial research. The field of land use planning is an interesting one, especially since it is such a dynamic international planning topic. The transportation infrastructure both public and private was scrutinized very closely during the trip to Kathmandu.

3.3 Research Setbacks

The first setback is that while land classification does exist, the land use policy is not very regulated. Land is first divided into two categories: agriculture and non-agriculture. The non-agricultural land is then classified as residential, commercial,

industrial, etc. An existing land use map does exist but it is loosely followed and barely updated due to lack of municipal zoning ordinances. Land use distribution occurs haphazardly with heavy mixes of uses. This is shown in figure 2 below with many uses in a compact space including multi-density residential with no height restrictions, office building in the background, and commercial uses such as the storehouse in the left foreground.

Figure 6 COMPACT LAND USES *MARCH 2009 WALTER SUWAL*

The second setback dealt with the availability and accuracy of information. Since modern planning is still getting its footing (Ministry of Physical Planning and Works was established in 2000), there exist data consolidation issues, as well as digitizing much of the paper records. The lack of daily electricity adds to this problem. Newer information especially census/statistical data is updated slowly, although the author obtained a copy of "Statistical Yearbook of Nepal 2007." The accuracy of the information varies due to little oversight of collection methods and records keeping (Ministry 2008).

The final setback was the lack of inter-governmental cooperation including between local and national organizations. There are several government institutions that should be working together to consolidate personnel and resources regarding land use planning in Kathmandu. The Ministry of Physical Planning and Works is supposed to remedy this although from the comments received from government officials in Kathmandu, it is a slow process. Also the local government and federal government

interactions and cooperation are lacking in terms of information sharing and decision making (Ministry 2008). This could be due to the reluctance of the federal government even in a planning context to give local government much power if at all.

3.4 Introduction of Data

Kathmandu's 35 Wards were the base unit of analysis in terms of quantitative examination. Population statistics and road statistics were evaluated to help provide the link between the land use planning techniques and the transportation infrastructure. The data analysis section has an in-depth look at the data, as well as visuals (GIS maps) to help with the overall examination. Unless otherwise noted, all maps were created by the author using ArcMap 9.2 and 9.3 software. Also in the data analysis section factors are introduced which help to link the effects of poor land use planning to the deterioration of the transport infrastructure in Kathmandu.

The accessibility of the transportation network can be addressed through how the network sustains current demand; the demand both in terms of population (density) and existing land use patterns. Both current population trends and land uses are examined and analyzed. The infrastructure can be examined and analyzed through comparing existing conditions with current and future planned transportation projects. Data on conditions of roads throughout the city was also analyzed. Current transportation public and private was examined to determine future transportation options, including public transit.

CHAPTER 4 Data Analysis and Findings

Much of the land use and transportation data and observations were collected firsthand in Kathmandu Nepal. Analysis is done via these observations as well as base map data collected during the trip. Specific data encountered in this chapter includes population data as well as roads statistics which are used firstly to show how the population has not been planned for in terms of land use and secondly how the transportation network, mainly city roads with some district highways, is lacking in support for the most important aspect of planning: the people. Furthermore, specific factors are addressed throughout analysis which prove that the effects of the land use planning practices on the transportation networks in Kathmandu are a clear danger to the viability of not only the transportation networks but the City as a whole.

4.1 Land Use Patterns

The land use patterns in Kathmandu follow a compact design. The uses are heavily mixed and the geography of the valley is the main factor preventing outward expansion. Most of the metropolitan area is covered with lots of urban residential developments, and the majority of land use patterns start out using a kind of sector model and distance decay from the center of the city, but without much needed zoning ordinances to control and direct growth; these land use patterns don't properly develop. This is shown in several land use maps which follow, the built up areas are concentrated in the center of the city and

disperse outwards, and population trends follow this same model. Non urban uses increase with distance away from the city center. In fact the largest land use category other than urban is cultivation which dominates the areas out side of the city core. The isolated settlements branching out from the city are mostly agricultural farming uses.

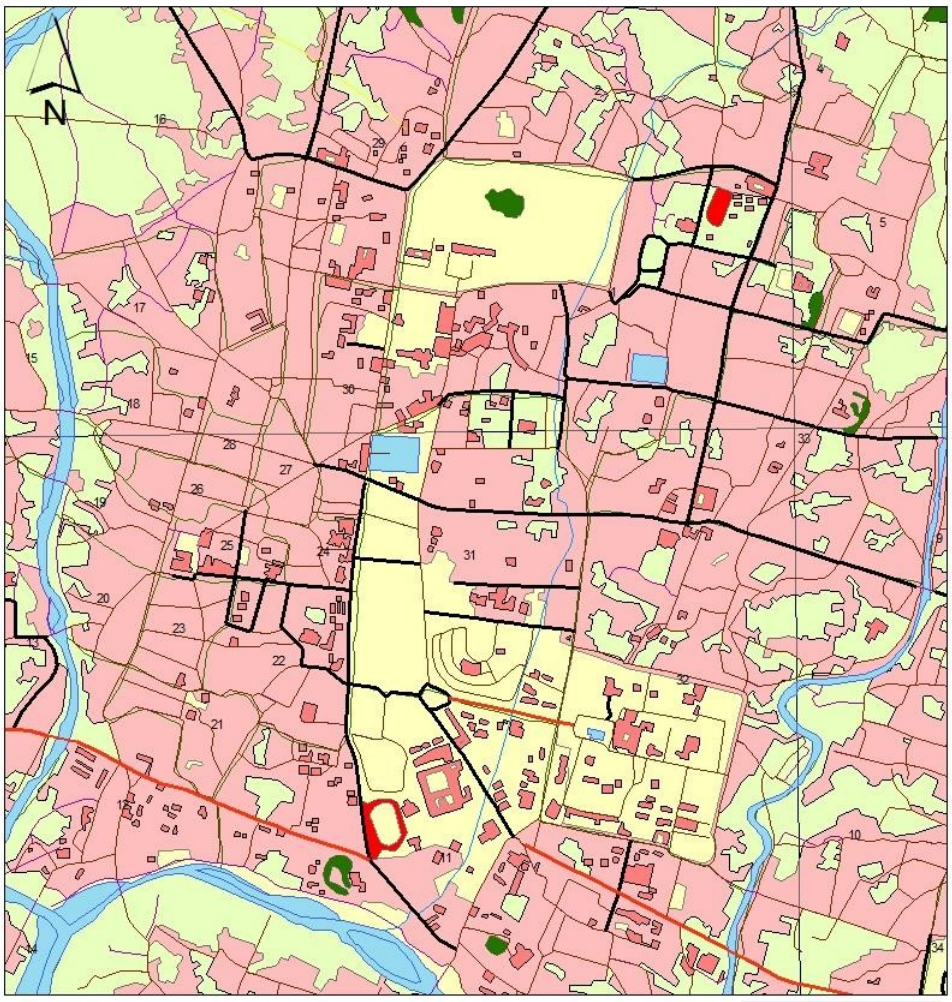
The current residential areas are extremely densely populated and thus many buildings are right next door to each other with only a little common cloister. This is due to a combination of rapid population growth as well as the historic compact settlement patterns. Industrial uses are much the same as they have been in the nation with an increase in construction and infrastructure. This construction is often interspersed with the residential uses, creating dangerous conditions for residents and increased pollution. The commercial uses while having seen an increase, are spread throughout the city due to lack of regulated transportation network, and also lack of reliable transportation, these uses include both local markets and regional shopping centers. Finally the agricultural uses in the urban setting still exist and are still localized, with people setting up fruit and vegetable stand at local markets or on street corners.

In terms of land uses, the city center on a micro level is well served as evidenced by the complex multi road level network this is shown in map 4. However, the transition of road hierarchy into the city is not sufficient. In terms of micro and macro levels, the micro road networks must be supported by the macro road network in order for the overall network to be accessible and the meet the land use demand. The details of this relationship will be discussed in the following sections regarding both land use and transportation including qualitative observations and quantitative population and transportation statistics.

Figure 7 City street mixed use development; urban commercial and rickshaw in foreground, residential in background *March 2009 Walter Suwal*

Map 4 shows a section of downtown Kathmandu along with the transportation network. It shows that while the road network is complex, the highways and district roads do not infuse the network into the heart of the city where it is needed most.

Map 4: Central Kathmandu City



Map by Walter Suwal
Data courtesy of
Nepal Survey

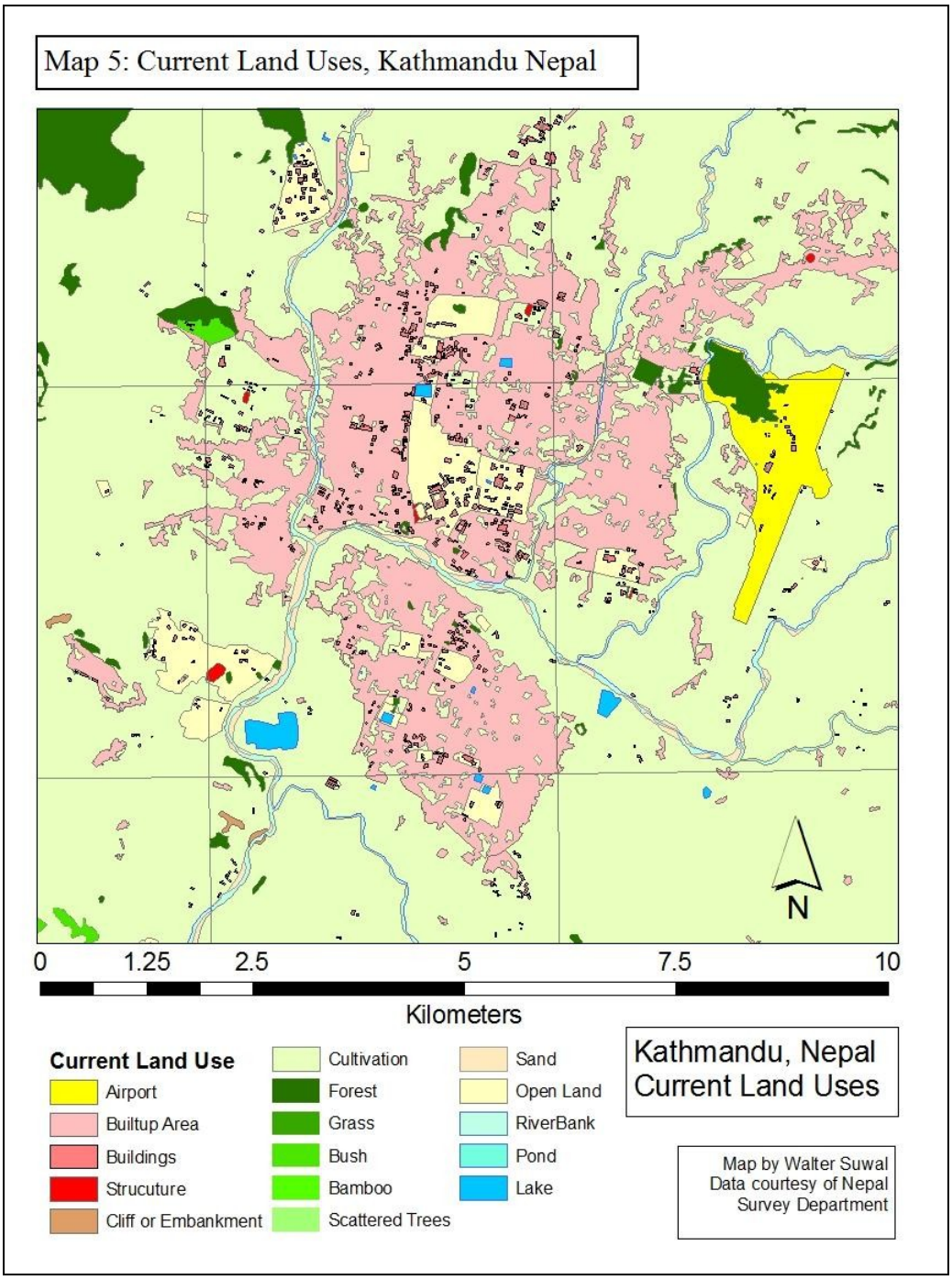
Kathmandu, Nepal

Highways
District Roads
Local Roads
Rivers

0 0.4 0.8 1.6 2.4 3.2

Kilometers

Map 5 is a current land use map made using data from the Survey Department; it has a different level of generalization than the KMC land use map (Map 3). This land use map shows the compactness of the urban development in Kathmandu Nepal.



