CHAPTER- I

INTRODUCTION

1.1 General Background

Investment on public transportation expands service and improves mobility to the people and if well invested with proper policies and plans, can potentially affect the economy. The cities are growing, so are its population, with excess to various facilities like health, education, job opportunities, more and more people are being attracted to urban areas. In case of Kathmandu Valley whose land area is 666km2, the population which is 1.7 million is expected to exceed 2.3 million by 2021 (NPHC, 2011). The people needs to move from one place to another in order to access to work, school/colleges, social, and recreation. But unfortunately due to lack of government's proper investment on public transit and due to availability of low quality public transportation services (mostly owned by private companies), around the valley, the urban population of Kathmandu Valley are switching to private transportation in order to fulfill their necessity of mobility. This trend have enormous cost to the city in long term. The cost could be either in monetary terms or in non-monetary terms. Non-monetary costs includes, environmental hazards, social problems, health problems etc., meanwhile monetary cost includes property damage, extra expenditure on infrastructure for the government, affected business sales due to higher traffic congestion etc.

In Kathmandu Valley, 683,847 vehicles were registered in the Bagmati Zone by the end of last fiscal year (MTPD, 2016). Private vehicles have the major percentage and most of them have majority in the valley's road. A study conducted by Metropolitan traffic police showed that the number of vehicles exceeds the length of the road in the valley. The length of the road is 4.8 million feet whereas length of vehicles is 7.2 million feet (MTPD, 2016)Even though the estimated growth rate of investment is 19% per annum (GON, 2010) and transport sector is identified as a major sector for the investment (NPC, 2010), the government seems to be only concerned in the extension of the road as a solution. The road expansion drive launched four years ago by the government plans to extend 400KM of road in Kathmandu Valley. The government spent Rs.1.81 billion excluding Rs.1 billion as compensation to the house owners whose houses were demolished for the road expansion drive (Kharel, 2016). Currently the ring road expansion project of Rs.5.15 billion is going on. But these expenditure will turn meaning less if more importance is only given to road expansion. Expansion of the road is not a solution to the problem of mobility that we are facing every day. Road expansion is not a clever solution, huge amount of government's budget is invested in road infrastructure every year and as more space for vehicles will induce additional traffic.

Kathmandu is following the car-oriented transport development patterns made by many cities in developed countries in the past. Ironically, many cities in developed countries are now trying to recover from a car-dominated development era by halting the building of more infrastructures for private vehicles and re-allocating road space for public transport and non-motorized transport. (Pardo, 2010). But it does not necessarily means that government must not invest in road infrastructure at all. It should be done by promoting the public transit along with road expansion drive. Thus, problem of mobility can be tackled with the help of sustainable investment on public transit and road infrastructure. Kathmandu has great potential of operating large quality buses, but smaller buses and micro-vans, especially built for family, are replacing larger ones for public service. The trend of public transportation development in Kathmandu valley is presented in the timeline below:

Figure 1.1: History of Public Transportation Development in Kathmandu Valley

1959	• Nepal Transport Service stars local bus service between Kathmandu and Patan, marking the beginning of public transportaion in Nepal.
1961	• Sajha Yatayat starts service
1966	• Nepal Transport Service, which owned 11 buses, closes its service.
1975	• Electric trolley buses introduced along the 13 km route from Tripusreshowr to Suryabinayak.
1993	• Seven Safa Tempos (electric three wheelers) introduced.
2000	• Following removal of diesel three wheelers, the numbers of Safa tempos were increased to 600 and micro buses were introduced.
2007	• Sajha Yatayat stops its service
2009	• Trolleybus system formally closed end of an era of government direct role in public transportation service.
2013	• Sajha Yatat restarts its service with 16 buses.

Source: UN-Habitat, 2014

The large bus operators and the only public vehicle operated by government, ‘Sajha Yatayat’ and ‘Trolleybus System’, went out of the service in the year 2007 and 2009 respectively. With the end of these bus services in valley, private sector started entering the transportation sector aggressively. The entry of private sector in transportation and lack of effective planning and regulation by the government made the situation of public transportation worst in the valley. But the revival of Sajha Yatayat in 2013, have raised some hope among the public. Currently, Sajha Yatayat, which operates 16 large buses carries about 10000 people every day. And by the end of 2016 it has plans to add 30 new large buses in major routs of Kathmandu valley. Unlike other mean of public transportation which operates small family vehicles, the buses operated by Sajha Yatayat are bigger which is helping the transit users in Kathmandu travel comfortably and also may be very little in quantity, but it has been helping Kathmandu cope with the problem of congestion as it carries more people at once. A standard bus occupies the same space that of two cars but carries almost forty times more passengers (CANN & UN-Habitat, 2014).

If road expansion project is undertaken along with promotion of proper public transit it can economically benefit the corridor, region or a nation as a whole.

1.2 Statement of the Problem

The proposed project examines how a proper investment in public transit will having positive economic impact in a small corridor of valley where the proper transit service is available. Those impacts can be generative impacts, redistributive impacts or financial transfer impacts (see appendix 1). A corridor where an unreliable transit service is available will provide economic disadvantages to the households by increasing the travel cost of the users, as they will have to spend their income on purchase, maintenance of the private vehicles they own, in addition they also have fuel cost and various tax to be paid, which in result will decrease personal disposable income as most of it will be spent to fulfill the mobility needs of households. In addition the poor public transit will effect government fiscal position as more budget will have to be spent on road infrastructure by the government to cope with increasing traffic congestion problem as the result of poor public transit service.

So is the expansion of roads and purchase of private vehicles to fulfill the needs of mobility, the current trend that is being followed in Kathmandu valley is the only solution that we have?

Land, government's budget, individual's income and almost all the resources are limited. So the investment on proper transit services and its benefits needs to be realized before it is too late.

1.3 Objectives of the Study

The general objective of this study is to present the economic impact of investment on sustainable public transit. However, the study have the following specific objectives:

- To realize the economic importance of quality public transportation service in Kathmandu valley.
- To estimate the public transit user's benefit through savings from operating cost of private vehicles, caused due to availability of quality and sustainable mode of public transportation in Kathmandu valley.

1.4 Significance of the Study

Like many other cities, Kathmandu's population is expanding, the need for mobility is also expanding as a result. At present only 28 percent of trips are made on public transportation. Numbers of private vehicles are gaining over the numbers of quality public vehicles, due to which streets of the Kathmandu are becoming more and more congested, more people may choose to use public transport services, provided that they are convenient and safe. But in past two decades the government have failed to make a proper investment decision on public transit. Which is having direct and indirect impact on the various economic sectors. Thus, to realize the problem of under investment on the public transit and to analyze the possible economic advantages of proper investment on public transit, this study is being conducted. The benefits to household sector is analyzed separately in this study through the use of Benefit – Cost Analysis and it has been tried to realize the economic benefits to the sector being studied in this research.

1.5 Limitations of the Study

This study is based upon both primary and secondary information. The topic itself is a broad concept. It is usually carried out on a regional level or national level. However, due to lack of time resources, money and availability of highly sophisticated software, this study is confined within limited things, which is known as the limitations of the study. The limitation of the study are as follows:

- Only one economic sector, i.e. house hold sector of the economy has been the subject of the investigation of the study.
- Most of the analysis is based on primary data. So the results obtained from this study may not be accurate due to the biasness of the respondents.
- The study only takes into account the economic impact from the savings and expenditure perspective of household and does not considers the economic impact from income perspective.
- This study consist of benefit evaluation of the project for 10 years period only.
- The monetary benefit from changes in operation and maintenance cost has only been measured in this study. The benefits form travel time savings,

reduction in accidents, decreased air pollution, land conservation, ecological habitat preservation, etc. has not been considered in this study.

1.6 Organization of the Study

This study is organized into five chapters. The first chapter contains the introduction part of the study, which includes general background of the study, followed by statement of the problem, objectives of the study, importance of the study, limitations of the study and, organization of the study. In the second chapter, review of literature is present, which contains international context and Nepalese context. The third chapter includes the research methodology including research design, population and sample, method of data collection and method of data analysis. In chapter four, the economic importance of sustainable transportation service in Kathmandu is analyzed Cost-Benefit Analysis. Finally, the summary of findings, conclusion and recommendations are presented in the final or the fifth chapter of this study.

CHAPTER-II

REVIEW OF THE LITERATURE

2.1 International Context

Offering an insight on bottleneck of urban transport, Eberhard B. (2013) argued that the bottlenecks of urban transport start to appear when the infrastructure is no longer able to handle the growing volume of private transport. He also highlighted the economic implications of urban transport led by road congestion. He argued that the congestion leads to enormous costs, as we lose relatively large sums of money through waiting times and additional fuel consumption.

