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"ANALYSIS OF THE RELATIONSHIP BETWEEN INCOME LEVELS AND MODES OF TRANSPORT IN KIGALI CITY"

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HAGENIMANA Emmanuel (REG.NO: PG20135051)

Under the Guidance of

Dr Md MAHABUBUL Bari

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SCHOOL OF ENGINEERING

(Nyarugenge Campus)

COLLEGE OF SCIENCE AND TECHNOLOGY

P.O. Box: 3900 Kigali, Rwanda

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COLLEGE OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING

Avenue de l'Armée, B.P. 3900 Kigali, Rwanda

DEPARTMENT OF

CIVIL ENGINEERING AND ENVIRONMENTAL TECHNOLOGY

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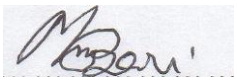
This is to certify that the Thesis Work entitled **"ANALYSIS OF THE RELATIONSHIP BETWEEN INCOME LEVELS AND MODES OF TRANSPORT IN KIGALI CITY"** *is a record of the original bonafide work done by* **HAGENIMANA Emmanuel (REG.NO: PG20135051)** in partial fulfilment of the requirement for the award of Masters of Science Degree in Transportation engineering and Economics at College of Science and Technology, University of Rwanda during the Academic Year 2012-2013**.**



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SUPERVISOR **HEAD**

Dr Md MAHABUBUL Bari Dept. of CE & ET

Submitted for the Project Examination held at UR-CST on7th /08/2014

DECLARATION

I hereby declare that the thesis entitled "**ANALYSIS OF THE RELATIONSHIP BETWEEN INCOME LEVELS AND MODES OF TRANSPORT IN KIGALI CITY**" submitted for the Degree of Master of Science is my original work and the thesis has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship of similar other titles. It has not been submitted to any other University or Institution for the award of any Degree or Diploma.

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Date: …./11/2014 HAGENIMANA Emmanuel

COLLEGE OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING

Avenue de l'Armée, B.P. 3900 Kigali, Rwanda

DEPARTMENT OF

CIVIL ENGINEERING AND ENVIRONMENTAL TECHNOLOGY

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Certified that this thesis titled **"ANALYSIS OF THE RELATIONSHIP BETWEEN INCOME LEVELS AND MODES OF TRANSPORT IN KIGALI CITY"** is the bonafide work of HAGENIMANA Emmanuel (Reg.No20135051) who carried out the research under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

Dr Md MAHABUBUL Bari
B.Sc. Eng. (Civil), M. Sc. Eng. (Environment),
M. Sc. Eng.s (Transport Planning & Engineering),
PhD (Transport Engineering & Economics)
Professional
Transport Adviser
Ministry of Infrastructure
P.O. Box 24 Rwanda

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ABSTRACT

In Rwanda more than 80% of urban population live in slums where the majority of households live in poverty and those people who live there do not have access to infrastructure, this influence negatively the income they earn. This study investigates the relationship between income levels and modes of transport in Kigali City by showing how the income levels are related to modes of transport used.

Many studies showed that transport contributes to income earning of the people and it is needed for assessing how income levels and modes of transport influence each other. In this research Generalized Linear Model (GLM) was used for showing the relationship between income levels and modes of transport in Kigali City. GLM was used because the dependent variables are categorical and it describes relationship between dependent categorical variables and independent variables. The living conditions (income levels) of people influence the modes of transport to be used, in this research the capabilities were used in generalized linear model and they influence both dependent and independent variables.

The data were collected in three different locations of Kigali City and the selection of people to be interview was random sampling where every head or representative of household had the same chance of being interviewed.

The results of SPSS show that income levels are related to modes of transport used in all areas of Kigali City, when income levels influence mode choice and also the availability of means (modes) of transport. For example the main mode of transport of the very poor and poor is walking on foot followed by bicycle. And the main mode of transport of very rich is private car followed by public transport, motorcycle and walking on foot. The model fits well with covariates and factors with goodness of fit of 904.800 while it does not fit well when covariates are removed from model where goodness of fit becomes 1220.423.

The study ended by concluding that the use of modes of transport are related to income levels in Kigali City and it recommends that further researches are needed for more investigation about the relationship between income levels and modes of

transport in Kigali City and also the provision of transport infrastructure should be enforced in all locations of Kigali City, especially in rural areas.

(Key words: Income, Kigali, Mode of transport)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF EQUATIONS

LIST OF SYMBOLS AND ABREVIATIONS

AIC:	Akaike's information criterion
ANOVA:	Analysis of variance
BIC:	Bayesian Information Criterion
C.I:	Confidence Interval
CAIC:	Consistent Akaike's Information Criterion
DF:	Degree of freedom
DFID:	Department for International Development
EICV:	Enquête Intégrale sur les conditions de Vie de ménage
Exp:	Exponential
GDP:	Growth Domestic Products
GHG:	Green House Gases
GIS:	Geographical Information System
GLM:	Generalized Linear Model
HH:	Household
ICF:	International Classification of Functioning
IFPRI:	International Food policy Research Institute
ITS:	Intelligent Transport System
KC:	Kigali City
Km:	Kilometre
LL:	Log Likelihood
MINECOFIN:	Ministry of Finance and Economic Planning
ML:	Maximum Likelihood
NISR:	National Institute of Statistics of Rwanda
ODI:	Overseas Development Institute
PDF:	Portable Document format
PT:	Public Transport
REMA:	Rwanda Environment Management Authority
RWF:	Rwandan Francs
S E:	Standard error
Sig:	Significance
SPSS:	Statistical Package for Social Sciences
SQ. Km:	Square Kilometre

UN:	United Nations
UNICEF:	United Nations Children's Fund
WB:	World Bank
$:	United States of America Dollar
%:	Percentage

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

According to Investopedia[1] income is money that an individual or business receives in exchange for providing a good or service or through investing capital. The income used in this research comprises income from employment, self-employment, household agricultural income, rental income, remittances and other private and public transfers received by an individual by NISR[2]. Based on income people are classified in different categories and those categories can be classified in poor (poverty) and rich (rich) categories.

According to Oxfam GB[3] poverty is a human condition which is characterized by the sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights.

Poverty could also be defined as the lack of command over commodities in general; alternatively, it could be the lack of command over some basic goods (e.g., food and housing). More generally [4] argued that poverty is the lack of «capability» to function in a given society.

According to Wikipedia[5] poverty is divided into two categories. First there is **absolute poverty** or **destitution** and this refers to the deprivation of basic human needs, which commonly includes food, water, sanitation, clothing, shelter, health care and education and second is **relative poverty** which is defined as contextually of economic inequality in the location or society in where people live.

Transport or transportation is the movement of people, goods, signals and information from one place to another. The term is derived from the Latin **‘trans’** "across" and **‘portare’** "to carry".

Transport is one of the important aids to trade. It makes possible production and distribution of goods and services. It makes possible production because of transfer of raw materials and other requirements from the place of supply to the production. It makes possible distribution because it supplies the goods from the place of production to the place of consumption [6]. The transport is done by using different modes of transport.

According to Colin & Zhi [7], transport tends to be treated as having direct relationship to income earning, is one way of earning income and it has significant impacts on economic

growth through the importance of access for people to services, infrastructures, etc. which in turn raise the human capabilities.

According to David, Lucia , & Elizabeth[8] improving transport conditions have the potential to positively impact on poor people's lives and increase their ability to participate in economic growth.

A study by David, Lucia , & Elizabeth[8] asserts that how rural people use transport, and what their transport needs are, seldom differentiates between poor and rich within communities.

Studies show probably no more than half of all rural travel is related to wage employment, although the share increases with a country's level of development. Frequently trips within villages, as opposed to trips to a destination outside the village, are greatest in number and account for the most time and kilometre tonnes. Barter[9] notes that the poor people travels shorter distances and make fewer trips, but take more time to do so than the rich.

In the poorest areas, household travel is dominated by subsistence tasks, which give a local-community orientation to most trips. Frequent journeys are made with small loads over short distances. Social and welfare needs are the main motivation for longer-distance trips, for which roads may be appropriate. From the literature, this research focuses on the relationship between income levels and modes of transport in Kigali City. The income level is looked onto the mirror of human capabilities while transport here is measured in terms of modes of transport used, distances run by people, purposes of travelling and costs of transports.

In general there is a gap between transport needs and means for satisfying the population in developing countries where the population growth is at the high level. For example according to Lourdes Diaz Olvera[10] in Dar es Salaam which is one of the main cities in the poorest countries in Africa is confronted with tremendous population growth accompanied by rapid and unplanned urban sprawl with a split between residential zones on the one hand and zones for employment, trade, health services, etc. on the other. In general context of poverty affecting the inhabitants as well as local and national finances, the failure of the period of "bottom-up socialism" paved the way to a form of development from below.

Lack of sustainable transport is big problem in many cities all over the world, especially in the developing countries and this problem leads to poverty in those countries. This problem

is also caused by high increase of population which is not proportional to the increase of the national economic growth and the available infrastructure does not support that population.

For the case on Rwanda, there are a high number of populations where the population is 10,537,222 people on the surface area of 263338 Km^2; this means a population density of more than 400 people per km^2. The annual growth rate is 2.6%. The Kigali City is one of the parts of Rwanda with very high population growth rate where it is 4% [11] and this high population growth is not proportional to the development or construction of infrastructure and this leads to different problems such as lack of appropriate means of transport for people, lack of regular public transport means and so on.

1.2 DEFINITION OF KEY WORDS

The following are the key words for this research and their meaning can help the reader to get clear understanding about this research.

1.2.1 Transport or mode of transport

Transport or transportation is the movement of people, goods, signals and information from one place to another and means used are called modes of transport. The term is derived from the Latin **'trans'** "across" and **'portare'** "to carry".Transport is one of the important aids to trade. It makes possible production and distribution of goods and services. It makes possible production because of transfer of raw materials and other requirements from the place of supply to the production. It makes possible distribution because it supplies the goods from the place of production to the place of consumption [6].Transport can be sustainable or not, Sustainable transport is defined as the set of transport activities together with relevant infrastructure that collectively does not leave problems or costs for future generations to solve or bear present builders and users of the system should pay such costs today [12].

Sustainable transportation provides access to all groups of people in the city in a manner that is within the environmental carrying capacity of the city and is affordable to both the providers and the users of the system. The system has low impact on the environment, encourages transit oriented development, green vehicles, car sharing, fuel-efficient transport systems, and non-motorized modes of transportation such as walking and biking. A sustainable transportation system is essential as it is an important aspect of a liveable city, a city that provides a high quality of standard of living. The concept of sustainability has three main following components social, economic and environment.

1.2.2 Income level

According to Investopedia[1] income is money that an individual or business receives in exchange for providing a good or service or through investing capital. Based on income the Rwandan population is classified in five categories (levels) of income namely very poor, poor, middle poor, rich and very rich [13].

1.3 PROBLEM STATEMENT

In Rwanda, urban development goes hand in hand with migration; urban development depends essentially on the contributions of rural populations. The low urbanization rate and low urban development place Rwanda in the margin of the demographic transition trend which characterizes the developing countries nowadays. However, this dynamic urbanization is neither well understood nor fully controlled. According to NISR[14] in Rwanda more than 80% of urban population lives in slums and the majority of households live under the poverty line. Those people who live there do not have access to different infrastructures and this causes many problems to them. In Rwanda, basing on income and capabilities of the households, there are five (5) levels of income namely the extremely poor, very poor, poor, food rich (rich) and very rich [13].

Studies indicated that improving transport conditions has the potential to positively impact on poor people's lives and increase their ability to participate in economic growth, a study by David, Lucia , & Elizabeth[8] asserts that how rural people use transport, and what their transport needs are, seldom differentiates between poor and rich within communities.

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Frequent trips within villages, as opposed to trips to a destination outside the village, are greatest in number and account for the most time and kilometre tons. [9] Noted that the poor travel shorter distances and make fewer trips, but take more time to do so than the rich. In the poorest areas, household travel is dominated by subsistence tasks, which give a local-community orientation to most trips. Frequent journeys are made with small loads over short distances. Social and welfare needs are the main motivation for longer-distance trips, for which roads may be appropriate.

From the literature, this research focuses on the relationship between income levels and modes of transport in Kigali City. The study investigates whether once a person is rich; he/she uses the most effective or expensive mode of transport. This can at the end show us whether there is a positive relationship between income levels and modes of transport in Kigali City.

This research is concerned with the analysis of the relationship between income levels and modes of transport by showing how income levels can influence the mode of transport to be used.

1.4 RESEARCH INTEREST AND MOTIVATION

In Rwanda there are many problems which affect the living conditions of people; those problems are at the different levels from one region to another. For example the problem of transport in urban regions is not at the same level as it is in the rural regions and also the problem related to income earning in urban regions is not at the same level as it is in rural regions. The causes and consequences of those problems are different and evaluation of how they change is different from one place to another.

