

Tribhuvan University

CENTRAL DEPARTMENT OF POPULATION STUDIES

Faculty of Humanities and Social Sciences

Master Thesis No:

**POPULATION GROWTH AND ENVIRONMENTAL DEGRADATION
IN KATHMANDU METROPOLITAN CITY**

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Bikash Tripathi 2008

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2008**

**POPULATION GROWTH AND ENVIRONMENTAL
DEGRADATION IN KATHMANDU METROPOLITAN CITY**

By
Bikash Tripathi

**A Dissertation Report Submitted to the Central Department of Population Studies,
Faculties of Humanities and Social Sciences in
Partial Fulfillment for the Requirements of
Degree of Master of Arts in
Population Studies**

**Central Department of Population Studies (CDPS)
Tribhuvan University
Kirtipur, Kathmandu, Nepal
2008**

Central Department of Population Studies
Faculty of Humanities and Social Sciences
Tribhuvan University
Kirtipur, Kathmandu

RECOMMENDATION LETTER

This is to certify that **Mr. Bikash Tripathi** has worked under my supervision and guidance for preparation of this dissertation entitled "**Population Growth and Environmental Degradation in Kathmandu Metropolitan City**" for the partial fulfillment of Master's Degree Arts in Population Studies. To the best of my knowledge the study is original based on primary data and carries useful information about the situation of Population and Environment in Nepal especially for Kathmandu Metropolitan City.

I, therefore, recommend it for evaluation to dissertation committee.

Dr. Pushpa Kamal Subedi

Central Department of Population Studies
Tribhuvan University
Supervisor

August, 2008

Central Department of Population Studies
Faculty of Humanities and Social Sciences
Tribhuvan University
Kirtipur, Kathmandu

APPROVAL-SHEET

This dissertation entitled "**Population Growth and Environmental Degradation in Kathmandu Metropolitan City**" by **Mr. Bikash Tripathi** has been accepted as partial fulfillment of the requirement for the Degree of Master of Arts in Population Studies.

The Dissertation Committee
Approved by:

Prof. Dr. Bal Kumar K.C.
(Head of the Department)

Mr. Tej Prasad Adhikari
(External Examiner)

Dr. Pushpa Kamal Subedi
(Supervisor)

August, 2008

ACKNOWLEDGEMENTS

As being the student of Population Studies, I was always thinking about the population pressure and environmental problem of Kathmandu Metropolitan city; so I intend to study about this subject matter. During the proposal preparation, I found **Dr. Pushpa Kamal Subedi** as my supervisor and his continuous cooperation has been extremely valuable for this work. This occasional dissertation paper also has emerged from long and intense discussions with different persons, who have made important comments on the manuscript. I have gained lots of fruitful experiences and have enlightened my experience when I was in the field in Kathmandu. Yet I most mention that and it is impossible to forget the rewarding association and continuous encouragement of the members of the Rangers' Association of Nepal (RAN) and Friends of Nature (FON).

It is difficult to acknowledge them all by their names. However, for supporting various capacities in the process of research study, generated acknowledgements are due to all the informants who have given invaluable information for the study. Acknowledgements credit also goes to the following individuals and institutions- all the respected teachers and friends, especially **Dr. Bal Kumar K.C. (Department Head, CDPS, TU)**, are grateful for me. Grateful acknowledgements are also extended to **Dr. Pushpa Kamal Subedi (Supervisor)** and **Mr. Tej Prasad Adhikari (External Examiner, Tribhuvan University)** for continuous support and suggestion. Finally, from the bottom of my heart I would like to thank the entire direct and indirect supporting member, who has helped me for the research study.

Above all, I would like to express sincere gratitude to my father Mr. Yoga Raman Tripathi, mother Ms. Sannani Tripathi, Sister Ms. Uma Tripathi, and Brother Mr. Prakash Tripathi for always being to support me in the higher education and encouraging me to go ahead in my life. I am greatly indebted to Mrs. Sharada Kaphle (Tripathi) my wife for inspiring throughout my life in the path of progress and for her close cooperation in every step.

August, 2008

ABSTRACT

Population and environment cannot be discussed in isolation as they are interrelated parts of the society as the two sides of same coin. The study concluded that environmental realm does not exist separate from the human actions. Uncontrolled growing populations are consuming more resources and more waste is being generated day by day. The major issue in the KMC is to manage the waste generated as there is lack of solid waste dumping site and the valley is like a bowl. Impacts of pollution in one place in the valley do not take time to spread up within valley causing the valley population to suffer from the pollution. With the pace of time, the environment of KMC is deteriorating day by day which ultimately harm the population. The more the population the more will be resource consumption and the more waste will be generated. The growing number of vehicles and road condition in the valley are causing more air pollution. Water supply is not sufficient for the increased population and solid waste collection and management is not effective and regular due to the lack of dumping site. The lack of waste treatment and collection the situation of clean, green, safe KMC is turning to dirty, dark municipality. Appropriate policy and urgent attention is needed to address the environmental situation of the KMC to control further deterioration of the environment of KMC. It's time to act now tomorrow can be too late, so urgent and strict rule and regulation is required to control the environmental condition of KMC.

ABBREVIATIONS / ACRONYMS

BANANA	Built Anything Near Anything is Not Applicable
CBS	Central Bureau of Statistics
CDPS	Central Department of Population Studies
CEN	Clean Energy Nepal
DANIDA	Danish Cooperation Agency
DOHM	Department of Hydrology and Meteorology
EPL	Environment Protection Laws
EPR	Environment Protection Regulation
ESPS	Environment Sector Support Program
HMG	His Majesties Government
ICIMOD	International Centre for Integrated Mountain Development
ICPD	International Conference on Population and Development
INGO	International Non Governmental Organizations
IUCN	International Union for the Conservation of Nature
KMC	Kathmandu Metropolitan City
LDCs	Less Developed Countries
MDCs	More Developed Countries
MOEST	Ministry of Environment, Science and Technology
MOPE	Ministry of Population and Environment
NAAQS	National Ambient Air Quality Standard
NBS	National Biodiversity Strategy
NBSM	National Bureau of Standards and Meteorology
NCS	National Conservation Strategy
NEPAP	Nepal Environment Policy Action Plan
NIMBY	Not In My Back Yard
NGO	Non Governmental Organizations
NWSC	Nepal Water Supply Corporation
PADCO	Planning and Development Collaboration International
PPP	Polluter Pay Principal
SDAN	Sustainable Development Agenda for Nepal
TDA	Town Development Act
UNEP	United Nations Environment Program
UNFPA	United Nations Family Planning Association
WCED	World Convention on Environment and Development
WHO	World Health Organization

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Chapter I

INTRODUCTION

1.1 The Contextual Background

Population growth and development of urban areas is the primary function of population development. The consumption pattern of population is directly related to the environmental degradation of the area. The more the concentration of population, the more will be destruction of environment. As primary inhabitant of the area is solely dependent upon the natural resources of the area, the environmental degradation takes place at an alarming rate. The degradation is seems more high in the developing country because there are less other resources available for the consumption. The growth of population and the environmental degradation is the prominent issues of present growing world.

As a country develops from primarily an agricultural to an industrial economy, large-scale migration of rural residents to towns and cities takes place. During this process, the growth rate of urban areas is typically double the pace of overall population increase. The gathering of people into large urban centers marks one of the fundamental transformations in human history. Starting about 6,000 years ago in various parts of the world, large towns, and eventually cities, grew out of what were formerly agrarian village societies. This process, often called the urban revolution, involved much more than just an increase in the size of communities. It also included marked changes in the way people interacted, in people's relationship with the environment, and in the way people structured their societies¹.

In 2008, the world reaches an invisible but momentous milestone: For the first time in history, more than half its human population, 3.3 billion people, will be living in urban areas. By 2030, this is expected to swell to almost 5 billion. Many of the new urbanites will be poor. Their future, the future of cities in developing countries, the future of humanity itself, all depend very much on decisions made now in preparation for this growth (UNFPA, 2007).

While the world's urban population grew very rapidly (from 220 million to 2.8billion) over the 20th century, the next few decades will see an unprecedented scale of urban growth in the

¹ *Encarta Reference Library 2005* Microsoft Corporation

developing world. This will be particularly notable in Africa and Asia where the urban population will double between 2000 and 2030: That is, the accumulated urban growth of these two regions during the whole span of history will be duplicated in a single generation. By 2030, the towns and cities of the developing world will make up 80 per cent of urban humanity (UNFPA, 2007).

Talking about the condition of Nepal, data on urbanization are not available from the beginning. The data on urbanization is available only from the first scientific census of 1952/54 though the census was continued from the 1911. The urban areas have given different name in different census, like *Sahar* in 1952/54, *Nagarpalika* in 1961, *Nagarpanchayat* in 1971 and 1981, again *Nagarpalika* (Municipality) in 1991 and it is declared as *Mahanagarpalika* (Metropolitan City) in 1995.

In the period of 40 years, the population of Nepal has increased nearly 3 fold reaching 23.16 million in 2001 from 8.3 million in 1952/54. In the same period urban population increased fourteen fold soaring from 236 thousand in 1952/54 to 3.2 million in 2001 (CBS, 2001). The data on urbanization in Nepal shows the urban population has grown by almost one million in single decade from 1991 to 2001.

1.2 Urbanization and Development

Urban refers to the dense and continuous agglomeration of people and their dwellings (Burrow, 1996). Urbanization is the process, which leads to the increasingly large number of people living in small places, and basically engaged in non-agricultural occupation. It leads to economic and social transformation, which necessitates concentration of people and their dwellings (Bashyal, 2002). As it is a complex process of change in socio-economic and environmental parameters and their relationship, there can be hardly a single definition of the concept of urbanization, which could be applicable in all situations. Demographers, geographers, urban planners, economists and environmentalists see it differently.

Urbanization refers to the process of growth in the proportion of population living in urban areas. Historically, the concept of urbanization has been related to specialization, industrialization and consequent economic development. Although the form of this relationship has remained contested, there is a general consensus among scholars that a fundamental characteristic of urbanization is the structural shift in employment from

agriculture to non-agriculture pursuits. In other words, urbanization is a territorial response to structural changes in the economy. A distinctive division of labor, technology based production of goods, trade of variety of goods and service, high level of spatial and economic interaction, and relatively high density and diversity of population are the basic tenets associated with urbanization. The distinction between town and country is not merely a distinction based on the nature of settlements, it is a distinction rooted in the economic structure and social relations of production and reproduction and in the processes of social and political consciousness and its articulation. Therefore, urbanization is often taken as a proxy for the level of development in general (Sharma, 2003).

Urbanization—the increase in the urban share of total population—is inevitable, but it can also be positive. The current concentration of poverty, slum growth and social disruption in cities does paint a threatening picture: Yet no country in the industrial age has ever achieved significant economic growth without urbanization. Cities concentrate poverty, but they also represent the best hope of escaping it (UNFPA, 2007). Though, there seems some negative factors of urbanization for the development, it is not possible to control urbanization and development as urbanized area are the prime centre for development.

The summary of trend of urbanization in Nepal in different census is shown in figure 1.1. This shows urbanization is growing day by day dramatically in progressive way.

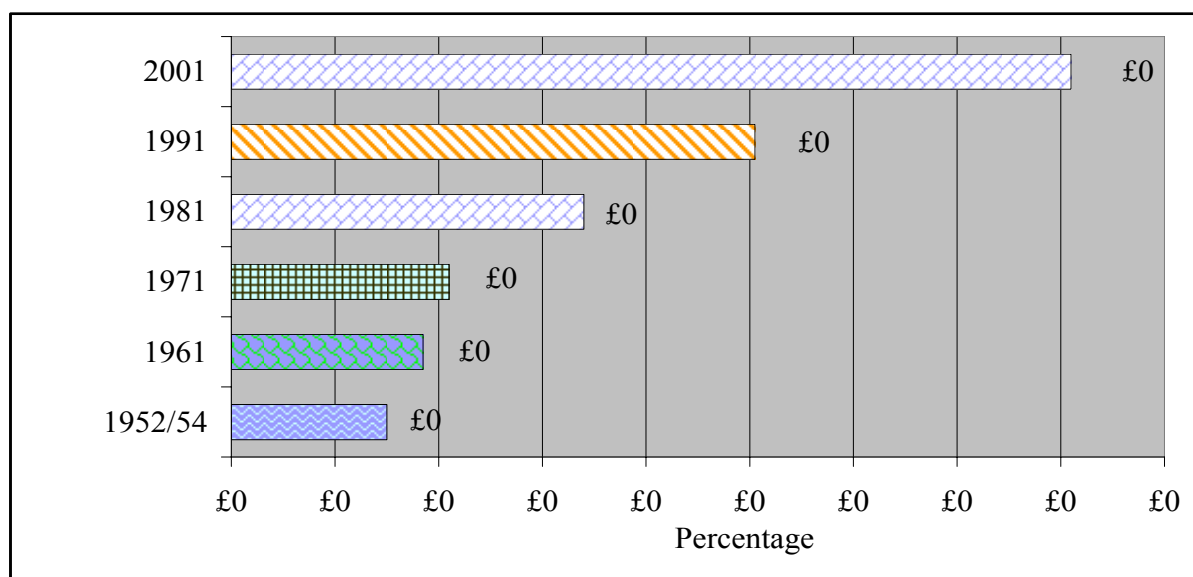


Figure 1.1: Percentage of Urban Population
Source: CBS (2003)

Urbanization creates some positive and negative impacts. It is transform of society from agricultural to non-agricultural occupation. Subedi (2003) have highlighted the following positive and negative impacts of Urbanization:

Table 1.1: Positive and Negative Aspects of Urbanization

Positive Impacts	Negative Impacts
1. Conductive to good life including	1. Air pollution
- Educational services	2. Water pollution
- Security	3. Noise pollution
- Access to organized hospital and medical care	4. Exposure to Traffic Accidents
2. Seat of government and commerce	5. Anti-social behavior

Source: Subedi (2003)

The major concern is how to manage the growing population in the urbanized area, as urbanization brings together with several problems and opportunities that demand urgent attention. The increase of urban population is not only due to the increase of population leaving in the city but it is also due to the development of new urban areas (33 urban areas in 1991 and 58 urban areas in 2001). Beside this, the addition from new birth, migrations etc. are the major cause of urban population growth.

1.3 Statement of Problem

Every developing nation has the problem of urbanization and no any country are far from the problem arising due to alarming increase of urban population. As comparing the problem it seems less in developed countries due to well planned infrastructure but the problems is seems very terrible in developing countries due to the haphazard expansion of urban areas without the proper plan of infrastructure development. The situation will be more terrible in the developing nation if the problem of environmental degradation combined with other natural disaster like earthquake and famine.

In Nepal, trends towards urbanization started around the middle of the 20th century. In the 40 years period between 1961 and 2001, the urban population increased 5 times, where as the total population nearly increased by 2.5 fold. The proportion of urban population has increased from 3.7% of the total population in 1961 to 16.2% in 2001(CBS, 2003). Urban

population has increased in absolute terms from 336,222 in 1961 to 3,227,879 in 2001. At present out of every 7 Nepalese, 1 person lives in town area; 40 years before, for every 28 Nepalese only 1 was urbanite (CBS, 2003).

Kathmandu Metropolitan City (KMC), the capital of the city has different opportunity of employment, education and other different facilities. Due to which the population is increasing day by day not by natural increase but mostly by in-migration from the rural and satellite areas. This is causing more depletion of natural resources like land, water and leading to more degradation of environment by air pollution, water pollution and haphazard solid waste dumping due to lack of proper landfill site. This problem has raised the concerns of environmentalists, population specialists, economics and infrastructure planners. The consequences of increased population in environment are crucial and not easy to imagine².

Kathmandu Valley has a history of early settlements from Gopal Bamsha and urban living from the time of Amsuverma. By 7th century, areas like Gokarna, Chavahil and Devpatan had developed as temple towns. Urban growth of the Valley took place during later part of medieval period (1476-1768 BS). After the unification of the country, it remained the capital of the unified Nepal and it grew rapidly as political and a cultural center (Subedi, 2003).

The overcrowded urban setting with people at work and vehicles to their destination are creating chaotic conditions with high level of noise. RONAST reports reveal that noise pollution in the Valley is extremely higher than the standards set by WHO. The growing traffic and echo of sounds from the buildings lining the streets are responsible for pollution that has unfavorable bearing on mental attitude of people.

Solid waste has remained a serious environmental problems associated with urbanization in Kathmandu Valley. Increased population lead to increased consumption or resources and increased waste. In Kathmandu Valley too, the piles of waste have been increased with population growth and industrial growth and industrial establishments. Numerous uncontrolled wastes are dumped in intimate proximity to dwellings in the Valley. As a result, the health of the urbanities is at risk in Kathmandu Valley (Subedi, 2003).