Pardo C.F. (2010) has pointed out the importance of political will in improving urban transportation policies in the city. It states that, political will has become a key ingredient to improve urban transport policies in cities. The knowledge of what is happening and how to improve a situation is already there, and tools to address problems are well known by many practitioners. When a city mayor or another decision maker takes these tools and apples them in their city knowingly and appropriately, positive outcomes and benefits for city inhabitants can result. The manual also states that, in Asian region, the number of motor vehicles per one thousand people has more than tripled in the past 30 years. Owing a private car or a motorized two-wheeler is a major aspiration for people in these cities, in particular, where public transport service in often inadequate and unsafe.

World Bank (2009) explains three dimensions of development namely distance, density and division. Distance is an important dimension for the balanced economic development. Transport investment cannot reduce the distance but can reduce the transportation cost (specially travel time) with help of technology. Therefore, transportation cost matters for the location of production and service centers. World Bank report further suggests to the developing country to make spatially connected transport infrastructure, transformation like growing cities and ever mobile peoples are essential for the growth. The pattern of spatial development is developing country is in evolving phase and yet to take firm shape. Therefore, the process of planned regional restructuring with the efficient transport technology like high speed rail to connect lagging region van be started for the balanced sustainable development.

Weisbrod G. and Reno A., (2009) has provided the difference between economic impact and benefit – cost analysis. The economic impact analysis focuses specifically on measurable changes in the flow of money (income) going to households and businesses, including both spending and productivity effects. Meanwhile, the benefit-cost analysis, which considers the valuation of both money and non-money benefits including social, environmental and quality of life impacts.

Mn DOT (2009), in its guidance to perform benefit – cost analysis for highway projects has defined benefit – cost analysis as a systematic evaluation of the economic advantages (benefits) and disadvantages (costs) of a set of investment alternatives. It has suggested that in case of benefit – cost analysis a “Base Case” is compared to one or more alternatives (which have some significant improvement compared to the base case). Furthermore, the guide book explains how does benefit – cost analysis fit into the project development process. The guide explains that benefit – cost analysis always tries to answer the question, “From an economic perspective, are the benefit worth the investment?” and this question is posed in different ways at different points in the project development process. The guide has also provided the drawbacks of benefit – cost analysis. It argues that, in principle, it is neither possible nor practical to project all possibilities through benefit – cost analysis, since it would involve large uncertainties.

It has divided the benefit – cost analysis of a highway improvement projects into four stages. The first stage is, planning the analysis and defining its scope, in which the frame work is established and purpose of benefit – cost analysis is defined. The second stage includes performing the engineering analysis of the alternatives, in which data needed are assembled and generated for the base case and the alternatives. The third stage consists of economic valuation which consists of two parts: (A) highway user benefit calculations and (B) cost calculation. Finally, stage four is the stage of evaluation in which result of benefit – cost analysis is shown as benefit – cost ratio or as net present value (NPV).

Litman T. A., (2009) has provided a comprehensive study of transportation benefits and costing. The study includes detailed analysis of various transport costs and benefits. These impacts were described in detail and categorized by various attributes: whether they are internal or external, fixed or variable, market or nonmarket. Using the best available data, the study provides monetized estimates of twenty three costs (such as: vehicle ownership cost, vehicle operation cost, water pollution, air pollution, operating subsidies, travel time, internal crash, external crash, healthful activity, internal parking, external parking, congestion, road facilities, roadway land value, traffic services, transport diversity value, greenhouse gas emission, noise, resource consumption, barrier effect, land use impact and waste disposal) for eleven travel modes (i.e. average automobile, compact car, electric car, van or light truck, rideshare passenger, diesel bus, electric bus/trolley, motorcycle, bicycle, walk, and telework) under three travel conditions and found that on average about a third of automobile costs are external and about a quarter are internal but fixed. Fuel efficient and alternative fuel vehicles tend to have somewhat lower external costs. It was also found that transit tends to have lower total cost under urban peak condition. Furthermore, ride sharing tends to have the lower marginal cost. It was also found that motorcycles tend to have relatively high costs due to their high crash risk and non-motorized modes (walking and cycling) have minimal external costs.

M N, Murty (2006):The growing demand for public transport in mega cities has serious effects on urban ecosystems, especially due to the increased atmospheric pollution and changes in land use patterns. An ecologically sustainable urban transport system could be obtained by an appropriate mix of alternative modes of transport resulting in the use of environmentally friendly fuels and land use patterns. The introduction of CNG in certain vehicles and switching of some portion of the transport demand to the metro rail have resulted in a significant reduction of atmospheric pollution in Delhi. The Delhi Metro provides multiple benefits: reduction in air pollution, time saving to passengers, reduction in accidents, reduction in traffic congestion and fuel savings. There are incremental benefits and costs to a number of economic agents: government, private transporters, passengers, general public and unskilled labor. The social cost-benefit analysis of Delhi Metro done in this paper tries to measure all these benefits and costs from Phase I and Phase II projects covering a total distance of 108 km. in Delhi. Estimates of the social benefits and costs of the project are obtained using the recently estimated shadow prices of investment, foreign exchange and unskilled labor as well as the social time preference rate for the Indian economy for a study commissioned by the Planning Commission, Government of India and done at the Institute of Economic Growth. The financial internal rate of return on investments in the Metro is estimated as 17 percent while the economic rate of return is 24 percent. Accounting for benefits from the reduction of urban air pollution due to the Metro has increased the economic rate of return by 1.4 percent. In addition to all these benefits, Delhi Metro provides incremental income to the Delhi public which has a per capita income more than two times the national per capita income. Therefore, accounting for income distributional effects of the Metro resulted in the reduction of the social rate of return to 22.7 percent.

Cambridge Systematics, Inc. (1999) in its research has presented economic importance of transit investment. The study was conducted with objective of analyzing the job creation and business revenue impacts of investment in public transit at the national level using state – of the art analytical techniques such as Regional Economic Models Incorporated (REMI) technique for the estimation of (A) the economic impact or value of changes in travel behavior that result from transit investment and use, i.e., value to both transit users and highway users, and (B) estimates of the direct, indirect and induced effects of transit investment on the economy as a whole, in addition to the transportation effects. Through the study it was found that transit capital investment is a significant source of job creation. In addition to that transit operations spending provided direct infusion to the local economy.

Cervero R. and Aschauer D. (1998) divides the transit-related economic impacts into three categories: Generative Impacts, Redistributive Impacts and Transfer Impacts. The report has described the impact as follows:

Generative impacts produce net economic growth and benefits in a region such as travel time savings, increased regional employment and income, improved environmental quality, and increased job accessibility. This is the only type of impact that results in a net economic gain to society at large. Redistributive impacts account for locational shifts in economic activity within a region such that land development, employment, and, therefore, income occur in a transit corridor or around a transit stop, rather than being dispersed throughout a region. Transfer impacts involve the conveyance or transfer of moneys from a one entity to another such as the employment stimulated by the construction and operation of a transit system financed through public funds, joint development income, and property tax income from development redistributed to a transit corridor.

Cervero R. and Aschauer D. (1998) suggested that a benefit-cost analysis is a widely accepted method for evaluation the economic impact of transportation projects. It is the best tool available to determine if society will be better off economically, setting aside all political consideration. It basically converts travel time savings, reductions in accidents, changes in operating costs, decreased air pollution, land conservation, ecological habitat preservation etc., into dollar values to monetize the benefits of a transportation investment, The dollar value is them compared to costs in benefit-cost ratio. Benefit-cost ration can be calculated by dividing the stream of benefits over a period of time by the project costs (including construction, operating, and maintenance costs). The stream of benefits and cost must be discounted with an appropriate discount rate to account for the time value of money. A benefit-cost ratio greater than one indicates that the project's benefits outweigh the costs.

For a research on Benefit-Cost Analysis of Portland's Westside LRT Extension (1988),cumulative benefits were measured over a 30-year operational timeframe and estimated cumulative benefits were discounted to their 1988 "present worth" and compared to capital outlays as well as 30 years of estimated annual operating and maintenance costs, also discounted to 1998 dollars. After the collection of the data, BCA was carried out in which the B/C ratio obtained was greater than one, implying that the project had higher benefit in comparison to its cost.

2.2 National Context

Pokharel R. and Acharya S.R. (2015) in their research has recognized the importance of transportation development for accelerated economic growth of Nepal. Through the broad – brush approach to review the past efforts, identification of current challenges and opportunities the research has come up with five key strategic measures for the development of sustainable transport system in Nepal. The five key strategic measures are: increase in transport investment; development of integrated transport system; adoption of new transport technology; identifying alternative source of funding and financing; and enhancing the institutional capacity for the effective implementation.