This research is focusing on the analysis of the relationship between income levels and modes of transport in Kigali City. It provides the information on transport in different regions of Kigali City, modes of transport according to the income level among people in Kigali City.

The results of this research will provide a modest contribution on some problems that delay the development of people in Kigali City. And also this research allowed a researcher to gain some ability to conduct a scientific research which is asked at master's degree level.

The results of this research will contribute to the improvement of living conditions of the Rwandan population, especially those who live in different areas of Kigali City.

1.5 OBJECTIVES AND HYPOTHESES FORMULATION

1.5.1. Main objective

The main objective of this research is to analyse the relationship between income levels and modes of transport in Kigali City.

1.5.2. Specific objectives

The following are specific objectives of this research:

1. To relate the income levels with respect to human capabilities
2. To develop relationship between different attributes of income levels and modes of transport
3. To develop relationship between different categories of income levels and modes of transport in Kigali city

1.5.3. The hypotheses of research

A hypothesis is defined as a tentative explanation of the research problem, a possible outcome of the research, or an educated guess about the research outcome [15].

This research will be guided by the following hypotheses:

- Modes of transport are different among three regions of Kigali City
- There is a relationship between income levels and modes of transport in Kigali City.

1.6 SCOPE AND DELIMITATION OF THE RESEARCH

Because this research is limited in time and space, it is focusing on the analysis of the relationship between income levels and modes of transport in Kigali City.

1.7 ORGANIZATION OF THE RESEARCH

This research will consist of five chapters and the following outlines how each chapter will be organized

Chapter 1: Introduction

This chapter includes the background to the research topic, meaning and explanation of Key words, problem statement, research interest and motivation, general objective; specific objectives research hypotheses.

Chapter 2: Research into income levels and modes of transport

This chapter contains the meaning and sources of income, categories of Rwandan population based on income and characteristics of transport, how it contribute in income earning and general understanding of Kigali City with its characteristics.

Chapter 3: Development of model for income levels and modes of transport

This chapter contains the methodology used to develop models for income levels and modes of transport in this research. These models show the mathematical relationship between income levels and modes of transport.

Chapter 4: Methodology for collecting data about income levels and modes of transport

This chapter encompass the methodology that used for data collection in this research. It shows how the sample size has been determined and how data have been collected.

Chapter 5: Analysis of the relationship between income levels and modes of transport

This chapter presents findings from the field work and interpretation of the results (outputs) obtained using SPSS by showing the relation between income levels and modes of transport.

Chapter 6: Conclusion and Recommendations

This is the final chapter which contains the research conclusion and it provides the recommendations about this research and for further researches.

CHAPTER 2. RESEARCH INTO INCOME LEVELS AND MODES OF TRANSPORT

This chapter reviews the literatures related to income levels and modes of transport by giving a deep understanding about income levels and modes of transport. It also gives general understanding about Kigali City where the research has been carried out.

2.1 MEANING OF INCOME

Income is money that an individual or business receives in exchange for providing a good or service or through investing capital [1].

2.1.1 Sources of incomes in Rwandan households

a) Agriculture Activities

Agriculture includes cultivation activities and livestock; it is the heart of Rwanda's economy. The sector occupies 79.5 per cent of the labour force and it contributes one-third of GDP and generates more than 45.0 per cent of the country's export revenues. The agriculture activities are the main sources of income in the majority of Rwandan households [16].

a) Labour

This is the way by which the households earn income by performing tasks under the control or direction of another in a given period of time, by doing home activities, by pursuing education activities, and so on.

c) Business activities

In this kind of earning income, members of a household do different works for being paid or do those works as a self-employed entrepreneur.

d) Income from properties

This is the way by which members of household or individual earn income from the owned properties by renting them for example or from legal rights to property held in trust [17].

2.1.2 Parameters for measuring the income levels

The following are the parameters which can be used for measuring the levels of income in Rwanda.

a) Household descriptions

The characteristics of a household show the level of richness for that household. For example a household with one or more vehicles is classified as a rich household and its characteristics show the level of richness or poverty in the region and also the number of people in household shows the level of income.

b) Number or % of people who afford health services

The affordability of health services for a given people or household shows his/her level of income, if the people cannot afford health services is classified as a poor people or poor household.

c) Number or % of illiterate people

The illiteracy is one of the characteristics of people, the high percentage of illiterate people is found in the poor area of given urban or rural region.

d) Availability of public water

According to Caterina [18] availability of public water is a parameter which can be used for measuring the income level of a given region. In Rwanda the public water are concentrated in more urbanised regions someone who has access to water services in his/her household is considered as a rich (high income level) and the other who does not have it is considered as a poor (low income level).

e) Money spent on transport

The rich household (with high income) spend much money on transport than poor household (low income), the money spent on transport show the level of income of a given household.

f) Availability of electricity in the study area

The poor families do not have access to electricity because it asks money for installation and other money for daily use of electricity.

g) Size of household by age and by gender

The poor household are characterised by a big number of unproductive people for example the number of children can be 6 or more and those children depend on their parents for daily living conditions.

2.1.3 Categories of income levels with respect to monthly income

The table below shows different categories of income levels based on household monthly income and households are classified in the following five categories of income levels: extreme poor, poor, middle poor, rich and very rich.

Table 2-1: Categories of income levels with respect to monthly income

Category	Income levels	Money earned per month in Rwf
1	Extreme poor	Below 20,000
2	Poor	20,001-50,000
3	Middle	50,001-100,000
4	Rich	100,000-500,000
5	Very rich	Above 500,000

Source: [13]

2.2 MODES OF TRANSPORT

Mode of transport (or means of transport or transport mode or transport modality or form of transport) is a term used to distinguish substantially different ways to perform transport. It is a general term used to specify the different kinds of transport facilities that are used by people to move from one place to the other and also to shift the goods from one place to other.

The most dominant modes of transport are land transport, water and aviation transports [9]. When more than one mode of transport is used by a person for transportation it can be described as a multi modal transport.

2.2.1. Different modes of transport used

Many modes of transport can be identified but land, water and aviation can be discussed at this moment because they are the most used modes of transport [19].

a) Land transport includes

- **Rail transport**

Rail Transport is a means of conveyance of passengers and goods by way of wheeled vehicles running on rail track, known as a railway or railroad.

- **Road transport**

A road is an identifiable route, through a city or village and be named as streets, serving a dual function as urban space easement and route.

The most common road vehicle is the automobile, a wheeled passenger vehicle that carries its own motor. Other users of roads include buses, trucks, motorcycles, bicycles and pedestrians.

b) Water Transport

Water transport is the process of transport that a watercraft, such as a barge, boat, ship or sailboat, makes over a body of water, such as a sea, ocean, lake, canal or river.

c) Aviation Transport

Air transport (aviation) is the second fastest method of transport, after space travel. For example commercial jets can reach speeds of up to 955 kilometers per hour. Aviation is able to quickly transport people and limited amounts of cargo over longer distances, but incur high costs and energy use; for short distances or in inaccessible places, helicopters can be used.

2.2.2. Components of a mode of transport

A transport mode is a combination of the following elements:

- Transportation infrastructure: thoroughfares, networks, hubs (stations, bus terminals, airport terminals), etc.
- Vehicles and containers: automobiles, motorcycles, trucks, wagons, trains, ships, and aircraft
- A stationary or mobile workforce
- Propulsion system and power supply (traction)
- Operations: driving, management, traffic signals, railway signaling, air traffic control, etc.

2.2.3. Worldwide comparison of the most important transport modes

Worldwide, the most widely used modes for passenger transport are the Automobile with 16,000 billion passenger km, followed by Buses with 7,000 passenger km, Air with 2,800 passenger km, Railways with 1,900 passenger km, and Urban Rail with 250 passenger km [20].

The most widely used modes for freight transport are Sea with 40,000 billion ton km, followed by Road with 7,000 billion ton km, Railways with 6,500 billion ton km, Oil pipelines with 2,000 billion ton km and Inland Navigation with 1,500 billion ton km.

The table below shows how different modes of transport are used in some countries of the world where the private car is the dominating mode of transport

Table 2-2: Comparison of some used modes of transport in some countries

Country	**EU 15**	**USA**	**Japan**	**World**
Passenger km per capita				
Private Car	10,100	22,700	6,200	2,700
Bus/ Coach	1,050	870	740	1,200
Railway	750	78	2,900	320
Air (domestic except World)	860	2,800	580	480

Source: [20]

2.3 TRANSPORT

Transport or transportation is the movement of people, goods, signals and information from one place to another. As it has been said above, the transport can be sustainable or not. In this chapter I am going to give clear understanding about sustainable transport, its characteristics and its linkages to sustainable development.

2.4 SUSTAINABLE TRANSPORT

A sustainable transport is the one that cover the following three dimensions of sustainability: Social dimension, Economic dimension and Environment dimension. For covering these dimension a more sustainable transportation system is one that allows the basic access and development needs of people to be met safely and promotes equity within and between successive generations (Social dimension), is affordable within the limits imposed by internalization of external costs, operates fairly and efficiently, and fosters a balanced regional development (Economic dimension) , limits emissions of air pollution and Green House Gases(GHG) as well as waste and minimizes the impact on the use of land and the generation of noise (Environment dimension) and is designed in a participatory process, which involves relevant stakeholders in all parts of the society [21].

2.4.1 Characteristics of sustainable transport

Sustainable transport should be characterised by the following characteristics

- **Support Economic Development:** Sustainable transport is one that is recognized as essential to economic development. Efficient and reliable movement of people and goods improves productivity and can stimulate economic growth. Moreover, with rising regional competition, quality of life has become increasingly important for drawing and retaining a talented and productive workforce. Transportation investments are keys to boosting a region's attractiveness to businesses and residents.
- **Support Social Equity:** People who are economically, socially, or physically disadvantaged need transportation options to give them opportunities to work, learn, and participate in society. Transportation is a large and growing expense for many families. Households in locations with poor accessibility to employment opportunities and other destinations and no alternatives to driving tend to spend more on transportation. Investments that improve accessibility and provide more transportation choices allow households to save money [22].
- **Provide more transportation choices***:* Develop safe, reliable, and economical transportation choices to decrease household transportation costs, reduce the nation's dependence on foreign oil, improve air quality, reduce greenhouse gas emissions, and promote public health
- **Promote equitable, affordable transport:** Expand location of efficient transport choices for people of all ages, incomes, races, and ethnicities to increase mobility and lower the cost is the key characteristic of sustainable transport.
- **Enhance economic competitiveness***:* Improve economic competitiveness through reliable and timely access to employment centres, educational opportunities, services and other basic needs by workers, as well as expanded business access to markets.

2.4.2 Link between sustainable transport and sustainable development

According to UN [12], the concept of sustainability has three main components: social, economic and environment. The goals of sustainable transportation, some of the aspects of sustainable transportation and how they support the three components of sustainability are as follow.

The development of a sustainable transportation system starts with the organization of space where it will be operated. The main objective is to reduce the demand for transportation by reducing the number of trips and the length of travel distance. The organization of space

helps in reducing the distances between places and people and as a result people travel less to obtain goods and services. Reducing the transportation demand reduces the use of scarce resources and produces less adverse impact on the environment and economy.

A sustainable transportation system also requires the provision of a diverse, integrated and balanced public transportation services. The transportation needs of different groups are different due to the distances they need to travel, their trip purpose, income, age, gender, physical ability etc. A wide range of public transit services has a better capability to meet the diverse range of travel needs of different groups. A sustainable transportation system also requires the provision of a public transit system that provides good connections with the major activity areas.

A sustainable transportation system should ensure efficient use of scarce resources. This may be achieved, by promoting fuel-efficient and green vehicles, car sharing and encouraging the use of non-motorized transportation. By promoting public transportation and non-motorized transportation, the transportation system is made more efficient to both the providers and the users. As less people use personal vehicles, the lower is the level of traffic congestion and demand for new roadways therefore the increase of savings.

Transportation is not just about moving people but it also involves the movement of goods. Freight traffic in urban areas is increasing because of the increase in urban economic activity and growing population in the cities. Even though, about 10 per cent of the total traffic is freight traffic, an estimated 40 per cent of the pollution caused by the transport sector in an urban area is caused by the urban freight transport. Some of the freight transport is done by using large trucks which have greater turning radius compared to most vehicles in the city. Furthermore, the freight delivery vehicles require considerable time for loading and unloading of goods at different points of the city. In dense part of the cities, all these contribute to traffic congestion therefore its impacts. As it is not a realistic idea to prevent freight transport from entering the city, a sustainable transportation system minimizes the amount of freight traffic in the city as much as possible by improving the efficiency of the freight transport operations through facilities such as consolidation centres or freight villages and through the use of web-based technology and Intelligent Transport System (ITS). Other than optimizing the use of scarce resources, reducing traffic congestion and air pollution there are other important benefits of a sustainable transportation system.