² *Encarta Reference Library 2005* Microsoft Corporation

The facilities and development are continuously increasing in Kathmandu Metropolitan City without proper planning. The settlements are being developed in haphazard way which are causing problem for the delivery of facilities like water supply and sanitation facility. Narrow roads and continually increasing number of vehicles are other problem for the management of urban areas. Kathmandu Valley, because of urbanization, is in the state of stress: overcrowded, poverty, stricken, crime-ridden, vandalized, and polluted. These are disorders associated with stress of social dissolution, insecurity, family dissolution, and cultural conflicts. Hence, there is an urgent attention needed for the effective management of population in KMC. Focusing in the issue of environmental situation of KMC this study aims to analyze the current situation of environmental condition of KMC and tries to give some recommendations for the further improvement.

1.4 Objectives of the Study

1.4.1 General Objective:

The general objective of this study is to assess the environmental condition of Kathmandu Metropolitan City and investigation of best alternatives for improvement.

1.4.2 Specific Objective:

The specific objectives of the study are to:

1. To assess the current situation of population growth and environmental parameters (water supply, solid waste management, air pollution, noise pollution etc.) of Kathmandu Metropolitan City.
2. To evaluate public perceptions and reactions on environmental condition of Kathmandu Metropolitan City.
3. To evaluate existing management system and recommend best option for better urban environmental management.

1.5 Significance of the Study

Population studies yield knowledge important for planning, particularly by governments, in fields such as health, education, housing, social security, employment, and environmental preservation. Such studies also provide information needed to formulate government

population policies, which seek to modify demographic trends in order to achieve economic and social objectives³.

With the increasing of population and opportunity in urban centers there will be also increase in number of slums and squatters. The situation of slums and squatters are different then other local people. They live in the river bank and waste land and also they don't have sufficient sources of water available for their basic need. They are forced to use river water which are mostly polluted due to sewerage discharge and uncontrolled solid waste dumping in river bank.

Kathmandu Metropolitan City covers an area of 47.8 square kilometer and the population density is 2738.8 person/square km (MOPE, 2004). While trend in population growth are pessimistic, the land use changes in the valley is also not optimistic. Total land under agriculture in the Valley has declined from 64 percent in 1985 to 41.4 percent in 2000. Similarly, urban area between these periods has increased by 120 percent (KVLTCP, 2002).

The study tried to assess the knowledge, attitude and practice of people in Environmental Quality of Kathmandu Metropolitan City. It focused only the existing information of environmental parameters and practice and perception by people of different sector. The research has tried to give some recommendations for the improvement of environmental conditions of Kathmandu. These explanations and findings are based on the primary data collected from questionnaire and secondary data collected from various literatures.

1.6 Limitation of the Study

The research study is fully field based and consultation of local peoples, stakeholders, INGO/NGOs and government officials was taken and interviewed them about the present environmental condition of Kathmandu Metropolitan City. This has shown the future path for the better management and urban environmental management.

The research study was carried out for the academic purpose only and so many of the intervening factors have not incorporated in the research other then as shown in conceptual framework. This research was confined to the assessment of existing situation and

³ *Encarta Reference Library 2005* Microsoft Corporation

investigation of alternatives for improvement. This study was done by using both primary and secondary data. Primary data was collected by using well-adopted methodologies in the selected sample areas of Kathmandu Metropolitan City.

Another limitation for this study was lack of time and budget. This research due to its academic purpose should complete in short time and so that there was less chances of taking huge data collection and data analysis.

1.7 Organization of the Thesis

In this study report Chapter I try to give general information and picture of the subject matter and study area, its objective, significance and limitation of the study. This chapter mainly focuses on the urbanization and development linked with population and development. Emerging issues and challenges for the better management of urban environment are described in this chapter. Chapter II is literature review and conceptual framework. Literatures related to environment, urbanization, population and development have reviewed in this chapter and based on that matter conceptual framework for the research study is prepared. Chapter III deals with the research methodology applied for the study and Chapter IV is fully description of the study area.

The study contains both primary and secondary data sources and Chapter V contains results and discussions on the study matter and findings from both primary and secondary data. Chapter VI is the summary of the findings and the conclusion and recommendation for the better urban management with sound environment.

Chapter II

LITERATURE REVIEW

2.1 Literature Review

Population and environment are like the two sides of coin. They cannot be deal in isolation. There is need of integration to understand the population, environment and development. To understand the relation of population to environment and development, literatures related to the subject matter were reviewed.

2.1.1 Population and Environment in the Context of Sustainable Development

Environment is an essential component of development and that environmental realm does not separate from human actions, needs, and aspirations. In fact environment and population are two sides of the same coin. The interpretation of their existence in isolation only suggests the naivety and the lack of understanding of the complexity of human-environmental interrelationships. They are inexorably interlinked and that these problems cannot be treated separately (Subedi, 1995).

According to WCED (1987), "Development cannot subsist upon a deteriorating environmental resource base; the environment cannot be protected when growth (population) leaves out of account the costs of environmental destruction."

Thus development customarily refers to economic progress that aims to meet the needs of people. However, a focus on meeting the needs of growing population is rather simplistic or incomplete view. A more precise conceptualization should incorporate economic and ecological parameters within the framework of development. While this conceptualization is commonly known as sustainable development (Redcliff, 1991), some authors have referred to this as co-evolutionary development as well (Norgaard, 1984). Thus, over the years, whereas the focus of development has been on fulfilling human needs and aspirations, there has been increasing realization that efforts to meet the needs of current population should not compromise the ability of future generations.

Meeting human needs and enhancing the quality of life i.e. development, requires important demands on the environment. It is people who make the demand and in terms of sustainable

development people should recognize that the limits of sustainability have structural as well as natural origin (Redclift, 1991). Chambers (1986) pointed out that environment and development are means not end in themselves and that environment and development are for people, and not people for environment and development. Thus, there is a clear link between population, environment and sustainable development. Growth of population brings a challenge to development and that additional demand on environment is imperative. Sustainable development in this regard aims at economic planning and management that does minimum damage to ecological processes without hurting human aspirations for economic and social improvement.

Keeping a balance between productive potential of ecosystem with a minimal or no damage of its environment and increase in human welfare which can cope with increasing numbers is a very critical issue of contemporary society. A focus on production increase to cope with increasing population should ensure that production itself does not degrade resources beyond a certain point. Population should be considered with ecological sustainability with a view that in a particular resource base and technological context sustainable development presupposes an upper limit of demand beyond which the resource system shows signs of stress and losses its regenerative capacity (Subedi, 1995).

The concentration of population with sustainability is the closest and most direct of all. At any given level of the human-determined elements--productivity and equity--there is only so much of the nature--determined quantities. If beyond a certain point we consume natural capital we will be living on what our descendents would need if they are to live as well as we do (Keyfitz, 1985).

2.1.2 Population and Environment: The Interrelationship

The existing symbiotic relationship between population and environment is not beyond our comprehension. However, the rapid growth in human numbers generates constraints on the development path with unsustainable burdens on environmental resource base that underpins much economic activity overwhelming the planning capability of governments (Mathema, 2000). The relationship between population and environment is complex and this complexity is further reinforced by the numerous dimensions of each factor. It is obvious that people modify their environment; the population in turn is also affected by changes in environmental conditions. The interdependence between them is so critical that human beings cannot exist

without environment and environment does not have any meaning without people. While the interrelationships unfold over space through time, the socio-economic factors play an important role in mediating the relationships.

Overtime population increases and its increased size puts pressure on the environment and its resource beyond their negative capacity. There has been a presumption that the impact of population growth is always negative. But it is not correct in all aspect; the issue of population is not only about its size but also about its structure, quality, and pattern of distribution. Population size alone is not the sole factor for environmental changes; it is the consumption level, pattern, and the technology that play a vital role in the overall environmental changes of an area. This in turn is related to the socio-economic structure of the society. In a similar manner, the institutions primarily political, social and economic have important say in the overall changes of the environment.

From the past, the studies related to the relationship between population and environments were in progress. Different perspectives were developed to define the interrelationship between environment and population.

2.1.2.1 The Linear Perspectives

Malthus and Boserup are the two most important names in the literature on population and environment. As early as the late 18th century, Thomas Malthus (1798, 1803, republished 1960) laid the foundation for a theory of population-resource interrelationships by proposing that a geometrically growing population tends to outrun an arithmetically growing food supply. According to him, the positive checks such as famine and increased mortality or preventive checks such as postponement of marriage and limitation of family size, work to reduce population growth. Malthus assumed that the natural resources are fixed and he is often criticized for not including a possibility of technological change. Other classical social theories of the 18th and 19th centuries such as Marx, Weber, and Durkhiem also have some attention to natural resources and the environment.

Boserup (1965, 1976, 1981) criticized the Malthusian theory on the grounds that it exclusively focuses on food production technology and ignores the effects of technological changes in other sectors and effects of environmental changes. Easter Boserup also criticized for not considering the effects of population change on both technology and environment. She

postulated that increasing population pressure itself induces technological change leading to a more instance use of land.

2.1.2.2 The Multiplicative Perspectives (The Equation $I = P A T$)

In this context, Ehrlich and Ehrlich (1990), take a view that environmental deterioration is the direct consequences of population growth. They argue that population growth causes a disproportionate negative impact on the environment and that redistributing population would be a dangerous pseudo solution to the population problem. In their original formulation, Ehrlich and Holdren (1971) suggested that the total impact of a society on the eco-system can be expressed as:

$$I = P * F$$

Where, I stands for total impact; P means population size; and F stands for impact per capita.

Furthermore, Commoner et al (1971), give emphasis on technological variables to create ecological crisis or not. They focus on technological changes are more important than mere population size and the impact per capita. In a simplistic term, the interrelationship of population and environment can be expressed as:

$$I = P * A * T$$

Where, I is a measure of environmental impact, P stands for an index of Population, A is per capita consumption, and T is a measure of environmental damage done by technology used in supplying each unit of consumption.

2.1.2.3 The Mediating Perspectives

Many social scientists are inclined to consider the impact of social, cultural, institutional and political factors, which mediate population and environment relationship. Bilsborrow (1992a and 1992b) has formulated a mediating for understanding the impacts of population growth on land use and agricultural production in rural areas in Latin America.

Socio-economic conditions such as poverty, government policies and market demands determine whether population growth leads to technological change in agriculture, soil, degradation or out-migration. Other mediating approaches (e.g. McNicoll 1990, Hogan 1992, Sahlins 1972) focus more exclusively on social and cultural rather than economic and policy factors, which mediate population and environmental connections.

2.1.2.4 Development-dependency Perspectives

This approach collapses all social, cultural and institutional factors that mediate population and environment relationship into the larger concepts of "development" focuses on the way in which development processes mediated population-environment relations. Jolly (1991) has termed a "dependency perspective", which stresses the overwhelming role that international political and economic forces play in shaping both demographic factors such as population growth and environmental outcomes such as degradation in developing countries. This approach further suggests that even major global environmental problems (depletion of ozone, greenhouse effect, toxic waste accumulation and loss of biodiversity) are the direct results of the prevailing model of development.

2.1.2.5 Complex Systems (Anthropological) Perspectives

This approach aims to understand the how ecological and human driven systems (socio-cultural, demographic and economic) dialectically interact and interconnect to form larger "socio-ecological systems" (Gallopín et. al 1988) within which population and environment relationships are embedded. Many areas for example, population ecology, human ecology and ecological anthropology, sub-disciplines within anthropology have also paid special attention to ecological systems models in studying the interfaces between demography, socio-economic, and natural systems.

Numerous studies (Gallopín, 1988; Fricke, 1993 etc.) have been carried out to interface between human demography dynamics, socio-economic organization, and natural systems in specific settings drawing on the biological concepts of niche and adaption at micro-level (community and household levels) within anthropology disciplines.

To support this perspective, on study of an agro-pastoral people in the Nepal Himalaya focuses on the role of population in their adaptation to a marginal mountain environment. It provides an example of the integration of household, economy, and fertility among a people at the earliest extreme of the demographic transition. Analysis shows that, population growth is shown to follow from the organization of village economy in an environment that encourages diversification (Fricke, 1993).

In Nepal, population has been increasing rapidly and even at low level of consumption and technology, the overall impact on environment looms more negative than otherwise. Most of the existing studies dealing with overall national scenario of population and environment in Nepal have portrayed a grim picture and bleak prospect for future (Shrestha, 1993; Pudasaini, 1993; Pant, 1992). Overpopulation is blamed for the increased pressure on resources such as land and that the poor and the landless have been seriously affected by overpopulation at the local level (Shrestha, 1982).

Several studies have shown the relationship between population and environment. In this regard May (1993), Shaw (1992), Turner and Meyer (1991), Subedi (1995) and UNFPA (1991) have highlighted the close relationships and interconnection among them. Subedi (1995) have highlighted the quantity, quality and behavior of population which affects rural environment from use pattern. The lack of technology and poverty causes' population to urbanize where there will be several problems related to space, water, waste disposal and pollution. Exogenous factors like wars, epidemics, floods, landslides etc. from natural vs. man induced disasters can create both positive and negative impacts to the environment of an area. It is true that the environmental situation is not encouraging, however, it should be recognized that contrary to these observations, some local level studies especially from the eastern Hills have shown positive effects of population growth as well (Subedi, 1993; Dahal, 1983).

2.1.3 Population, Environment and Development

Population primarily depends upon natural resources in the developing countries. This relation is altered by the intervention of development. Development can make the relationship in the positive way if the environmental components are incorporated in the process of development otherwise the environment will be more threatened from development activities.

Population-Environment diversity arises from the multiplicity of populations with differing distributions, densities, dynamics and compositions; and the plethora of environments, reflecting the varying influences of factors such as continentality, latitude, altitude, climate, vegetation, geology, soils, slope and drainage. The Population-Environment diversity also arises from a considerable number of intervening political, social and economic variables (e.g. policies, cultures, technology, institutions, development, consumption, trade) whose variations greatly affect the perceptions and utilization of environments by populations (Clarke, 1995).

Stress was laid on the two way nature of Population-Environment relationships - that environment influences population and that population influences environment - although this is a simplistic view. With the passage of time, there has been great growth in population, technology, consumption and human-induced environmental changes overtaking - in the more developed world at least - many of the environmental constraints imposed upon humanity. Low densities and low consumption of early societies had local impacts, responding to environmental conditions more than altering their environments (Clarke, 1995).

Clarke (1995) also focus on the issue that the global rates of population growth and development - aggregates of immensely diverse local rates - are now so rapid that there is much anxiety about the future, when the pressures of population upon the environment will be much greater. One certainty is that there can be no simple correlation between population, development and environment, as their patterns have diverse influences and there are considerable difficulties of scale linkage. Whereas demographic transition in more developed countries (MDCs) was associated with rapid economic development, especially industrialization and urbanization, in less development countries (LDCs) it has been less caused by economic development than by social and political factors.

Clarke (1995) has given model for relating Population-Environment to development. Natural resources, together with other factors, enter the production process. Population affects directly consumption and labor. This model helps to understand the consequences of population growth to environment and development as population growth only is not the sole cause for the environmental degradation of the country. There are so many intervening factors which affect them. Consumption pattern and production are not limited though ecosystem have limited regenerating capacity, the positive or negative externalities of development also affect the relation of population and environment controlling the development process.

The study done by Clarke, 1995 mainly focuses on the integration of environmental component to the development for the better environment with maximizing the benefit to the people living in the area. Development always focuses on the maximizing the benefit and the study suggest not to compromise with the environmental quality of an area while planning development activities.

2.1.4 The Urban Environment

Clean air, potable water, healthy food and stable spaces are the basics amenities of life. But the quality of environment is getting deteriorated and basic amenities are being polluted due

to the population explosion, rapid industrialization and unplanned urbanization. Environmental pollution is the result of complex of rapid and unplanned urbanization and industrial-technological revolution (Sthapit, 2002).

Nepal is experiencing population explosion and rapid urbanization. Since last four decades, there has been a rapid population growth in municipalities and the number of new urban areas is increasing significantly. In Nepal, the pace of urbanization increased sharply from 1950s. The level of urbanization in Nepal is very low by and standard but the percentage of total population living in urban areas is increasing over the decades. The proportion of urban population has increased from 3.0 percent in 1952/54 to 16.2 percent in 2001 and that the absolute number has increased from 238,275 in 1952/54 to 3,227,879 in 2001. During the same period the number of urban localities has increased from 10 in 1952/54 to 58 in 2001. The average growth rate of urban population is above 6 percent. Several factors are responsible for such a rapid growth of urban population. Whereas the role of rural-urban migration and reclassification (incorporation) is substantial, the contribution of natural growth is considerable (Subedi, 1995; Joshi, 2002; CBS, 2003).