CAAN and UN – Habitat, (2014) has define public transport as a shared passenger transport service, which is available for use by anyone who pays the set fares. It generally operates on fixed routes and may include modes such as three-wheelers, mini/micro bus, buses, trolleybuses, trams, trains and ferries. The public transportation services besides reducing, congestion and air pollution by providing transportation services to a large number of people, high capacity public transport systems may also influence the urban form and quality of life in cities. A good public transportation system makes efficient use of urban space, provide efficient and affordable mobility and access to work, school/colleges, social, recreation and economic activities. A standard bus occupies the same space that of two cars but carries almost forty times more passengers.

SajhaYatayat, (2014) after conducting a research on the travel pattern in Kathmandu valley has found that the pattern is highly radial with most trips starting or ending in the central business district (CBD) of Kathmandu and the public transport service in Kathmandu Valley is fully operated by private sector and self-financed i.e. without any government subsidies.

The World Bank and Australian Aid (2013) conducted a research to develop safe, efficient and environment friendly transport in Kathmandu valley. The research has further emphasized on the particular needs of women in transport. The study was conducted between October and December, 2013 and comprised a review of secondary data and the collection of primary data via a questionnaire survey of public transport users in the Kathmandu valley. Qualitative conversations and focused group discussions with users and non – users of public transportation was carried out as well. Through the research it was found that the major users of public transport service in Kathmandu valley were the people engaged in work and education. The findings provided no evidence of gender differences in trip changing. It was also found that the both gender (i.e. men and women) were concerned with the overcrowding and personal insecurity. 80 % of women and 70 % of men noted overcrowding as their main concern. Personal insecurity was twice as likely to be mentioned by women as man and included fear of pick pockets, personal injuries as well as various forms of sexual harassment.

Roychowdhury A., Chandola P. and Bansal R. (2013) has related sustainable mobility with clean air. Through their research it was found that vehicular emissions was contributing factor to significant human exposure with pollution concentration of 3 – 4 times higher in our breathe. Additionally it was also found that in densely – populated cities more than 50 – 60 percent of the population lived and worked near road side where the pollution concentration was found much higher. In case of Kathmandu Valley, it was found that the vehicle emissions contributed about 38 percent if the PM 10 levels.

JICA (2012) study explores the situation of public transport operations in Kathmandu Valley. According to this study, there are 6600 public vehicles including Large Bus, Mini Bus, Micro Bus and Tempo operated by individual operators providing the services for passengers. Meanwhile public transport vehicles constitute only 2.3 percent of all vehicles on the road.

Adhikari N. (2012), conducted a benefit cost analysis to measure the health benefit from reducing air pollution in Kathmandu valley. The study estimated the health benefits to individuals from a reduction in current air pollution levels to a safe level in the Kathmandu metropolitan and Lalitpur sub-metropolitan areas of Kathmandu valley, Nepal. A dose response function and a medical expenditures function were estimated for the purpose of measuring the monetary benefits of reducing pollution. Data for the study were collected over four seasons from 120 households (641 individuals) and three different locations. Household data were matched with air pollution data to estimate welfare benefits. Through the study it was found that the annual welfare gain to a representative individual in the city from a reduction in air pollution from the current average level to a safe minimum level is NRS 266 per year (USD 3.70). Furthermore, the results were extrapolated to the total population of the two cities of Kathmandu and Lalitpur and it was found that the reduction in air pollution would result in monetary benefits of NRs 315 million (USD 4.37 million) per year.

Asian Development Bank (2010) supported Kathmandu Sustainable Urban Transport Project (KSUTP) has identified various problems with the existing public transport routes in Kathmandu, some of which are: duplication of routes, inefficient vehicle type, concentration of route terminals in the city center and poor quality of service. Furthermore, they conducted an interview and revealed that commuters with the option to use private transport elected not to use public transport due to reason like: overcrowding, waiting time at bus stops, delays caused by bus waiting for full capacity before departure, irregular operation without time table and travel time longer when public transport is used.

CHAPTER-III

RESEARCH METHODOLOGY

3.1 Research Description

Recently 'Sajha Yatyat' one of the leading cooperative sector in public transportation service provider planned to add 30 large sized buses to its existing fleet of 16 buses with the investment of Rs. 100 million. Each bus with the seating capacity of 40 passengers is capable of carrying 100 people at a time. The time frame for this study has been considered to be 10 years. In order to get most out of the analysis the time has been divided into four parts. So that the optimum benefit of the transit analysis can be analyzed in this study. Thus, the time period considered for this study is as follows:

- A.M. peak (9a.m. – 11a.m.)
- Midday (12p.m. – 3p.m.)
- P.M. peak (4p.m. – 6p.m.)
- Evening (7p.m – 9p.m.)

3.2 Study Area

Among the 30 new buses being bought by 'SajhaYatyat' 5 of them are planned to be operated in 'Koteshowor – Maitighar' route. The route is a freeway link between the outskirt of the city and the central city. Impacts are measured on the travelers on this corridor, independent of origin. Since, it is more difficult and less logical to define some travel-shed around each origin and destination, the origin is kept independent.

3.3 Base Case

For this study, the no-build case of no new transit project versus the transit project is considered for the simplicity. Thus, the study describes what the world would be like in the future with and without the project, holding all else constant. Any differences in the results is attributed to transit improvement.

3.4 Population and Sample

The population for this study comprises of the motorbike users, car users, and local bus users with in the area of Maitighar – Koteshowr route of Kathmandu valley. The route being studied is of high economic value as it links the outskirt of Kathmandu to central Kathmandu, where most of the economic activities takes place.

The number of private vehicles needed for this study is obtained by counting their numbers four times a day for one week continuously. After the counting of the numbers of the private vehicles, the observations is extrapolated and the numbers thus obtained is used for this study.

3.5 Data Collection Technique

This study comprises of primary data collection. The primary data is collected through a sequenced mixed methods approach using quantitative tools. (See Appendix 5). The data collection is focused on the Maitighar – Koteshowr route of Kathmandu valley which is that of high economic value as it connects the outskirt of Kathmandu to the Central Kathmandu. Secondary data required for the analysis required for this study is acquired from the various sources as per the requirement of this study

3.6 Primary Data Collection

3.6.1 Participant Observation

An initial participant observation exercise is undertaken in order to find out the volume of motorbike users, car users and local bus users. A total of 4 observations per day is taken at different times of the day along the Maitighar – Koteshowr route for this initial participant observation. As the travel volume varies throughout the day (i.e. peak and off peak times), the 4 observations per day is conducted to know average travel volume throughout the day.

3.6.2 Questionnaire Survey

A short questionnaire survey is designed and carried out on the private vehicles users. The survey is administered between 9a.m. and 11a.m. and includes 200 respondents of which 50 percentage motorbike users and 50 percentage car users. Only one question is asked to the respondents. The question model used in this study is given below:

A. Given the proper mode of public transportation in this route, would you consider switching from private vehicle to public transportation?

The answer for the above question is acquired in yes and no model. And the response acquired from the questionnaire survey is later used in chapter 4 of this study to compute the data for change in travel volume.

3.7 Secondary Data Collection

Secondary data is used to acquire the information or data required to know the user cost of private vehicle users. Data from insurance companies, tire retailers, department of physical infrastructure and transportation, various motorbikes and cars dealers, and service stations is used in this study to calculate the user cost of private vehicle users.

Furthermore, data required for the calculation of direct cost in this study is acquired from the head office of Sajha Cooperative.

3.8 Data Analysis Technique

A Benefit-Cost Analysis (BCA) is carried out for the purposed Sajha Yatayat service extension program in Maitighar – Koteshowr route of Kathmandu valley. In order to conduct benefit cost analysis of the project, first the user cost for the individuals under the study using private vehicles as a means of transportation is calculated. In addition to that the user cost of currently operating local buses is calculated. The calculated cost is then unitized to common units of measurement. The travel volume via all mode of transportation under this study is calculated as well.

After the calculation of user cost and travel volume the perceived user cost and change in travel volume is calculated for the calculation of user benefit over a 10 – year operational timeframe, set at 2016 - 2026. Estimated user benefit is discounted to 2016 “present worth” and compared to capital outlays as well as 10 years of estimated annual operating and maintenance costs, also discounted to 2016 rupees for the calculation of Net Present Discounted Value (NPV) of the benefit incurred. Additionally, the obtained NPV is further converted into annualized value in order to spread the net present value into even annual payments. For simplicity 10 percentage real discount rate is considered for this calculation. The Microsoft Excel software is used in order to analyze the data and to estimate the annualized net present discounted value of the benefits.