One specific factor which can relate land use and transportation is the fact that built up areas grow so fast, transportation networks can't keep up with the demand; this could be the early stages of urban sprawl. One of the basic properties of land use planning is projections, especially population projections in order to plan for the demand of people. The few population projections found during the research were lacking in predicting the population boom that Kathmandu has experienced during the modern area. As with most Third World nations, increased population can be due to a number of factors including, immigration, fear of infant mortality rates (families will seek to have more children if the infant mortality rates are high), as well as lack of migration of the native people. The unexpected increase in population means that planners and government officials have to play catch-up in order to meet these new demands. This in turn has a direct effect on the transportation network which must meet the demands of the population to provide for a viable network.

Figure 8 Durbar Square market *March 2009 Walter Suwal*

Another factor regarding land use is that the transportation networks currently are unable to support the traffic so people develop businesses where they live and the existing transit gets even more neglected for those who still need it. Along with the underlying issue of population projections and the demands of increased populations, businesses and commercial enterprises are also affected. When the transportation networks can't meet the basic needs of the people to get where they need to go (i.e. work, school, etc) people will try to adapt as best they can. Countless examples of non standardized heavy mixed uses can be seen throughout Kathmandu City. Some of the uses are partly cultural including housewives who sell clothing out of their homes. Other examples such as copy/print services, and cafes are built either in or next to people's homes or close enough because the transportation network will not allow commercial uses too far from residential areas.

Figure 9 Urban Residential and Commercial; transitioning land uses *March 2009 Walter Suwal*

4.2 Existing Transportations

At first glance as shown in map 6 the transportation infrastructure seems to serve the area with a vast amount of roadways. However the amount of roads itself does not mean that the infrastructure serves the population. In terms of a network, the infrastructure may be lacking in some areas. In fact the hallmark of a good network is allowing for the flow of 'resources' (in this case people or vehicles) to all parts of the network. Due to the insufficient land use patterns, and the road data to be presented, the transportation network in Kathmandu does not allow for this flow. Upon close examination, the aptly named "ring road" highway serves as a beltway as it encircles the city and the Tripureswor-New Baneswor Highway cuts through the center to split the south part of the city. These roads are both highly traveled and do serve the population well at a macro level. A few other district level roads do run through the city but they are disjointed and do not provide viable access to all parts of the city.

Figure 102 LATE NIGHT PEDESTRIAN TRAFFIC JAM *MARCH 2009 WALTER SUWAL*

Poor foresight and design into where roads and transportation are placed can lead to unexpected results. One example of this is that people begin to make their own roads from trails, and walkways when such avenues are more convenient to them than actual road ways. As is human nature, people want and need convenience. If people are not provided with adequate transportation routes, inevitably they will strive to find or make their own. Examples include natural areas being trampled by foot paths, or motorists and cyclists taking shortcuts on obvious pedestrian walkways. This not only leads to congestion it also becomes a safety issue especially when pedestrian rights of ways are involved.

Figure 13 THOROUGHFARE, VARIOUS TRANSIT TYPES *MARCH 2009 WALTER SUWAL*

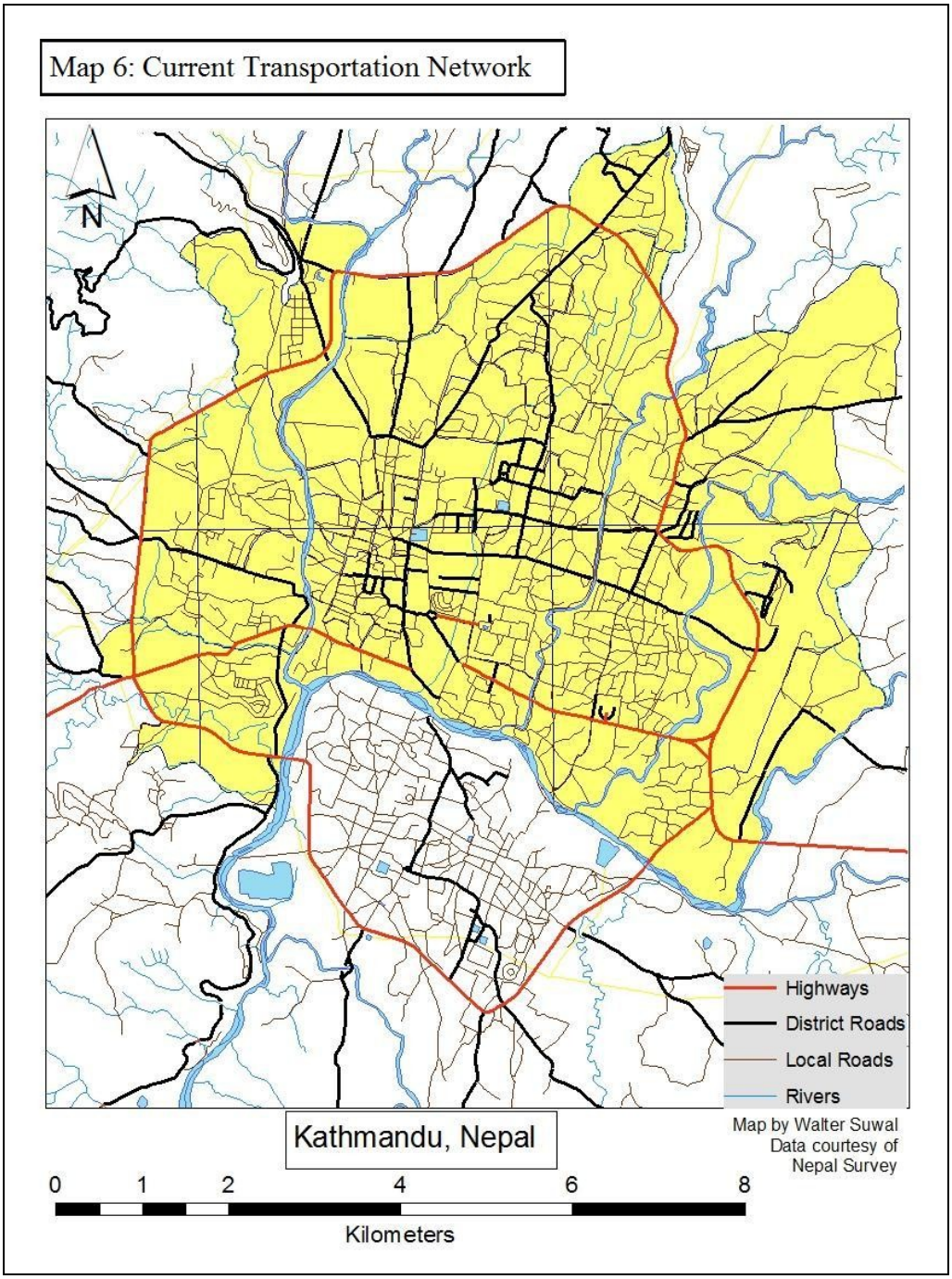
Unless you are lucky enough to afford and have room for an automobile, the main forms of transportation on the streets of Kathmandu are Bike, Motorcycle, scooter or walking. The roads are in bad need of repair, some roads are not even paved while others can barely be called roads at all. One explanation for the disjointedness of infrastructure

could be that while there are multiple forms of transit used in Kathmandu including public transit, much of the transit offered is antiquated. While roaming the streets of Kathmandu, rickshaws can still be seen, as well as overcrowded under maintained buses and zillions of taxi cabs. While the buses and taxis seem to be a viable form of transportation, the city [Kathmandu] lacks public transit regulations and therefore the safety and reliability necessary to form an accessible transit network is missing.

Figure 14 NO PARKING *MARCH 2009 WALTER SUWAL*

The traffic police force is extremely lacking, there are very few traffic officers and fewer armed police officers, which leads to an almost constant state of "traffic anarchy" in terms of pedestrian, driver, and rider safety. In addition the few traffic laws are seldom enforced and therefore seldom followed, there is a constant state of "merging" rather than turning and turn signals are scarcely used. The unsafe driving conditions are coupled with narrow streets and alley ways that only remotely pass as viable roadways.

Map 6 displays the thransportation network of Kathmandu with the KMC background to give perspective and relationship to the transportation network.



4.3 Population and Roads

The population statistics were gathered from the Kathmandu Metropolitan website used with permission from the KMC. These statistics were used to create the population density map. With over 600,000 residents cramped into a space less than 10 kilometers wide, population density is an important factor coupled with the land use patterns in determining the implications on the transportation network.

In Table 7 Population Statistics by Ward (Appendix B), population trends are presented including total population by ward, area by ward, as well as population density by ward. For this data set the area is given in terms of hectares (the preferred unit of area analysis of the KMC). The range of population density varies from 37 persons per hectare to 1025 persons per hectare. The average population density is 309 people per hectare while the median is 194 people. As previously stated in this paper, population trends are essential in the land use planning process, since the people are the ones using the land in many forms.

The density follows a classic distance decay model. The population density is greatest at the heart of the city, and disperses moving away from the city center. Also the area surrounding the airport is sparsely populated. This is evidenced by ward 27 which is in the middle of a downtown area having a density of 1025 persons per hectare and ward 8 which is right next to the airport having the lowest population density at 37 persons per hectare. Ward 8 also has some forested areas inside its boundary.

In Table 8 Transportation Statistics (Appendix B), data is presented regarding the conditions of roads by ward with respect to the road lengths, good roads, and paved roads.

The main factor which pertains to land use and population is the percentage of good roads by ward. For this data set, the percentages of total roads lengths which are in good condition are presented. The objective comparative terms Good, Fair, Poor are used by the KMC as a reference guide. The range of roads in good condition varies from 15.8% to 76%. On the average 35.19% of roads are in good condition.

The road conditions also follow a similar pattern as the population density. One important thing to note is that the ward with the highest percentage of good roads (ward 33) is seemingly isolated to the northeast of the city center. In terms of population density ward 33 has a population density of 252 persons per hectare which is just below the average. This may suggest that either population trends are following existing transportation corridors or that the transportation network is 'branching out' to meet the needs of the population settlement patterns. Either way this growth corridor is a clear example of how the land use and transportation network is positively related.

Figure 15 CITY STREET TRAFFIC; HUMAN, RICKSHAW, AND COW *MARCH 2009 WALTER SUWAL*
(as in India cows are still seen as a sacred animal)

In Table 8 Transportation Statistics (Appendix B), in addition to the percentage of good roads by ward, the total length of road by ward and the percentage of paved roads by ward are also presented. The road lengths are given in kilometers (the preferred unit of area analysis of the KMC). Since the length of roads in each ward is proportional to the area of the ward, it is not necessary to present those specific statistics here. The road conditions have been displayed previously and along with the percentage of paved roads provide an excellent illustration of current transportation infrastructure.

The specific categories of roads given by the KMC include brick-paved, stone-paved, black topped, gravel, dirt, and trail. The brick, stone, and blacktop roads were aggregated to form "paved roads." The percentage of paved roads by ward ranges from 8.09% up to 100%. The average percentage of paved roads is 60.71%.

Figure 16 Outskirts poor road conditions; fringe of the KMC on the way to Pokhara (a sub metropolitan city) *March 2009 Walter Suwal*

The roads in the city center (while fewer in number and length) are generally in better condition than those further away from the center. Also logically the roads in the city center are more likely to be paved than roads in the outer wards, again this follows with the population density and compactness of land uses. In conjunction with the land use and population trends, the transportation infrastructure is also streaming in a northeastern pattern. This can be seen not only in the population data (Map 7) but also in the road condition data and the paved roads data (Maps 8 and 9 respectively).