Growth of urban population is causing the considerable changes in urban landscape and urban environment. The observation is Kathmandu Metropolitan City clearly justifies this. Over the years, hundreds of hectares of prime agriculture land has been converted into residential and market areas as concrete structures. A study carried out PADCO in 1984 reported that about 40 percent of agriculture land of Kathmandu was converted into urban complex between one decade 1971 and 1981. The population growth and development of urban facilities are continuously increasing in the Kathmandu and present situation is more terrible from the environmental perspective.

Being the capital city of the country, center of industries, organizations and government offices, commercial centers, educational institutions, culture, many people visit this place and many of them reside here, thereby increasing its population. The population of Kathmandu Valley in 1981 was 0.74 million while it was 1.64 million in 2001. It is projected that with the current population growth rate the population of this will reach 2.96 million by 2030. Immigration is the main cause of urbanization in Kathmandu Valley. Between 1981-1991, 37.5 percent were immigrants responsible for population growth in Kathmandu Valley (KVLTCP, 2002).

Solid waste is the major problem in the Valley. There are piles of waste posing environmental health threat to the Kathmanduites. Numerous uncontrolled waste disposals in close proximity to dwellings in the Valley have transformed the entire urban area into slums and historical beauty and public health are threatened (Subedi, 2003). Solid waste collection and its disposal has become a major problem in the urban areas primarily in Kathmandu city. Waste left to decompose at open space, streets corners, and river banks has become a normal feature of urban landscape in Kathmandu. At least 42 percent of the households waste generated from three municipalities of Kathmandu valley is estimated to be 284 tons per day. Of the total waste generated, 16.5 percent (47 ton/day) is industrial, commercial, and institutional waste and the rest is domestic waste (ICIMOD, 1993). While 213 ton is collected, 71 ton is left to decompose in the street corners, open spaces, and river banks resulting into repugnant odor and unpleasant sight of the cities.

Households' access to piped sewerage system is limited. The existing pipes are very old and that leakage is not uncommon. Of the total households only 17 percent have an access to piped sewerage in Kathmandu (EMA, 1992). The load of pollution in Bagmati River has increased by 6 to 10 folds in last decade. Out of 4,271 industrial establishments in the country, about 71 percent of them are concentrated in Kathmandu Valley. Most of them discharge untreated water into the stream. It is claimed that Bishnumati has no more water. Of the total volume of the flow, 90 percent is sewage and no living creatures can survive there. Not only quality, quantity of water availability is in decreasing trend. Of 190 million liters of water demand in the valley, only 80 million liters is supplied (Subedi, 2003).

Very limited sewerage treatment facilities exist and most of them are largely non-functional. The treatment plants which are functioning are also not successful to treat waste in desirable quality due to low retention time of waste in the treatment plant.

Haphazard establishment of industries in urban areas primarily in Kathmandu has further aggravated the problem of urban environment. Unregulated and mushroomed garment and carpet industries and the untreated effluent discharged directly into the rivers have not only polluted the river water of Kathmandu valley, they are equally responsible for air pollution and filthy environment. Untreated sewage from Kathmandu and Patan together with industrial effluent has not only exceeded the self-purification capacity, but also Bagmati has turned into an open sewerage especially between Thapathali and Chobhar (ICIMOD, 1993).

The discharge of untreated wastewater and the disposal of solid waste into rivers and the other bodies of water are common practice in Kathmandu Valley. All these domestic and industrial wastes like solid or liquid form lead to the accumulation of invisible ground and surface water pollution. Quality of surface water in general is microbially polluted in Kathmandu Valley. Drinking water sources tested in different localities showed that 88 percent of samples were bacteriologically contaminated and a few samples showed that presence of Choliform bacteria up to 4,800 per 100 ml (Jha, 2003). This bacterial contamination gradually increases as the piped water passes through densely populated areas. Similarly, an examination of physical, chemical, bio-chemical and micro-biological components of ground and surface water found that water in Kathmandu is bacteriologically unfit for drinking in both summer and winter (ICIMOD, 1993).

Urban development has environmental consequences. Usually, there is a transformation of large areas of surface and it occurs by encroaching the open areas, agricultural land or land under forest. Hills are bulldozed into new shapes and ditches are filled with rocks and wastes. As a result, soil and groundwater regime are modified bringing alteration in habitat, and hydrological cycle (Hardey et al., 1992).

Noise is also a threat to the environmental health in the Valley. It affects human health in several ways, temporary and permanent hearing loss, decreased working efficiency, sleep disturbances, annoyance, fatigue, and difficulty in general conversation. People working in high noisy environments are found to experience cardiac, digestive and neurotic problems. A research carried out by RONAST, 2003, revealed that, in pursuit of urbanization machines and processes of industries have released noise levels above threshold levels of 70-80 dB. Balaju Textile area recorded as high as 120 dB of noise level. Kalanki, Balkhu Chock, Sat Dobato, Putalisadak, New Baneshowr, Koteshowr, Narayan Goapl Chock and Tripureshowr were most noisy. Noise pollution in Kathmandu Valley increased by between 3-12 percent since 1997, according to RONAST, 2003.

2.1.5 Government Policies and Programs

Government of Nepal has incorporated population and environmental concerns into the nation's development process.

2.1.5.1 Environmental Policies

Policies and programs of government of Nepal on environment are stated in a number of documents of which, The Tenth Plan, Nepal Environment Policy and Action Plan (NEPAP) - 1993, National Conservation Strategy (NCS) - 1988, Environmental Protection Law (EPL) - 1995, Environmental Protection Regulation (EPR) - 1996, Sustainable Development Agenda for Nepal (SDAN) - 2002, Nepal Biodiversity Strategy (NBS) - 2002 are major notable policies and programs.

The seriousness of environmental problems was first recognized in the 1980s and the inclusion of 'Environment and land use policy' in the Sixth Plan (1980-85) is one indication of this. Onwards environment has continuously obtained an important place in the government plans and programs. The focus of environment policies as documented in the Eighth Plan is on the incorporation of preventive and mitigating measures at different levels. Some specific focuses include disseminating awareness and information about environment, incentives for industries which provide continuity in environmental protection, identification of critical regions, proper attention on traditional preservation technology, extensive legal provision, and a special concern in designing and incorporating programs that minimize negative impact of environment. However, it lacks the fact that man is the principal actor of environmental changes and very little attention was given to integrate population and its critical role in the environmental programs.

Although there are existing legislations which can deal with environmental issues, no coherent legislative and administrative framework exists for the control of water, air, noise and land pollution. The existing laws deal with environmental matters in a fragmented, incomplete and uncoordinated manner. The Nepal Water Supply Corporation Act (NWSC) - 1989, empowers the corporation to control drinking water pollution and prohibits anyone from polluting drinking water. Provision for the control of environmental pollution is also found in the Town Development Act (TDA) 1988. The Municipality Act (1991) includes a provision to regulate the disposal of solid and hazardous wastes. Further the Kathmandu Valley Development Authority Act (1986) established the authority to control environmental pollution, with regard to air and noise pollution, including legal provisions for control. Likewise, the Civil Aviation Act (1958) also contains mechanisms for the control of noise from aircraft. Furthermore, there is an Explosive Act (1986) which regulates noise level associated with the use of explosives.

These legislations do not specify the environmental standards to be followed, although tolerance limits for industrial effluent discharged into inland surface waters have been purposed by the National Bureau of Standards and Meteorology (HMG/NBSM - 1987). The National Conservation Strategy (HMG/IUCN - 1988) recognizes the need for establishing environmental standards for water and air quality as well as for noise levels. Environmental Standards for water, air, noise and land pollution establish bench mark against which pollution levels can be compared. Standards are the main authority for enforcing any pollution control program, standards set for pollution thresholds or environmental quality levels (Pandey, 1992).

Interim Constitution of Nepal (NPC, 2007) addresses environmental issues as:

Part 3, article 16: Right Regarding Environment and Health:

- (1) Every person shall have the right to live in clean environment.*
- (2) Every citizen shall have the right to get basic health service free of cost from the State as provided for in the law.*

Part 4, article 33: Responsibility of the state:

- (o) To use existing natural resources including water resources of the country for the interest of the nation.*

Part 4, article 35: State policies:

- (4) The State shall, while mobilizing the natural resources and heritage of the country that might be useful and beneficial to the interest of the nation, pursue a policy of giving priority to the local people.*
- (5) The State shall make necessary arrangements to maintain clean environment. The State shall give priority to the protection of the environment, and also to the prevention to its further damage due to physical development activities by increasing the awareness of the general public about environmental cleanliness, and the State shall also make arrangements for the special protection of the environment and the rare wildlife. Provision shall be made for the protection of the forest, vegetation and biodiversity, its sustainable use and for equitable distribution of the benefit derived from it.*

Thus environmental issues have been kept in high priority in Nepal in different laws, though the target have not achieved till date due to the explosive population growth and unsustainable use of the natural resources.

2.1.5.2 Population Policies

Resettlement programs were in operation as early as during the late 1950s, the Third Plan (1965-70) recognized the need to slow down the growth of population and initiated the program of Nepal Family Planning and Maternal and Child Health Project in 1968. The broad policies of this program were: to curtail birth rate; to control migration; to develop urban areas; and to regulate the migrants from the hills to Terai (the plains).

Later on, the government adopted a National Population Strategy (1983), the first comprehensive population policy of the nation which took a multi-sectoral, integrated approach to population control. As Sharma (1992) points out the intent was to initiate a process whereby population policies are integrated with social and economic development programs. The Eighth Plan first put focus on establishing adequate balance between population growth, socio-economic development and environment and thereby helps citizens fulfill their basic human needs. It also keep target to regulate internal migration.

In the process of planned development, the Tenth Plan implemented from the fiscal year 2002/3. The Tenth Plan is the third one in order after the restoration of democracy. As a policy continuation of the Eighth and the Ninth Plan, this plan has envisaged to expedite poverty alleviation by giving priority to high economic growth, good governance, and social justice. In this context, strategies are directed towards achieves the set goal through participatory development process together with establishing the effective role of women in the national economic and social development, mainstreaming the down-trodden and ethnicities in the development process, and clearly defining the role of government, local bodies, the private sector, non-governmental organization and the civil societies.

The long-term objectives of the tenth plan (2002-2007) was to attain the fertility rate of Nepal to the replacement level by the end of Twelfth Plan by relating the population with the development and to help alleviate the poverty to create an affluent society by developing educated, healthy, and skillful human resource (NPC, 2002). Following the long-term objectives of tenth plan the Three Year Interim Plan of Nepal has long term vision is to provide the help to the Nepalese people live a quality life for all by owning different aspects of effective population management as an integral part of development and human rights. By 2017, the vision is to bring the fertility rate to the level of replacement through the medium of women empowerment and poverty alleviation (NPC, 2007). Poor institutional management

and capability to translate policies into programs and actions, duplication of programs and lack of coordination are the barriers to achieve the target.

2.2 Conclusion

Present world is undergoing rapid urbanization process. Rapid urbanization has resulted many environmental issues such as the air pollution, water pollution, land pollution, waste management etc. Solid waste management is the pressing issue in the urban areas of Nepal. The solid waste produced in most of the municipalities has become emerging problem mainly due to the haphazard urban development and high population density, the per capita waste generation rate of the municipalities of Nepal varies from the 0.25 to 0.5 kg/person/day, depending upon the level of urbanization in general (Manandhar, 2006).

Preparatory meeting of ICPD, 1994 had already stated the critical role of population growth with environmental changes. In particular, it stated that as world population grows to historically unknown levels, and as the pace of urbanization continues unabated, resource depleting technologies, life styles that generate excessive and sustainable development. Considering this, the earth summit urged for the establishment of environmental court to provide justice for those functioning in the management of the resources and in resolving environmental issues with due authority and authenticity. Legal proceeding, prompt act and punishment as well as provision of specific and timely remedy do establish a course of perpetuated action and eventually a social and economic system do evolve in the community and society at large (UNEP, 1993).

The theory that environmental degradation is largely due to population growth is not supported by the data. Rather commoner blames the negligent technology, especially on the part of industrial countries. According to him even though these countries contain less than a quarter of the world population, they were responsible for three quarter of the world's 2.5 billion tons of waste in 1985. Moreover, their per capita now averaged 1.6 tons a year or about 10 times as much as in developing countries (UNFPA, 1991).

Urbanization is in alarming rate in global context causing the development of mega cities. If the proportion will continuously increase then higher proportion of population will live in urban areas in coming areas, which may cause not only degradation of environment of urban areas but also that may also lead to the lack of manpower in rural and satellite areas which are

the major source of resources to be supplied for the consumption in urban areas. In 1950, there were 83 cities with population of more than a million, 34 of them were in developing countries. Today there are more than 280, and this number will be expected to be doubled by 2015. All the new million person cities are going to be in the developing countries, as are 11 of the world's biggest cities today (Subedi, 1995).

Sharma (1982) states that the level of urbanization in Nepal is low but in the 1971-1981 periods, the urban growth rate was nearly 3 times greater than the rural growth rate (7.55% compared to 2.66% for the nation as a whole). Urban growth rates are likely to remain high primarily due to migration.

Environmental problems in Kathmandu Metropolitan City are exacerbated by accelerating population growth, human and vehicular congestion, virtual lack of land use, subdivision and other planning controls, weak pollution control programs and urban poverty. Furthermore, the problems are also compounded by lack of awareness, weak institutional capacity and poor enforcement of any existing regulations and policies. Government institutions, business and residents all are responsible for creating the environmental problems of the Kathmandu valley⁴.

Planned urbanization in Kathmandu Valley is the immediate need. Since urban development and housing was not a priority sector in Nepal, innovative planning systems for urban development could not happen in the past (Joshi, 2002). Today, however, in the case of Kathmandu Valley, there is a long term development plan (2000-2020). Before that only reductionist and fragmented approach to urbanization and environmental preservation existed. At present, there are different aspects considered for planned Kathmandu Valley. It includes regional base, stratified structure of development nodes, interrelation between land use and transportation, access to open areas, livable community, and so on. There are different principles followed for Valley's urban expansion, such as proportionate urban expansion, infrastructure ability, carrying development works at specific places, and controlling urban expansion in environmentally sensitive areas (KVLTCP, 2002).