They following algebraic formulas are the basis for the benefit-cost calculation in this study.

$$\sum_{i=1}^{n}\sum_{j=1}^{k} v_{ij}\,(1+r)^{-n}$$

$$= v_{11}(1+r)^{-1} + v_{21}(1+r)^{-2} + v_{n1}(1+r)^{-n} \ldots + v_{12}(1+r)^{-1} + v_{22}(1+r)^{-2} + \cdots + v_{n2}(1+r)^{-n} + \cdots + v_{1k}(1+r)^{-n} + v_{2k}(1+r)^{-n} + \cdots + v_{nk}\,(1+r)^{-n}$$

$$C = K + OM(1+r)^{-n}$$

$$B - C = \sum_{i=1}^{n}\sum_{j=1}^{k} v_{ij}\,(1+r)^{-n} - C$$

Where:

B = present value of the stream of benefits

C = present value of the stream of all costs

K = construction costs in the base year

v = estimated value in each year

OM = operating and maintenance expenses

n = economic (service) life of the investment

r = discount rate

k = types of economic benefit (e.g., travel time savings, changes in operation and maintenance costs, accident reductions, air pollution reductions, etc.)

After the calculation of stream of benefits and costs they are discounted to present value in order to reflect the opportunity cost of alternative uses of the money. The formula used for the calculation of present value is:

$$PDV = \frac{FV}{(1+i)^n}$$

Furthermore, the present value is converted into annualized value. It is done in order to spread the net present value into even annual payments. The formula used to calculate annualized net present value is:

$$Annualized\ Net\ PDV = \frac{Net\ PDV}{\left(\frac{1-\frac{1}{(1+i)^n}}{i}\right)}$$

CHAPTER-IV

ECONOMIC IMPORTANCE OF SUSTAINABLE TRANSPORTATION SERVICE IN KATMANDU

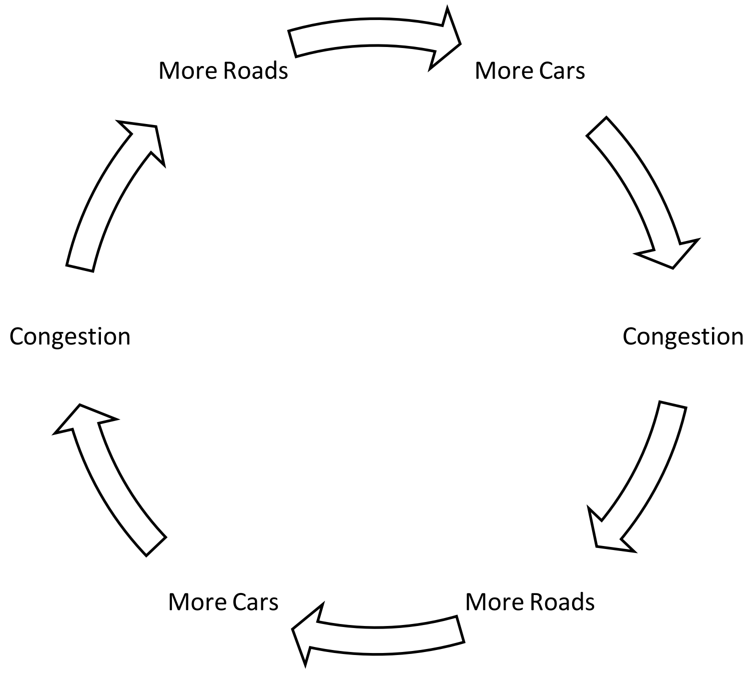
4.1 Sustainable Investment on Public Transportation:

Transportation system plays a vital role in development of a city or a country as a whole by providing access for people to education, markets, employment, recreation, health care and other key services. Cities with transport modes in an integrated system or in another words cites that have more sustainable modes of transportation such as BRT, LRT, metro and some non-motorized transport such as cycling and walking are more likely to evolve and prosper as centers for trade, commerce, industry, education, tourism and services. Statistically, most of the cities around the world which rank at the top in terms of quality of life have high quality sustainable urban transport system that prioritize public transport and non-motorized modes.

Unfortunately, in most developing cities such as our Kathmandu, the condition of urban transportation system is way to worst. The most visible transport problem in Kathmandu is its traffic congestion, and it has adverse effect on local and national GDP. The number of private vehicles has been increasing continuously and dominates the roads of Kathmandu. Owing a private car or a motorized two-wheeler is a major aspiration for people in Kathmandu due to availability of poor public transport service. But rather than developing the sustainable mode of public transport, our city managers are following the car-oriented transport development patterns made by many cities in developed countries in the past. Ironically, many cities in developed countries are now trying to recover from a car-dominated development era by halting the building of more infrastructure for private vehicles and re-allocating road space for public transport and non-motorized transport.

In Kathmandu, the trend is still largely in favor of the expansion of infrastructure for private motor vehicles. Policies for more and more road construction have clearly failed to cope with ever increasing demand from rapid motorization, resulting in a vicious circle as shown in figure 4.1. The figure below presents the vicious circle of car-oriented transport development.

Figure 4.1: Vicious Circle of Car-Oriented Transport Development



Source: Buis, 2009

The cycle above shows the exact scenario of how our government is trying to solve the current mobility problem in Kathmandu. The ongoing road expansion project which is still in progress in Kathmandu valley is a good example of how the increase of infrastructure to alleviate travel demand will have apparently positive consequences in the short term, but some months later there will be a much greater congestion than before, thus increasing the problem rather solving it.

Thus, investment on public transport is the only sustainable investment that stake holders need to do in order to cope with the growing travel demand in Kathmandu valley.

4.2 Economic Importance of a Public Transit Investment

The fundamental importance of a public transit investment is to improve mobility. However, a quality public transit investment also have some great varieties of economic importance associated with it. Some of the major economic importance of a quality public transit investment are mentioned below:

- User Benefits (travel time savings, safety benefits, changes in operating costs)

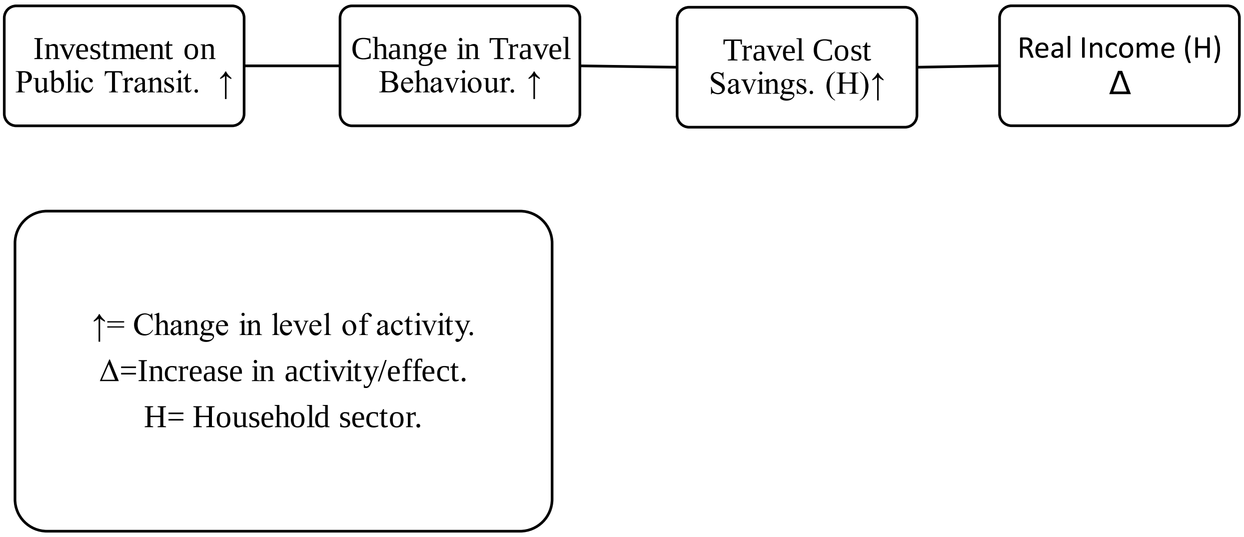
- Employment and income growth unrelated to system construction, operation, or maintenance.
- Urbanization benefits (e.g., higher productivity, lower infrastructure costs).
- External benefits (e.g., air quality improvements).
- Accessibility benefits (e.g., access to employment).
- Land development (e.g., clustered development around transit stations).
- Employment and income growth due to land development.
- Increased economic activity within corridor.
- Employment and income growth related to system construction, operation, or maintenance.
- Property tax impact.

So these are the few major importance among many benefits of public transit investment. However, due to resources and time limitations only the change that occurs in operation costs of private vehicles due to public transit investment is realized in this study.