In addition to the descriptive statistics for both the population data and the transportation data, further analysis was necessary in order to show the relationship between population distribution and transportation infrastructure. This more complex analysis is computed in the PASW Statistics 17 software (formerly SPSS).A sample output file is shown in Appendix B.

As already stated the data involved the variables of population density, roads lengths, roads in good condition, and paved roads. This further analysis provides a way to not only test if a relationship exists but also to determine the strength and significance of the relationship. The results will then be applied to the hypothesis to see if it holds up to the analysis. A simple correlation examination was performed between the population density (the independent variable) and each of three dependent variables:

Road_Length – the actual length of roads in each ward (km)
Good_Roads – the percent of good road lengths in each ward
Paved_Roads – the percent of paved road lengths in each ward

The correlation matrix is shown below

Table 5: Correlation Matrix

Correlations

		Road Length	Paved Roads	Good Roads	Pop Density
Road_Length	Pearson Correlation	1	-.823**	-.365*	-.690**
	Sig. (2-tailed)		.000	.031	.000
	N	35	35	35	35
Paved_Roads	Pearson Correlation	-.823**	1	.248	.733**
	Sig. (2-tailed)	.000		.151	.000
	N	35	35	35	35
Good_Roads	Pearson Correlation	-.365*	.248	1	.180
	Sig. (2-tailed)	.031	.151		.301
	N	35	35	35	35
Pop_Density	Pearson Correlation	-.690**	.733**	.180	1
	Sig. (2-tailed)	.000	.000	.301	
	N	35	35	35	35

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Scatter plots were developed for each variable correlation pair, these plots are shown below. Important to note is that in addition to the scatter plot, a line of regression was added to easily recognize the direction of the relationship.

After the initial correlation and linear regression were examined, the overall relationships between individual transportation data and population density was apparent. The road length variable had a negative relationship with the population density as shown in Chart 1. The good roads variable had a positive relationship with the population density as shown in Chart 2. The paved roads also had a positive relationship with the population density as shown in Chart 3. This initial correlation study, however, was not enough to determine whether the relationships were significant to the data as a whole.

Chart 1: Road Length vs Population Density

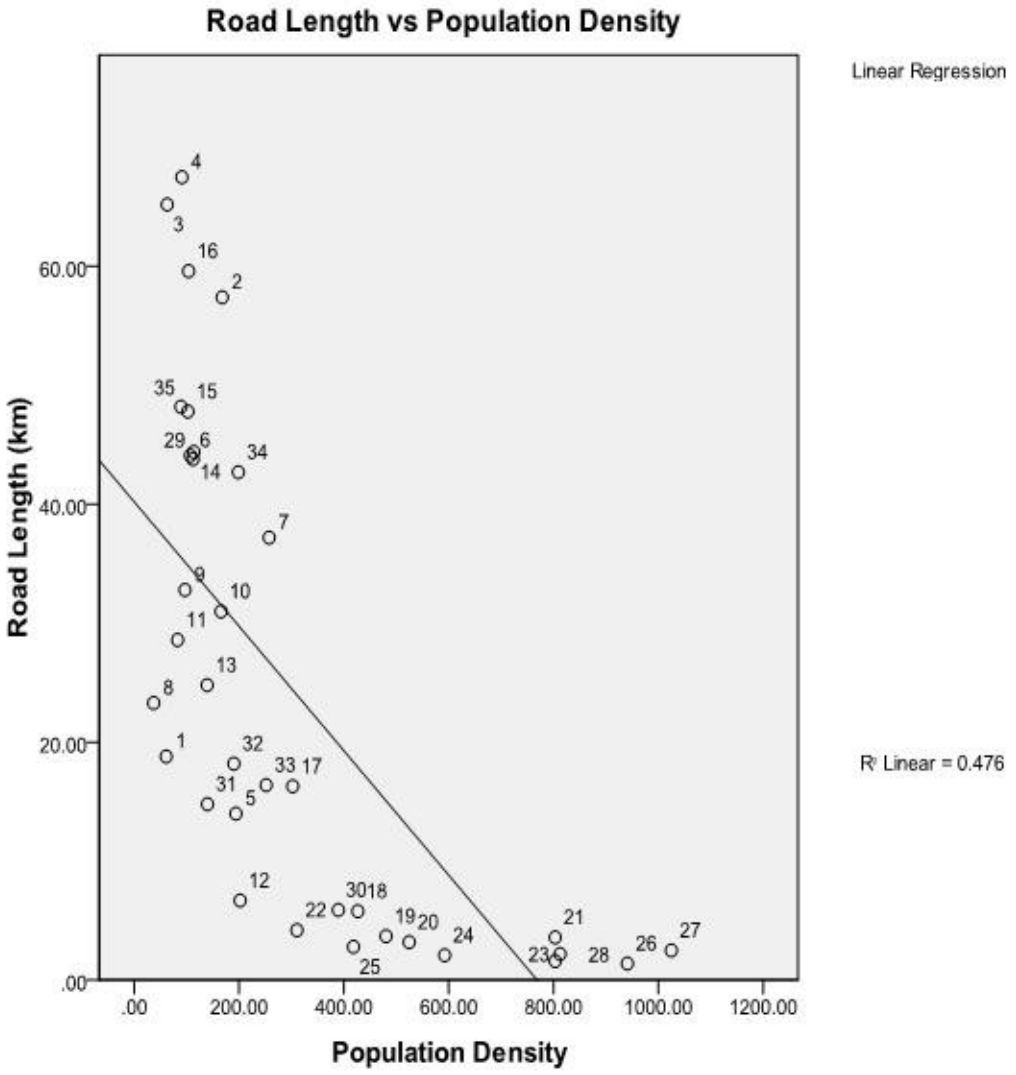


Chart 2: Good Roads vs Population Density

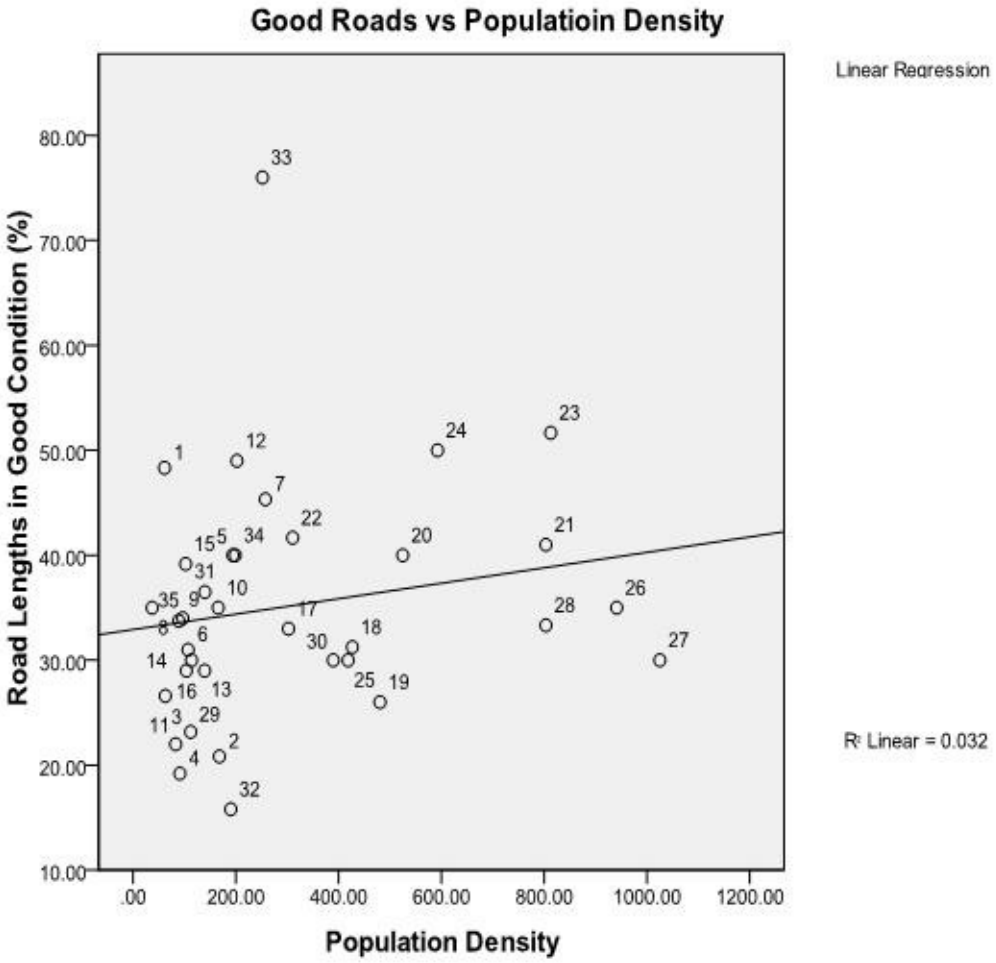
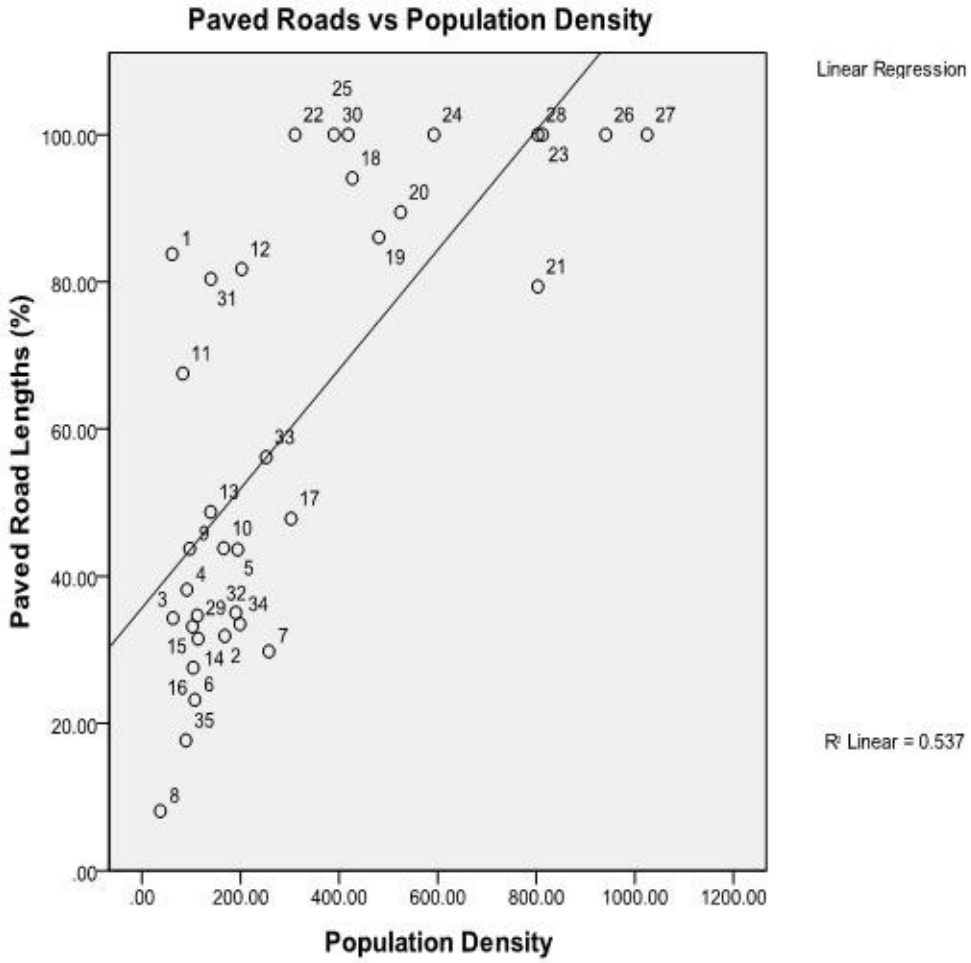


Chart 3: Paved Roads vs Population Density



Another correlation was performed using a modified version of the original data. The initial data variables were standardized by dividing them with the original population of each ward, that was the strength and significance of relationships would be easier to establish. These dependent data variables were calculated:

Road_LengthPopulation – 'Road_Length' / 'Population'
Good_RoadsPopulation – 'Good_Roads' / 'Population'
Paved_RoadsPopulation – 'Paved_Roads' / 'Population'

The standardized correlation matrix is shown below

Table 6: Standardized Correlation Matrix

Correlations

		Road LengthPopulation	Good RoadsPopulation	Paved RoadsPopulation	Pop_Density
Road_LengthPopulation	Pearson Correlation	1	-.417*	-.477**	-.615**
	Sig. (2-tailed)		.013	.004	.000
	N	35	35	35	35
Good_RoadsPopulation	Pearson Correlation	-.417*	1	.920**	.654**
	Sig. (2-tailed)	.013		.000	.000
	N	35	35	35	35
Paved_RoadsPopulation	Pearson Correlation	-.477**	.920**	1	.736**
	Sig. (2-tailed)	.004	.000		.000
	N	35	35	35	35
Pop_Density	Pearson Correlation	-.615**	.654**	.736**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	35	35	35	35

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

As before scatter plots were developed for each variable correlation pair, these plots are shown below. Important to note is that in addition to the scatter plot, a line of regression was added to easily recognize the direction of the relationship.