The Asia Program mentions that there is a direct relation between a sustainable urban transportation system and poverty reduction. Poverty is still a major issue in many

developing countries all over the world. The majority of the people in urban areas of those countries live in slums.

Thus, having a sustainable transportation system for those countries is very important as it will reduce the poverty level in the region bringing economic prosperity to all the citizens. Access to affordable transportation for everyone is a key to improved health, education and social empowerment. Access to affordable transportation for everyone can ensure that everyone is able to get to work at a place of their choices. A sustainable transportation system may also work as a catalyst in the development process. A city with a sustainable transport system can easily attract new businesses and other activities. Thus, the benefits of having a sustainable transportation system is not limited to mitigating traffic congestion and improving air quality only but it also helps to reduce poverty and brings economic prosperity to the city.

2.4.3 Needs for Sustainable transport in developing countries

The provision of sustainable transport means is crucial for economic development of developing countries; it can increase the efficiency and flexibility of their response to economic change. Economic infrastructure like roads allows greater choice in operating income earning activities. Where the provision and quality of infrastructure are deficient, poor people's coping mechanisms are hampered. Where access to services is limited and becomes more time consuming, human resources may be diverted away from income-generating activities for example in the country where the transport cost is very high, an increased amount will be used for transport while it should be used for other income generating activities. Where services have become prohibitively expensive or have declined in quality, there can be negative implications for household health and wellbeing [23]. The developing countries need sustainable transport means for their sustainable economic growth and development.

2.5 GENERAL UNDERSTANDING OF KIGALI CITY

Kigali is located at Rwanda’s geographical heart; City of Kigali is not only the national capital, but also the country’s most important business centre and main port of entry.

City of Kigali, which started in 1907 as a small colonial outpost with little link to the outside world, is now more than 100 years old. Today, City of Kigali has come of age-as the capital of Rwanda and made phenomenal strides. It is a city that has not just survived, but

has prevailed and has grown into a modern metropolis, a heart of the emerging Rwandan economy and a pride of every Rwandan.

Among the safest and friendliest of African capitals, City of Kigali is blessed with a moderate high altitude climate that belies its tropical location, and is conveniently located within three hours' drive of the main tourist sites. The Rwandan capital provides both a comfortable and welcoming introduction to this land of a thousand hills and an ideal springboard from which to explore this magical country. Kigali City is made up of three districts namely Gasabo, Kicukiro and Nyarugenge. It is presently inhabited by approximately 1 million inhabitants. Kigali City is 70% rural with a population which is relatively young, the youth make up about 60% and women make slightly more the 50% [24].

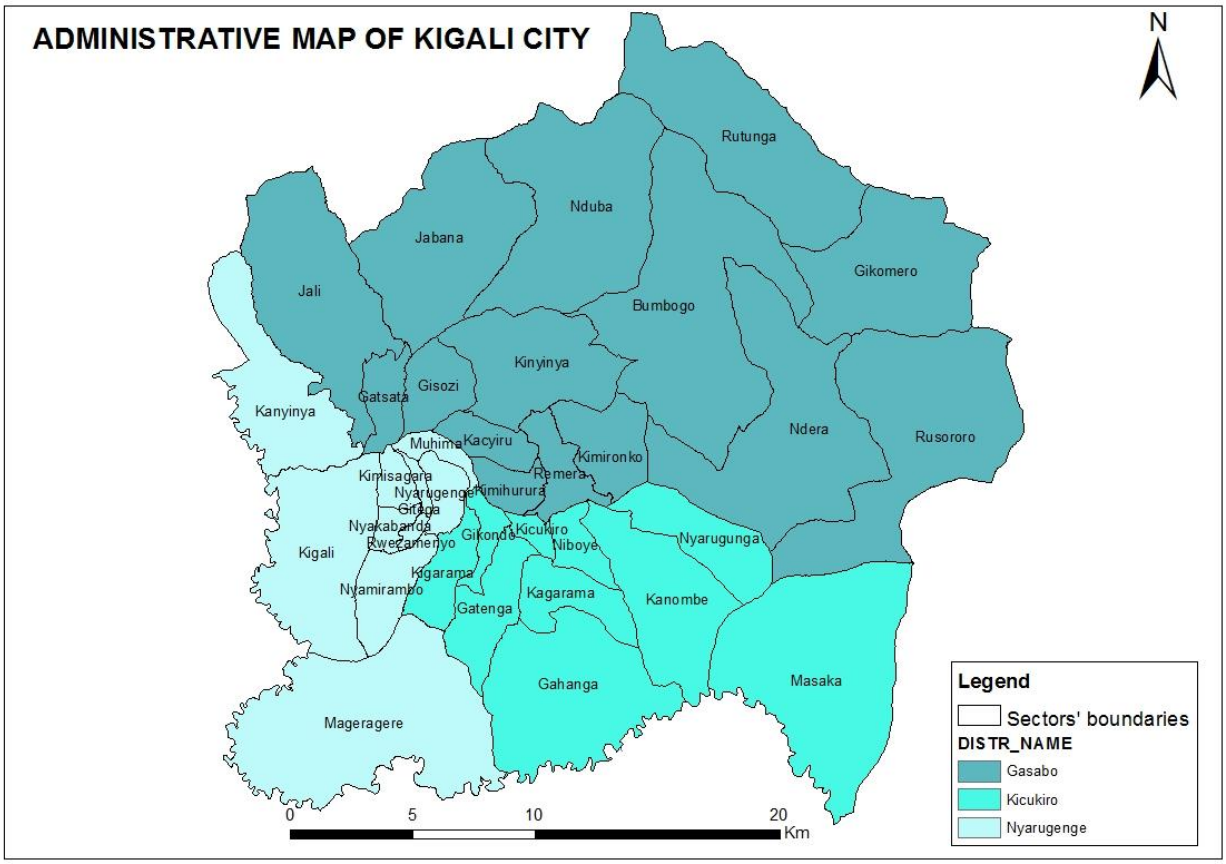

Figure 2-1: Administrative map of Kigali City

2.5.1 Topographic characteristics of Kigali City

The City of Kigali has a high altitude, Sprawling across about four ridges and the valleys in between, within an average elevation from 1335 m to 2050 above sea level. With its

elevation variation of 715 meters from highest to lowest points, the terrain of Kigali City is an undulating landscape of steep hills punctuated with narrow elongated wetland basin that snake through the hilly, steep terrain. Because of the varied elevation of Kigali, topography and steep are the most limiting natural constraints for infrastructure development [25].

2.5.2 Infrastructure in Kigali City

Kigali City has its target of being a state of the art and aesthetically appealing city having sustainable infrastructure that includes roads, good and reliable drainage systems, street lighting as well as green spaces and city parks.

a) Roads

The responsibility for road construction and design lies with the Public Infrastructure Unit in the City of Kigali and road standards lies within the Ministry of infrastructure. While there are a number of internationally acceptable standards for roads, bridges, and pathways that could be adopted, there is also a need to provide protocol for modifying provisions to incorporate native materials acceptable for Rwandan road construction practices [26].

Over the last five years, the City of Kigali has undergone phenomenal development growth especially in infrastructure development. Notable infrastructural development has been done in road construction and rehabilitation as well pedestrian sidewalks. These projects have been comprehensively been undertaken to take care of the diverse road users: motorists, pedestrians, cyclists and People with disabilities. In this sector the following has been achieved;

- Asphalt roads network has increased from 106 km to over 270 km.
- 31.7 km of stone paved roads was constructed
- 99.2 km of sidewalks was constructed
- Two new bus terminus of Kimironko and Kicukiro were constructed while Nyabugogo and Remera termini were rehabilitated
- 20 ravines of 9.8km were constructed

The above projects were completed on time worth of Rwf 68 billion. In the same period, different feasibility studies were undertaken on various roads (over 360 km) in the City of Kigali.

To ease traffic congestion, the City encouraged investors to purchase higher capacity buses and over 200 Coasters were imported. The formation of the Rwanda Federation of Transport Cooperatives has boosted the investment of public transport in the City.

Regulations governing motorcycles were introduced and they were also encouraged to form cooperatives with remarkable success. Traffic lights were also installed to facilitate the free flow of traffic during the night [27].

b) Drainage systems

The drainage system in Kigali has a total distance of 102.800 km and this comprises of 96.193km that is not constructed and the remaining being constructed but still has a lot to be desired.

c) Street lights

Generally the priority areas for street lighting (Airport area, administrative areas, and commercial areas) in the city are well lit up. Many of the new constructed roads are being lit and the City has plans of lighting all major roads. The City of Kigali has introduced state of art traffic lights and there are plans of installing more new traffic lights at busy junctions.

d) Green Spaces and City Parks

As far as green spaces are concerned, Kigali City having a concept which suggests that we are custodians of our important green spaces and valued areas so that they can be enjoyed by future generations. Whilst doing so it is vital that we provide the framework to satisfy the needs of the current generation, if Kigali is to continue to thrive as a City [26].

2.6 DEMOGRAPHIC AND SOCIAL-ECONOMIC CHARACTERISTICS IN KIGALI CITY

2.6.1 Demographic characteristics in Kigali City

The following table shows the population distribution, population change, sex ratio, population rate and density in three districts of Kigali City.

Table 2-3: Population of Kigali City by District in 2002 and 2012

District	2002 Total population	2012 Population			Population Change (2002-2012)	Sex Ratio	Average Annual rate (2002-2012)	Population Density
		Male	Female	Total				
Nyarugenge	236,990	148,282	136,578	284,860	20.2	109	1.9	2,127
Gasabo	320,516	274,342	256,565	530,907	65.6	107	5.2	1,237
Kicukiro	207,819	162,755	156,906	319,661	53.8	104	4.4	1,918
Kigali City	**765,325**	**585,379**	**550,049**	**1,135,428**	**48.4**	**104**	**4.0**	**1,556**

Source: [28]

Gasabo District is the most populated in Kigali City with 530,907 inhabitants, followed by Kicukiro District with 319,661 inhabitant and Nyarugenge District is the least populated with 284,860 inhabitants.

The population of Kigali City has grown by about 48.4% from 2002 t0 2012. This increase is more marked in Gasabo with 65.6% and Kicukiro with 53.8% Districts. Equivalently, Kigali City has experienced an average annual growth rate of 4.0% during the indicated period. This growth rate is higher in Gasabo District with 5.2% and Kicukiro District (4.4%) and very much low in Nyarugenge District (1.9%). It is important to note that the growth rate in Kigali City is higher than the national average of 2.6%.

The population density of Kigali City is 1,556 persons per sq.km. It is highest in Nyarugenge District (2,127 persons per sq.km) and Kicukiro District (1,918 persons per sq.km), and relatively lower in Gasabo District (1,237 persons per sq.km), as shown on the following map on population density of all districts of the country.