4.3 The Effect of Sustainable Transit Investment

This research attempts to analyze the relationship between the transit investment and its economic importance to namely one sector of the economy, i.e. household. This research is based on the hypothesis that a sustainable investment on public transportation will improve the quality of public transportation system which will induce change in travel behavior of the public, which is by using the quality public transport. As a result there is savings in travel related expenditure of an individual which will raise the real income of the household. The following “logic diagram” helps to illustrate broad cause and relationship effect of transit investment.

Figure 4.2: Cause and Relationship effect of Transit Investment



As seen in the logic diagram above, the investment on public transit will increase the quality of public transit service. The improvement in quality of public transit service leads to change in travel behavior of public. For example, a person driving a car to his/her work daily might choose to travel in a public bus given that the quality of the public bus is good. So the positive change in travel behavior leads to travel cost savings to the household sector, as it is comparatively cheaper to travel in public vehicles rather than travelling in private vehicle. Thus, the saving resulted from the decreased travel related cost will lead to increase in real income of a house hold.

In order to conduct an imperial research on economic viability of public transit investment on the income of household through savings from operation and maintenance cost, a benefit – cost analysis is carried out.

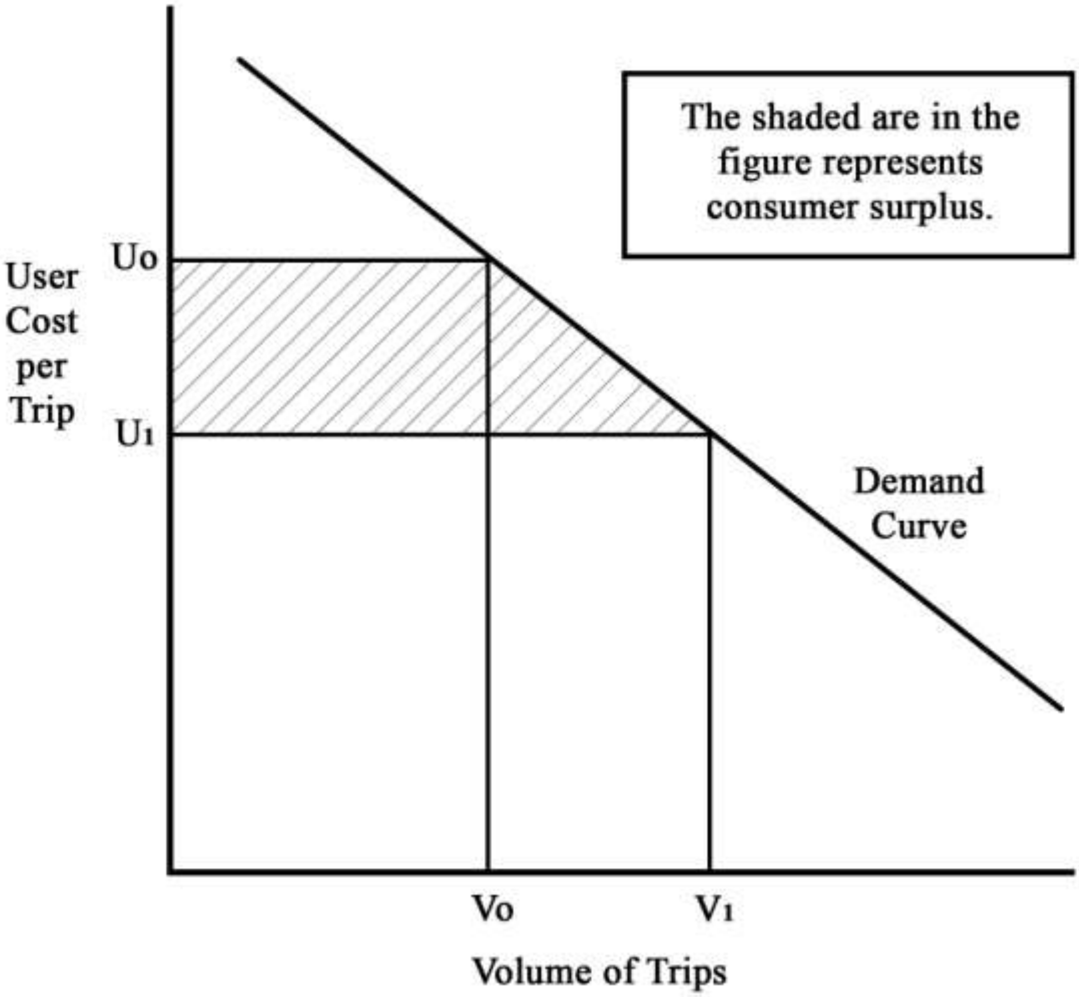
4.4 User Benefits and Costs

In order to get the preliminary estimate of the net benefits to travelers of a transit improvement, consumer surplus is measured in this study. Thus, for user benefit accounting, following estimates are made:

- Estimates of the quantity of trips – making before and after the improvement.
- Estimates of the change in perceived user costs that results from the improvement.

The figure below explains why the above mentioned estimates are necessary.

Figure 4.3: User benefits from transit improvement



In the figure, X axis represents the volume of trips and Y axis represents the user cost per trip. As transit improvement takes place, there is change in the travel volume and perceived user costs, which is the basis for the calculation of net benefits to travelers from a transit improvement. For travel that occurred before an improvement the initial level of volume of trips is V_0 and the user cost isU_0. As pointed out earlier, after an improvement in transit service the volume of trips rises to V_1 and the user cost fall to U_1. (Law of demand).

Therefore, the gross gain in consumer surplus is the change in perceived user costs multiplied by the pre-improvement quantity of travel (which is represented by shaded rectangle on left side in figure 4 – 1). Thus, the gross user benefit can be calculated as:

$$B = (V_0)(U_0 - U_1)$$

Furthermore, travel that is induced by the improvement generates benefits that are equal to the change in perceived user costs times approximately one-half the induced volume of travel (which is represented by the shaded triangle between V_0 andV_1)

Therefore, the total user benefit can be calculated as:

$$B = \left(\frac{V_0 + V_1}{2}\right)(U_0 - U_1)$$

As indicated in the formula, benefit depend fundamentally on the change in travel values (V_0 toV_1) and change in user costs, (U_0 toU_1). The first component of the formula calculates an average volume by adding before and after volumes and dividing by two. This calculation consists with trying to estimate the triangle of consumer surplus in figure 4 – 1. The second component of the formula calculates the difference in user cost. Other this remaining the same, when $(U_0 - U_1)$ large, benefits are large.

4.5 Measuring User Costs

Various forms of transportation modes are often available on city roads. To name a few there are people using public vehicles, also there are people using their private vehicles to fulfill their mobility needs, plus some people travel by bicycle and also some prefer to walk if possible. The important thing is that all these modes of transportation has interconnection among each other and all there mode have some own kind of user costs involved. An improvement in transit service has impact on these user costs. If transit improvement does not change the cost of travel perceived by users, it cannot affect user travel behavior. Furthermore, if an improvement has no effect on travel behavior, it is hard to say that it will generate direct user benefits.

Therefore, it is important to measure changes in user costs of all modes across the whole affected network. In case of this study, two major forms of user cost has been calculated to measure the benefit generated from the transit improvement. They are:

- Transit user cost, and

- Private vehicle user cost.

4.5.1 Transit User Cost

Transit user cost are of various types. Even a simple transit trip includes a complex pattern of travel time and cash outlays. A transit user typically must get to the transit vehicle, wait for it to arrive, travel in the vehicle, and then get from transit stop to final destination, which has its own kinds of costs involved. However, for this study only the fares paid by the transit user is considered as the only cost incurred to a transit user.

- Rs. 15 per vehicle – KM for one way trip. (Source: SajhaYatyat)

4.5.2 Private Vehicle User Cost

For this study, I have considered two relevant mode of transportation which are relatively common in Kathmandu roads, they are motorbike and car and currently operating inefficient mode of public transportation. The transit improvement affects the motorbike and car operating costs. In addition to that, it may also change household's decisions about owing a private vehicle. In this section the perceived unit costs of operating and owing motorbikes and cars in measured. The operation cost of a motorbike or car involves costs that are, to a large extent, direct variable with the use of the vehicle (fuel, tire ware, annual road tax, maintenance and repair etc.) as well as costs that are relatively fixed once the decision to own a private vehicle has been made (insurance and the capital cost of the vehicle).

In order to measure the benefits of a transit improvement, all costs (variable and fixed) is reduced to unit costs (per vehicle – Km travelled or per trip) and incorporated in the long-run perception of cost.

Additionally, to cope with the problem of construction and use of an estimate of average vehicle operating costs due to presence of varieties of vehicles in Kathmandu roads, an average number is applied to all vehicle categories under this study. It can be illustrated with table below.

Table 4.1: Average value of most incurred private vehicle expenses.