Chart 4: Standardized Road Length vs Population Density

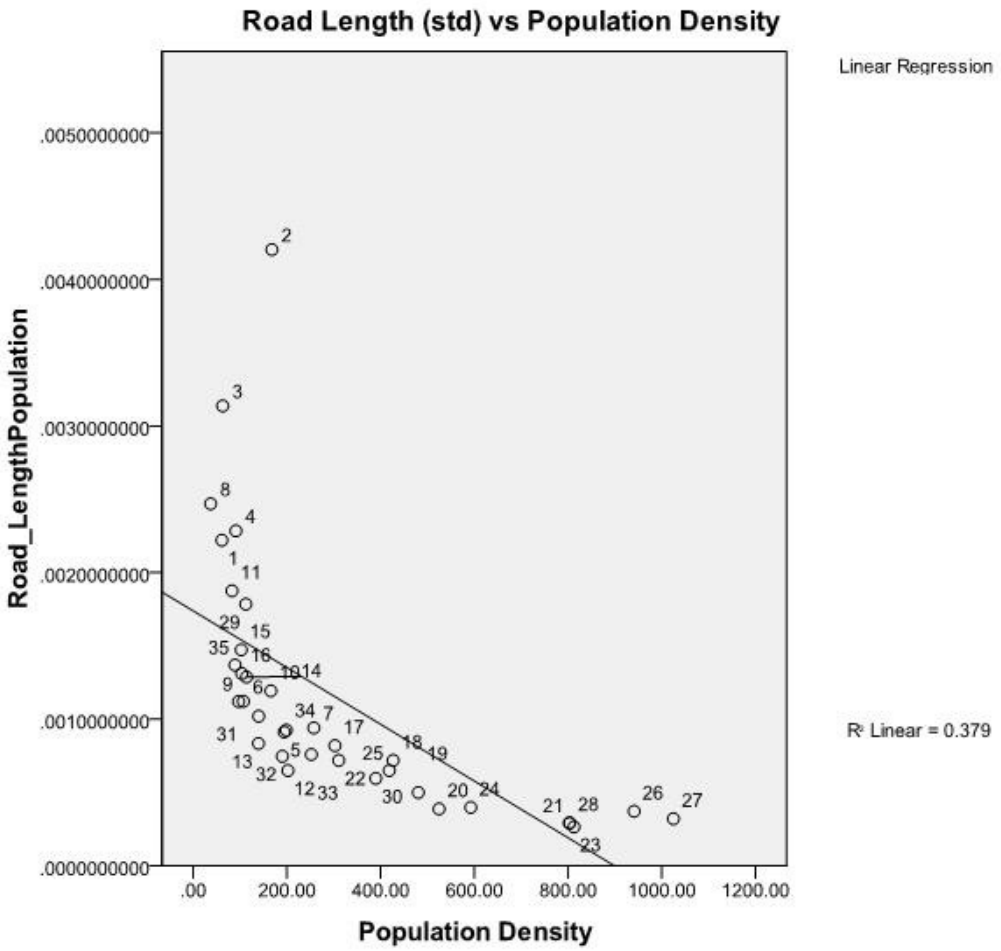


Chart 5: Standardized Good Roads vs Population Density

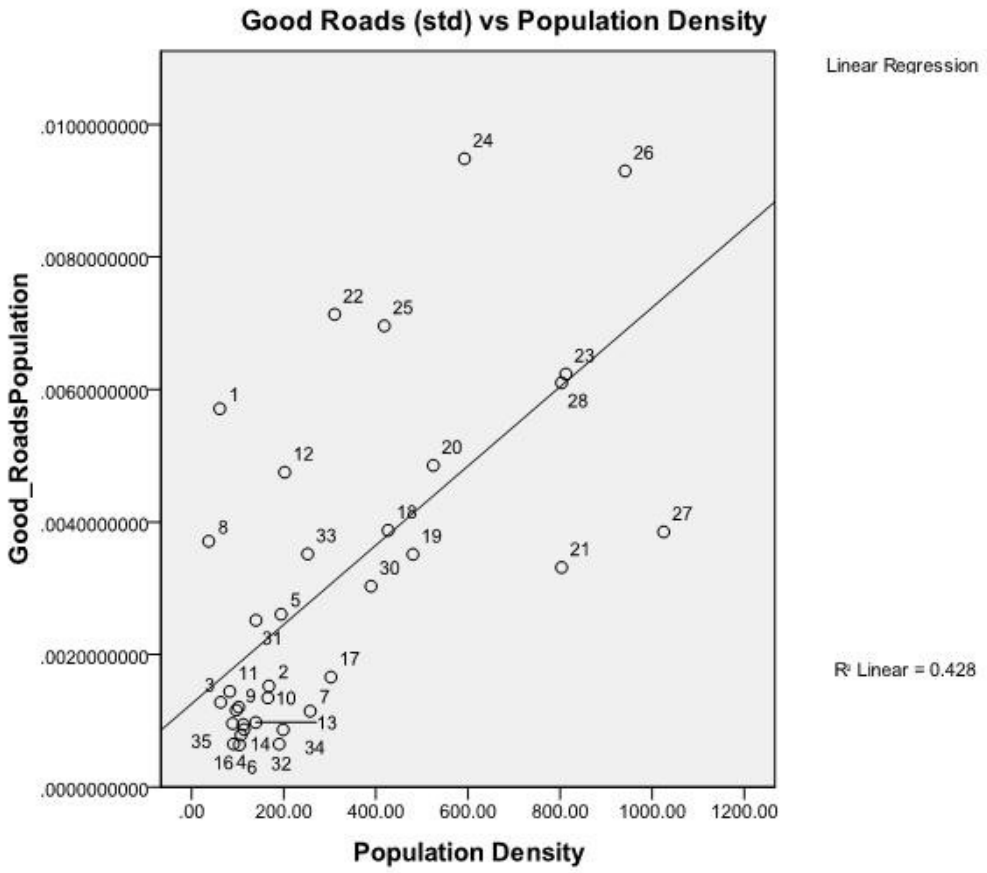
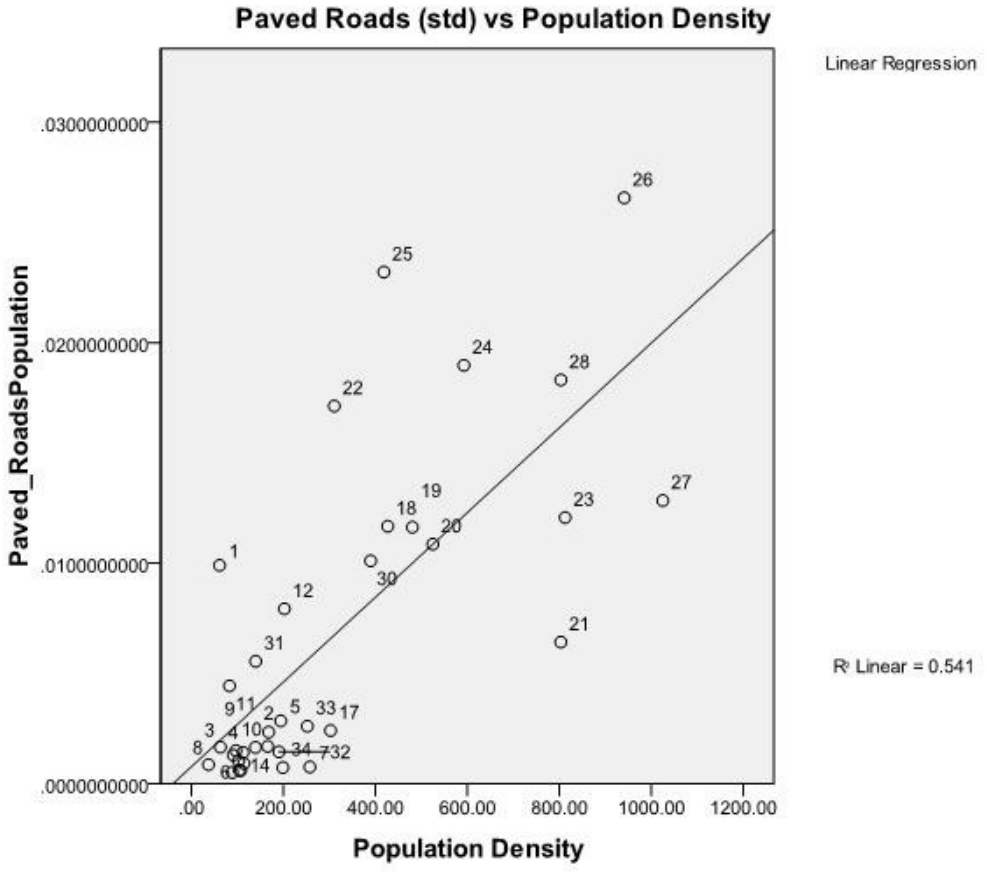