⁴ Adhikari, A.P. (1996) *How to Turn the Valley Green*, The Rising Nepal, Friday Supplementary, May 3, 1996, Kathmandu: GPS

2.3 Conceptual Framework

Urbanization refers to the dense and continuous agglomeration of people and their dwellings (Burrow, 1996). With this statement it is clear that urbanization consists crowd of people. Based upon the objective, literature review the conceptual framework of the study population growth, urbanization and environmental degradation is designed as;

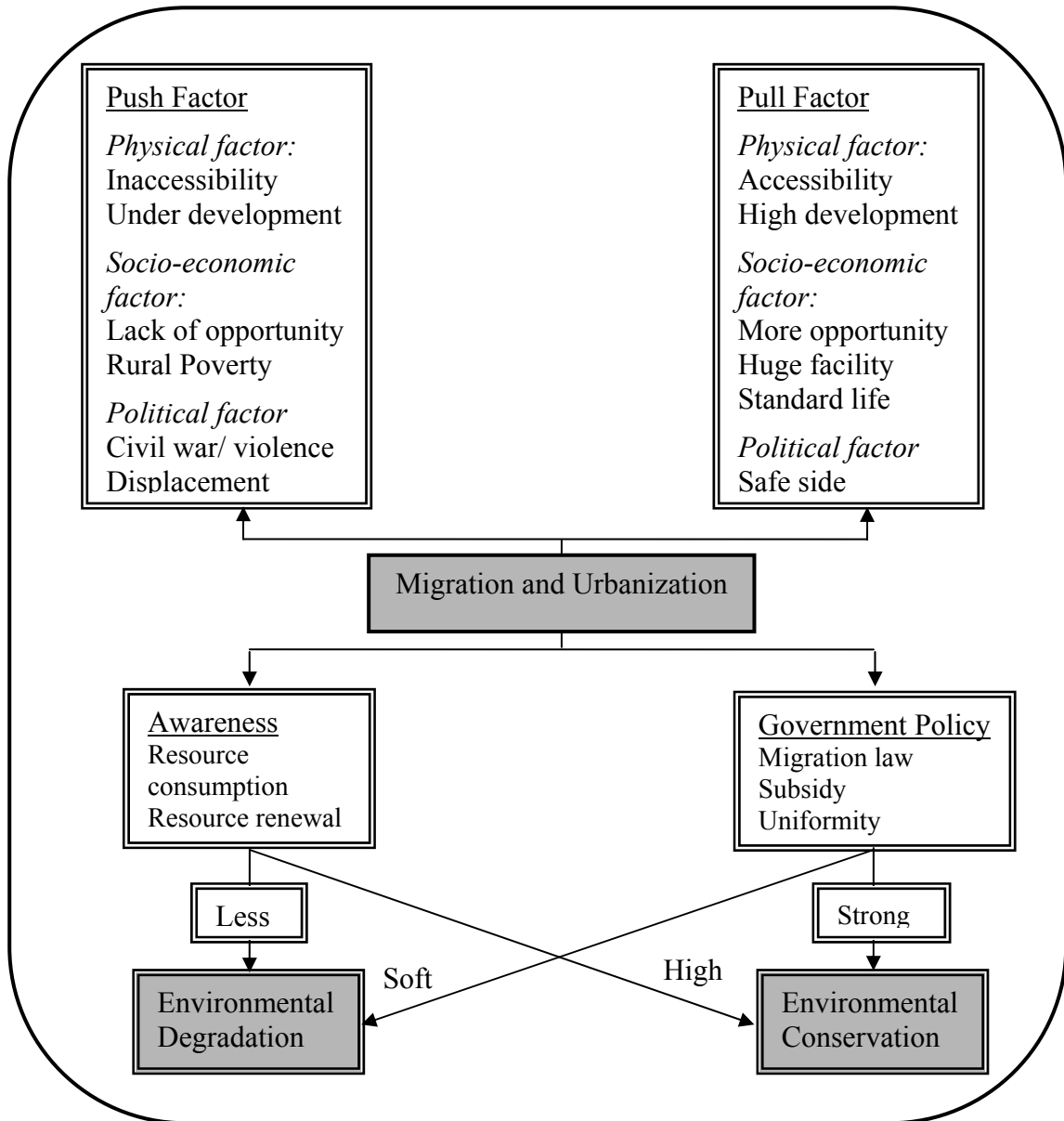


Figure 5.1: Conceptual Framework of the Study

The people in urbanized area are native and migrant together. For the migration, there is always acting tow forces; Push factors and Pull factors. Physical inaccessibility and under development, lack of opportunity and rural poverty push the people to migration. In this context in the past decades people have been migrated due to civil war and violence. In

contrast urban area pull people due to physical accessibility, high level of development associated with more opportunity with huge facility and standard life. The urban areas are also politically safe for the displaced people. These two factors play active role in migration of people. The migrant always seeks for the better and safe place for the migration and they found the urban area as the most suitable places to settle down. This is causing rapid urbanization and development of new urban area. Environmental degradation or conservation depends upon the awareness level of local people and migrants and government policy. If the people are highly aware and government policy is strong the environment will be conserved and if the people are less aware about the issue of resource consumption and resource renewal and the government policy is soft about the migration law and subsidy the environment of urban area will be more degraded. In the context of Kathmandu Valley, it lacks the environmental emphasis from its establishment. Due to the threshold in environmental parameters the environment of Kathmandu Valley is deteriorating day by day.

Chapter III

RESEARCH METHODOLOGY

3.1 Research Process

After the approval of proposal incorporating all the suggestions and comments made during the finalization, the work followed-up by discussion with the advisor which helped in planning the fieldwork and also afforded an opportunity to gather baseline information of the research area. The check list and questions for the interview were prepared. Consultation of advisor during the fieldwork provided timely feedback discussion enabled gathering more information. Compilation of necessary information, tabulation, processing and presentation of the information are part of data analysis. Reporting the results and subsequent discussions led to the conclusion and recommendation also are part of overall thesis. The research process followed is listed in Annex – 3.

3.2 Research Approach

The modes of research design were questionnaire surveys and direct observation. The approach for whole research is exploratory case study approach where data collection is through questionnaire survey and exploring knowledge, attitude, behavior and practices of the people of different sectors. The study adopted descriptive and explorative research design. A descriptive study is used to describe the phenomena. It is helpful to understand and document the management process and path followed for the environmental improvement. The explorative research design helps to find the specific objectives.

When the research is concerned with the issue of environmental degradation the study would provide space to understand the current situation of population growth and environmental degradation. The respondents of this study were taken purposively as different sectors like health, environment, management and general public to gather information regarding their understanding.

The research pursued based on the direct observation, questionnaire survey and expert's comments. Discussion with proficient professional and expert encouraged critical thinking on

concepts used in this research. The inputs and suggestions made during the field study and informal discussion by different friends and concerned people has further refined the study.

Table 3.1: Matrix Followed for the Research Study

Objectives	Specific Indicators	Method of Information Collection
To assess the current situation of population growth and environmental parameters (water supply, solid waste management, air pollution, noise pollution etc.) of Kathmandu Metropolitan City	- Population density - Condition of environmental parameters (Water/Air Quality, Noise Pollution Level and Solid Waste Situation)	- Questionnaire survey/Interview - Informal discussion - Literature review
To evaluate public perceptions and reactions on environmental condition of Kathmandu Metropolitan City	- Knowledge and practices about environmental quality	- Questionnaire survey/Interview - Informal discussion
To evaluate existing management system and recommend best option for better urban environmental management	- Environmental rules/regulations - Concerning authority	- Questionnaire survey/Interview - Informal discussion - Literature review

Source: Research Design, 2008

3.3 Sample Size

The population of Kathmandu Metropolitan City is huge and the time limitation for the study is very short. So, for the analytical purposes total of 150 persons from different background like environmental professional/students, health professionals/students, management professional/students and general public will be asked to fill up the questionnaire. The questionnaire will be distributed by purposive sampling process and requested to fill up the questionnaire and the findings will be generalized.

3.4 Unit of study

The methodology on studying population growth and environmental degradation aims to find out the cause and consequences of population growth in Kathmandu Metropolitan City and aims to prepare the recommendation for better environmental management. For this we need to study technical and socio-economic aspects. So, both socio-economical and technical research methods are employed for analytical and descriptive study.

This study will be conducted on the basis of both primary and secondary data. Primary data and information is proposed to collect by questionnaire survey and discussions. Secondary data and information will be collected from books, literatures and from concerned authorities.

3.5 Sources of Information

The nature of the study was such that it required much of information both from primary and secondary sources. Both qualitative and quantitative data were collected to draw the conclusion and result.

3.5.1 Primary Data

Primary data will be collected from the purposive sampling and the respondents are requested to fill up the questionnaire to know knowledge, attitude and practices about environmental problem of Kathmandu Metropolitan City.

Questions were asked to obtain information on six general areas as postulated below:

- a. General information
- b. Solid waste problem and management
- c. Drinking water scarcity
- d. Air pollution level
- e. Sound/Noise pollution level
- f. Population growth

3.5.1.1 Methods and Tools for Primary Data Collection

a. Questionnaire with selected respondents

Questionnaire was given for different people in collecting opinions, interests and reactions on environmental condition of Kathmandu Metropolitan City.

b. Facilitative discussion

Discussion was done with initiation of open-ended questions about environmental condition of Kathmandu Metropolitan City for different group of people (environmental students/professionals, health professionals/students, management professionals/students and general public) to explain issue and thought for the better management of environmental condition of Kathmandu Metropolitan City.

c. Direct observation

Different parts of the Kathmandu valley and the respective environmental condition was directly observed and incorporated in this study.

3.5.1.2 Site Selection Criteria

For the direct observation, the site was selected across the river bank of Bagmati and Dhobikhola corridor. For the questionnaire survey the respondents were selected purposively to fulfill the objective and information from different sectors was generalized.

3.5.2 Secondary Data and Source of Secondary Information

Secondary data are very important to understand the historical facts and status of the environmental condition and population level of Kathmandu Metropolitan City. The secondary data helps to derive the correlation of the present situation with past situation. So, the important secondary data sources were gathered by reviewing literatures, related books and documents, published report from CBS, previous research related to population growth and environmental condition etc were thoroughly reviewed and studied as secondary information. Mainly the literatures were reviewed from CDPS library and CBS library.

a. Literature Review:

Relevant information related to environmental condition was collected from several books, reports, publications then analyzed, reviewed and incorporated in this study as per the objectives of study.

b. Data collection from KMC:

The data on population growth level and environmental condition of Kathmandu Metropolitan City was also collected from the KMC record and personals.

c. Progressive contextualization:

This method was employed to collect the hidden issues of environmental degradation going outward in space and backward in time.

3.6 Data analysis

The data were analyzed immediately after the completion of field works and interpreted with simple mathematical and statistical tools such as pie chart and bar diagrams and presented in the report. Both qualitative and quantitative analysis methods were applied to analyze the data. Qualitative data is presented in described ways so that the basic findings of the research is interpreted and justified. The information collected from the field was carefully recorded in structured format and the information obtained were categorized, plotted according to the objectives and developed the research matrix in order to manage and analyze. The study was mainly focused on the knowledge, attitude and practice (KAP) of the residents of KMC so the technical aspect of analysis $I = P * A * T$ were not covered in this study.

3.7 Instrumentation

The information thus collected from field and from secondary sources was first coded keeping similar information together. As far as possible the questionnaire was used of close ended and the findings from open ended questions were generalized. The results from open and close-ended questions were arranged according to their similarity. Then they are posted in the computer and the data analysis was done by using simple statistical tools like bar-diagram and pie charts, histograms etc.

Chapter IV

DESCRIPTION OF STUDY AREA

Population growth is one of the important factors for the environmental condition of an area. The more the population level, the more will be resource consumption and waste generation. So, in this context without proper management of waste generated, it is obviously true that the environmental problem will arise.

4.1 Introduction of Study Area

Nepal officially the **Federal Democratic Republic of Nepal**, also Republic of Nepal, is a landlocked country in South Asia. It is bordered by China to the north and by India to the south, east and west. The Himalaya mountain range runs across Nepal's northern and western parts, and eight of the world's ten highest mountains, including the highest, Mount Everest, are within its territory. Geography of Nepal is uncommonly diverse. Nepal is of roughly trapezoidal shape, 800 kilometers (500 mi) long and 200 kilometers (125 mi) wide, with an area of 147,181 square kilometers (56,827 sq mi)⁵.

Nepal is divided into 14 zones and 75 districts, grouped into 5 development regions. The capital Kathmandu lies in the Bagmati Zone of Central Development Region and it is the largest city in the country. The latitudinal and the longitudinal extension of Kathmandu Valley are 85°11'31"E-85°31'38"E and 27°32'13"N-27°49'10"N respectively. The valley lies between the Himalayas in the North and the Mahabharat range in the South. The average altitude of the Kathmandu is 1300 masl. The Valley has got bowl-like structure with high surrounding hills like Phulchoki (3,132 m), Shivapuri (2,713 m), Champadevi (2,400 m) and Nagarjun (2,100 m). The river Bagmati and its tributaries- Bishnumati, Manohara, Dhobikhola, Balkhu, Hanumante Khola and Nakhu Khola drain the Valley in a centripetal pattern covering on the center and existing via the narrow Bagmati gorge near Chovar in southern part of the Valley. Urbanization of the valley commenced in the late 1950s accelerating during the 1970s. According to the population census of 2001, Kathmandu district has the biggest urban population and the highest number of households (ICIMOD, 2007).

⁵ <http://en.wikipedia.org/wiki/Nepal>, assessed on August 10, 2008

Table 4.1: Kathmandu District and KMC at a Glance

	Kathmandu District	Kathmandu Metropolitan City
Area	395 KM ²	49.45 KM ²
Total Population	1081,845 (2001)	671,846 (2001)
Male Population	576,010	360,103
Female Population	505,835	311,743
Household No.	235,387	152,155
Average Household Size	4.6	4.5
Population Density	2,739/KM ²	13,586.37/KM ²
Population of KMC	4.67 Percentage of Nepal	
Position	latitudes 27°32'13" and 27°49'10" north and longitudes 85°11'31" and 85°31'38" east	
Altitude	1300 to 1315 masl	
Climate	Sub-tropical, Temperate and Cool-temperate	
Major Lakes and Ponds	Taudaha and Indradaha	
Population Growth Rate	4.83 percent	

Source: CBS (2006), ICIMOD (2007)

Kathmandu is the capital city of the country and was declared as Metropolitan City on December, 1995. Presently it covers an area of 49.45 square kilometers out of the total area 395 square kilometer of the Kathmandu district. It holds total population of 671,846 (CBS, 2001) though the figure does not take account of floating population and recent migration. So, the population of KMC could be so high than the figure shows.

Table 4.2: Population Growth of Kathmandu Valley in the National Context (1952/54-2001)

Census Year	Total Population of Kathmandu Valley	Growth rate of Kathmandu Valleys Population	Total Population of Nepal	Growth Rate of Nepal
1952/54	410,955	-	8,256,625	-
1961	459,990	0.91	9,412,996	1.40
1971	618,911	3.01	11,555,983	2.07
1981	766,345	2.18	15,022,839	2.66
1991	1,105,379	3.73	18,491,097	2.10
2001	1,645,091	4.83	23,151,423	2.20

Source: Subedi (1996), KVLTCP (2002), CBS (2006)

The average annual growth rate of nations' population was higher than the average annual growth rate of Kathmandu valley's population during 1952/54 to 1961. The rate of change of Kathmandu valley's population however had declined from 3.01 percent during 1961-1971 to 2.16 percent during 1971-1981.

With these data, derivation of population projection for the population of Kathmandu valley is estimated in Annex 2.

Census Year	Total Population of Kathmandu Valley
2011	2,665,047
2021	3,823,887
2031	6,182,684

Population growth as shown by the straight trend line equation shows the very worsening scenario of KMC. With the increase in population it is obviously true that the more environmental problems will be created. The population of Kathmandu valley's population increased by 4.83% in 1991-2001, though due to floating population in Kathmandu valley may be so high than the figure shows.

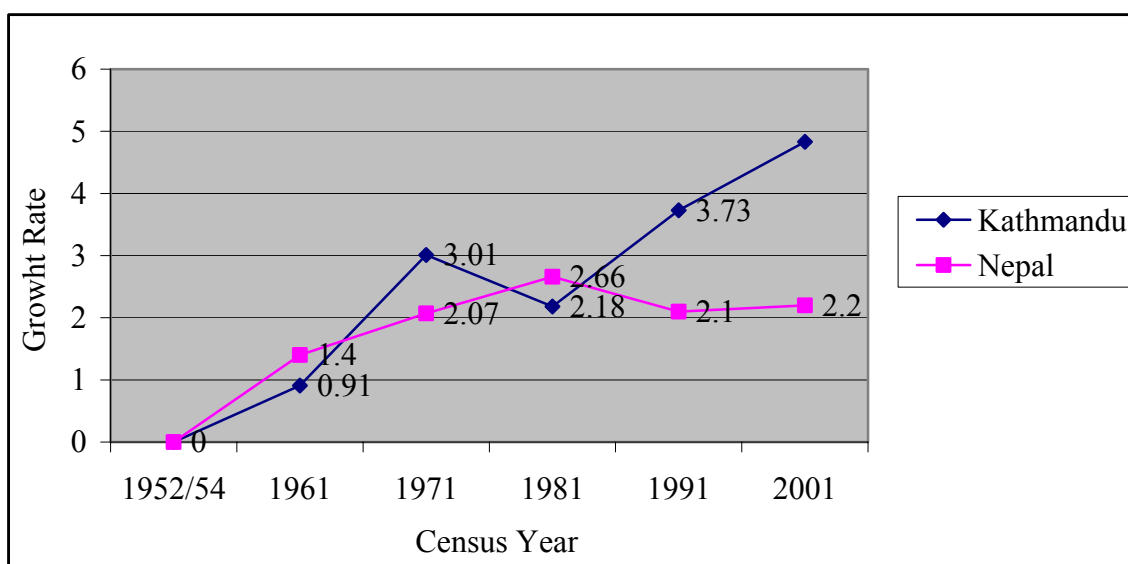


Figure 4.1: Population Growth of Kathmandu Valley in the National Context (1952/54-2001)

Source: Subedi (1996), KVLTCP (2002), CBS (2006)

4.2 Climatic Characteristics of KMC

Kathmandu, the capital city of the country lies in the sub-tropical climatic region. Most of the rainfall occurs during summer and winter temperatures are mild. Occasional snow fall in winter around the valley in hills like Phulchoki, Nagarjun, Nagarkoat etc. makes city dwellers feeling very cold and memorable event for whole year. The major rivers of this area are Bagmati, Bishnumati, Rudramati, Ikshumati etc. The maximum and minimum temperature of this city stands 29°C in June and 1°C in January. Annual mean temperature of Kathmandu valley observed in Airport stations for different years is presented below.