Components	Motorbikes (Average Value)	Cars (Average Value)
Fuel	Rs. 100	Rs. 100
Maintenance	Rs. 1200	Rs. 5000
Tires	Rs. 3500	Rs. 12000
Annual Road Tax	Rs. 7375	Rs. 30850
Insurance	Rs. 2150	Rs. 8650
License and Registration.	Rs. 1500	Rs. 2500
Vehicle Cost	Rs. 250000	Rs. 3000000

Source: Researcher’s Survey, 2016

In the table 4.1, the data are gathered from various sources and average value has been derived from the gathered data. For example, the annual road tax of a motorbike varies from Rs. 2500 to Rs. 15000 annually depending upon the motorbike’s capacity. The capacity has been divided into four categories by government of Nepal. Therefore the average annual road tax has been derived by using simple arithmetic mean. Likewise, same method has been applied to the other components in table 4.1.

The values calculated above is not of any use to this study until they are converted into Rs. /KM. Which means that it is necessary to find out how much a private vehicle owner spends for each KM he/she travel by his/her private vehicle. To do so, the cost of owing and operation selected motor vehicle in Kathmandu valley has been summarized with the help of the table below:

Table 4.2 Cost of owning and operating selected motor vehicles (2016, Rs. /KM)

Category	Vehicle Type	
	Motorbike	Car
Operating Costs (Rs. /KM)		
Fuel (Variable)	2.85	12.5
Maintenance (Variable)	1.67	1.67
Tires (Variable)	0.35	0.8
SUBTOTAL	4.87	14.97
Ownership Costs (cost per year)		
Insurance (Fixed)	2150	8650
License and Registration (Fixed)	1500	2500
Annual Road Tax (Fixed)	7375	30850
SUBTOTAL	11025	42000
Vehicle Cost (Fixed)	250000	3000000
VEHICLE ANNUAL COST (10 years of life)		
10000 KM per year	2.5	30
15000 KM per year	1.67	20
20000 KM per year	1.25	15
TOTAL COST PER KM (Rs. /KM)		
10000 KM per year	3.60	34.2
15000 KM per year	2.40	22.8
20000 KM per year	1.80	17.1
AVERAGE COST PER KM (Rs./KM)	2.6	24.7
TOTAL OPERATING COST PER KM (Rs. /KM)	8	40

Source: Researcher's Calculation

In the table 4.2, the variable costs are converted to Rs. /KM using the average value of various components of variable factors. For example, per liter mileage of a motorbikes in Kathmandu valley ranges from 25 – 45 KM/lt., from which we get an average value of 35 KM/lt. Now the current worth of petrol in Kathmandu valley is divided by the average mileage, which gives us 2.85 Rs. /KM. Meaning that a motorbike owner in Kathmandu valley spends net amount of Rs. 2.85 for every KM he travels. The same method is applied to the other components of variable factors.

In case of fixed factors. Different method has been used to calculate the fixed cost per kilometer. In order to calculate fixed cost per kilometer, it is assumed that the vehicles has an average life of 10 years. Separate calculations are done assuming that a vehicle travels 10000 KM/year, 15000 KM/year and 20000 KM/year to calculate their fixed cost per KM. After the calculation of cost per KM for three different scenario (i.e. 10000 KM/year, 15000 KM/year and 20000 KM/year), an average value has been calculated out of these three scenario, in order to calculate average fixed cost per KM for motorbikes and cars.

After calculation of variable cost per unit and fixed cost per unit, both costs are added to realize the total operating cost per KM.

4.6 Calculating Transit's Benefits

The previous sections of this study provide information on the unit costs associated with the use of each type of vehicle in the transportation network. However, the study is not able to reach to a conclusion without the calculation of benefits from the transit improvement. Therefore, in order to compute transit benefits, the following information is required.

- The amount of travel before the improvement, by the transportation mode;
- The perceived user cost associated with that previous travel pattern;
- The amount of travel after the improvement, by transportation mode;
- The perceived user cost associated with the revised travel patterns.

This study takes place with the context of base case and the improvement alternative, which is studied over the relevant analysis horizon. As pointed out in chapter 1 of this study, some sophisticated travel demand modeling could not be used in this study. Therefore, some rough estimates of the travel demand responses to the transit improvement is made using the data gathered from the survey conducted in the corridor under this study. The detailed information about the survey is described later, in section 4.7 of this chapter.

The volume and user cost data generated in the base case and in the improvement case serve as the basis for transit benefit – cost calculations. Thus, they are tabulated by corridor in order to perform the transit benefits calculations.

Table 4.3 below presents the computation of necessary data required for the calculation of transit benefits.

Table 4.3 : User cost calculations – bus transit (A.M. peak demand)

Data Type and Abbreviation	Data Units	Calculation	Corridor 1 Bus Transit		
			Base Case	With Project	
				Local Buses	Sajha Buses
Raw Activity Data					
Corridor Length (L)	KMs		4	4	4
Vehicles (M)	Number		50	50	5
Passengers Per Vehicle (D)	Number		60	50	100
Passengers (Q)	Number	M×D	3000	2500	500
Fares (F)	R.s./Pass-KM		20	15	15
Operating Costs Paid by Passengers (C)	R.s./Veh-KM		-	-	-
Intermediate Calculations of Perceived Costs					
Out-of-Pocket Cost (P)	R.s./Pass-KM	F	20	15	15
Final Calculations of Perceived Costs					
Total Perceived User Cost (U)	R.s./Pass-KM	(P)	20	15	15
Travel Volume (V)	Pass-KM	(L)×(Q)	15000	10000	2000

Source: Researcher’s Calculation

The table 4.3 shows a 4 – KM. – long corridor that carries both local buses and the newly introduced Sajha bus service. Currently, 50 medium sized local buses are operating in the route under study. Such buses has the seating capacity of 30 people.

However due to lack of proper supervision, such buses are often overcrowded and carry double their capacity. So the passenger per vehicle in case of local buses is estimated to be 60 people per vehicle. Meanwhile, the newly introduced Sajha bus service operates large buses on the same route, which can easily carry 100 people at a time. Due to the introduction of Sajha bus service it is seen that there is decrease in the number of passengers in case of local bus service. The addition of the five Sajha Buses reduces ridership on the existing local buses from 15000 to 10000 during (9A.M. to 11A.M.) peak traffic period.

Furthermore, the local buses has been charging Rs. 20 per one way trip, whereas Sajha bus service has standard rate of minimum Rs. 15 per one way trip. The introduction of Sajha bus service has decreased the fares of local bus service from Rs. 20 to Rs. 15, which is the change in perceived user costs for local bus transit for (9A.M. to 11A.M.) peak traffic period.

TABLE 4.4: User cost calculations – motorbike and car traffic (A.M. peak demand)

Data Type and Abbreviation	Data Units	Calculation	Corridor 1 Motorbike		Corridor 1 Car	
			Base Case	With Project	Base Case	With Project
Raw Activity Data						
Corridor Length (L)	KMs		4	4	4	4
Vehicles (M)	Number		12000	10800	2400	1800
Passengers Per Vehicle (D)	Number		1	1	2	2
Passengers (Q)	Number	M×D	12000	**10800**	4800	**3600**
Fares (F)	R.s./Pass-KM		-	-	-	-
Operating Costs Paid by Passengers (C)	R.s./Veh-KM		8	6	40	30
Intermediate Calculations of Perceived Costs						
Out-of-Pocket Cost (P)	R.s./Pass-KM	F+C/D	8	6	20	15
Final Calculations of Perceived Costs						
Total Perceived User Cost (U)	R.s./Pass-KM	(P)	8	6	20	15
Travel Volume (V)	Pass-KM	(L)×(Q)	48000	43200	19200	14400

Source: Researcher’s Calculation

Table 4.4 also represents the same corridor of total length 4 KM. In this table, the comparison between other modes of transportation on Kathmandu valley namely motorbikes, cars and the newly introduced Sajha bus service is carried out for the A.M. Peak traffic period. The number of motorbikes and cars in the base case is 12000 and 2400 respectively. The calculation of the total number of motorbikes and cars is done through the help of observation method. A counting survey was conducted for this purpose. Additionally, through the survey carried out on the motorbikes and cars users on the corridor under study, it was found that 10 % of motorbike riders opted to choose Sajha bus over motorbike and 25 % of car riders opted to choose Sajha bus over private car, which is the basis for the estimate of vehicle numbers with the implementation of the project. The calculations for the operation cost of private vehicles are done in the section 4.4 of chapter 4, which is imported in this table for the calculation of perceived costs before and after the introduction of Sajha bus service.

Now that the necessary data is assembled and tabulated as in table 4.3 and 4.4, the actual calculation of user benefits is carried out. As mentioned earlier in section 4.4, the basic idea for measuring user benefits is to measure the shaded area of figure 4.1, using volume and user cost information from the table 4.3 and 4.4.