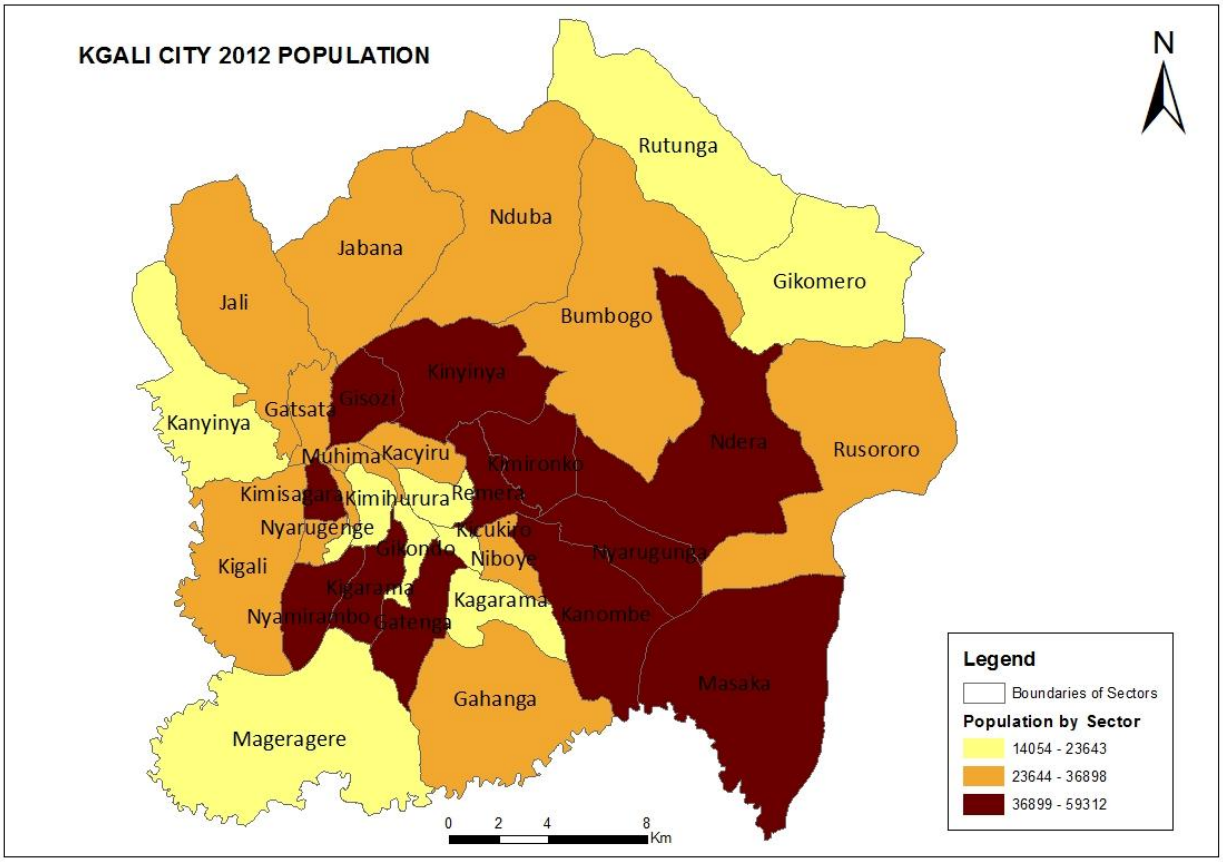

Figure 2-2: Kigali City 2012 Population by Sector

2.6.2 Social-Economic characteristics

Rwanda's economy depends primarily on subsistence agriculture. Rwanda's real GDP growth averaged 8.3 per cent between 2002 and 2009.Per capita GDP swelled those years from $206 to $520, or 252% higher. While 47 per cent of Rwandans enjoyed clean water in 2000, 75 per cent were so fortunate in 2010. 78 per cent of the country was considered poor in 1995 that number stood at 57 per cent in 2009 [29].

2.7 CONCLUDING REMARK

This chapter explains income and based on monthly income of households, five categories of income levels have been identified and also the modes of transport has been defined for making readers to understand what other wrote about it. In this chapter researches related to transport have been used and it has been seen that transport contributes to the income earning of households and therefore development of the country. And also this chapter gives general understanding of Kigali City by showing its different characteristics as the study area for this research.

CHAPTER 3. DEVELOPMENT OF MODEL FOR INCOME LEVELS AND MODES OF TRANSPORT

3.1 INTRODUCTION

This chapter contains the methodology used to develop model for income levels and modes of transport in this research. This model shows the mathematical relationship between income levels and modes of transport.

3.2 THE GENERALIZED LINEAR MODEL: MULTINOMIAL CUMULATIVE LOGIT

Because the dependent variable is the ordinal variable, the generalized linear model uses the ordinal logistic regression; hence a **multinomial cumulative logit** model was developed to determine a relationship between income levels and modes of transport.

3.2.1. Dependent variable

The dependent variable in this model is income level which is divided into five categories namely very poor, poor, middle poor, rich and very rich.

3.2.2. Covariates

The covariates of this model are transport elements namely different modes of transport, number of trips made using each mode of transport per day, distance travelled per day per person, speed used by each mode of transport, money spent on mode of transport used, purpose of travelling and problems faced by transport users.

3.2.3. Latent capabilities

The latent capabilities are taken into account by the model because they influence the living conditions. These are taken as capabilities measuring levels of income. According to Legido-Quigley[30], there are ten central human capabilities as follow:

1. Life: Being able to live to the end of a human life of normal length; not dying prematurely, or before one's life is so reduced as to be not worth living.

2. Bodily Health: Being able to have good health, including reproductive health; to be adequately nourished; to have adequate shelter.

3. Bodily Integrity: Being able to move freely from place to place; to be secure against violent assault, including sexual assault and domestic violence; having opportunities for sexual satisfaction and for choice in matters of reproduction.

4. Senses, Imagination, and Thought: Being able to use the senses, to imagine, think, and reason and to do these things in a "truly human" way, a way informed and cultivated by an adequate education, including, but by no means limited to, literacy and basic mathematical and scientific training. Being able to use imagination and thought in connection with experiencing and producing works and events of one's own choice, religious, literary, musical, and so forth. Be able to use one's mind in ways protected by guarantees of freedom of expression with respect to both political and artistic speech, and freedom of religious exercise. Be able to have pleasurable experiences and to avoid non-beneficial pain.

5. Emotions: Being able to have attachments to things and people outside ourselves; to love those who love and care for us, to grieve at their absence; in general, to love, to grieve, to experience longing, gratitude, and justified anger. Not having one's emotional development blighted by fear and anxiety (Supporting this capability means supporting forms of human association that can be shown to be crucial in their development).

6. Practical Reason: Being able to form a conception of the good and to engage in critical reflection about the planning of one's life (This entails protection for the liberty of conscience and religious observance).

7. Affiliation:

A. Being able to live with and toward others, to recognize and show concern for other human beings, to engage in various forms of social interaction; to be able to imagine the situation of another. (Protecting this capability means protecting institutions that constitute and nourish such forms of affiliation, and also protecting the freedom of assembly and political speech.)

B. Having the social bases of self-respect and non-humiliation; being able to be treated as a dignified being whose worth is equal to that of others. This entails provisions of non-discrimination on the basis of race, sex, sexual orientation, ethnicity, caste, religion, national origin.

8. Other Species: Being able to live with concern for and in relation to animals, plants, and the world of nature.

9. Play: Being able to laugh, to play, to enjoy recreational activities with other people.

10. Control over one's Environment:

A. Political: Being able to participate effectively in political choices that govern one's life; having the right of political participation, protections of free speech and association.

B. Material: Being able to hold property (both land and movable goods), and having property rights on an equal basis with others; having the right to seek employment on an

equal basis with others; having the freedom from unwarranted search and seizure. In work, be able to work as a human being, exercising practical reason and entering into meaningful relationships of mutual recognition with other workers.

3.2.4. Theoretical framework of a relationship between income levels and modes of transport

The following features need to be present in this framework for explaining all the capabilities above:

Capabilities are latent, unobservable and interdependent, and are endogenous in this structural model.

(i) Capabilities are influenced by a set of social, political and institutional factors, some of which may in turn be influenced by them. In addition to capabilities there also some observed endogenous variables in this model.

(ii) Capabilities are also influenced by a set of observable external (exogenous) causes such as natural environment factors, cultural elements, social, economic and political causes

(iii) Achievements/functionings are measurable and are linked to the under-lying capabilities (the set of relationships link the two is so-called measurement model or qualitative response model).

(iv) The relationships between the latent capabilities and the observed functionings are also affected by exogenous elements for example individual characteristics.

Let me now introduce some notations which will help me to formulate the theoretical framework in precise terms. I shall denote by

$\hat{\mathbf{Y}}$: a vector of latent unobserved capabilities

Y: a vector of observed indicators representing the functioning associated with the capability vector

Z: a vector of observed variables that influence the capabilities but are also influenced by them

X: a vector of exogenous causes **$\hat{\mathbf{Y}}$** and **Z**

W: Vector of exogenous factors entering the measurement equations i.e. the relationships between observed indicators *y* and latent variables **$\hat{\mathbf{Y}}$**

For each vector, a typical element will be denoted using a subscript *i*, e.g. **$\hat{\mathbf{Y}}$,** $i=1,\ldots m$

Note that we do not have latent exogenous variables though theoretically, it is perfectly possible to allow for such a case. The reason for not including them in the above framework is that we do not see their relevance in our practical context where we would normally directly observe all exogenous factors.

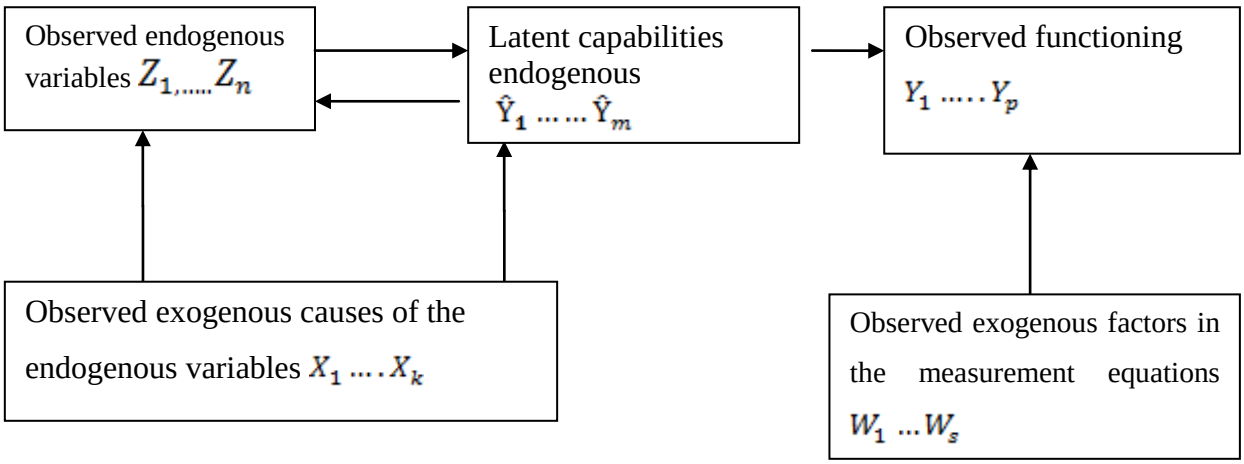

Figure 3-1: The General Theoretical Framework with abstract variables

Source: [31]

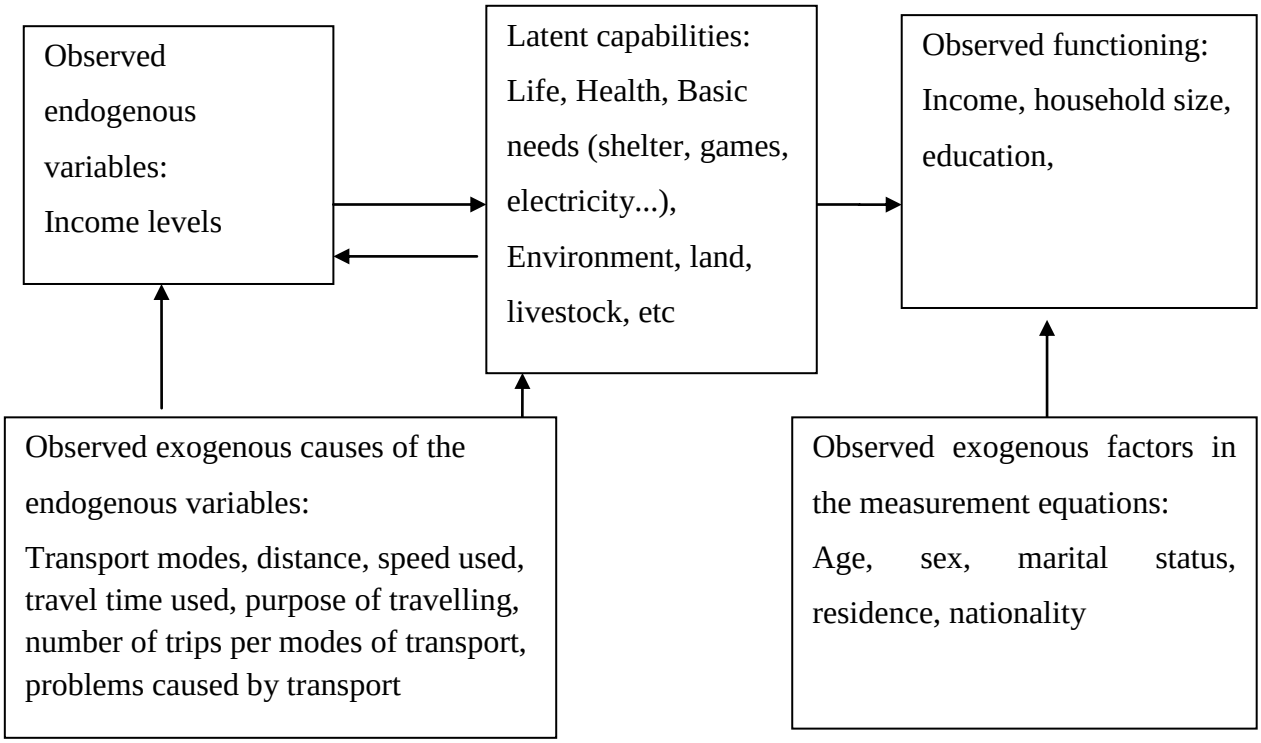

Figure 3-2: The General Theoretical Framework with examples

3.3 THE MATHEMATICAL MODEL

The generalized linear model is used and has the following general equation.

$$Log\left(\frac{p_i}{1-p_i}\right) = logit(p_i) = \beta_{i0} + \beta_{i1}x_{i1} + \cdots + \beta_{ip}x_{ip}$$

Equation 3-1

Where $x_{i1} \ldots \ldots x_{ip}$ are continuous measurements corresponding variables to factor levels and $\beta_{i1\ldots\ldots\beta_{ip}}$ are the parameters, p_i is the probability of an event.