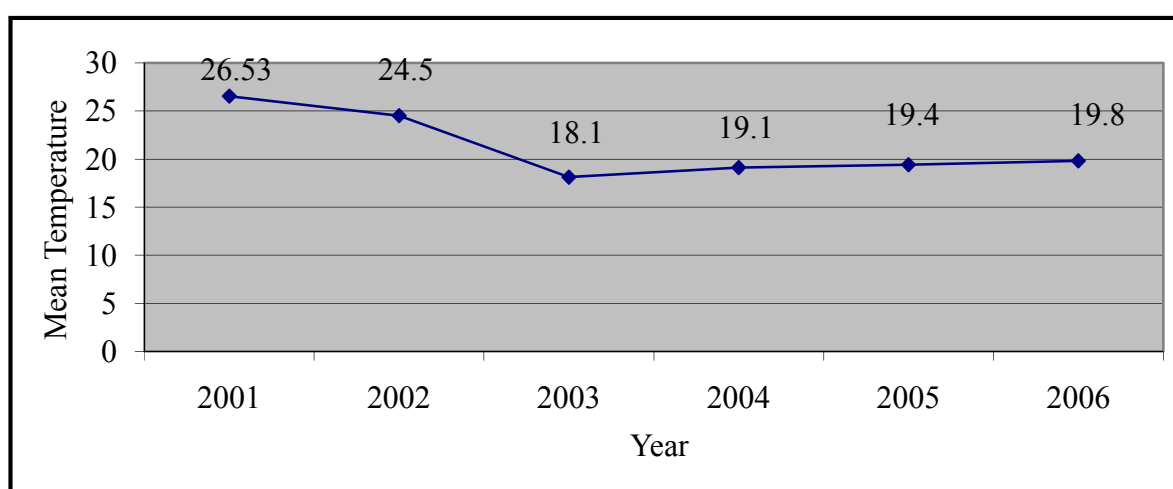


Figure 4.2: Annual Mean Temperature of Kathmandu Valley (2001-2006)

Source: CBS (2006), DOHM (2008)

The highest mean temperature of KMC was recorded up to 26.53 °C in 2001 and the temperature gradually decreased to 18.1 °C in 2003. After 2003 the temperature of KMC is continuously rising up. One of the major reasons for this temperature fluctuation in the KMC is the thermal effect of pollution to trap heat. Before 2001, there were several brick kilns were operated in the valley causing more particle pollution. After 2001 government start regulating the brick kilns to cleaner technology and the thermal effect was decreased. Again with time the increased numbers of vehicles are again contributing for the thermal effect due to particle pollution and the temperature of KMC after 2003 slightly increasing. Another cause to this temperature flocculation in the KMC is precipitation, the temperature in low in high rainfall year and temperature is high in low rainfall year.

Most of the rainfall occurs in summer and the rainfall is partially decreased towards winter. The rainfalls are the major source for the recharge of ground water and springs. The annual rainfall of Kathmandu valley observed from Airport stations is presented below.

Annual precipitation record of KMC shows great variation in different years. This shows the climatic variability in the valley. The pollution level is less in high rainfall year and more in less rainfall year as rain dilutes the pollution from the air and surrounding.

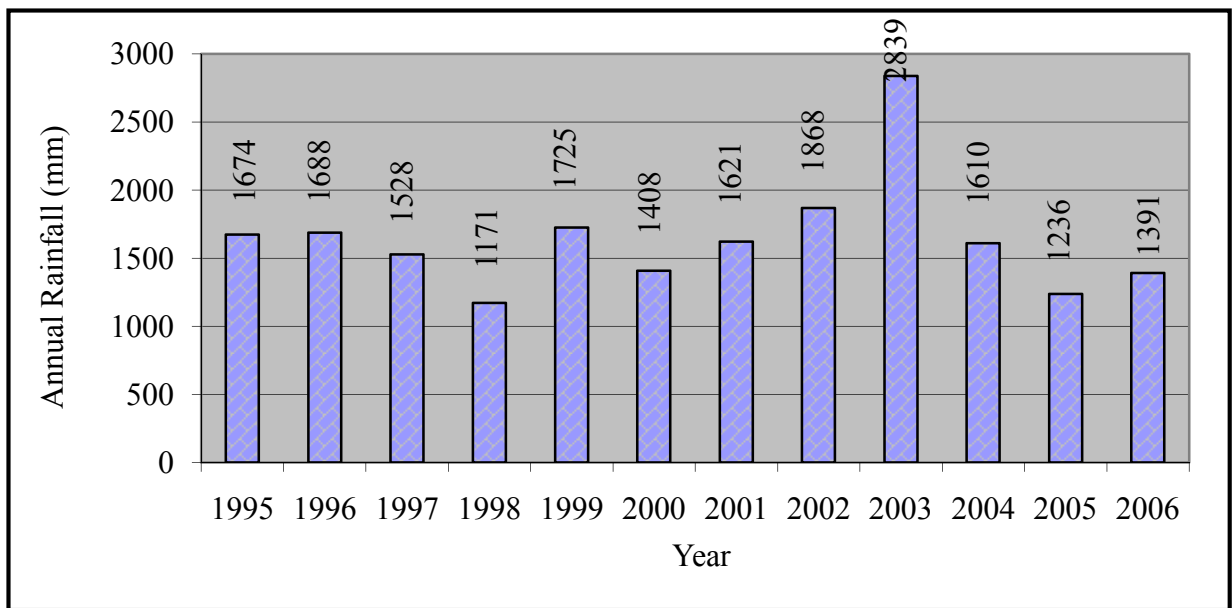


Figure 4.3: Annual Rainfall in Kathmandu Valley (1995-2006)

Source: CBS (2006), DOHM (2008)

The maximum annual rainfall recorded in KMC from 1995 to 2006 was recorded in 2003 in which 2839 mm annual rainfall was received. The average rainfall of this whole period shows 1646.57 mm annual rainfall in KMC. The variation of rainfall in KMC is also associated with temperature of KMC. Precipitation and temperature affects one another.

4.3 Socio-economic Characteristics of KMC

Kathmandu city contains people from different background of the country. There is so vast interconnection and linkages between populations residing in the KMC. No any area is free from the mixing of population. This is creating very complex socio-cultural phenomenon in the valley.

This is due to the lack of opportunity in the remote areas and physical facilities available in the valley. From the ancient times, the city is being importance for different reason as it was heart of cultural centre, way of trade between China and India and after *Sah* dynasty it is the capital city of the country. Presently the parliament has declared Nepal as federal democratic country.

The traditional ethnic groups of KMC are *Newari* community and the major festivals are *Dashain, Tihar, Gaijatra, Ghodejatra, Indraajatra, Gathemangal, Teej, Shiva Ratri* etc. The major religions occupied by the people of KMC are Hindu and Buddhist followed by Islam, Christians and others (Subedi, 1998).

Between 1984 and 1998, circa 6,300 hectares (ha) of fertile and productive agricultural land were lost to urbanization, industrialization, and quarrying of sand, soil, and stone. Between 1984 and 1994, the valley's urban area increased from 3,096 to 8,378 ha and 5,282 ha of fertile agricultural lands were lost to urbanization (MOPE, 1999). It is estimated that more than half of the valley's 'A' grade land; i.e., 43% of the existing agricultural land, will be lost to urban sprawl by 2010 (HFA 1991, MOPE 1999).

Squatter settlements are another aspect of urban settlement. In 1985, there were 17 squatter settlements in the valley with a total population of 3,000 (MOPE, 1999). In 1994, there were 33 squatter settlements with a total population of 15,000 (Thapa, 1994). Sixty per cent of these squatter settlements are on public land and 40% are in public buildings such as temples and traditional free shelters provided by the community called '*Patis*' (Rabenau, 1990). A survey of 24 squatter settlements carried out by students from Trondheim university in 1988 revealed that 54% of the settlements were located in urban areas and 46% on river banks; 66% of the houses had permanent structures and 52% were without tap water; and 63% had no electricity and 66% had no toilet facilities (ICIMOD, 2007).

Chapter V

RESULT AND DISCUSSIONS

5.1 Resident Status and General Information about KMC

The total population of KMC is so high not only due to natural growth but because of in-migration from the satellite areas. People are entering into the city day by day for the hope of better education, search for job, hope of better life and some people are also forced to move from birth place as there was civil war in Nepal in last decade, which directly and indirectly forced to move several people in urban areas from the village. After the completion of school education, there are very few number of higher education institutions in the rural area. Some established higher education institutions are also not well equipped with qualified manpower. There is lack of employment opportunities in the rural areas and people are migrating towards urban areas day by day with the hope of getting better employment opportunities and better education opportunities.

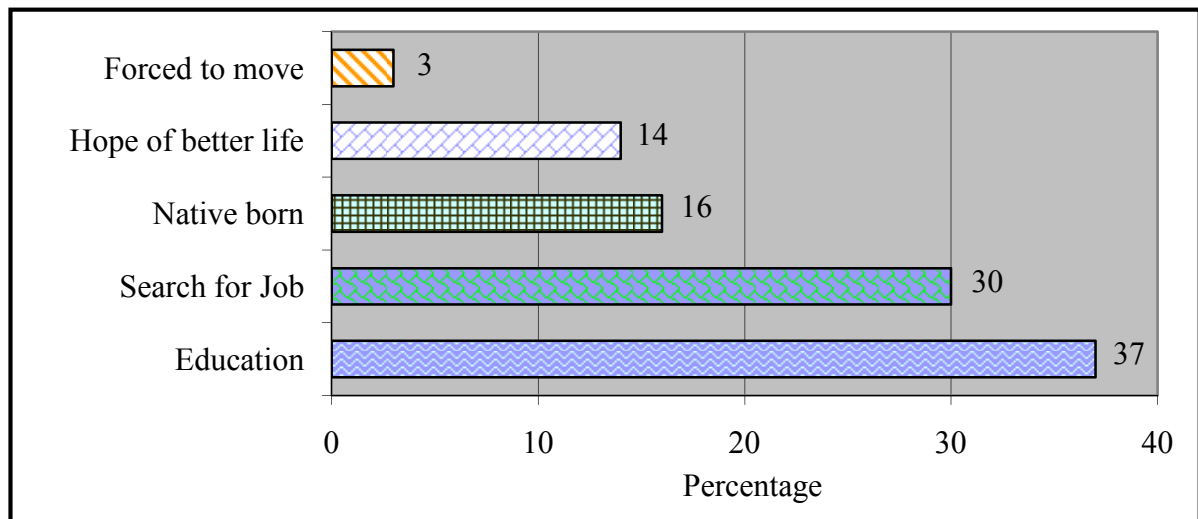


Figure 5.1: Causes of Migration to the KMC

Source: Field Survey (2008)

In the survey, the question was asked about the cause of migration and it was found that 37% of the respondent respond that they are migrated for the educational facility, 30% respond about the search for job, 16% of the respondents were native born, 14% respond about the hope of better life and the rest 3% were forced to move from their birth place to KMC.

The people are not aware about the environmental quality of KMC but they claim that the pollution level of KMC is higher than the value of World Health Organization (WHO). The people gave mix response that 56% of the respondents respond that water pollution is the major pollution which harms human health; in contrast 31% of the respondents respond that air pollution is the major factor and 13% respondents respond that solid waste pollution is the major factor for the adverse effect on human health.

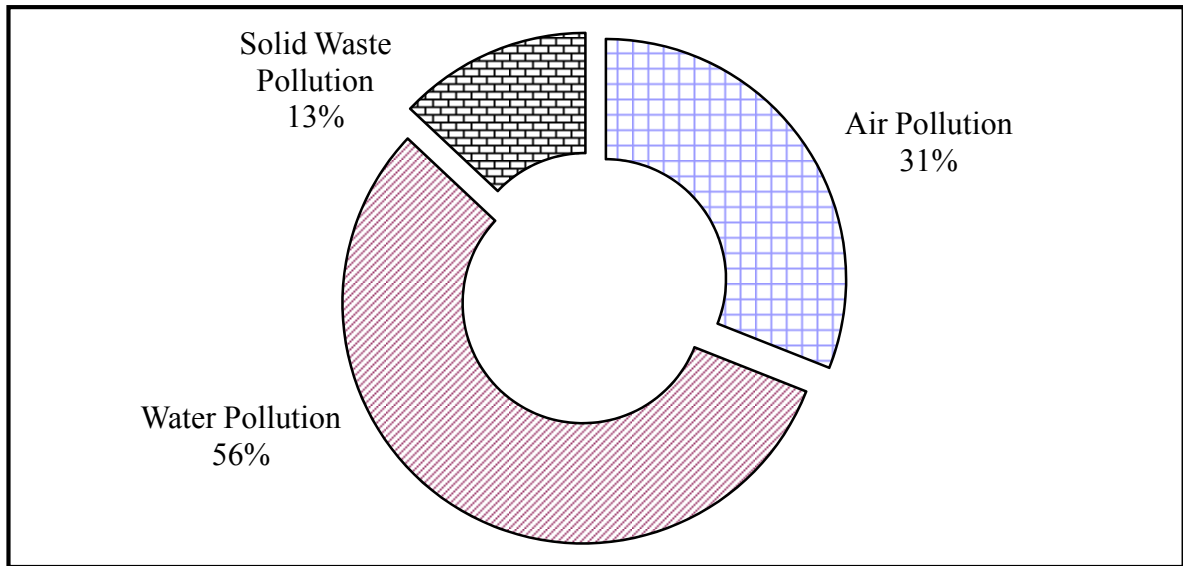


Figure 5.2: Knowledge on Pollution Harmful for Human Health

Source: Field Survey (2008)

About the management responsibility of waste and pollution control general public and management students/professionals focus on the strict government policy where as health professionals/students and environmental professional/students focus on the individual behavior. In the study it was found that Government policy is also not suitable for the effective management of environmental quality. Due to lack of awareness and waste collection and disposal facility there is not possible of eliminating environmental problem without creating proper awareness to the residents of KMC.

5.2 Solid Waste Management in KMC

Waste can be defined as a material worthless to somebody and which the person wants to get rid of. It is a valuable resource material at wrong place.

Definition of Waste:

Waste is a resource material and a source of danger as well, depending upon situations.

Resource: Waste for one person or purpose may be a material resource for other person or purpose.

Source of danger: Waste may be a source of danger to natural environment and public health, if not managed properly (Tuladhar, 2007).

Solid waste can be defined as a pollutant (i.e. cause) of air, water and soil pollution with implications on public health. It can be also an aesthetic or visual pollutant. It is primarily an urban problem in Nepal, with localized problems in some rural areas of socio-cultural/religious importance, trekking routes and tourist destinations. The general solution of solid waste management is safe and environmentally sound SWM with efficient collection & disposal service (Tuladhar, 2007).

Average solid waste generation in the KMC is increasing day by day. It is due to population pressure and the changing consumption behavior. People are using more junk food and packed food day by day and this is also causing increase in solid waste generation. Beside this, the construction of new building, demolition of old building and cleaning of urban road contribute more on the municipal waste generation. Daily solid waste generation in KMC is:

Table 5.1: Daily Solid Waste Generation in KMC

Waste generation ratio	Year							
	2000	2001	2002	2003	2004	2005	2006	2007
Domestic Waste Generation (l/d/p)	1	1	1	1				
Total Domestic Waste Generation (m ³ /day)	700	725	730	750	765 [#]	780 [#]	795 [#]	810 [#]
Street Waste Generation* (m ³ /day)	70	72.5	73	75	76.5	78	79.5	81
Commercial Waste* (m ³ /day)	70	72.5	73	75	76.5	78	79.5	81
Waste Generation from Neighboring Cities* (m ³ /day)	70	72.5	73	75	76.5	78	79.5	81
Total Waste Generation (m ³ /day)	911	944	949	975	995	1014	1034	1053

* Assumed 10% of Domestic Waste

[#] Assumed as linear growth of waste quantity

Source: CBS (2006), KMC, (2008)

The efficiency and collection of solid waste is increased in the recent years due to the involvement of private sector in the solid waste collection. In the year 2003 the solid waste collection by private sector was 243 m³/day following 55 m³/day collections in 2000.