The calculation of transit benefit done previously is only carried out for one period of time of the day, the A.M. peak hour (i.e. 9 A.M. – 11 A.M.). Furthermore, the analyses are performed for the other period of time of the day, which are midday, P.M. peak hour and evening. Results for other periods of the day are derived by extrapolation. Table 4.5 and 4.6 below summarizes the total perceived user cost and total travel volume before and after the introduction of the new bus service.

Table 4.5: User costs for all models and times (Rs. per passenger – KM)

Total Perceived User Cost	Motorbike		Car		Bus Transit		
	Base Case	With Project	Base Case	With Project	Base Case	With Project: Local	With Project: Sajha
A.M. Peak	8	6	20	15	20	15	15
Midday	8	6	20	15	20	15	15
P.M. Peak	8	6	20	15	20	15	15
Evening	8	6	20	15	20	15	15
Total	**32**	**24**	**80**	**60**	**80**	**60**	**60**

Source: Researcher's Calculation

In the table 4.5, the perceived user cost for different time periods of the day, before and after the introduction of the project are tabulated from the earlier calculations in table 4.3 and 4.4 and the total perceived user cost is obtained by the summation of perceived user costs occurred in different times of the day. Likewise, in the table 4.6, the travel volume for different time periods of the day, before and after the introduction of the project are tabulated from the earlier calculations in the table 4.3 and 4.4 and the total travel volume is obtained by the summation of travel volume occurred in different times of the day.

Table 4.6: Travel volume by transportation mode (passenger – KM.)

Total Travel Volume	Motorbike		Car		Bus Transit		
	Base Case	With Project	Base Case	With Project	Base Case	With Project: Local	With Project: Sajha
A.M. Peak	48000	43200	19200	14400	15000	10000	2000
Midday	24000	21600	9600	7200	3200	1600	1000
P.M. Peak	48000	43200	19200	14400	15000	10000	2000
Evening	24000	21600	9600	7200	3200	1600	1000
Total	**144000**	**129600**	**57600**	**43200**	**36400**	**23200**	**6000**

Source: Researcher's Calculation

Now the necessary data for the calculation of total annual user benefits has been computed, the actual calculation of total annual user benefits for all modes of transportation under this study in all time periods (i.e. A.M. peak, midday, P.M. peak, and evening) is carried out. For each transportation mode and time period, benefits are calculated by taking the difference in user costs $(U_0 - U_1)$ and it is then multiplied by the average passenger volume $\left(\frac{V_0+V_1}{2}\right)$ that results from this project.

Table 4.7: User benefits – all time period, all modes.

Mode	Average Volume ($\underline{V}$) $\frac{(V_0 + V_1)}{2}$	Change in User Cost (ΔU) $(U_0 - U_1)$	User Benefit (Rupees) $B = \left(\frac{V_0 + V_1}{2}\right)(U_0 - U_1)$
	Data from Table	Data from Table	
Motorbike	136800	8	10944
Car	50400	20	10080
Bus – Local	29800	20	5960
Bus – Sajha	3000	5	150
Total Daily Benefit			27134
Total Annual Benefit			8140200

Source: Researcher's Calculation

As shown in Table 4.7, the daily benefit for all time periods for all modes of transportation is Rs. 27134 with the introduction of the Sajha bus service. Most of these benefits accrue to motorbike users (Rs. 10944), followed by private car users (Rs. 10080), local bus users (Rs. 5960) and Sajha bus users (Rs. 150). Assuming 300 workdays in a year (50 weeks times 6 days per week), the total annual benefit from all modes is Rs. 8140200 for all time periods.

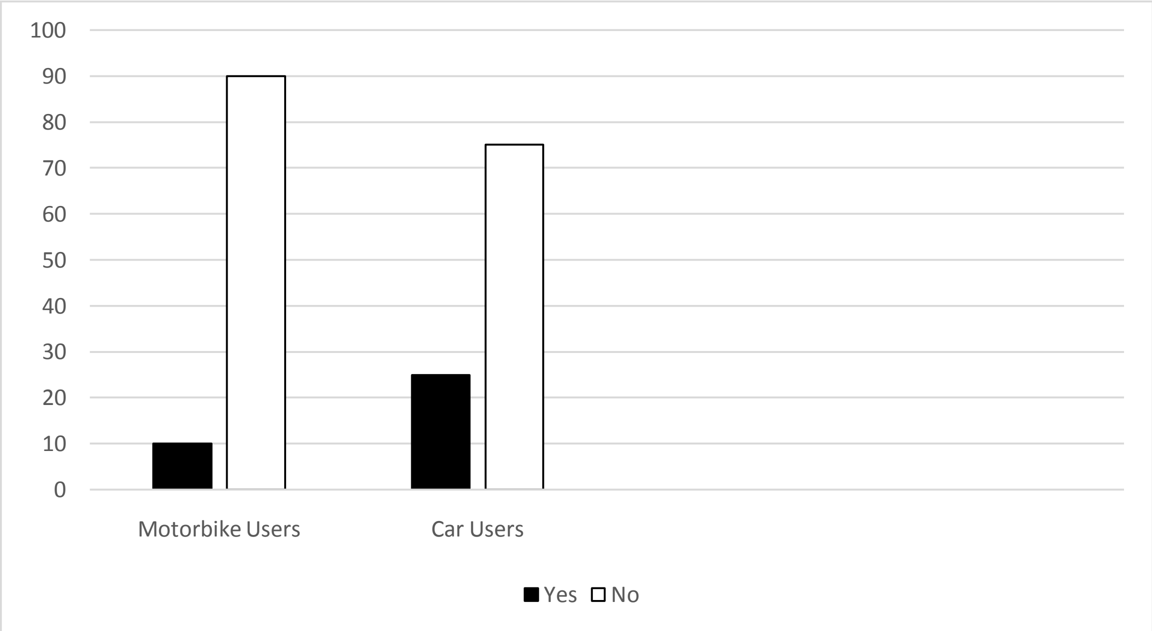
4.7 Calculation of Travel Demand Response:

In order to calculate the change in travel demand after the introduction of the project, a short questionnaire survey is carried out with private vehicle users using the Koteshowr – Maitighar route. The total of 200 respondents is interviewed for the calculation of the travel demand. Out of 200 respondents 50 percentage are motorbike users and 50 percentage are car users. One simple yes/no question is asked to the respondents. The question asked to the respondent is:

A. Given that a quality bus service available in this route, would you prefer to travel in such mode of public transportation?

The outcome of the questionnaire survey is presented below:

Figure 4.4: Outcome of the questionnaire survey



Source: Researcher's Survey, 2016

Through the survey to calculate the travel demand it was found that out of 100 motorbike users very few that is 10 percentage motorbike users answered yes to above questionnaire. But unlike motorbike users, car users were more interested in travelling by bus rather than by car. About 25 percentage of car users answered yes to above questionnaire. The result obtained through the above questionnaire is thus extrapolated to the total number of cars and motorbikes users under this study and outcome is used to calculate the change in travel volume before and after the implementation of the project.

4.8 Calculating Direct Costs (Capital and Operation)

These are the costs that are paid by transit agencies, in case of this study "Sajha Co-operative". Direct costs are of various types, however in this case, only the capital costs and operating costs has been considered as direct costs. Capital costs includes the total amount of money paid by the co-operative to purchase 5 new large size buses. Operating costs are recurring costs that include salaries, wages and benefits, materials and supplies, utilities, and other expenses related to ongoing operation and maintenance.

The buses owned by 'Sajha Cooperative' has a salvage value. It means that if the buses are well maintained, it can be sold at the end of the project and the operator (i.e. Sajha Cooperative) can get back some money at the end of the project life. Currently, the Sajha Cooperative expects that the buses will be well maintained and they can sell them at 10% depreciation value annually of their initial purchase price at the end of the project, which is the salvage value of the buses. Thus, the salvage value is added during the final calculation of this benefit cost analysis. Table 4.8 below summarizes the total direct cost incurred to the Sajha Cooperative.

TABLE 4.8: Direct cost: capital and operation

Capital (Total: Year 0)		Operating (Annual: Year 1-10)	
5 New Buses @ Rs. 3400000	17000000	Labor @ Rs. 625000 per (operating) bus	3125000
Value of land. (For Parking)	1750000	Fuel @ Rs. 1300000 per (operating) bus	6500000
		Maintenance @ Rs. 1430000 per (operating) bus	7150000
Total: 18750000		Total: 16775000	

Source: Sajha Cooperative Annual Report, 2016

4.9 Discounting and Annualizing Values

The benefits and costs calculated so far in this research occur in different years. For example, purchase of buses takes place at the beginning of the project, while other benefits and costs are realized subsequently during operation. Therefore, the stream of benefits and costs are discounted to present value in order to reflect the opportunity cost of alternative uses of the money. The formula used for the calculation of present value is:

$$PDV = \frac{FV}{(1+i)^n}$$

Furthermore, the present value is converted into annualized value. It is done in order to spread the net present value into even annual payments. The formula used to calculate annualized net present value is:

$$Annualized\ Net\ PDV = \frac{Net\ PDV}{\left(\frac{1-\frac{1}{(1+i)^n}}{i}\right)}$$

Table 4.9 shows the discounting and annualizing of the benefits and costs incurred under this study

TABLE 4.9: Benefit-cost calculation, 10% real discount rate.