Estimates for the parameters and response probabilities are typically obtained by the method of maximum likelihood. These estimates will be computed and returned by software package. Note that the generalized linear model can be rewritten in terms of the probability of a positive response.

$$P_i = \frac{\exp(\beta_{i0} + \beta_{i1}x_{i1} + \cdots + \beta_{ip}x_{ip})}{1 + \exp\,(\beta_{i0} + \beta_{i1}x_{i1} + \cdots + \beta_{ip}x_{ip})}$$

Equation 3-2

Where P_i is the probability of event [32]

For the case of data to be used for this research, the model contains factors, covariates and error term and the generalized linear model equation is written like this

$$Log\left(\frac{p_i}{1-p_i}\right) = logit(p_i) = \beta_{i0} + \beta_{i1}x_{i1} + \cdots + \beta_{ip}x_{ip} + \in_{CV} + \in$$

Equation 3-3

Where $x_{i1} \ldots \ldots x_{ip}$ are continuous measurements corresponding variables to covariates levels

p_i is the probability of an event

$\beta_{i1\ldots\ldots\beta_{ip}}$ are the parameters

$\in_{CV}$ are the factors

$\in$ is the error term

Goodness of fit

The goodness of fit will be used for testing how the model fit. In generalized linear model, the goodness of fit contains following parameters: Deviance, Scaled deviance, Pearson Chi-Square, Scaled Pearson Chi-Square, log Likelihood, Akaike's Information Criterion (AIC), Finite Sample Corrected, Bayesian Information Criterion and Consistent.

For testing the fitness of model some of these parameters will be used.

In this research, the following parameters can be used

Deviance is usually defined as the log likelihood of the final model, multiplied by (-2). Deviance is equal to Scaled Deviance. It fits model when it is low.

Pearson Chi-Square: This is a goodness-of-fit measure that compares the predicted values of the outcome variable with the actual values. **Pearson Chi-Square is equal to** Scaled Pearson Chi-Square.

It is calculated as $\sum_{i-1}^{n} \frac{(y_i - \hat{y}_i}{\hat{y}_i}$

Equation 3-4

Where $\hat{\mathbf{y}}_i$ is the predicted value of y_i

n is the Sample size or total number of observation

Log Likelihood: The log likelihood of the final model, it is good when it is high and the goal is to maximize log Likelihood.

Likelihood is a probability, specifically the probability that the observed values of the dependent may be predicted from the observed values of the independents. Like any probability, the likelihood varies from 0 to 1. The log likelihood (LL) is its log and varies from 0 to minus infinity (it is negative because the log of any number less than 1 is negative). LL is calculated through iteration, using maximum likelihood estimation (ML). Log likelihood is the basis for tests of a logistic model. Because - 2LL has approximately a chi-square distribution, -2LL can be used for assessing the significance of logistic regression analogous to the use of the sum of squared errors in OLS regression.

Akaike's information criterion (AIC): The Akaike's information criterion is a goodness-of-fit measure which is defined as

(-2 ln *L* + 2*k*)

where *k* is the number of parameters in the model and *L* is the likelihood function of the final model.

Akaike's Information Criterion is commonly used to compare models, where the lower the Akaike's Information Criterion, the better. The step with the lowest AIC thus becomes the "final model." By the lowest AIC criterion, the best model would be model.

Bayesian Information Criterion: This is the Bayesian information criterion, a goodness of fit measure which is defined as

$$BIC = \frac{-2lnL + kln(n)}{n}$$

Equation 3-5

Where n is the total number of observations, k is the number of model parameters, and L is the likelihood function of the final model. Bayesian information criterion is also used to compare models, where the lower the BIC, the better. The step with the lowest BIC thus becomes the final model. Often BIC will point to a more parsimonious model than will AIC as its formula factors in degrees of freedom, which is related to number of variables. By the lowest BIC criterion, the best model would be model.

3.4 CONCLUDING REMARK

In this chapter shows the developed model for showing mathematically the relationship between income levels and modes of transport in Kigali City where income levels are considered as dependent variable, data related to modes of transport are considered as covariates and data related to ten human capabilities are considered as factor for this model (generalized linear model).

CHAPTER 4. METHODOLOGY FOR COLLECTING DATA ABOUT INCOME LEVELS AND MODES OF TRANSPORT IN KIGALI

4.1 INTRODUCTION

In order to reach the mentioned objectives and verify hypotheses different methods were used for primary data and secondary data collection. This chapter highlights all the methods and procedures used for collecting data and gathering all information concerning the research topic.

4.2 DATA SOURCES

For conducting a scientific research, two approaches are possible for collecting the needed data, either the information required is already available and needs to be extracted, or the information is not available and needs to be collected. By using the first approach, the information is said to be collected using the **secondary sources** while the second will be **primary sources**. In this research, both primary and secondary sources were used for collecting needed information.

4.2.1 Secondary sources

The following section describes how secondary data have been collected and different methods for their acquisition.

Literature research

Some important secondary data were collected before starting collection of primary data, which is important to develop the field work plan and finally they were used in the analysis phase. The published materials, books and articles were consulted. The gathered information through those documents served for building background information and literature review.

Spatial datasets

Spatial dataset implies the dataset that has a spatial component that allows to geo-reference the described phenomena to a location or region on the earth (Geodata, n.d). In this research spatial datasets included administrative boundaries of Kigali City and location of case study for this research. These data were used for assessing the availability of means of transport and relationship between income levels and modes of transport in Kigali City.

4.2.2 Primary data sources

For collecting primary data, the combination of field observation and interview using questionnaires were used for people who have been interviewed to evaluate the relationship between income levels and modes of transport in Kigali City, especially in selected regions.

a) Field observation

Observation was used for viewing events on the field in the study area and for selecting the people to be interviewed. This opportunity was used to get information about transport and poverty in different locations of Kigali City.

b) Field survey

The questionnaire forms were given to field surveyors and the respondents responded to them by giving the answer to field surveyors. This method permitted to use a short time in data collection and each respondent was freely to respond to the asked questions and gave probably precise answer. Respondents were mainly local population from different households in the selected areas. One person (head of household) was supposed to answer the question in the behalf of the household.

4.3 SELECTION OF TARGETED AREAS IN KIGALI CITY

Due to limited time and economic means, it is not possible for the researcher to get to every person (head of household) in Kigali City that is why the research methodology for sampling system was used to avoid dealing with all population. The sampling system allowed the researcher to determine representative sample applied to all population in order to make the work possible in the limited time using limited economic means.

The sample size was selected from entire Kigali City covering three districts namely Gasabo, Kicukiro and Nyarugenge. Each District is represented by one Sector and that Sector has been selected according to its characteristics.

4.3.1 Sampling techniques

For sampling technique the stratified sampling was used. Stratified Sampling is a method of sampling that involves the division of a population into smaller groups known as strata. In stratified random sampling, the strata are formed based on members' shared attributes or characteristics.

The main advantage with stratified sampling is how it captures key population characteristics in the sample. Similar to a weight average, this method of sampling produces

characteristics in the sample that are proportional to the overall population. Stratified sampling works well for populations with a variety of attributes, but is otherwise ineffective, as subgroups cannot be formed. The researcher classified the study area in three strata which are urban, inter-urban and rural areas according to their characteristics.

Urban area: urban area has been defined as an area of population density varies between 10522 and 24603 people per square kilometre. It consists of high density of residential houses.

Inter-urban area: this area has defined as area of population varies between 2579 and 10521 people per square kilometre. It consists of low density residential compare to urban area, adjacent to higher zones with mixed uses.

Rural area: rural area is the area that its population varies between 420 and 2578 people per square kilometre and consists of sparsely settled lands in open or cultivated states. These include woodland, agriculture land and grassland. Typical buildings are residential houses.

According to their characteristics each District is represented as this, Nyarugenge District is represented by Kimisagara Sector as urban area, Gasabo District is represented by Gisozi Sector as inter-urban area, and Kicukiro is represented by Masaka Sector as rural area.

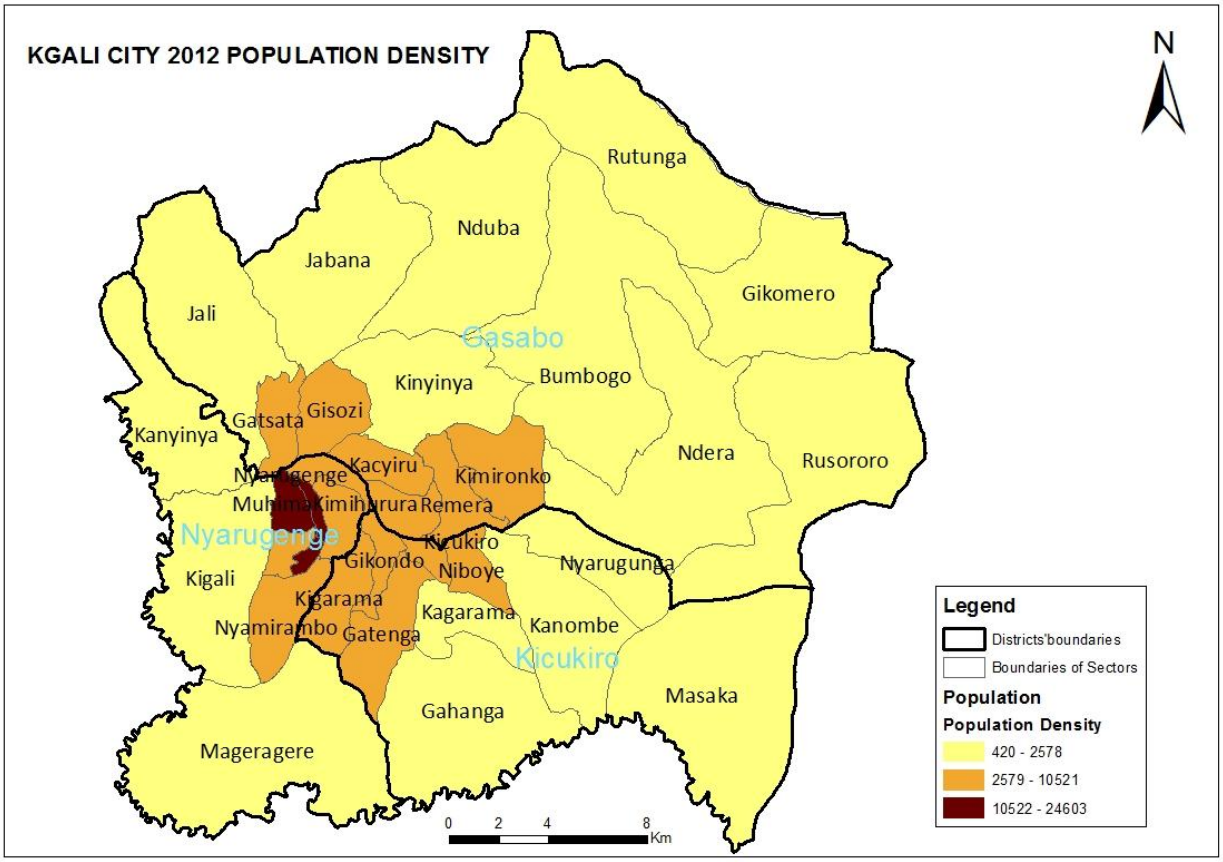

Figure 4-1: Kigali City 2012 Population density

Because the unit of survey was the household, it has been necessary for determining the number of households in the targeted areas and their number have been determined as this.

According to NISR[28] the number of people for each Sector is known and the mean number of people per household in Kigali City is 4.7 persons per household and this permit the researcher to determine the number of households in these three Sectors above.