Another important factor for the effective management of solid waste is the growing awareness to local people. The waste generation ratio is increasing but the total amount of waste is not increased in that ratio. People are practicing vermin composting and pit composting to biodegradable waste. Only the rest waste is collected by collectors. In this matter the average waste generation ration from one family is found to be 2-3 kg/day and 17% people are using pit composting and vermi-composting in their home/yard. The rest 83% of the population dispose solid waste through collector. No anyone respondent respond about the throwing of solid waste in open space and river bank.

People are not classifying the biodegradable and non-biodegradable waste and this is causing the increase in waste quantity. People are spending Rs. 50.00-Rs. 100.00 per family to manage and collect the waste generated in their home. The general people are aware that the hospital waste is harmful, they do not know the cause why the hospital waste is dangerous but they focus that the hospital waste should not be mixed with other solid waste and that should be treated separately. Environmental/health professionals respond that hospital waste may be hazardous as they can transmit disease and needle and blade can make wound to the waste management workers.

The major constraint for the solid waste management is on the collection mechanism and dumping site. Another important factor for the solid waste management is the awareness level of local people. Without creating awareness to the local people, solid waste management is not easy with only command and control approach.

Asking about the major constraints for solid waste management almost all i.e. 99% respondents focus on the waste collection mechanism if not effective, 79% of the respondent focus on the dumping site for the solid waste management, 44% gives emphasis on the awareness level of local people and as the major constraints for the solid waste management. Some respondents (21%) also gave their view on the mixing of hospital waste in other waste is also adding the problem for solid waste management

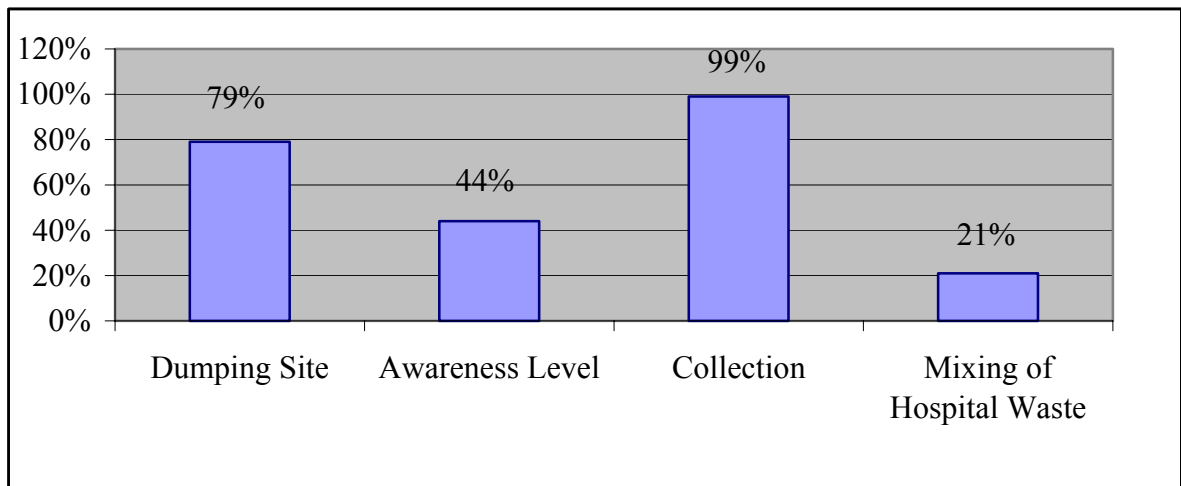


Figure 5.3: Major Constraints for Solid Waste Management

Source: Field Survey (2008)

The response on proper management of garbage and solid waste was received in the study as it is mandatory to separate degradable and non-degradable waste (37%), and proper collection and management facility (46%), practice of decomposition (10%) and increase in the fee for solid waste collection (5%).

For the effective waste management in KMC question was asked with different options. The people gave mix response about the solid waste management in KMC. Most of the respondents (59%) responded about the reduction of waste quantity, 34% about the recycle of waste and 7% about the reuse of reusable waste.

5.3 Drinking Water Supply Situation of KMC

Kathmandu Valley has a number of traditional, stone water-spouts: 237 in Kathmandu (Amatya, 2006). These water spouts are evidence of the engineering skills of the past. The spouts are located within rectilinear pits built into the ground and supplied through ‘Raj Kulos’ (state canals), which met irrigation needs using local water sources. Even though they received state sanctions, they were decentralized in operation. Modern construction and the falling water level in the valley have led to the drying up of many of these stone water spouts. Distribution of improved drinking water started around 100 years ago during the period of the Rana Prime Minister, Bir Shamsheer. Kathmandu’s first drinking water system, ‘Bir Dhara’, was built at that time. The Bagmati River and its tributaries are the valley’s principal river

system and its springs are the main source of drinking water for residents, particularly for greater Kathmandu – the urban core of the valley (ICIMOD, 2007).

Not all households and people in the Kathmandu valley receive safe drinking water. The dependency of households for drinking water on a variety of sources is different within Kathmandu valley as there is more access to drinking water supply in core area of valley i.e. urban area and the satellite areas of Kathmandu valley lacks the supply of drinking water supply. The dependency in rural areas is more on well/kuwa like natural sources and also they depend mostly on public/neighbor's tap for drinking water. The summary of water dependence can be seen from below Table.

Table 5.2: Main Source of Drinking Water in Kathmandu Valley

Place of Residence	Percent of households by type of main source of drinking water							Total
	Own tap	Public/neighbor's tap	Tube-well/borehole	Well/Kuwa	Tanker water	Mineral water	Others	
Urban	81.7	7.8	5.5	1.8	1.5	1.1	0.6	100
Rural	35.2	54.4	2.1	5.1	0.5	0.0	2.7	100

Source: CBS (2005)

Water borne disease is so high in the Kathmandu valley like dysentery, cholera and so on. The people are not aware about the necessity of testing water quality which they are using. The piped water is also not safe all the time and there are so many contaminations in ground water. Department of Water Supply and Sewerage, Water Quality Section tested 56 water samples on 2005 from different areas in Kathmandu valley out of which 21 were found to be contaminated with arsenic. Arsenic is very harmful for the human health. Beside this, there are so many mineral contaminations observed in ground water, the adverse effect depends upon their contamination percentage. The higher the contamination, the higher will be the adverse effect to human health. People are forced to use that water because there is not easy access to the alternative water source.

Majority of the people depend upon municipal supply and ground water sources for drinking water. Only few people are dependent upon stone spout and tanker supply for drinking water.

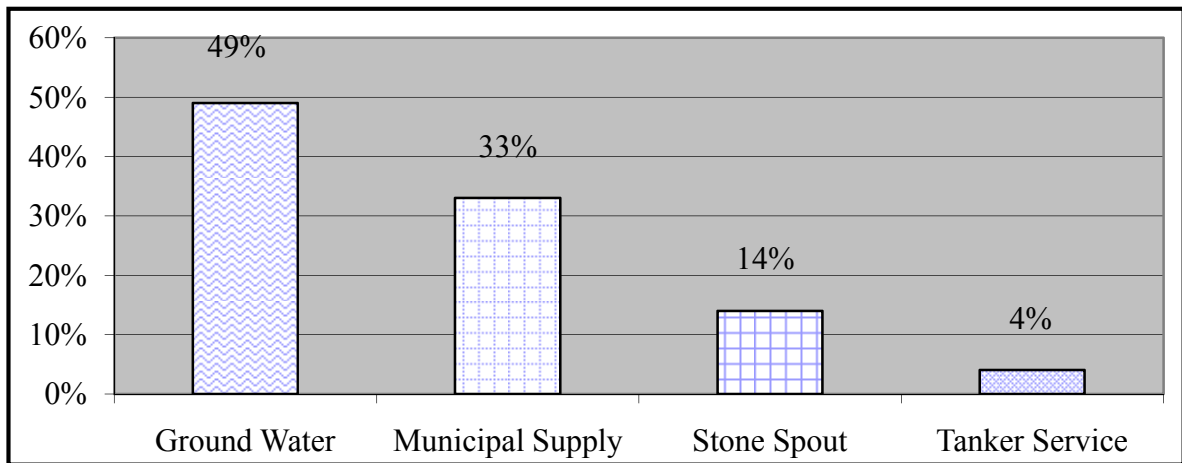


Figure 5.5: Dependency on Drinking Water

Source: Field Survey (2008)

In the survey 49% of the respondents respond that they are dependent upon ground water, 33% respond about the dependency on municipal supply, 14% respond on the dependency on stone spout and rest 4% respond on the dependency on tanker supply for the drinking water.

Though CBS records shows the dependency on municipal supply is 82% in the survey only 33% respond about the dependency in municipal supply. Similarly CBS record shows less than 10% people dependent upon ground water sources but in our survey almost 50% (i.e.49%) of the respondent replied as the dependency upon ground water. The major cause may be the survey was focused mostly in the total use quantity.

People are using water without testing the water quality and they are not sure about the quality of water they are using but they are hopeful it to have been potable. Most of the people are using any one of the water treatment like boiling, filtering and use of chemical for drinking water. They are ready to pay more than 100% if they can get regular and sufficient supply of good quality of water.

The people focus that the ground water and municipal supply are both equally contaminated from their general assumption. They focus on the increase of fees and regular supply of water for the effective management of water supply. They also emphasis on the regulation of ground water extraction as there is limit of ground water availability.

5.4 Air Pollution Level and Control in KMC

“Air pollution” refers to the accumulation of any substances in the air in sufficient concentration to effect man, animals, vegetation or other materials. Adverse impacts of air pollution depend on the nature, concentration, and duration of exposure. Main anthropogenic air pollutants of concern are Particulate Matter less than 10 micron (PM₁₀), Sulfur Dioxide (SO₂), Oxides of Nitrogen (NO_x), Carbonmonoxide (CO), Lead (Pb), Ozone (O₃) and Hydrocarbons (HC).

The World Health Organization (WHO) estimates that air pollution causes approximately 3 million pre-mature deaths per year. Of this, about 800,000 deaths are due to outdoor air pollution (150,000 in South Asian cities) (CEN, 2003).

Compared to other Asian cities, Kathmandu is particularly vulnerable to emissions of air pollution. Kathmandu valley is surrounded by 500 m - 1000 m high hills, and low wind speeds in the valley create poor dispersion conditions, predisposing Kathmandu to serious air pollution problems. Several studies (MOEST 2005, CEN 2003 etc.) have showed that the quality of the air in Kathmandu Valley has been deteriorating over the last decades. An important factor causing air pollution is the vehicles, contributing significantly to air pollution through exhaust emissions, and through persistent re-suspension of dust particles from the poorly maintained roads of the Valley (MOEST, 2005).

With focusing on the ambient air quality of Kathmandu valley, HMG/MOPE initiated air quality management program jointly with the Danish Government (DANIDA) taking initiatives to conduct the programs that can contributed to a reduction of the air pollution in Kathmandu Valley. From 2002 HMG/MOPE and DANIDA Environmental Sector Programs Support (ESPS) implemented long-term air quality monitoring program in Kathmandu Valley to increase public awareness through continuous publication of the population's exposures to various important air pollution and to provide a basic data base for decision makers to perform air quality management in Kathmandu Valley.

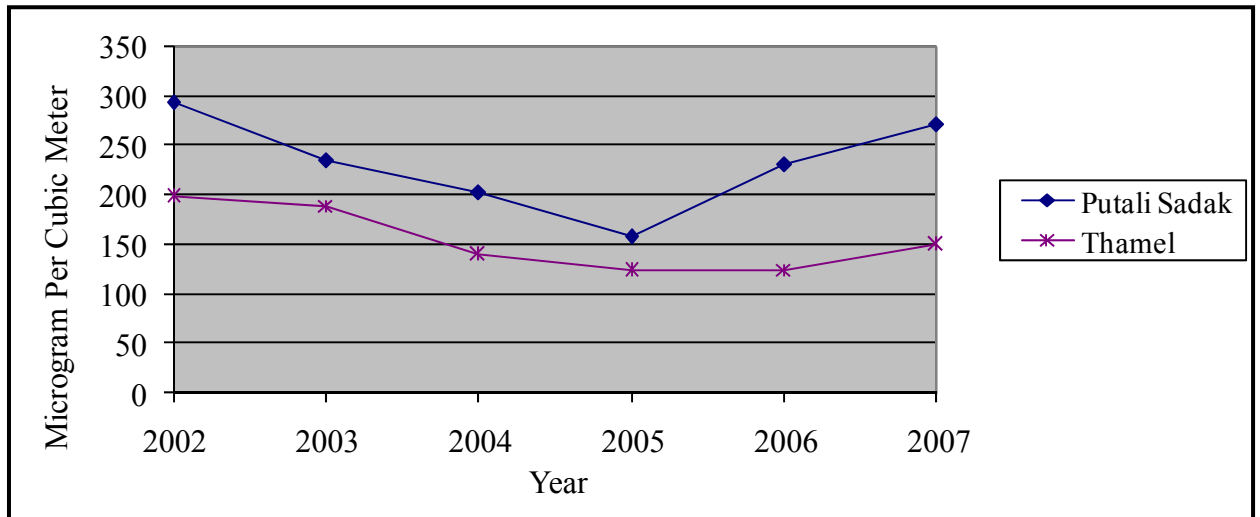


Figure 5.6: PM₁₀ Level in Air of Kathmandu Valley

Source: MOEST (2008)

Kathmandu valley is especially vulnerable to air pollution due to rapid and haphazard urbanization and significant increase of vehicular transport on narrow streets. Furthermore, the bowl like topography of the valley restricts wind movement and retains the pollutants in the atmosphere. The air quality of Kathmandu Valley shows a clear annual pattern of variation as it is especially bad during the winter season when inversion, where cold air flowing down from the mountains is trapped under a layer of warmer air, creating a lid, which keeps the pollutants sealed within the valley. During the dry season, the daily concentration of PM10 exceeds the National Ambient Air Quality Standard (NAAQS).

A number of initiatives have been taken by MOPE since 1999 in order to improve the air quality. Introduction of Nepal Vehicle Mass Emission Standard (EURO-1) has ensured that less polluting vehicles have been imported since 2000, and a number of highly polluting vehicle types have been banned in Kathmandu Valley. Another important step taken by the government is to ban the new registration of highly polluting brick kilns by September 2004 (MOEST, 2005).

Clean air is vital for human survival. A normal human being breathes about 22,000 times every day and takes in approximately 25 kg of air to sustain its requirement of oxygen (CEN, 2003).

Ambient air quality of Kathmandu valley is different in different season. The pollution level is reduced with the start of monsoon in Kathmandu valley as rain generally cleans down the air pollutants allowing Kathmandu people to breath in fresh air.

The major contributors for air pollution in the KMC are vehicle and transport and the poor road condition is playing a catalytic role in the contribution of air pollution. Different types of industry in the valley are also polluting air through the industry emission as there is not proper monitoring mechanism for air filter and emission standard.

Asking about the major contributors for air pollution in the survey, 48% of the respondent respond that vehicle and transport are the major contributors for air pollution, 37% gave emphasis on the poor road condition, 11% respond that the industry are the major source for air pollution and the rest 4% respond on the haphazard solid waste dumping as the major contributors for air pollution.

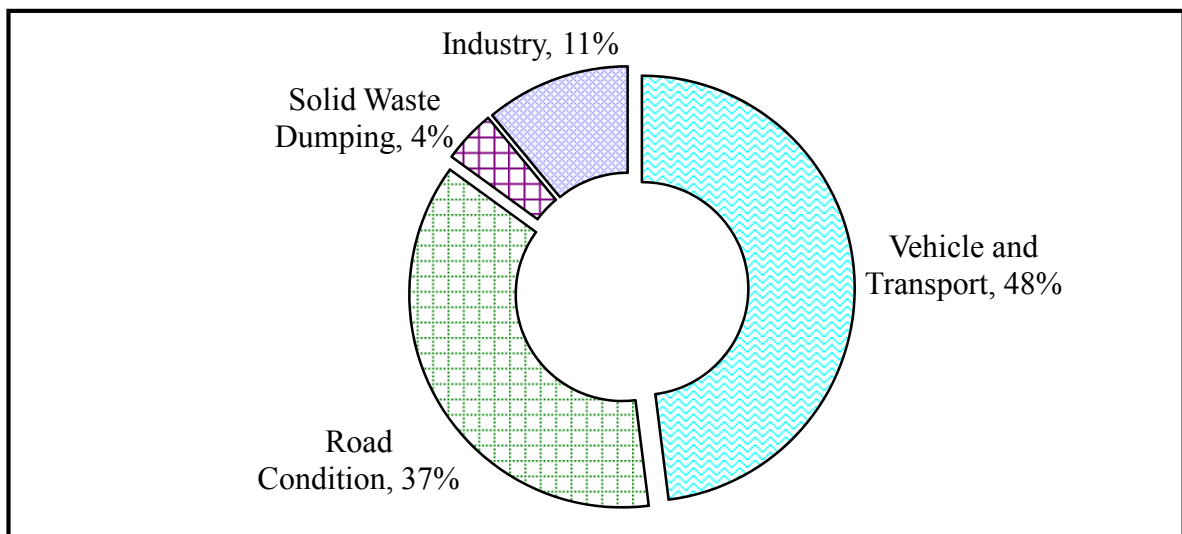


Figure 5.7: Major Contributors for Air Pollution

Source: Field Survey (2008)

About the band of polluting vehicles in KMC and allow them outside valley, people gave mixed responses that some of them response that the decision is good and some response that same condition will arise in the near future in the outside valley. They also focus on the stop of private vehicle registration in KMC and proper city bus services.