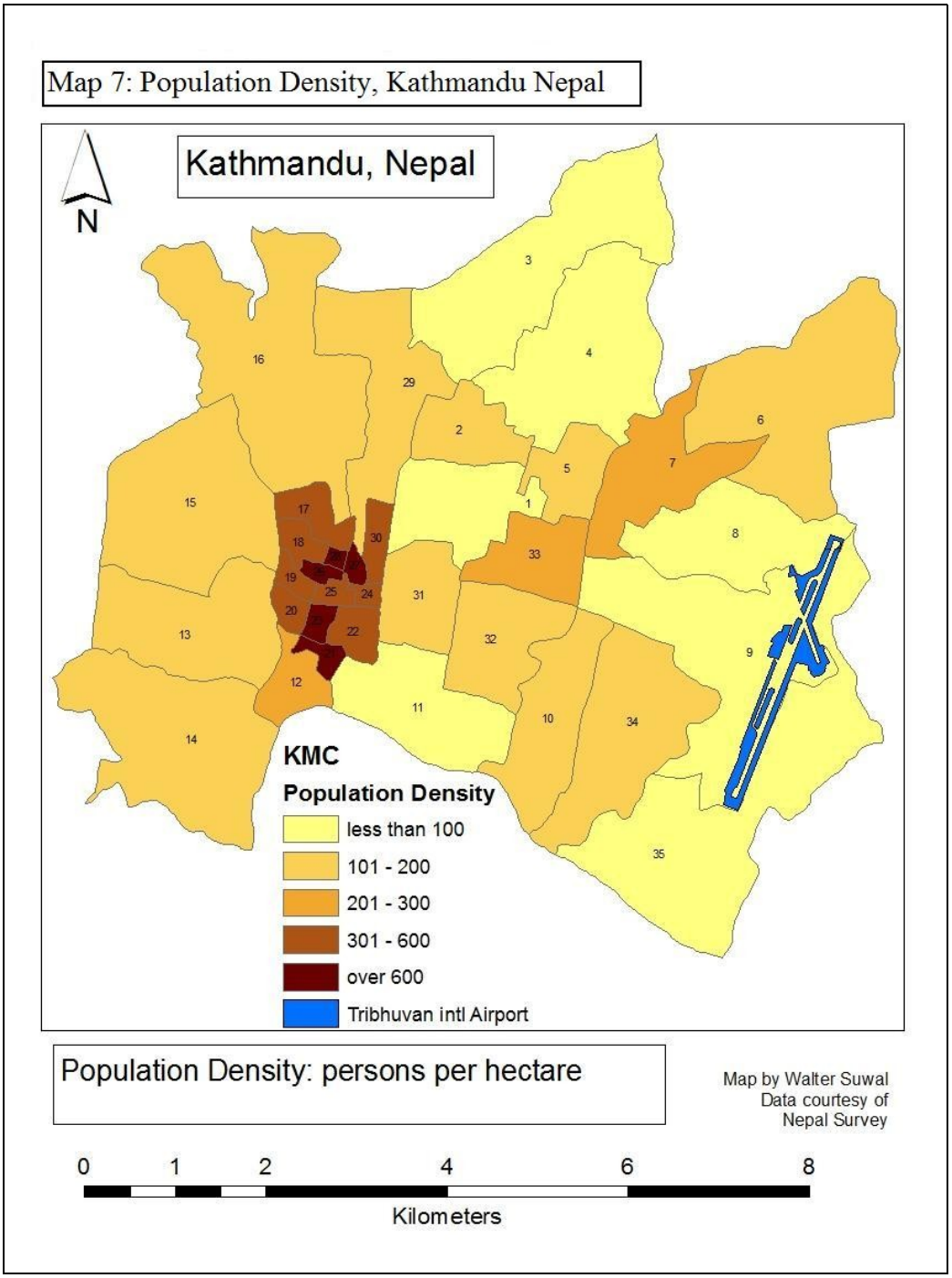
Chart 6: Standardized Paved Roads vs Population Density



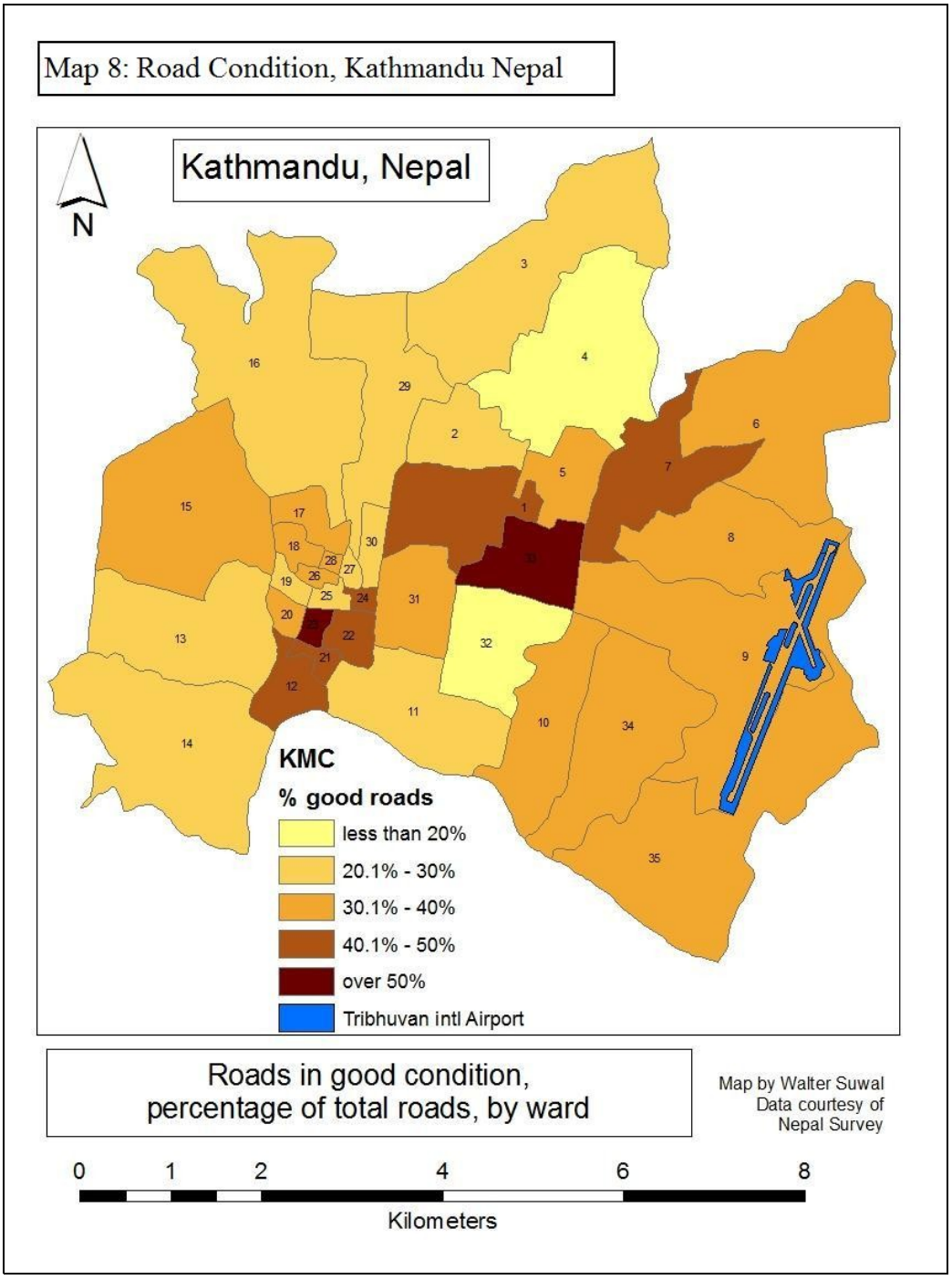
After the second correlation and linear regression were examined, the relationships between individual transportation data and population density was even more evident than before. The directions of the variable relationships were the same as before, but now the strength and significance of the relationships was more pronounced.

The standardized road length variable had a negative relationship with the population density as shown in Chart 4 as well the strength of the relationship is significant is having a Pearson score of -0.615. The standardized good roads variable had a positive relationship with the population density as shown in Chart 5 and not only is the relationship stronger, it is significant having a score of 0.654. The standardized paved roads again had a positive relationship with the population density as shown in Chart 6 and this relationship also proved to be significant with a score of 0.736. This initial correlation study along with the linear regression analysis shown as the linear regression line and the r2 value on each chart was more than enough to determine the strength, direction, and significance of each relationship. Since the Pearson score measures correlations on a -1/+1 scale, all of the relationships are significant at the 0.01 level.

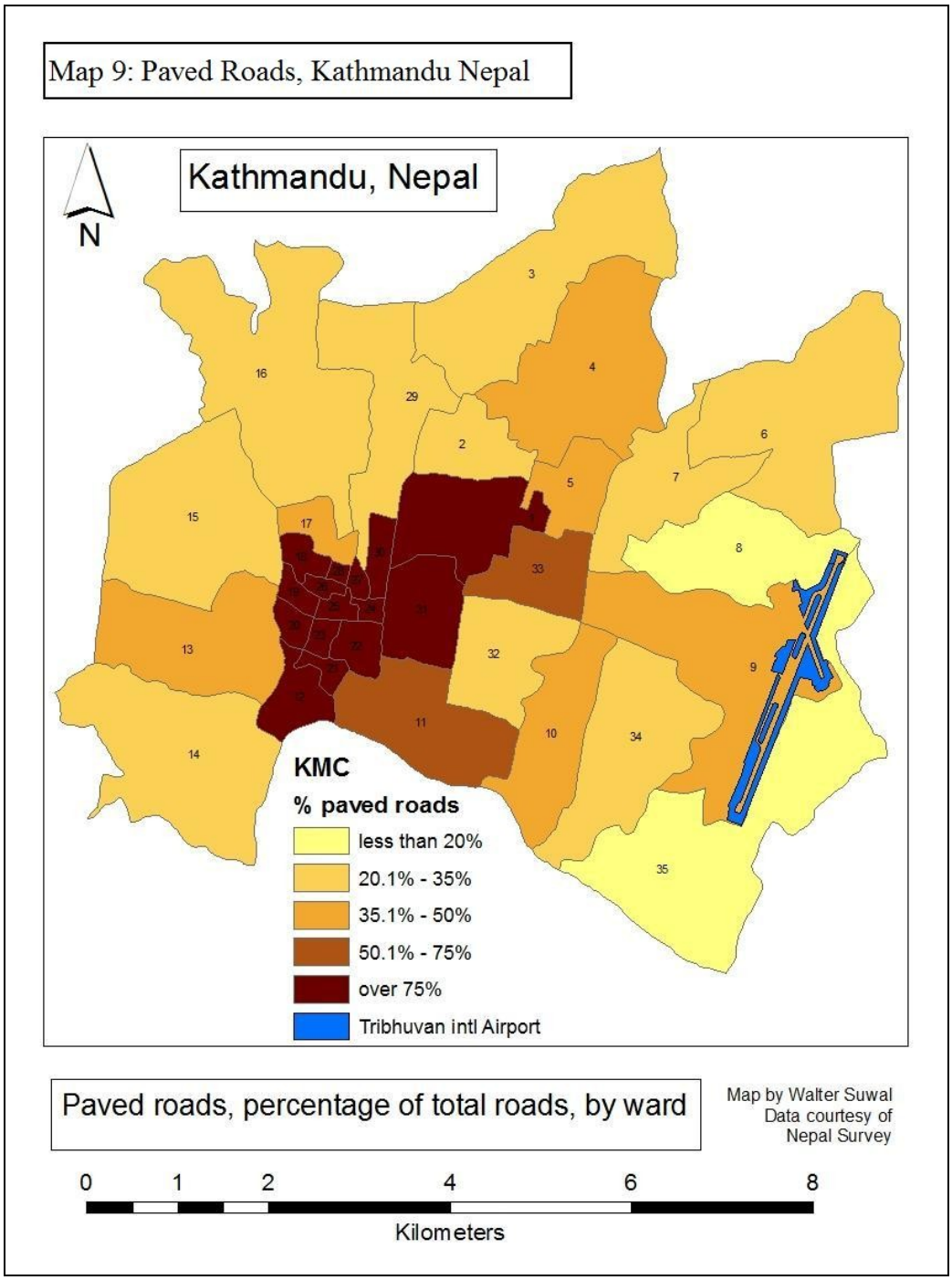
The population trends for the City of Kathmandu by ward as shown in Map 7 Population Density, was compared to ward area (hectares) to obtain population density