Table 4-1: The number of people and household in those three Sectors

Name of Sector	**Number of People**	**Number of Households (HH)**
Kimisagara	47,133	$HH = \frac{47,133}{4.7}$=10,028
Gisozi	44,075	$HH = \frac{44,075}{4.7}$=9,378
Masaka	39,621	$HH = \frac{39,621}{4.7}$=8,430
Total	**130,583**	**27,836**

Source: [28]

The following maps show the location of each sector among three these sectors above

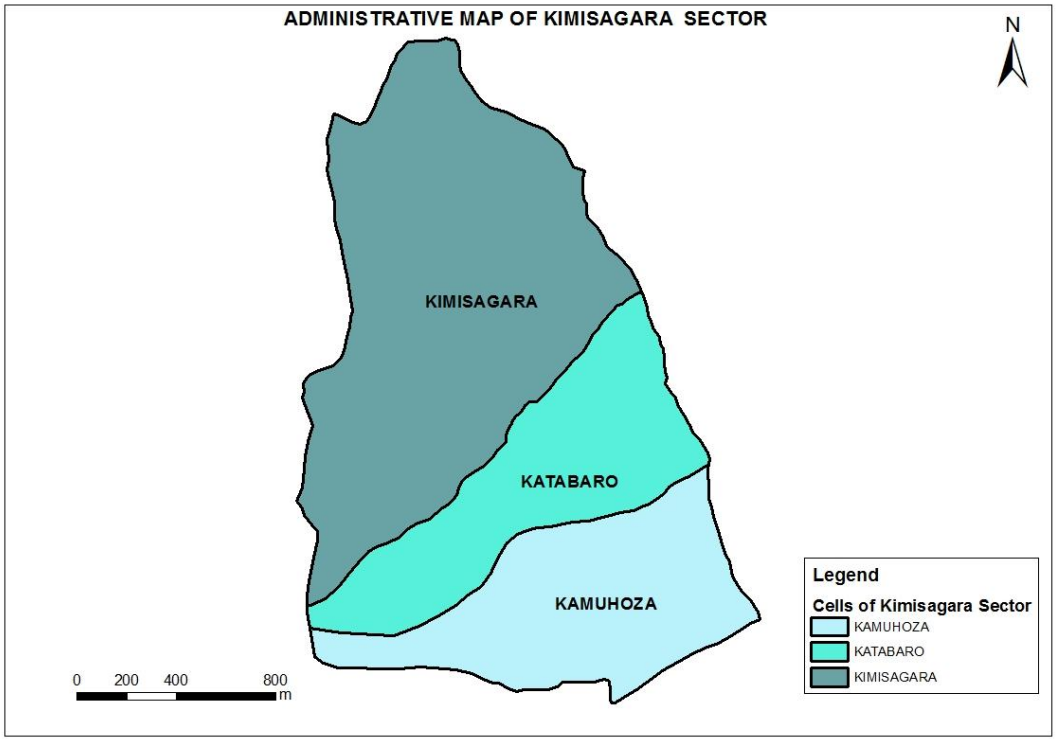

Figure 4-2: Kimisagara Sector administrative map

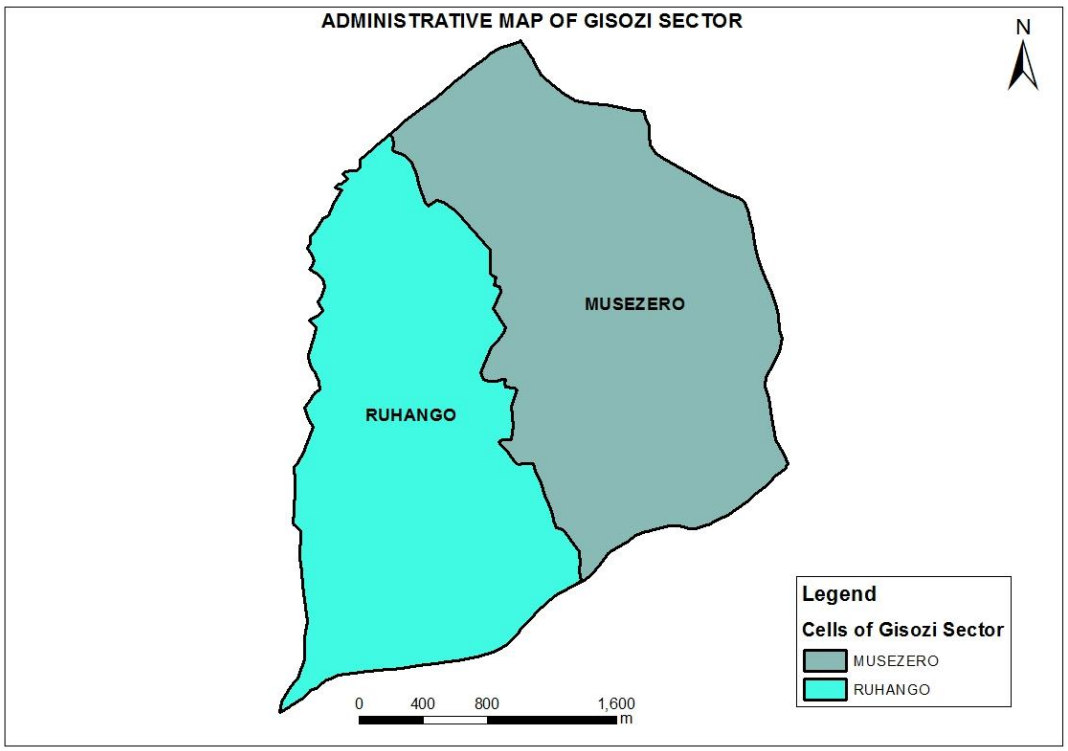

Figure 4-3: Gisozi Sector administrative map

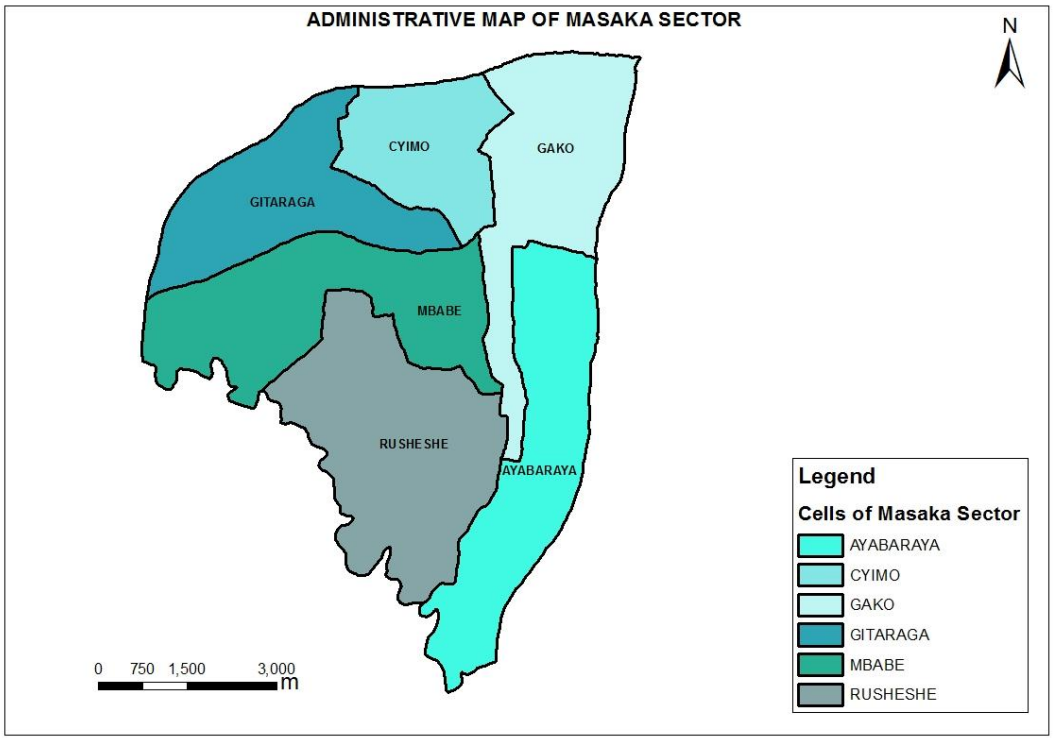

Figure 4-4: Masaka Sector administrative map

4.3.2 Sample size determination and justification

Because of some economic and time barriers sample size determination must be precise and more accurate. When calculating a sample size for a study whose dependent variable is categorical, a Cochrane sample size formula and a confidence interval of 95% are required. In addition, to determine a relationship between categorical independent variables and more than two independent variables, a large sample size is required. That is, a sample size (350 to 400 individuals) to detect small effects in all specifications is necessary [34] and by using the formula below, the sample size in this study is 394 individuals. The formula below is used for sample size determination and under this formula the researcher was able to determine the sample size of household to be surveyed in targeted areas of Kigali City.

$$n = \frac{N \times n_0}{N + n_0}$$

Equation 4-1

Where **n** is the sample size,

$\mathbf{n_0}$ is the constant calculated from the probability of two complementary p and q; where p=q=0.5

$$\leftrightarrow p + q = 1$$

N the universe or total targeted population within the selected areas.

In this theory, [35] has developed the equation which gives the value of n_0 as follow

$$n_0 = \frac{z^2 \times p \times q}{e^2}$$

Equation 4-2

Where **z** is the threshold of confidence which is estimated to be equal to 2 and **e** is the stroke of errors that is estimated to 5% or 0.05 when the confidence interval is 95%, **p** is Complementary event of probability (p=0.5) and **q** is probability whose value equals to 0.5

From this n_0 is calculated as $n_0 = \frac{2^2 \times 0.5 \times 0.5}{(0.05)^2} = 400$

Therefore

$$n = \frac{N \times n_0}{N + n_0}$$

Equation 4-3

$$\text{n} = \frac{\text{Number of household} \times 400}{\text{Number of household} + 400}$$

In this research the targeted population is represented by households and their number in the selected areas are shown in the table below as this:

Table 4-2: Number of Household in targeted Sectors

N_0	**Sector name**	**Number of household**
1	Kimisagara	10,028
3	Gisozi	9,378
3	Masaka	8,430
Total		27,836

Source: [28]

From this table above the total population (N) is 27,783 households and from this the sample size is determined in this way

$$n = \frac{27836 \times 400}{27836 + 400} = 394.33 \approx 394$$

The sample size in the target areas is 394 households and these households have to be found in three sectors and each Sector has its own number of households as this according to their number of households.

Table 4-3: Sample size determination for each targeted Sector

No	Sector name	Number of households	Sample size
1	Kimisagara	10,028	$n1 = \frac{10028 \times 394}{27836} = 142$
2	Gisozi	9,378	$n2 = \frac{9378 \times 394}{27836} = 133$
3	Masaka	8,430	$n3 = \frac{8430 \times 394}{27836} = 119$
Total		**27,836**	**394**

4.4 JUSTIFICATION OF DATA COLLECTION AND ITS TIME OF COLLECTION

As it has been seen above three locations were selected for interview and each one has been interviewed by one field surveyor, this means that three field surveyors were used for this research, plus researcher for coordination and assistance on the field survey. The sampling of person to be interviewed was random sampling where every head or representative of household had the same chance of being interviewed in those three locations. For covering all locations in the selected sectors the field surveyor did the interview in this way, he interviewed one head or representative of household and he went to the next household randomly and so on until the sample size is covered.

Because the data to be collected were supposed to be provided by a head or representative of household, the data were collected in all working hours in the working days and weekends, in rural areas where people do their daily activities near their households and in other regions data were collected after working hours (from 5:00 to 7:00PM) and during the week end when the heads or representative of households are available in their homes.

4.5 CONCLUDING REMARK

This chapter explains in details the data collected and describes how these were done during the fieldwork in Kigali City. The literature research was used for getting secondary data. Field observation; interview and field survey were used for primary data collection. In this part it is where sample size has been determined and it is 394 individuals for this study. It shows also how collected data can be processed and interpreted using Microsoft office Excel, SPSS, and Word and this will be done in next chapter.

CHAPTER 5. RELATIONSHIP BETWEEN INCOME LEVELS AND TRANSPORT ELEMENTS

This chapter includes the outputs of data collected and processed using SPSS, their interpretation show the relationship between income levels and modes of transport in different locations of Kigali City.

5.1 DESCRIPTION OF THE VARIABLES IN THE MODEL

Below are the descriptive statistics of the variables included in the models in Kigali City. The main mode of transport is walking on foot where by average number of trips by walking are 4.37 trips per day per person. The second mode is the public transport with a mean of 2.18 trips per day. The third mode of transport is the motorcycle where the average number of trips is 1.47. The fourth and last mode of transport is the private car and bicycle with an average of 1.37 trips per day per person for each.