To control air pollution in the KMC responses received on band polluting and old vehicles from the city is 24%, mandatory air filter in industry emission is 17%, improve the condition of road and make green belt is 51% and adoption of polluter pay principle is 8%.

5.5 Sound/Noise Pollution Level in KMC

World Health Organization (WHO) has specified the limit for sound/noise pollution for road traffic as 70 dB. The sound/noise pollution levels of KMC from road traffic exceed the limit in day time and night time the noise level is almost is equal to WHO level (NHRC, 2003).

The sound/noise pollution level exceeds the WHO guideline value in most of the parts of KMC. The observed maximum noise levels is 109 dB and the minimum is 103 dB in selected 6 areas. The major portion of sound/noise level in the urban areas is contributed by traffic and pressure horn of the vehicle. The urban areas of developing country are mostly vulnerable to the sound/noise pollution as there is not enough restriction and monitoring mechanism to control the sound/noise pollution.

S.N.	Places	Noise Levels (dB)	WHO Guideline (dB)
1	Putalisadak	105	70
2	New Baneshowr	108	
3	Kalanki	109	
4	Koteshowr	104	
5	Narayan Gopal Chock	106	
6	Tripureshowr	103	

Source: RONAST (2003)

In the survey, people respond that it is necessary to band the pressure horn within valley and hospital and schools should declared and strictly monitored as horn restricted area.

The people respond that it is not necessary to expand KMC rather decentralization and population growth should be controlled. Respondents give emphasis to translocation of the carpet, garment and other industry from the crowded city and no permission to open new industry inside KMC.

About the effect of sound/noise pollution to the public information collected in summarized in chart below:

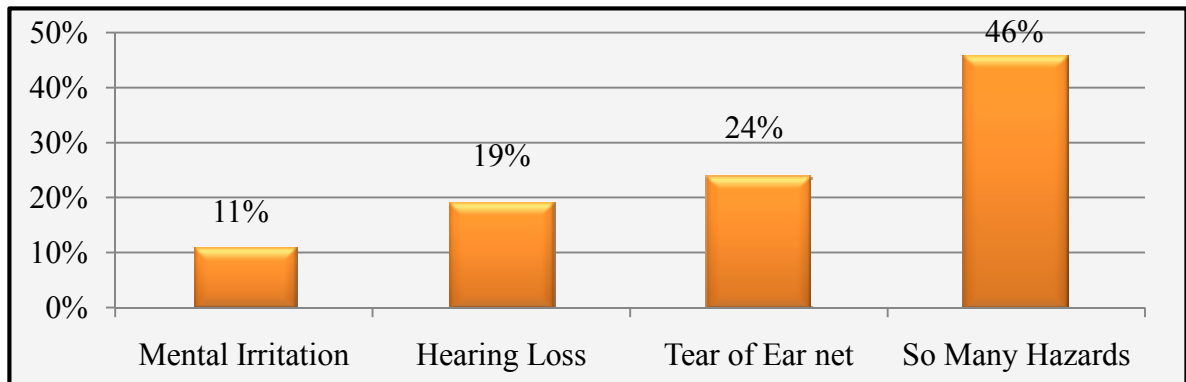


Figure 5.8: Effect of Sound/Noise Pollution

Source: Field Survey (2008)

46% of the respondent respond that there are so many hazards of sound/noise pollution, 24% gave emphasis on tear of ear net, 19% on hearing loss and rest 11% respond that sound/noise pollution cause mental irritation to the people.

5.6 Management of Population Growth of KMC

Due to the various opportunities population pressure is growing day by day in the KMC. People entered into the KMC seeking opportunity and along the time they plan to settle permanently in the city. Responses to control the population growth in the KMC received as:

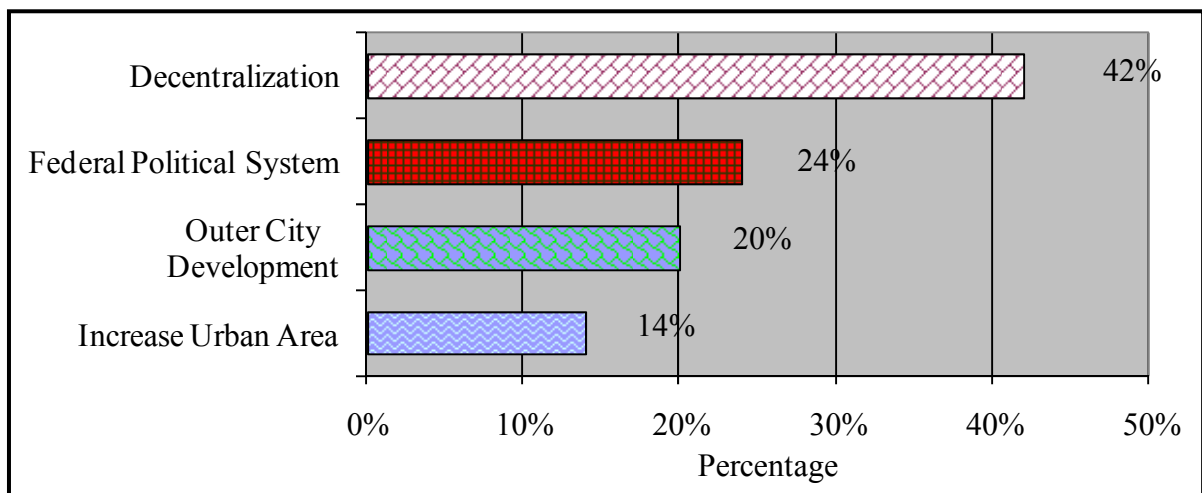


Figure 5.9: Option to Control Population Pressure in KMC

Source: Field Survey (2008)

In the survey 42% of the respondent respond that decentralization is needed to control population pressure in KMC, 24% respond on the requirement of federal political system. Similarly, 20% respond on outer city development and only rest 14% respond on the increase in urban area.

People of KMC are not satisfying with the activities of I/NGOs working in the sector of environmental management of KMC. Though they give green signal on the activities carried out by NGOs jointly with mobilization of community to control the pollution of Bagmati River. They mostly focus on the activities of I/NGOs should be diverted to awareness creation to the local people and launching real program with coordination among line agencies.

5.7 Discussion

Population growth is increasing at an alarming rate and the resource consumption and environmental degradation is in fast pace. Agricultural lands are being converted to concrete city day by day and river bank and open space are being used for solid waste dumping. There is no clear provision and monitoring mechanisms for the new construction and solid waste management.

Solid waste management is the most critical issue for the growing cities particularly in the developed countries where there is lack of technology and awareness to decrease the solid waste generation at the source and also there is lack of technology to reuse, recycle and resource recovery.

Drinking water supply is not sufficient and there is not any rule and regulations for the ground water extraction. Water quality is poor in many parts of the city.

Particulate matter and other anthropogenic pollution is so high in ambient air and the quality of ambient air is so poor. Though quality of air is first priority for the human life, it is not of good quality in the KMC and if the situation is not urgently addressed the air quality will be poorer in future.

Sound/Noise level is higher than the WHO guideline and horn restricted area are not free from horn of vehicles and there is still use of pressure horn within the city. The noise level is causing severe health impact to the local people.

There is urgent attention needed for the management of population growth in the city. The population growth rate in the valley is so high and it has already crossed the threshold limit. The management situation will be more problematic in the future if the management of population in KMC is not urgently started.

Chapter VI

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary

People are not aware about the environmental condition of the city and they are less willingness to pay for the environmental management. People are also not satisfied with the government initiation and regulation for the environmental management. The major issue in this matter is there is not clear responsibility handed over till now to monitor environmental compliances and the ministry of environment is added to the other ministry from time to time. Presently, ministry of environment is under Ministry of Environment, Science and Technology (MOEST). The major findings of the research study are summarized below.

Table 6.1: Summary of Findings of the Research Study

Objectives	Findings
Current situation of population growth and environmental parameters	<ul style="list-style-type: none">- Population growth at an alarming rate- Environmental degradation is in fast pace- Water supply system is not adequate and no timely available of water- Noise level is higher and noise restricted area are not protected by noise- Air pollution level is high but efforts have been taken to control air pollution- Solid waste problem is the major problem of the KMC and lack of sustainable management of solid waste
Public perceptions and reactions on environmental	<ul style="list-style-type: none">- People from all the sector are not aware about the environmental problem of the KMC- They are not satisfied with government policies as there is not strict regulations for the environmental management
Existing management system and recommendation	<ul style="list-style-type: none">- Management system is weak and poor to implement and monitor environmental rule and regulation compliances- Polluter pay principal and compulsory environmental rule compliance is necessary

6.2 Conclusion

The study on Population Growth and Environmental Degradation in the Kathmandu Metropolitan City intended to assess the current situation of environmental condition of KMC. Environment influences population and that population influences environment. So, population is responsible for the environmental influences or environment is responsible for the population could be matter of further research. Environmental changes cannot remain isolated from human activities and behavior. The rapid growth of population in KMC is the main factor for the alteration of population-environment balance which is causing severe environment degradation of the city. More interestingly, it can be said that there is vast interconnection between population and environment on which development factor intervenes.

Environmental degradation mostly harms the poor and marginalized community as they will be solely dependent upon environmental goods and services. The slums and squatters residing along the bank of Bagmati River are mostly suffered from the pollution and waste disposal into the Bagmati River. They are forced to use the ground water and stone spout nearby Bagmati River which could be directly contaminated with the River water. Similarly, the rich communities use the private vehicles and get benefit but the poor people who use public transport or walking have to bear problem raised from the pollution. There is necessity of Polluter Pay Principal (PPP) for the control and management of environment.

Based on the information, discussion and analysis following conclusions are made regarding the population growth and environmental degradation of the KMC:

6.2.1 General Information

- a. People have migrated in the city for the hope of better employment opportunity and education
- b. No people are sincere and aware about the environmental condition of the city
- c. Individual practice and government policy are equally responsible for the environmental quality improvement of the country
- d. There is lack of monitoring mechanisms for the compliance of environmental rules and regulations

6.2.2 Solid Waste Management

- a. People are not separating bio-degradable and non-biodegradable waste in their home
- b. Composting of bio-degradable waste in home is not practiced in residence
- c. Mixing of hospital waste into the solid waste is adding more problem for the solid waste management
- d. 4R principal of waste management is not in practice

6.2.3 Drinking Water Supply

- a. People are not getting sufficient drinking water and the supplied water is also not potable at all the time
- b. Ground water of the valley is contaminated with mineral components but people do not have alternative for not use the ground water
- c. People are agree to pay more for the regular supply of potable water

6.2.4 Air Pollution Level

- a. Vehicular emission and industrial emission are the major two factors for the contribution of air pollution
- b. Old vehicle and three wheeler shifted from valley are creating environmental problem in the flat land of Terai
- c. Adoption of polluter pay principle and mandatory air filter in industry is necessary for the control of air pollution

6.2.5 Sound/Noise Pollution Level

- a. Sound/noise pollution level exceeds the WHO guideline in most part of the city.
- b. Pressure horn should be banned in city and horn restricted zone should be clearly followed
- c. Sound pollution can create mental irritation along with several problem

6.2.6 Population Growth and Management

- a. Development of satellite city and decentralization of power is necessary for the control of population growth in the city

- b. Organizations working for the environmental sector should launch real program for awareness creation
- c. Strict law and compliance monitoring is required for the management of environmental condition of the city

6.3 Recommendations

Based on the information, discussion, analysis and conclusions following recommendations are made for the improvement of environmental condition of the KMC:

6.3.1 Recommendations for the Control and Management of Population Growth and Urbanization

- a. Re-locate industry and other employment generating company to satellite areas. For this the government should make clear provision of pay off of tax and other revenue for the re-location of the industry.
- b. Decentralize power and establish major offices in the regional level. Government has declared Nepal as federal republic country, in this context the government offices and other facilities like health, education, and employment generating industry should be established and equally distributed to the federal level.
- c. Stop operating of large industry in the valley and re-locate them outside valley.
- d. Building code and other facilities for the urban development. New building construction and other facilities establishment should be regulated.

6.3.2 Recommendations for the Management of Solid Waste

- a. Launch awareness program from mass media.
- b. Mobile solid-waste collection center establishment.
- c. Mandatory law for the public to separate bio-degradable and non-biodegradable waste.
- d. Provide incentive for the decomposition of bio-degradable waste. Like, government can buy the compost fertilizers produced in slightly high rate and it can be supplied to farm land.
- e. Generation of gas from waste could be another opportunity from solid waste.
- f. Solid waste collection fees should be minimized or stop for the effective management of solid waste.

- g. Handover of solid waste management to the private sector. Government can be act as regulating and monitoring body.
- h. Proper awareness program to stop NIMBY and BANANA syndrome for the effective management of solid waste.
- i. Proper adoption of 4-R principal of solid waste management helps to solve the problem.
- j. Proper regulation and monitoring mechanisms for the effluent standard.

6.3.3 Recommendations for the Protection and Management of Safe and Pure Drinking Water

- a. Kathmandu Valley Drinking Water Limited should give top priority to check and control of water leakage from the old pipelines.
- b. Replace of old water pipelines with new ones.
- c. Protection of stone spouts.
- d. Regulation of ground water extraction like fees, maximum extraction per day etc.
- e. For the potable water focus on treatment should be given from the reservoir up to the end user tap.
- f. Public awareness on the minimization and reuse of water should be focused to get rid of water scarcity too some extent.
- g. Collection of water from stone spouts at night time will help to minimize water demand of certain location around stone spout.
- h. Extraction of ground water by Water supply authority and regular supply after treatment will help to reduce water borne disease.

6.3.4 Recommendations for the Control of Air Pollution

- a. Establishment of Polluter Pay Principal (PPP).
- b. Vehicle failed to meet the national standard should be strictly removed from operating in the valley.
- c. For the problem of particulate matter in air the road should be repair timely so that soil dust will not be added to the air.
- d. Effective air filter should be made compulsory for the vehicles.
- e. Promote environment friendly vehicles like electric vehicle, gas vehicle, battery vehicles, bicycles, super bike should be given priority and the tax should be pay off for these vehicles.

- f. Industries like Brick and dying causing more pollution should be removed from the valley.
- g. Plantation along the road side could be another advantage for the control of air pollution.
- h. Odd day odd number vehicles and even day even number vehicles and so on can be applied for the control of more traffic in the road, which will ultimately reduce to the air pollution.
- i. Ensure the use of clean fuels.
- j. Proper regulation and monitoring mechanisms for the emission standard.

6.3.5 Recommendations for the Control of Noise/Sound Pollution

- a. Banned pressure horn within the valley.
- b. Strictly implement horn restricted zone and strengthen monitoring mechanisms for the noise pollution.
- c. Noise standard should be followed by all vehicles from motorbike to public buses.
- d. Develop new parks and open space which filter sound and reduce noise pollution.
- e. Electric vehicles also reduce sounds in operation as comparing other petroleum vehicles. So promotion of electric and cleaner vehicles could be an added advantage for the noise/sound pollution control.