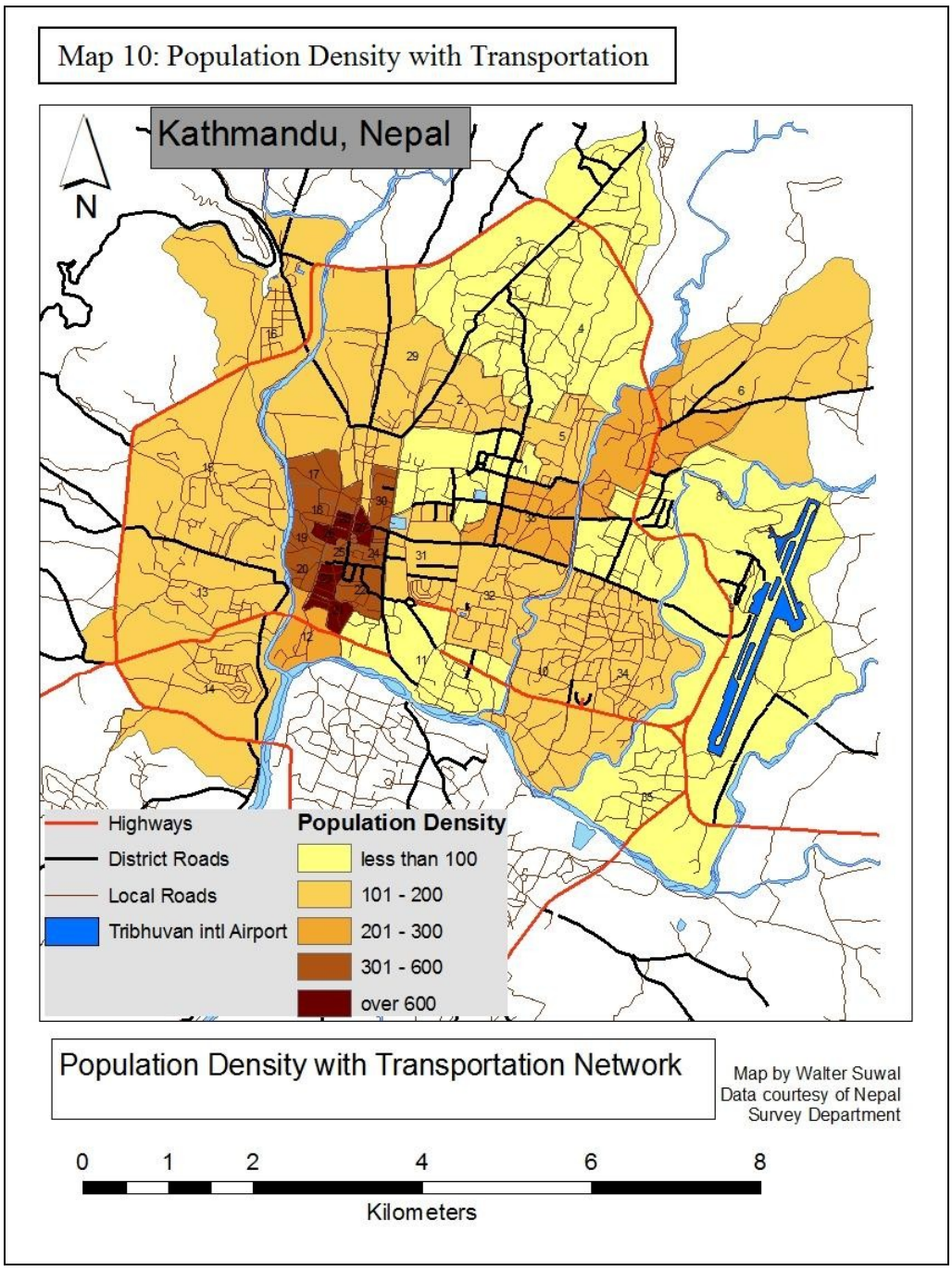
To produce Map 8, the lengths of good roads (as deemed by the KMC) were divided by the total road lengths, to obtain a percentage of road lengths which are currently in good condition.



To produce Map 9 the lengths of paved roads (blacktop, stone, and brick) were divided by the total road lengths to obtain a percentage of roads lengths which are in paved as opposed to earthen or gravel.



Map 10 is a combination of the population density data (Map 7) along with the transportation network to show how the wards are served by transportation.



4.4 Current projects and Public Transit

Several current and planned transportation projects exist on the planning docket in Kathmandu. These projects are all at different stages in terms of planning and implementation and some may not even come to pass, but their mention here is important in that the planners of Kathmandu are taking initiatives that can follow along with the "The Physical Development Plan for the Kathmandu Valley." If implemented several of these projects may have immediate implications on the urban environment and infrastructure while the effects of others may only be seen in the future. These projects include:

- Trolley Bus, TB plan around inner Ring Road (29 km)

  The trolley bus plan would add to the already utilized ring road, and will be agreat improvement to the public transportation infrastructure. It will allow for a safe and alternative from of transit as long as regulations are in place along with the implementation. Public transit implications are further explored in the next section.

- Koteswor – Sallaghari – Bhaktapur 6 Lane Road in progress
- Outer Ring Road plan (60 km)

  The 6 land road and the outer ring road would serve to ease congestion on district raods and allow for increased flow of the network from kathamndu to the neighboring town of Bhaktapur. Outer ring road specifically would further allow the population on the outskirts (the farming settlements talked about earlier) to access the rest of the city.

- Bagmati Corridor project – Tripureswor – Gokarn
- Bishnumati Link Road upgrading project (maps 10 and 11)

  The Bagmati Corridor project and Bishnumati link road project are more comprehensive and thererfore have their own objectives; their importance is that they are forerunners for other projects in Kathmandu and other parts of nepal.

Figure 17 Bagmati River bed; the normal water level should cover the stairs
March 2009 Walter Suwal

The Bishnumati Road Project is an important one both in terms of planning as well as environmental quality. The importance of this project is further explained by these reasons:

1. It is one of the most successful planning projects to date in Kathmandu, including an environmental analysis, resettlement pland and construction oversight.
2. This would include corridor improvemetns including a major north south transportation axis, and potential land use implication
3. Both urban and environmental impacts would be felt by the project
4. The project will serve to direct growth as opposed to much of the reactionary planning which currently dominates the city.

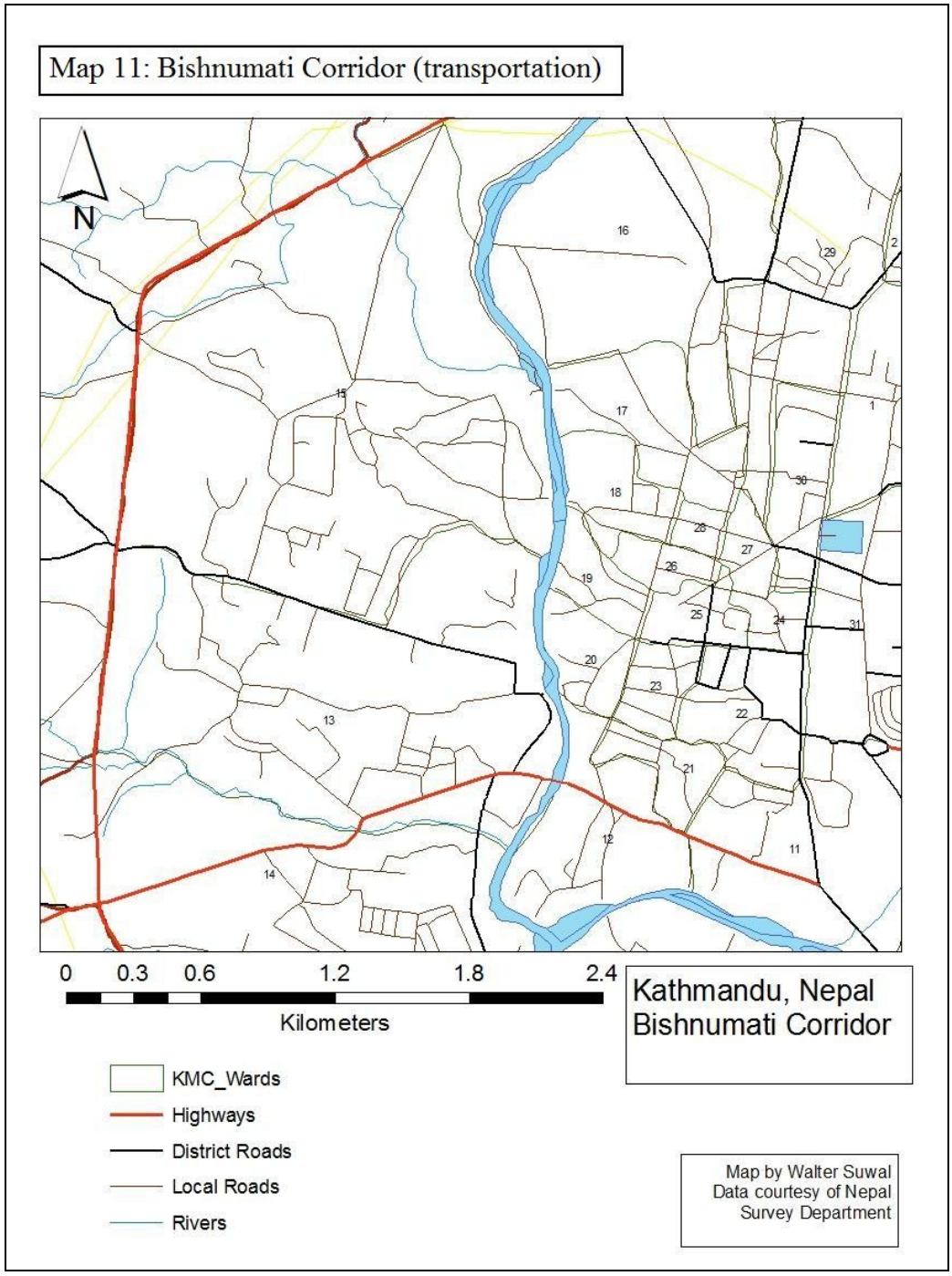
Information regarding this project and further research can be found in two very detailed government reports: "Upgrading of Bishnumati Link Road: Due-Diligence Report & A short Resettlement Plan" and "Detailed Engineering Desing and Construction Supervision for Ugrading of Bishnumati Link Road Sub-Project."

One area in which focus could be strengthened is public transportation. Public transport is available but at a cost – to your wallet and personal health – the buses and taxis are readily available, but corruption is common as is the case with charged fares. In the case of bad taxi drivers, riding in Kathmandu can be scary, basically the rules of the road are: if a larger vehicle is coming get out of the way. Near-misses with pedestrians / bicyclists and near misses with other vehicles are a common occurrence on even a short routine trip through the city. Right of way as observed in Kathmandu exists only on a very basic level.

The unregulated public transit system is a real issue in Kathmandu. Regulated public transit would increase ridership and allow for more improvements. Increased planning could mean the formation of better regulated public transportation. In addition to the obvious safety concerns with public transit, other aspects can be improved with land use planning and regulated public transit. One such aspect is the traffic police. Increased public transit means that it will be easier for traffic police to monitor and deal with traffic on a daily basis. Also regular transit routes with dedicated times and stops will not only utilize the existing transportation network, but will allow people a greater sense of stability in their daily routines. Revenues from regulated public transit could be used not only to purchase more types of public transit, but also improve existing public transit systems.

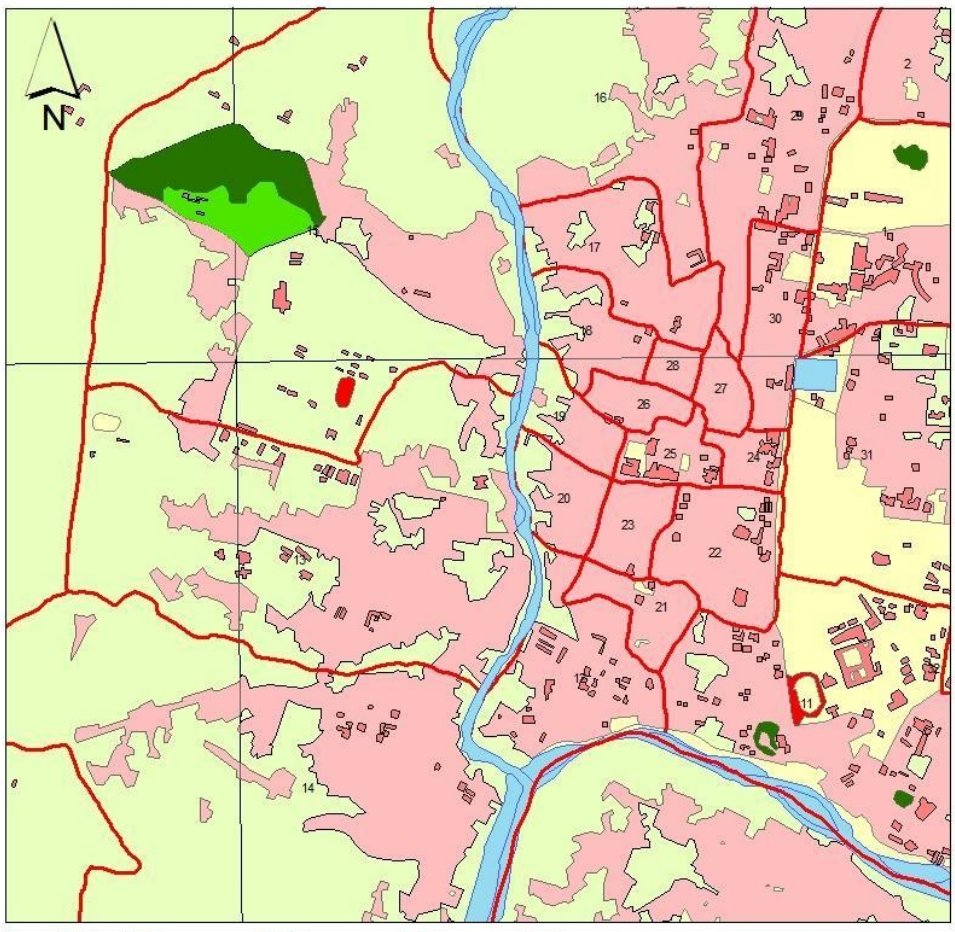
Figure 18 Over capacity city bus *March 2009 Degju Suwal*

Map 11 shows a section of western Kathmandu, in which the Bishnumati road in progress will link the north and south along the Bishnumati River.