Table 5-1: Description of the independent variables in the model

Descriptive Statistics

	N	Mean	Std. Deviation
Number of trips by walking per day	394	4.37	1.662
Distance by walking per day in Km	394	4.77	2.503
Travel time per day by walking in minutes	394	3.78	1.542
Speed by walking in Km/h	394	2.98	.981
Number of bicycles owned	394	1.15	.383
Number of trips by bicycle per day	394	1.37	.907
Distance travelled by bicycle	394	1.85	1.853
Travel time per day by bicycle in minutes	394	1.43	.958
Speed by bicycle in km/h	394	1.73	1.573
Money spend on bicycle per day in Rwf	394	1.67	1.485
Number of motorcycles owned	394	1.12	.375
Number of trips by motorcycle	394	1.47	.902
Distance travelled by motorcycle per day in km	394	1.93	1.781
Travel time by motorcycle per day in minutes	394	1.83	1.685
Speed of motorcycle in km/h	394	1.69	1.221
Money spend on motorcycle per day	394	2.07	1.986
Number of car owned	394	1.18	.465
Number of trips by car	394	1.37	.972
Distance travelled by car per day in km	394	1.55	1.366

Travel time by car per day in minutes	394	1.68	1.703
Speed of car per day in km/h	394	1.45	1.041
Money spend on car per day in Rwf	394	1.47	1.157
Number of trips made using PT	394	2.18	1.190
Distance travelled per day using PT in km	394	3.28	2.373
Travel time by PT per day in minutes	394	3.29	2.162
Speed of P T per day in km/h	394	2.62	1.328
Money spend on PT per day in Rwf	394	2.86	1.772
Purpose of travelling	394	3.66	2.328
Problem caused by transport	394	.11	.312
Those problems of transport	394	2.56	1.720
Valid N (listwise)	394		

5.2 DESCRIPTION OF CAPABILITIES AMONG CITIZENS OF KIGALI CITY

Most of people in Kigali City fall in the category of middle poor. Only 27% of the population in Kigali does not possess electricity, 82% of the population does not own livestock. The average population has attained their secondary education (mean=3.35). Only 34% does not possess a job while the average land size is 0.27 hectares in Kigali, an average that is below the national average of 0.53 ha [28]. The study ended by revealing that 89.0% of the population is living in good conditions. Only 18% of the population own at least one livestock. A number of cattle owned by a household in rural areas of Kigali City is estimated at around 3 while it is none in interurban and urban Kigali. A number of rabbits owned by a household in rural areas of Kigali are estimated at around 5 while it is 4 in interurban Kigali. A number of goats owned by a household in rural areas of Kigali are estimated at around 3 while it is 2 in interurban Kigali. A number of chickens owned by a household in rural areas of Kigali are estimated at around 5 while it is 2 in interurban Kigali. Sheep and pigs are not owned among rural, interurban and urban Kigali City. More results about capabilities in Kigali City are found in appendix 2-1.

5.3 INCOME LEVELS AND MODES OF TRANSPORT IN KIGALI CITY

The table below illustrates the main modes of transport across different categories of income levels in Kigali City. In rural of Kigali, the main mode of transport of the very poor and poor is walking on foot followed by bicycle. However, a poor may travel by motorcycle and public transport. The main mode of transport of middle poor is walking on foot followed by bicycle and private car, motorcycle and public transport. The main mode of transport of rich is private car, followed by bicycles, walking on foot, public transport and motorcycle. The main mode of transport of very rich is private car followed by public transport, motorcycle and walking on foot.

In interurban region of Kigali, the main mode of transport of the poor is walking on foot, followed by bicycle and last is the public transport. The main mode of transport for the poor is walking on foot followed by bicycle, public transport and motorcycle. The main mode of transport of middle poor is walking on foot followed by bicycle, public transport and motorcycle. The main mode of transport of rich in interurban is private car followed by walking on foot, motorcycle, public transport and bicycle. The main mode of transport of very rich is private car followed by public transport, motorcycle, bicycle and walking on foot.

In urban Kigali, the main mode of transport of very poor and poor is walking on foot followed by bicycle, public transport and motorcycle. The main mode of transport of middle poor is walking on foot followed by bicycle and private car, public transport and motorcycle. The main mode of transport of the rich and very rich is motorcycle, followed by private car, walking on foot and public transport.

5.4 FACTORS INFLUENCING CHOICE OF MODE OF TRANSPORT IN KIGALI

The table below shows how the people choose the modes of transport in Kigali City where the majority (25.6%) choose the mode of transport based on its influence on their life and it is followed by the availability of modes of transport with 24.4%, the people use the available modes of transport in the region, on the third place there is affordability with 23.9%, they choose it based on the transport cost, on the fourth there is reliability with 14.7% and last factor is the travel time with 11.4%.

Table 5-2: Factors that influence the mode choice in Kigali City

Factors	Frequency	Per cent	Valid Per cent	Cumulative Per cent
Availability	96	24.4	24.4	24.4
Good for my life	101	25.6	25.6	50.0
Affordability	94	23.9	23.9	73.9
Reliability	58	14.7	14.7	88.6
Travel time	45	11.4	11.4	100.0
Total	**394**	**100.0**	**100.0**	

Table 5-3: Income levels and transport elements in Kigali City by region

				Number of trips by walking per day	Number of trips by bicycle per day	Number of trips by motorcycle	Number of trips by car	Number of trips made using public transport
				Mean	Mean	Mean	Mean	Mean
residence of the respondent	Rural	Income level of the respondents	very poor	3.72	2.30	.	.	.
			poor	4.08	2.83	1.00	.	1.00
			middle poor	4.11	2.80	1.43	2.00	1.40
			rich	3.06	3.33	2.00	4.00	2.25
			very rich	2.00	.	2.50	3.25	3.00
	Interurban	Income level of the respondent	very poor	3.95	2.85	.	.	1.00
			poor	4.00	2.40	1.00	.	1.20
			middle poor	4.33	2.86	1.00	.	1.75
			rich	3.10	2.00	2.83	3.25	2.31
			very rich	2.11	2.00	2.33	3.25	2.44
	Urban	Income level of the respondent	very poor	3.50	2.14	1.00	.	1.50
			poor	3.97	2.00	1.00	.	1.50
			middle poor	3.50	3.00	1.20	3.00	1.67
			rich	3.09	.	3.25	3.22	2.27
			very rich	2.73	.	3.75	2.92	2.25

Legend:

Code	1	2	3	4	5	6	7
Number of trips by walking, bicycles, motorcycles, car and public transport	0	1-2	3-4	5-6	7-8	9-10	>10

5.5 THE GENERALIZED LINEAR MODEL FOR INCOME LEVELS AND TRANSPORT ELEMENTS

The income levels in this model are explained by used mode of transport. However, income levels are explained by other factors such as capabilities like living conditions, possession of assets like land parcel, house, livestock, level of education and access to health care here measured by having a medical insurance, access to electricity, ability to play game, etc. The model is first developed according to residence and then the overall model. In this model very rich and very poor are taken as a reference categories one by one.

5.5.1 Relationship between income levels and transport elements in the interurban regions of Kigali City

Having very rich as a reference category, with covariates as main effects of the model; the number of motorcycles owned, number of trips travelled using motorcycle; travel time by public transport and the purpose of travelling have a statistically significant relationship with income levels. That is, being very rich has a relationship with those covariates.

For covariates with a statistically significant relationship, positive coefficients indicate positive relationships between predictors (covariates) and outcome while negative coefficients indicate inverse relationships between them and being very rich in interurban regions of Kigali City. An increasing value of a covariate with a positive coefficient corresponds to an increasing rate of being very rich. For example, number of motorcycles owned and trips by motorcycles indicate a positive relationship with being very rich (significance values: 0.000 and 0.014). More results can be found in appendix2-2.

Holding very poor as a reference category in the model, negative coefficients for covariates correspond to an inverse relationship with very poor in interurban areas while positive coefficients correspond to a positive relationship with being very poor. For example, a number of motorcycles owned and the trips by motorcycles indicate a negative relationship with being very poor in interurban areas of Kigali City. More results can be found in appendix2-3

A model fits well with covariates with a deviance of 281.134compared to a model without covariates having a deviance of 417.357.

Table 5-4: Goodness of fit of the model with covariates in the interurban region of Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	281.134	462	.609
Scaled Deviance	281.134	462	
Pearson Chi-Square	748.247	462	1.620
Scaled Pearson Chi-Square	748.247	462	
Log Likelihood[b]	-140.567		
Akaike's Information Criterion (AIC)	349.134		
Finite Sample Corrected AIC (AICC)	373.420		
Bayesian Information Criterion (BIC)	447.406		
Consistent AIC (CAIC)	481.406		

Dependent Variable: Income Level

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

Table 5-5: Goodness of fit of the model without covariates in the interurban region of Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	417.357	424	.984
Scaled Deviance	417.357	424	
Pearson Chi-Square	526.338	424	1.241
Scaled Pearson Chi-Square	526.338	424	
Log Likelihood[b]	-209.372		
Akaike's Information Criterion (AIC)	426.743		
Finite Sample Corrected AIC (AICC)	427.056		
Bayesian Information Criterion (BIC)	438.305		
Consistent AIC (CAIC)	442.305		

Dependent Variable: Income Level

Model: (null)

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

5.5.2 Differences among income levels on transport in interurban regions of Kigali City

As it is indicated in ANOVA table of appendix2-4, there is a statistically significant difference among income levels on transport in interurban region since their significance

level is less than 0.05. That is, the number of modes of transport used, number of trips by all modes of transport, distance travelled using each mode of transport, time used, speed used and the amount of money spent using each mode of transport are different among very poor, poor, middle poor, rich and very rich people of interurban regions of Kigali City.

5.5.3 Relationship between income levels and transport in rural regions of Kigali City

The appendix2-5 describes the relationship between income levels and transport in rural areas of Kigali City. Speed by walking in km, number of trips by bicycle per day, distance travelled by bicycle, travel time by bicycle, speed by bicycle in km/h, distance travelled by motorcycle per day, money spent on motorcycle per day, number of trips by public transport, speed of public transport per day in km/h, money spent on public transport per day in Rwf, purpose of travelling and problem caused by transport have statistically significantly (sig <0.05) relationship with income levels in rural of Kigali and have discernable effects on the model.

For covariates, positive (negative) coefficients indicate positive (inverse) relationships between predictors and outcome. An increasing value of a covariate with a positive coefficient corresponds to an increasing rate of being very rich. For example, spending much money on public transport indicates a negative relationship with very rich (coefficient: -0.702).

Holding very poor as a reference category, negative coefficients of the covariates correspond to an inverse relationship with very poor in rural areas while positive coefficients correspond to a positive relationship with being very poor. For example number of motorcycle owned has a negative relationship with being very poor. More results can be found in appendix2-6

A model fits well with covariates with a deviance of 226.642 compared to a model without covariates having a deviance of 352.448.

Table 5-6: Goodness of fit of model with covariates in rural regions of Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	226.642	346	.655
Scaled Deviance	226.642	346	
Pearson Chi-Square	474.380	346	1.371
Scaled Pearson Chi-Square	474.380	346	
Log Likelihood[b]	-113.321		
Akaike's Information Criterion (AIC)	294.642		
Finite Sample Corrected AIC (AICC)	322.976		
Bayesian Information Criterion (BIC)	389.132		
Consistent AIC (CAIC)	423.132		

Dependent Variable: Income Level

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

Table 5-7: Goodness of fit for a model without covariates in rural regions of Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	352.448	376	.937
Scaled Deviance	352.448	376	
Pearson Chi-Square	476.000	376	1.266
Scaled Pearson Chi-Square	476.000	376	
Log Likelihood[b]	-176.224		
Akaike's Information Criterion (AIC)	360.448		
Finite Sample Corrected AIC (AICC)	360.799		
Bayesian Information Criterion (BIC)	371.564		
Consistent AIC (CAIC)	375.564		

Dependent Variable: Income Level

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

5.5.4 Differences among income levels on transport in rural regions of Kigali City

The appendix2-7 indicates that there are no significant differences among income levels in rural regions of Kigali City on speed used per day when walking, number of bicycles owned, number of trips by bicycle per day, number of trips made using public transport per day, travel time by public transport per day, speed used when using public transport and money spent on public transport while there are statistically significant differences for other transport elements.

5.5.5 Relationship between income levels and transport elements in urban regions of Kigali City

Number of motorcycles owned, number of cars owned, number of trips by car, money spent on car per day in Rwf have a statistically significant relationship with income levels while others do not have significant effect on the model.

For covariates, positive (negative) coefficients indicate positive (inverse) relationships between predictors and outcome. An increasing value of a covariate with a positive coefficient corresponds to an increasing rate of being very rich in urban regions of Kigali City. For example number of trips by walking per day has a negative relationship with being very rich in urban regions of Kigali City (-.033).More results can be found in appendix2-8

Holding very poor as a reference category, for covariates, positive coefficients indicate positive relationships between predictors and outcome while negative coefficients indicate inverse relationships between predictors and outcome. An increasing value of a covariate with a positive coefficient corresponds to an increasing rate of being very rich in urban regions. A decreasing value of a covariate with a negative coefficient corresponds to a decreasing rate of being very poor in urban areas of Kigali City. More results can be found in appendix2-9.

A model fits well with covariates with a deviance of 275.932 while the deviance without covariates is 434.897.