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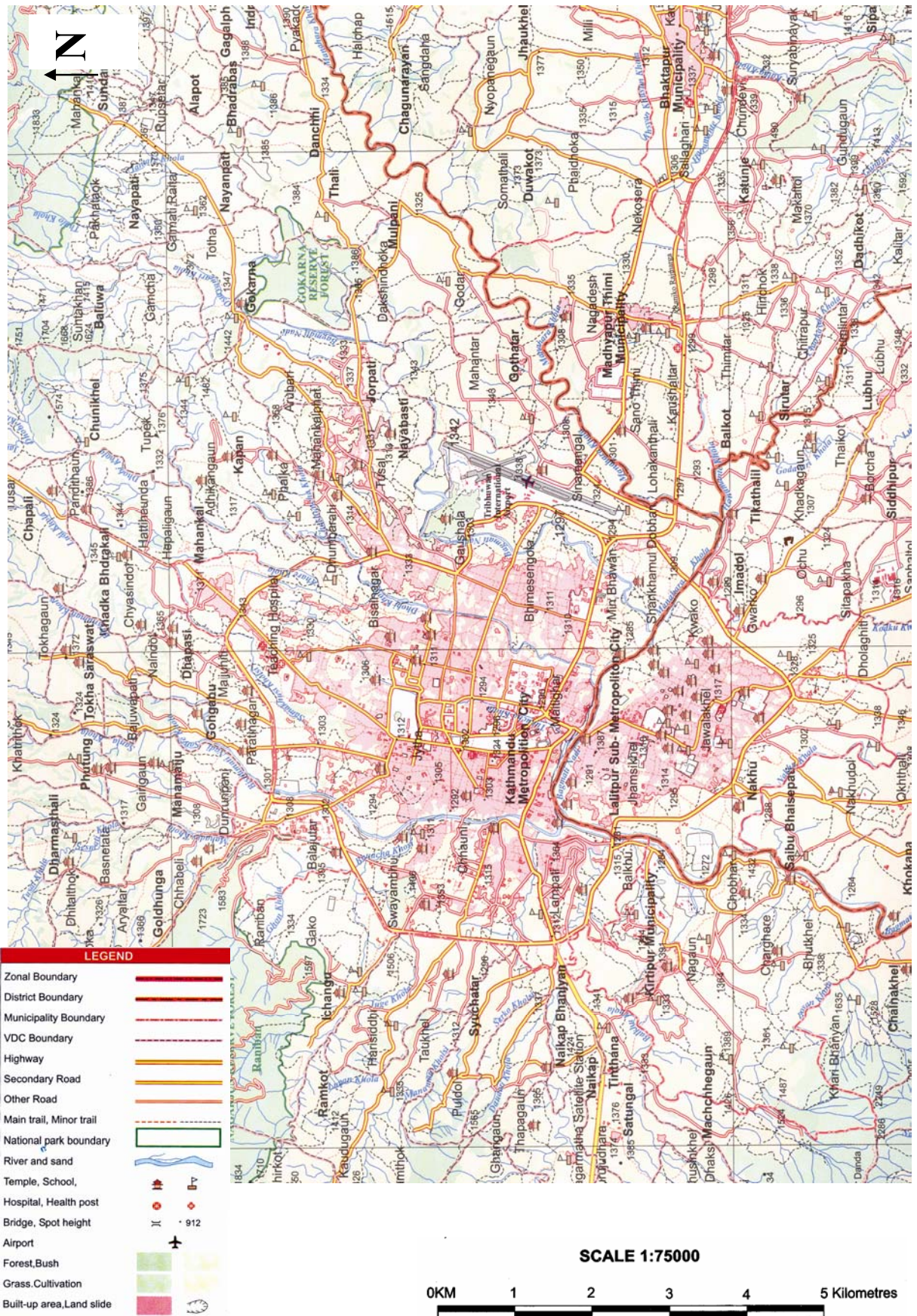
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Annexes:

Annex 1:

MAP OF STUDY AREA



Annex 2:

**DERIVATION OF THE POPULATION PROJECTION OF KMC BY
EXPONENTIAL GROWTH METHOD**

Census Year	Total Population of Kathmandu Valley
2001	1,645,091
Growth Rate	4.83 %

By Exponential Growth Rate Method: $P_t = P_0 e^{rt}$

Where, P_t = Total Population

P_0 = Base Year Population

r = Growth Rate

t = Time Interval

Growth Rate = 4.83% = 0.0483

(1) Projection of Population for 2011,

Time Interval = 10 Year

$$P_t = 1645091 \times e^{0.0483 \times 10}$$

$$P_t = 1645091 \times 1.62$$

$$P_t = 2,665,047$$

(2) Projection of Population for 2021,

Time Interval = 20 Year

$$P_t = 1645091 \times e^{0.0483 \times 20}$$

$$P_t = 1645091 \times 2.61$$

$$P_t = 3,823,887$$

(3) Projection of Population for 2031,

Time Interval = 30 Year

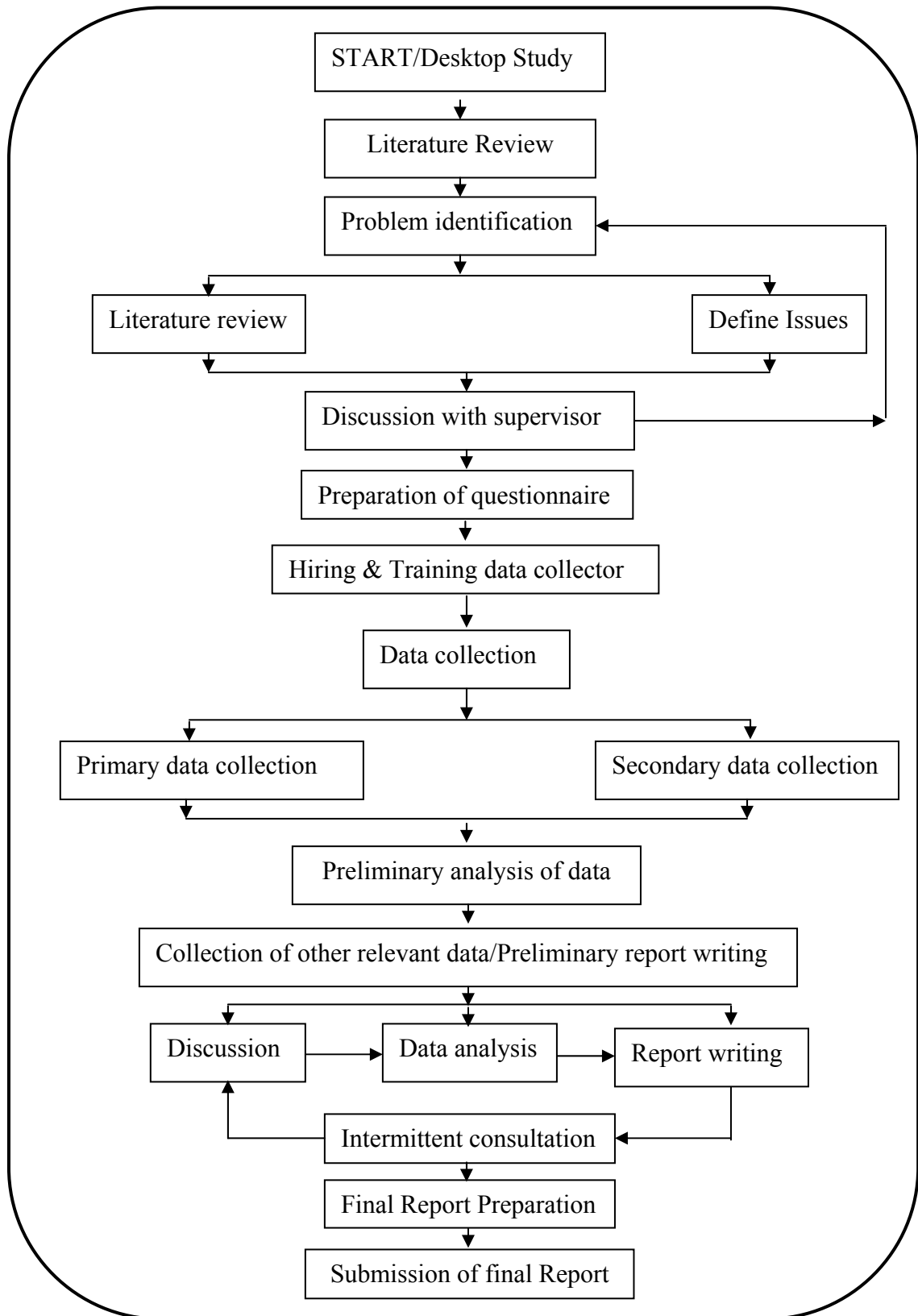
$$P_t = 1645091 \times e^{0.0483 \times 30}$$

$$P_t = 1645091 \times 4.22$$

$$P_t = 6,182,684$$

Annex 3:

RESEARCH PROCESS FOLLOWED FOR THE STUDY:



Annex 4:

**QUESTIONNAIRE USED IN INTERVIEW FOR THE INFORMATION
COLLECTION.**

Population Growth and Environmental Degradation in Kathmandu Metropolitan City

Researcher: Bikash Tripathi,
Master of Humanities in Population Studies
Central Department of Population Studies (CDPS)
Kirtipur, Kathmandu, Nepal

INTERVIEW SCHEDULE

Name:	Schedule no:
Age:	Location:
Occupation:	Interview Date:

This survey is part of the **Population Growth and Environmental Degradation in Kathmandu Metropolitan City** study being carried out to determine the impacts of population growth, with particular focus on environmental condition. You are selected in a purposive sampling process to participate in this survey. The information will kept secret and will be used to estimate the impact upon the environmental degradation. The information generated will also be used to identify alternative for the improvement of environmental condition of the Kathmandu city. You are kindly requested to participate in this interview, which aims to gather information to fulfill these requirements by providing information to the questions in this questionnaire. I greatly appreciate your participation in this study.

I. GENERAL

1. Are you originally from Kathmandu?

Yes

No

If no, reason for migration

A. Education

B. Search for job

C. Hope of better life

D. Forced to move from birth place

2. Are you sincere about environmental problem of Kathmandu valley?

A. Yes

B. No

C. I don't know

3. In your opinion what is pollution level of Kathmandu valley?

Parameter	Below than WHO	Equal to WHO	High than WHO
Air pollution			
Water pollution			
Sound/Noise pollution			
Solid waste pollution			

* WHO: World Health Organization Guideline

4. In your opinion which pollution is more harmful for human health?

- A. Air pollution B. Water pollution
 C. Sound/Noise pollution D. Solid waste pollution

5. Who is more responsible for pollution control and management?

- A. Government B. User committee
 C. Local governing body D. Individual community

6. What is the main reason of not efficient management of pollution?

- A. Lack of monitoring mechanism
 B. Lack of awareness
 C. Lack of waste disposal facility
 D. No suitable government policy

II. SOLID WASTE

1. How much garbage is generated in your home in average?

- A. 0.5 - 1 kg/day B. 1 - 2 kg/day
 C. 2 - 3 kg/day D. More than 3 kg/day

2. What are you doing for garbage management?

- A. Vermi-composting B. Pit composting
 C. Through in open space/river D. Dispose through collector

3. How much money you are spending per month for solid waste disposal?

- A. Not at all B. Rs. 25- Rs. 50
C. Rs. 50- Rs. 100 D. More than Rs. 100

4. Are you classifying biodegradable and non-biodegradable waste?

- A. Yes B. No

5. Is it necessary to separate hospital waste from other waste?

- A. Yes B. No

If yes, what should be done?

6. What are the major constraints for solid waste management?

- A. Dumping site B. Collection mechanism
C. Awareness level of local people
D. Mixing of hospital waste and non-biodegradable waste to other degradable waste

7. What should be done for proper management of garbage and solid waste?

- A. Mandatory to separate degradable and non-degradable waste
B. Proper collection and disposal facility
C. Practice of decomposition
D. Increase in the fee for solid waste collection

8. Different options of solid waste management are given, please order them from preferences:

- A. Reduce B. Recycle
C. Reuse D. Resource recovery

III. DRINKING WATER

1. How are you getting drinking water in your home?

- A. Municipal supply B. Stone spout
C. Tanker service D. Ground water

2. What is the quality of water you are using?

- | | | | |
|-------------------|--------------------------|------------------|--------------------------|
| A. Potable | <input type="checkbox"/> | B. Sometime pure | <input type="checkbox"/> |
| C. All time dirty | <input type="checkbox"/> | D. I don't know | <input type="checkbox"/> |

3. Have you ever tested your drinking water?

- | | | | |
|--------|--------------------------|-------|--------------------------|
| A. Yes | <input type="checkbox"/> | B. No | <input type="checkbox"/> |
|--------|--------------------------|-------|--------------------------|

Have you found?

- | | | | |
|--------------------------|--------------------------|-------------|--------------------------|
| A. Fecal coliform | <input type="checkbox"/> | B. Bacteria | <input type="checkbox"/> |
| C. Mineral contamination | <input type="checkbox"/> | D. Iron | <input type="checkbox"/> |

4. Do you use any method of purification in drinking water?

- | | | | |
|-----------------|--------------------------|-----------------|--------------------------|
| A. Boiling | <input type="checkbox"/> | B. Filtering | <input type="checkbox"/> |
| C. Use chemical | <input type="checkbox"/> | D. No treatment | <input type="checkbox"/> |

5. Are you agree to pay more if pure potable water is daily supplied to your home?

- | | |
|--|--------------------------|
| A. Yes, less than 50% increase | <input type="checkbox"/> |
| B. Up to 100% increase | <input type="checkbox"/> |
| C. More than 100% increase | <input type="checkbox"/> |
| D. No agree to pay more, its government duty | <input type="checkbox"/> |

6. Which water may be more contaminated?

- | | | | |
|---------------------|--------------------------|------------------|--------------------------|
| A. Ground water | <input type="checkbox"/> | B. Stone spouts | <input type="checkbox"/> |
| C. Municipal supply | <input type="checkbox"/> | D. Tanker supply | <input type="checkbox"/> |

7. What can be done for the effective management of drinking water?

- | | | | |
|------------------------------------|--------------------------|--------------------------------------|--------------------------|
| A. Increase fee and regular supply | <input type="checkbox"/> | B. Regulate ground water extraction | <input type="checkbox"/> |
| C. Control of leakage | <input type="checkbox"/> | D. Alternative water source required | <input type="checkbox"/> |

IV. AIR POLLUTION

1. What are the major contributors for air pollution?

- A. Vehicle and transport B. Industry
C. Solid waste dumping D. Road condition

2. "Dilution is the solution of pollution" with this statement do you think its good decision to band old vehicle in Kathmandu and allow them outside Kathmandu?

- A. Good decision to control heavily polluted vehicles in crowded city
B. Its ok, pollution level is negligible in outside valley
C. Human pressure is less in outside valley
D. Same condition will be arise in future

3. Is it necessary to control private vehicle registration in Kathmandu?

- A. Yes B. No
C. Not possible without proper city bus service

4. What can be done to control air pollution?

- A. Band polluting and old vehicles from the city
B. Mandatory air filter in industry emission
C. Improve the condition of road and make green belt
D. Adopt polluter pay principle

V. SOUND/NOISE POLLUTION

1. Is it necessary to band pressure horn within valley?

- A. Yes B. No C. Don't know

2. Why hospital and school area should be considered as horn restricted area?

.....
.....
.....

3. What may be major health hazard of sound pollution?
- | | | | |
|----------------------|--------------------------|--------------------------|--------------------------|
| A. Hearing loss | <input type="checkbox"/> | B. Tear of ear-net | <input type="checkbox"/> |
| C. Mental irritation | <input type="checkbox"/> | D. So many other hazards | <input type="checkbox"/> |
4. Is it necessary to expand Kathmandu city?
- A. Yes B. No
- C. Band to expand and new construction
5. Is it necessary to remove carpet, garments industry from the crowded city?
- A. Yes B. No
- C. Not allowed for new industry

VI. POPULATION GROWTH

1. In order to control population growth in Kathmandu, what should be done?
- A. Increase urban area
- B. Focus on outer city development
- C. Decentralize power and office in local level
- D. Federal political system required
2. To control population growth and environmental damage many I/NGOs are working, are you satisfy with their work?
- A. Yes B. No
- C. Little done D. More improvement necessary
3. Focus of I/NGOs should be on:
- | | | | |
|---|--------------------------|---------------------------|--------------------------|
| A. Public awareness program | <input type="checkbox"/> | B. Launching real program | <input type="checkbox"/> |
| C. Pressure government to adopt strict environmental rules and regulation | <input type="checkbox"/> | | |
4. If any suggestions to control pollution growth and environmental degradation in Kathmandu?

.....

.....

Thank You!

Annex 5:

LIST OF PLATES:



Plate 1: Solid Waste Dumping in front of Critical Area of Health Facilities, KMC



Plate 2: Emission from the Dyeing Factor in Bouddha, KMC



Plate 3: Changing Paradigm of Solid Waste Collection Dhobikhola



Plate 4: Solid Waste Collection - Traditional Practice at Chabahil



Plate 5: Road Cleaning in Morning Time at Maitighar



Plate 6: Solid Waste Dumping and Collection in Day Time at Chabahil