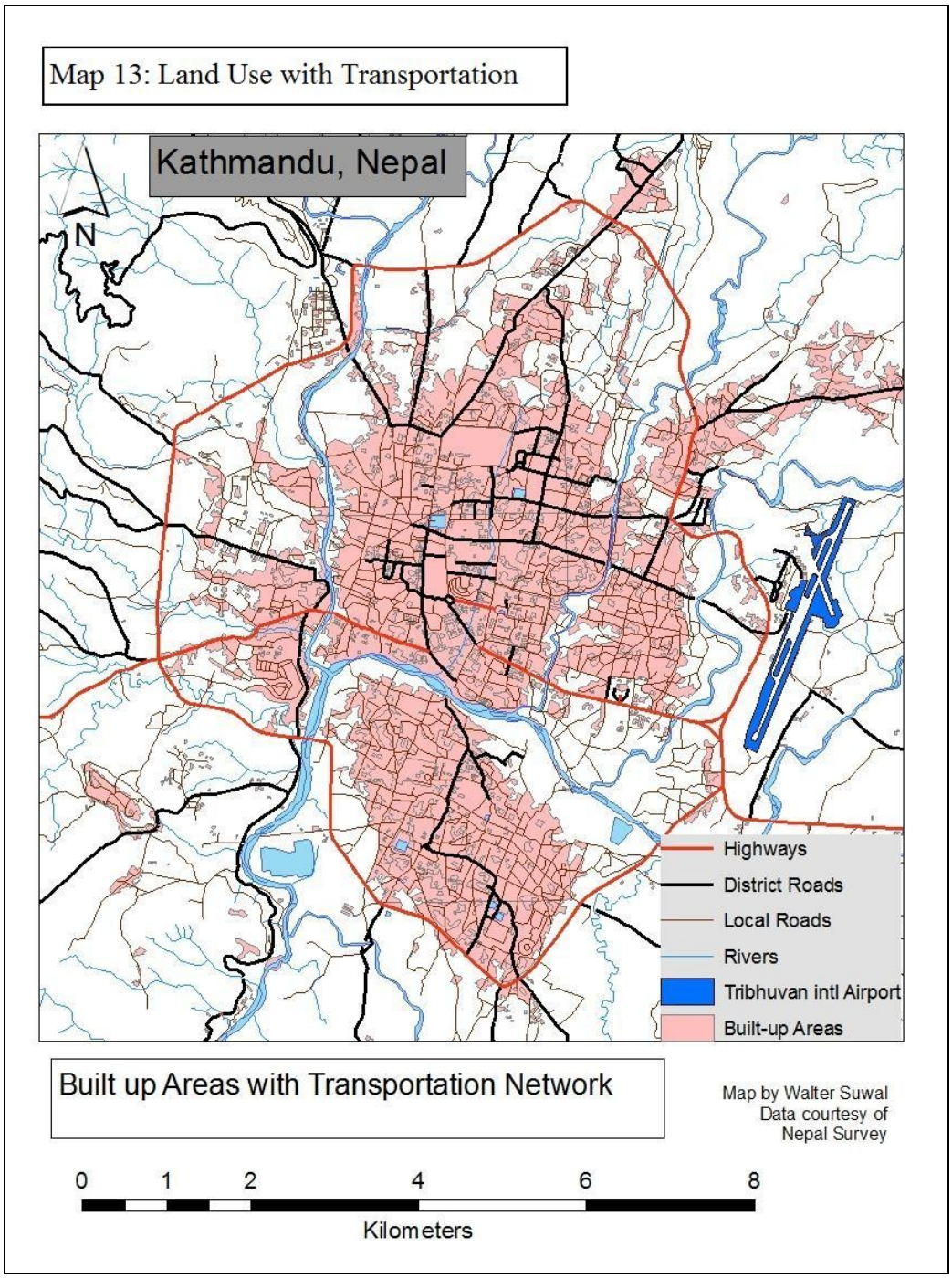


Map 12 also displays the Bishnumati Road Project area. In addition to the transportation network the land use is included to show the potential impacts of the upgrade project.

Map 12: Bishnumati Corridor (land use)



This final map (Map 13) shows the transportation network with the land use patterns as defined by the Survey department of Nepal, where the data was obtained.



CHAPTER 5 Conclusion

With the political situation in Nepal changed almost daily since the general elections in 2008, stabilization of the government is one of the chief concerns in everyone's mind. Only then will planning and infrastructure be allowed to flourish. Based on the historical look, the city of Kathmandu and Nepal as a whole, have laid the foundations for land use planning and the nation is on track to be heading in the right direction towards an integrated political planning process. Nepal has proven that it possesses the knowledge and know-how to make plans and create implementation strategies. The nation definitely needs a strong progressive governance structure in order to accomplish long term goals. Without a long range focus, many of the planning efforts may have to be 'shelved.'

The background of the nation presented in this paper is only a taste of the complex cultural and political situation in Kathmandu. However it is one piece of the puzzle in unlocking the unique conditions in order for planning to thrive on both a micro and macro level. The existence of development plans and government due-diligence reports is proof enough that general planning and specifically land use planning has occurred over time. The current state of the existing conditions including land uses, land use patterns, population settlement patterns, road conditions and transportation infrastructure verify that the planning efforts on a whole have not been enough to improve the future conditions in Kathmandu.

The findings presented in Chapter 4 indicate some trends in terms of the relationship between population distribution and transportation infrastructure. The following are the relationship summaries relating to population distribution:

Population Density and Road Lengths – the data and analysis found that as the population density increased in a ward the lengths of roads in each ward decreased significantly

Population Density and Good Roads – the data and analysis found that as the population density increased in a ward the percentage of good roads in each ward increased significantly

Population Density and Paved Roads – the data and analysis found that as the population density increased in a ward the percentage of paved roads in each ward increased significantly

The fact that the road lengths decreased as the population density increased means that the land use planning practices have not provided for an accessible transportation network for the population. The actuality that the road conditions (both good roads and paved roads) increased as the population density increased is good and may seemingly contradict the hypothesis. However the fact that the average percentage of roads in good condition by ward is only 35% is troubling in that on average less than half of the roads are in good condition. This road condition trend along with the road lengths trend means that indeed the planning practices has been lacking in providing for transportation infrastructure.

The public transportation option presented in the previous chapter is given as a working solution to ease some of the transportation infrastructure problems in the City of

Kathmandu. This type of infrastructure change will only occur with increased land use planning and the introduction of transit oriented development planning. In addition as stated throughout the paper, regulation and laws must be in place and enforced regarding general traffic rules as well as for public transit wither at the national or local level.

To facilitate the planning process both short term plans and long term comprehensive plans must be created. So far, the majority of Kathmandu plans have either been project specific or infrastructure specific. These plans must be combined to include the land use and transportation aspects of development. An economic component would also be helpful. Land Use Planning specifically needs more of an emphasis as a specialized discipline and revamping curriculum at local universities may help with this. One thing that is happening that must continue is the number of international conferences attended. This is vital not only for establishing connections with other planning professionals, but also to acquire the latest skills and proficiencies in the planning field especially land use and spatial planning.

Along with stronger leadership and an increased planning focus, Nepal needs more accountability in terms of intergovernmental interactions. The national agencies including the Survey Depart and National Geographic Information Infrastructure office have traditionally had most of the political power. These national organizations should listen to and cooperate with the localities such as the Kathmandu Metropolitan City Office if they want to have a successful planning process in place. Not only will this interaction increase data availability and accuracy, it will provide a better atmosphere for research and solving planning problems.

Several points touched upon in this paper could be leads for further study and research. In addition to the complex political structure, the cultural structure of Nepal is very unique in the world. Very much a national that grew up on trade and tourism, a variety of asian and western influences can be found in the nation. Also with the unique culture, the transition from religious kingdom to secular state could be studied as to its impacts on governance and planning. Finally the general isolationism of Nepal over almost its entire history has had a toll of the infrastructure both in terms of physical infrastructure and planning infrastructure.

The bottom line for the City of Kathmandu and the Nation of Nepal is that, while great strides have been made in recent history regarding politics, planning, human rights, and international status, there is much to be done. Along with the recommendations presented in this paper, the nation has to take a good look at general current situation and 'plan' for the future in order to be a player in the international community.

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In Kathmandu, Nepal

Talk with government officials, members of NGO’s
Residents of Kathmandu (including family and friends) and CAB (College of Applied Business)

Appendices

APPENDIX A Interviews

Key Points from Interviews in Kathmandu Nepal

Tribhuvan Man Singh Pradhan
GIS Manager Kathmandu Metropolitan City

GIS metric addressing system of KMC
Land Management Information System
Map Projection is a big Problem
Spatial Data Versus non-Spatial Data issue with politicians
Most decision makers do not fully understand the field of planning and GIS
Kathmandu Valley Mapping Project

Suresh Man Shrestha
Chief Survey Officer, Survey Department Nepal
National Geographic Information Infrastructure Project

No Zoning Ordinances relating to land uses, the only zoning in municipal
Survey Department Maintains all base maps of Nepal
ICIMOD – Land Resources Maps

Indra Narayan Manandhar
Former Professor Tribhuvan University: Geography
Worked on comprehensive plan in 1960s

Planning comes from many different fields
Interdisciplinary field
No planning curriculum currently in any schools and universities; geography is the gateway to the planning field
Planners and Politicians are very different

APPENDIX B Large Tables

Table 7: Population Statistics by ward in Kathmandu							
Ward Number	total pop	area (h)	pop density people/hectare	Ward Number	total pop	area (h)	pop density people/hectare
1	8,464	138.4	61	19	7,400	15.4	481
2	13,655	81.3	168	20	8,240	15.7	525
3	20,782	329.7	63	21	12,369	15.4	803
4	29,539	324.1	91	22	5,840	18.8	311
5	15,340	79.0	194	23	8,289	10.2	813
6	39,316	366.8	107	24	5,272	8.9	592
7	39,530	153.5	258	25	4,310	10.3	418
8	9,434	253.8	37	26	3,764	4.0	941
9	29,263	301.9	97	27	7,789	7.6	1025
10	25,977	156.8	166	28	5,462	6.8	803
11	15,244	183.9	83	29	24,543	218.6	112
12	10,313	51.0	202	30	9,896	25.4	390
13	29,721	213.3	139	31	14,502	103.7	140
14	34,488	302.9	114	32	24,355	128.0	190
15	32,441	316.5	102	33	21,597	85.7	252
16	45,450	437.4	104	34	46,136	232.1	199
17	19,876	65.7	303	35	35,184	395.0	89
18	8,065	18.9	427				