	Benefits (Costs) by Project Year. (in thousands of year 2016 Rupees)										
Impact Type	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
User		8140	8140	8140	8140	8140	8140	8140	8140	8140	8140
Transit Revenue		13508	13508	13508	13508	13508	13508	13508	13508	13508	13508
Operation and Maintenance Costs		-16775	-16775	-16775	-16775	-16775	-16775	-16775	-16775	-16775	-16775
Capital Cost	-18750										
Salvage Value											5925
Present Discounted Value (PDV)	-18750	4430	4027.3	3661.2	3328.3	3026	2750.7	2501	2273.3	2066.6	4163
Net PDV	13476.8										
Annualized Net PDV	2193.28										

Source: Researcher's Calculation

4.10 Analysis of the Results

The net present value of Rs. 13 million is equivalent to an average annual amount of Rs. 2 million for every year over the 10 years project life, annualized at a discount rate of 10 percent. Meaning that the project will benefit the users of the corridor by increasing their personal real income through savings from private vehicles operation and maintenance cost to around Rs. 2 million annually for over 10 years project life. Based on this annualized number, the Sajha bus is considered an efficient investment.

CHAPTER-V

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of Findings

Through this study it is found that a motorbike owner pays 8 rupees for every kilometer he/she rides and a car owner pays 40 rupees for every kilometer he/she drives. So if we multiply the figures above by 4, which is the total length of the route under study, a motorbike owner pays 32 rupees and a car owner pays 160 rupees to travel 4 kilometers distance. The same route or distance if travelled in a Sajha bus will costs a person 15 rupees. So if we do a simple math we can see that a private vehicle owner can save a lot of his/her income if he/she choose to travel by bus. But simple math done above does not provides us with economic viability of the transit service as operating Sajaha bus also has some cost. The results obtained from the above calculation will yield much more saving in personal income of the transit user and will exaggerate the economic importance of Sajaha Yatayat.

Thus, through the use of benefit-cost analysis to analyze the economic importance of Sajaha Yatayat, it is found that a total of about 8 million rupees annual benefit occurs to the private vehicle users due to savings from the personal income. After deducting the streams of costs that is incurred to operate and maintain the buses with the benefit about 13 million rupees of net present value in 2016 rupees is obtained. The net present value of 13 million rupees is equivalent to an average annual amount of 2 million rupees (for every year over the 10-year project life, annualized at a discount rate of 10 percent). So, from the perspective of economic efficiency, the newly introduced Sajha bus service is expected to generate Rs. 2 million annually in net benefits. Which means that around Rs. 2 million increase in personal real income through savings from reduced operation and maintenance cost of private vehicles for over 10 years can be achieved through the saving from mobility expenditure. Meaning that the project creates net benefits, independent of who pays for it, how it is financed: it is a good investment. If extrapolated to realize the benefit throughout the Kathmandu, such investment yields much more savings to the total household of Kathmandu valley. The economic impacts of capital investment on Sajha Yatayat is likely to be even more when there is increase in reliability of the bus service through up gradation and expansion of existing service.

5.2 Conclusion

This study is carried out in a very small area of Kathmandu, yet it tend to yield net benefit. Kathmandu is a metropolitan city with more than 10 million people living in it. So if the service is expanded throughout the valley it can have enormous amount of benefits to the individuals living in Kathmandu. This study has looked upon the benefit of transit investment from one perspective only. But the possibilities are enormous. Benefits of transit investment can be realizes in almost all sectors of the economy. Kathmandu does not need a fly over or under pass to reduce the mobility problem it is facing at the moment. Because more roads will automatically induce more traffic. Besides huge cost bared by the government to build wider and bigger roads. The roads expansion without proper investment on public transit can prove to be of great economic loss. The amount of savings an individual will have will be lesser and lesser as they will spend most part of their income on mobility needs. Consequently, an investment capacity of an individual will degrade, which can have an adverse effect on capital formation.

In Kathmandu, mobility has emerged as one of the major challenge for its development. The whole consumption pattern of the residents of the valley has been adversely affected due to unmanaged and poor public transportation that are currently available in Kathmandu valley. As most of the portion of the income of the residents of Kathmandu valley is being invested in fulfilling their mobility needs, the whole consumption pattern has been affected by it.

5.3 Recommendations

The economic benefits of investment is enormous.

- Government should implement strong policies to discourage the use of small family vehicles such as micro buses as a means of public transportation.
- Public awareness programs related to advantages of using public vehicles should be given to public to encourage them to use public vehicle to fulfill their mobility needs.
- Introduction of modern and effective means of information technology in the field of public transportation. So that people get hassle free public transportation service.

- Discourage the import of private vehicles such as cars and motorbikes by implementing effective policies such as increase in tax on fuel for private vehicles and provide subsidies to public vehicles, increase in import tax for private vehicles, introduction of various concession facilities for public vehicle users etc. But also keeping in mind the quality of public transportation service before implementation of such policies.

APPENDICES

Appendix-1: Definition of Economic Impact and its Types

Definition – What is Economic Impact Analysis?

In the context of transportation planning and policy, economic impact analysis (EIA) analyzes how a program or a project affects the economy of a given area. The economic impact area may be small as a neighborhood or as large as the nation, depending on the scale of the program or project. At a corridor level, economic impacts may be measured in terms of the change in demand for locations – as reflected by increase in property values, increased investment in new construction activity or increased density of development. At a regional or state level of analysis, the measures of economic impacts are in terms of changes in business output or gross national product (GNP) or gross domestic product (GDP), and associated changes in jobs and in wage income.

What is generative impact?

Generative impacts produce net economic growth and benefits in a region such as travel time savings, increased regional employment and income, improved environmental quality, and increased hob accessibility. This is the only type of impact that results in a net economic gain to society at large.

What is redistributive impact?

Redistributive impacts account for locational shifts in economic activity within a region such that land development, employment, and, therefore, income occur in a transit corridor or around a transit stop, rather than being dispersed throughout a region.

What is financial transfer impact?

Transfer impacts involve the conveyance or transfer of moneys from one entity to another such as the employment stimulated by the construction and operation of a transit system financed through public funds, joint development income, and property tax income from development redistributed to a transit corridor.

Appendix-2: Detailed Methodology

The mixed method approach to primary data collection

1. Questionnaire survey for private vehicle users (motorbike and car)

   A short survey was administered with 200 private vehicle users (50% motorbike users and 50% car users).

2. Participant Observation

   To estimate the average number of vehicles using the route under study, I undertook 4 observation for 5 days continuously. The observation was carried out 4 times a day. They are as follows:

- A.M. peak (9a.m. – 11a.m.)
- Midday (12p.m. – 3p.m.)
- P.M. peak (4p.m. – 6p.m.)
- Evening (7p.m – 9p.m.)

The finding were thus extrapolated according to the needs of this research.

The map indicates the public transit route where participant observation and surveys were conducted.

Figure 4.5: Map of area under study

Source: Google Maps, 2016

Appendix-3: Types of Public Transport in Kathmandu Valley

According to 2012 data, there are 5295 public vehicles operated by 51 firms which provide regular route transportation in Kathmandu valley. All public transport services in Kathmandu are now run by private operators. Most have fewer than ten vehicles; many have only one, and a number of these are owner-drivers. The table below shows the types of public transport that are currently operating in Kathmandu valley roads.

Table 4.10: Types of public transportation in Kathmandu valley roads

Transport type	Local names	Description	Type of routs	Numbers	Number of routes
Large bus	Tula bus	With seating capacity for 46-60 people.	Highways, ring road and major feeder roads	320	2
Mini bus		With seating capacity for 26-45 people	Larger roads as well as inner feeder roads depending on the size and accessibility	2036	107
Micro bus	Nilo-micro and Seto-micro	With seating capacity for 6-14 people	Inner feeder roads and minor feeder roads	2036	90
Tempos		With seating capacity for 11 people	Short routes	913	21
Taxis		With seating capacity for 3 people	Everywhere	7000	
Rickshaws		With seating capacity for 2 people	Mostly in tourist areas of Durbar Square and Thamel	188	

Soruce : Jica, 2012

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