Table 8: Transportation Statistics by ward in Kathmandu							
Ward Number	road length (km)	paved (% of total)	good roads (% of total)	Ward Number	road length (km)	paved (% of total)	good roads (% of total)
1	18.8	83.78%	48.33%	19	3.7	86.05%	26.00%
2	57.4	31.88%	20.83%	20	3.2	89.47%	40.00%
3	65.2	34.30%	26.60%	21	3.6	79.37%	41.00%
4	67.5	38.17%	19.20%	22	4.2	100.00%	41.67%
5	14.0	43.62%	40.00%	23	2.2	100.00%	51.67%
6	44.1	23.20%	31.00%	24	2.1	100.00%	50.00%
7	37.2	29.78%	45.33%	25	2.8	100.00%	30.00%
8	23.3	8.09%	35.00%	26	1.4	100.00%	35.00%
9	32.8	43.73%	34.00%	27	2.5	100.00%	30.00%
10	31.0	43.81%	35.00%	28	1.6	100.00%	33.33%
11	28.6	67.54%	22.00%	29	43.8	34.65%	23.17%
12	6.7	81.74%	49.00%	30	5.9	100.00%	30.00%
13	24.8	48.73%	29.00%	31	14.8	80.41%	36.50%
14	44.4	31.50%	30.00%	32	18.2	35.04%	15.80%
15	47.8	33.17%	39.17%	33	16.4	56.18%	76.00%
16	59.6	27.56%	29.00%	34	42.7	33.49%	40.00%
17	16.3	47.82%	33.00%	35	48.2	17.69%	33.75%
18	5.8	94.09%	31.25%				

Sample SPSS output

Correlations

```
CORRELATIONS
  /VARIABLES=Road_LengthPopulation Good_RoadsPopulation
Paved_RoadsPopulation Pop_Density
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.


[DataSet0] C:\Users\Waltman\Documents\ktm_stats.sav
```

```
CORRELATIONS
  /VARIABLES=Road_Length Paved_Roads Good_Roads Pop_Density
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.

[DataSet0] C:\Users\Waltman\Documents\ktm_stats.sav
```

Interactive Graph

```
IGRAPH
  /VIEWNAME='Scatterplot'
  /X1=VAR(Pop_Density) TYPE=SCALE
  /Y=VAR(Good_RoadsPopulation) TYPE=SCALE
  /COORDINATE=VERTICAL
  /POINTLABEL=VAR(Ward) ALL
  /FITLINE METHOD=REGRESSION LINEAR LINE=TOTAL SPIKE=OFF
  /YLENGTH=5.2
  /X1LENGTH=6.5
  /CHARTLOOK='NONE'
  /SCATTER COINCIDENT=NONE.


[DataSet0] C:\Users\Waltman\Documents\ktm_stats.sav
```

APPENDIX C KMC data and maps

Kathmandu Metropolitan City at a glance (courtesy of the KMC planning office)

Founded : Tenth Century by Gunakama Dev
Location : 27° 42' North latitude
85° 20' East longitude

Altitude : 1,350 meters (above sea level)
Area : 51.3 Sq. Km.
Climate : Sub-tropical cool temperate
Maximum 35.6°C (April)
Minimum –3°C (January)
Annual rain fall : 1407 mm (most of it during June–August)
Average humidity : 75 percent
Population : 671, 846 (3 percent of national population – census 2001)
Growth Rate : 4.64%
Number of households: 1,52,155 (a.p.d. 175.7 per hector)
Major religions : Hinduism, Buddhism
Principal Languages : Nepali, Newari
(English is understood and spoken by general public)
World Heritage Sites : Durbar Square (Hanuman Dhoka), Swoyambhunath, Pashupatinath, Bouddha Nath
Main economic activities : Trade, tourism, carpets, garments, cottage industries
Trade – 21%
Manufacture – 19%
Agriculture – 9%
Education – 6%
Transport – 6%
Hotels & Restaurants – 5%
Educational Institutions :23 Colleges
98 Higher Secondary Schools
50 Lower Secondary Schools
236 Primary Schools
110 Pre-primary Schools
Literacy rate :83 Percent

Airport:Tribhuvan International Airport
(1,816,105 travelers pass through TIA annually)

Roads: 109,400 vehicles enter in 16 – hour period

Housing and Development

Domination of brokers in land development

Predominant private owner occupied housing system

53,311 units Housing Stock/deficit 10,942 units in 1991/34000 additional housing units needed by 2003.

2000 squatter families / 56 settlements

Standard Cost NRS.950,000.00 for 35 Sq.m. house in 80 Sq.m. plots

Rate of Building Construction – 18.4%

Building Typology of KMC

RCC – 47%

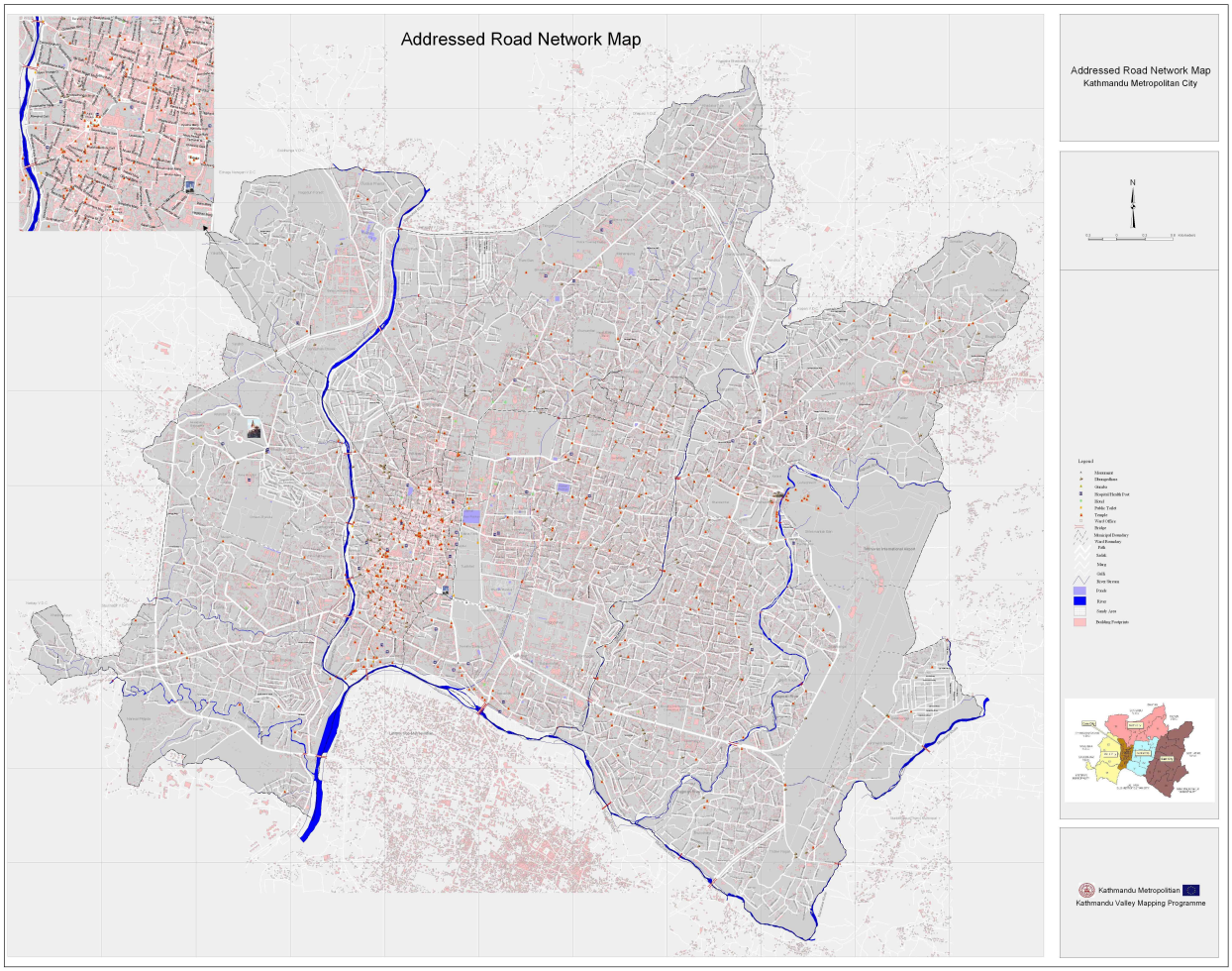
Fired Brick Cement Joint – 28%

Mud Brick Plastered – 17%

Mud Mortar Joint – 8%

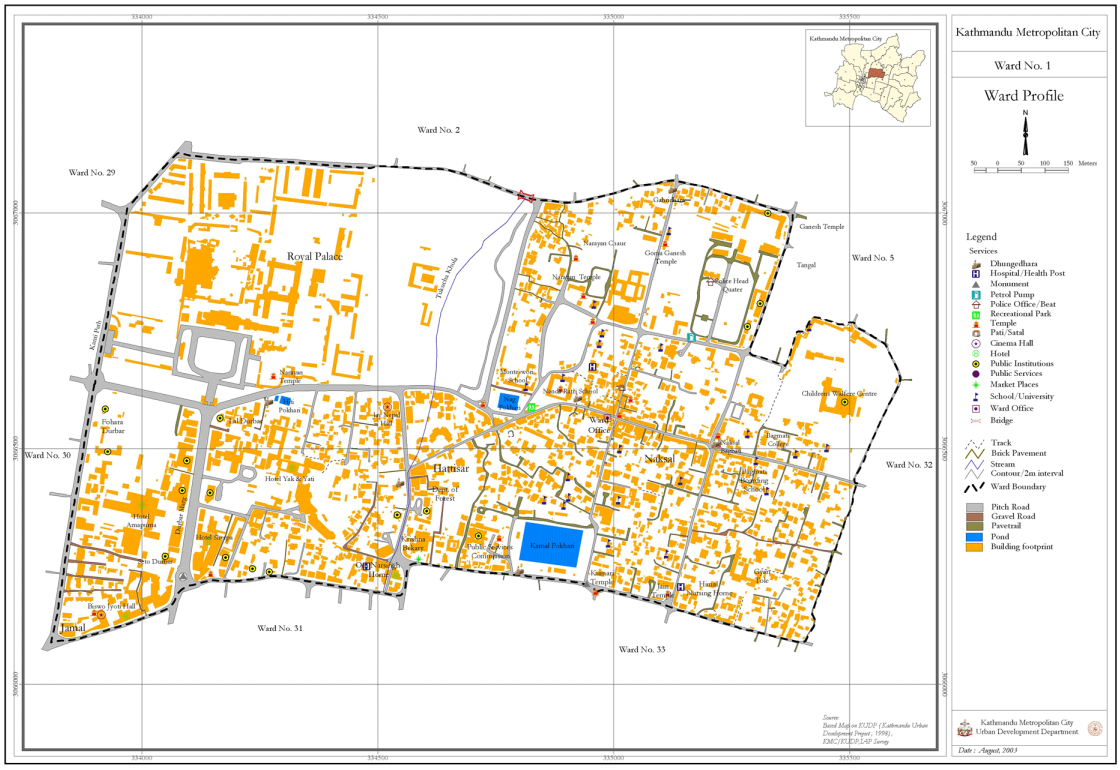
Figure 11 Kathmandu Metropolitan City Office *March 2009 Walter Suwal*

Transportation Network in Kathmandu, Nepal
Copyright Kathmandu Metropolitan City Planning Office



Administrative Wards and Sectors in Kathmandu, Nepal
Copyright Kathmandu Metropolitan City Planning Office

Sample Ward Detail (Ward No. 1) in Kathmandu, Nepal
Copyright Kathmandu Metropolitan City Planning Office



VITA

Walter M. Suwal was born and raised in Henrico County outside of the city of Richmond, Virginia. He has spent all of his life and education in Virginia although international travels and studies have taken him to Europe, Central America, and the Indian sub-continent. Education includes Mills Godwin High School; Virginia Tech: Bachelor of Arts in Geography; Virginia Commonwealth University: Post-Bachelors Certificate in GIS, and Master of Urban and Regional Planning.