Table 5-8: Goodness of fit with covariates in urban regions of Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	275.932	442	.624
Scaled Deviance	275.932	442	
Pearson Chi-Square	601.028	442	1.360
Scaled Pearson Chi-Square	601.028	442	
Log Likelihood[b]	-139.353		
Akaike's Information Criterion (AIC)	346.705		
Finite Sample Corrected AIC (AICC)	368.948		
Bayesian Information Criterion (BIC)	447.203		
Consistent AIC (CAIC)	481.203		

Dependent Variable: Income Level

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

Table 5-9: Goodness of fit without covariates in urban regions of Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	434.897	448	.971
Scaled Deviance	434.897	448	
Pearson Chi-Square	556.309	448	1.242
Scaled Pearson Chi-Square	556.309	448	
Log Likelihood[b]	-219.528		
Akaike's Information Criterion (AIC)	447.056		
Finite Sample Corrected AIC (AICC)	447.348		
Bayesian Information Criterion (BIC)	458.879		
Consistent AIC (CAIC)	462.879		

Dependent Variable: Income Level

Model: (null)

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

5.5.6 Differences among income levels on transport in urban regions of Kigali City

In urban of Kigali City, this study shows that there are statistically significant differences among income levels on transport, except for number of trips by walking per day, distance by walking per day in km, travel time per day by walking in minutes, speed by walking in km/h, distance travelled per day using public transport in km, speed used by public transport per day in km/h, problem caused by transport, problems of transport which do not differ among five categories of income level as it is indicated in appendix2-10.

5.5.7 Relationship between income levels and transport in Kigali City (KC)

When very rich category is used as reference category, the covariates with negative coefficient and significance value less than 0.05 such as number of trips by walking per day, distance travelled by walking per day, distance travelled by public transport and purpose of travelling, have a statistically significant negative relationship with being very rich in Kigali City.

The covariates with positive coefficient and significance value less than 0.05 such as number of motorcycles, number of trips by motorcycles, distance travelled by motorcycles in km, speed used by walking per day, number of trips using public transport and problems caused by transport, indicate a statistically significant positive relationship with being very rich in Kigali. More results are indicated in appendix2-11.

Holding very poor as a reference category, for covariates, positive coefficients indicate positive relationships between predictors and outcome while negative coefficients indicate inverse relationships between predictors and outcome. An increasing value of a covariate with a positive coefficient corresponds to an increasing rate of being very rich in Kigali City. A decreasing value of a covariate with a negative coefficient corresponds to a decreasing rate of being very poor in Kigali City. More results are indicated in appendix2-12

A model fits well with covariates with a deviance of 904.800 while the deviance without covariates is 1220.423.

Table 5-10: Goodness of fit of the model with covariates in Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	904.800	1318	.686
Scaled Deviance	904.800	1318	
Pearson Chi-Square	1697.376	1318	1.288
Scaled Pearson Chi-Square	1697.376	1318	
Log Likelihood[b]	-453.786		
Akaike's Information Criterion (AIC)	975.573		
Finite Sample Corrected AIC (AICC)	982.202		
Bayesian Information Criterion (BIC)	1110.768		
Consistent AIC (CAIC)	1144.768		

Dependent Variable: Income Level

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

Table 5-11: Goodness of fit of the model without covariates in Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	1220.423	1240	.984
Scaled Deviance	1220.423	1240	
Pearson Chi-Square	1558.294	1240	1.257
Scaled Pearson Chi-Square	1558.294	1240	
Log Likelihood[b]	-612.984		
Akaike's Information Criterion (AIC)	1233.968		
Finite Sample Corrected AIC (AICC)	1234.071		
Bayesian Information Criterion (BIC)	1249.873		
Consistent AIC (CAIC)	1253.873		

Dependent Variable: Income Level

Model: (null)

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

5.5.8 Differences among income levels on transport in Kigali City

The ANOVA table in appendix2-13 indicates that there are statistically significant differences of transport among income levels in Kigali City. There are statistically significant differences among income levels on transport except for problems of transport which do not differ among five categories of income levels. That is, the number of modes of transport used, number of trips made using all modes of transport in Kigali, distance used, travel time, speed used and money spent on transport are different across all categories. However, people from very poor to very rich do face same problems of transport.

5.5.9 Relationship between income levels and transport elements in Kigali City when all data are considered as covariates

Generally, the covariates with negative coefficient and significance value less than 0.05 such as nationality, number of people per room, benefits of living with many people, treatment on work have a statistically significant negative relationship with being very rich in Kigali City.

The covariates with positive coefficient and significance value less than 0.05 such as level of studies attended, highest level that can be paid for his or her children, played game, distance travelled by motorcycle per day in km, indicate a statistically significant positive relationship with being very rich in Kigali City. See more results in appendix2-14.

Holding very poor as a reference category, for covariates with positive coefficients indicate positive relationships between predictors and outcome while negative coefficients indicate inverse relationships between predictors and outcome. An increasing value of a covariate with a positive coefficient corresponds to an increasing rate of being very rich in Kigali City. A decreasing value of a covariate with a negative coefficient corresponds to a decreasing rate of being very poor in Kigali City. Find more results in appendix2-15. Some covariates which are not significant such as possession of medical insurance, Distance travelled per day using PT in km etc can be removed for evaluating their impacts on this model.

A model fits well with all covariates with 675.841 as deviance while the deviance after removing some covariates which are not significant is 812.886.

Table 5-12: Goodness of fit of the model without all data as covariates in Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	675.841	1269	.533
Scaled Deviance	675.841	1269	
Pearson Chi-Square	2160.497	1269	1.703
Scaled Pearson Chi-Square	2160.497	1269	
Log Likelihood[b]	-339.307		
Akaike's Information Criterion (AIC)	844.613		
Finite Sample Corrected AIC (AICC)	889.594		
Bayesian Information Criterion (BIC)	1174.651		
Consistent AIC (CAIC)	1257.651		

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

Table 5-13: Goodness of fit of the model after removing insignificant covariates in Kigali City

Goodness of Fit[a]

	Value	df	Value/df
Deviance	812.886	1127	.721
Scaled Deviance	812.886	1127	
Pearson Chi-Square	1103.564	1127	.979
Scaled Pearson Chi-Square	1103.564	1127	
Log Likelihood[b]	-411.295		
Akaike's Information Criterion (AIC)	880.590		
Finite Sample Corrected AIC (AICC)	885.370		
Bayesian Information Criterion (BIC)	995.904		
Consistent AIC (CAIC)	1024.904		

Dependent Variable: Income Level

Model: (Threshold),

a. Information criteria are in small-is-better form.

b. The full log likelihood function is displayed and used in computing information criteria.

5.5.10 Income levels with respect to transport

Table 5-14: Income levels with respect to number of trips

		Number of trips by walking per day	Number of trips by bicycle per day	Number of trips by motorcycle	Number of trips by car	Number of trips made using public transport
		Mean	Mean	Mean	Mean	Mean
Income level of the respondent	very poor	4	2	1	1	2
	poor	5	1	1	1	2
	middle poor	5	2	2	1	3
	rich	4	1	2	2	3
	very rich	4	1	2	2	2
Overall Average		**4**	**1**	**2**	**1**	**2**

Legend:

Code	1	2	3	4	5	6	7
Number of trips by walking, bicycles, motorcycles, car and public transport	0	1-2	3-4	5-6	7-8	9-10	>10

Interpretation:

The overall average number of trips by walking in Kigali is between 5 and 6, 0 trips by bicycles, 1 and 2 trips by motorcycles, 0 trips by private car and between 1 and 2 trips by public transports.

Table 5-15: Income levels versus distance travelled

		Distance by walking per day	Distance travelled by bicycle per day	Distance travelled by motorcycle per day in Km	Distance travelled by car per day in km	Distance travelled per day using public transport
		Mean	Mean	Mean	Mean	Mean
Income level of the respondent	very poor	5	3	1	1	3
	poor	5	2	1	1	4
	middle poor	6	2	2	1	3
	rich	5	1	2	2	4
	very rich	3	1	3	3	2
Overall Average		**5**	**2**	**2**	**2**	**3**

Legend:

Codes	1	2	3	4	5	6	7	8	9	10
Distance by walking in km	0	0-1	1.1-1.5	1.6-2	2.1-2.5	2.6-3	3.1-3.5	3.6-4	4.1-4.5	>4.5
Distance by bicycle in km	0	1-5	5.1-10	10.1-15	15.1-20	20.1-25	>25			
Distance by motorcycle in km	0	1-20	21-40	41-60	61-80	>80				
Distance by car in km	0	1-20	21-40	41-60	61-80	>80				
Distance by public transport in km	0	1-20	21-40	41-60	61-80	>80				

Interpretation:

The overall average distance travelled by people living in Kigali by walking is between 2.1 and 2.5 kms, 1 and 5 kms by bicycles, 1 and 20 kms by motorcycles, 1 and 20 kms by car and 21 and 40 kms by public transport.

Table 5-16: Income levels versus travelled time by each mode of transport

		Travelled time per day by bicycle	Travelled time by motorcycle per day in minutes	Travelled time by car per day in minutes	Travelled time by public transport per day in minutes	Travelled time per day by walking
		Mean	Mean	Mean	Mean	Mean
Income level of the respondent	very poor	2	1	1	3	4
	poor	1	1	1	4	4
	middle poor	2	2	1	4	4
	rich	1	2	2	3	4
	very rich	1	3	4	2	3
Overall Average		**1**	**2**	**2**	**3**	**4**

Legend:

Code	1	2	3	4	5	6	7	8	9	10
Travel time by walking in minutes	0	1-20	21-40	41-60	61-80	81-100	101-120	>120		
Travel time by bicycles in minutes	0	1-20	21-40	41-60	61-80	81-100	101-120	>120		
Travel time by motorcycles in minutes	0	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80
Travel time by car in minutes	0	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80
Travel time by public transport in minutes	0	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	>80

Interpretation:

The overall average travelled time by walking is between 41 and 60 minutes, 0 minutes by bicycle, 0 and 10 minutes by motorcycle, 0 and 10 minutes by car and 11 and 20 minutes by public transport.

Table 5-17: Income levels versus speed used by each mode of transport

		Speed by walking in Km/h	Speed by bicycle in Km/h	Speed of motorcycle in km/h	Speed of car per day in km/h	Speed of PT per day in km/h
		Mean	Mean	Mean	Mean	Mean
Income level level of the respondent	very poor	3	2		1	2
	poor	3	2	1	1	3
	middle poor	3	2	2	1	3
	rich	3	1	1	2	3
	very rich	3	1	1	3	2
Overall Average		**3**	**2**	**1**	**2**	**3**

Legend:

Code	1	2	3	4	5	6	7
Speed used by walking in km/h	0	1-2	2.1-4	4.1-6	>6		
Speed used by bicycle in km/h	0	1-5	5.1-10	10.1-15	15.1-20	20.1-25	>25
Speed used by motorcycle in km/h	0	1-20	21-40	41-60	61-80	>80	
Speed used by car in km/h	0	1-20	21-40	41-60	61-80	>80	
Speed used by public transport in km/h	0	1-20	21-40	41-60	61-80	>80	

Interpretation:

The overall average speed used by walking in Kigali is between 2.1 and 4 km/h, 1 and 5 km/h by bicycle, 0 km/h by motorcycles, 1 and 20 by private car and 21-40 km/h by public transport.

Table 5-18: Income levels versus money spent on each mode of transport

		Money spent on bicycle per day in RWF	Money spent on motorcycle per day in RWF	Money spent on car per day in RWF	Money spent on public transport
		Mean	Mean	Mean	Mean
Income level of the respondent	very poor	2	1	1	3
	poor	1	1	1	3
	middle poor	2	3	1	3
	rich	1	3	2	3
	very rich	1	3	3	2
Overall Average		**2**	**2**	**2**	**3**

Legend:

Code	1	2	3	4	5	6	7	8	9
Money spent on bicycle per day in RWF	0	0-200	201-400	401-600	601-800	801-1000	1001-1200	>1200	
Money spent on motorcycle per day in RWF	0	0-300	301-600	601-900	901-1200	1201-1500	1501-1800	1801-2100	>2100
Money spent on car per day in RWF	0	0-300	301-600	601-900	901-1200	1201-1500	1501-1800	1801-2100	>2100
Money spent on public transport per day in RWF	0	0-300	301-600	601-900	901-1200	1201-1500	1501-1800	1801-2100	>2100

Interpretation:

The average money spent on bicycle per day is between 0 and 200 RWF, 0 and 300 RWF on motorcycle, 0 and 300 RWF on car and 301 and 600 RWF on public transport.

5.6 CONCLUDING REMARK

This chapter shows that the category of income level influences the mode of transort to be used. In Kigali City, the main mode of transport of the very poor and poor is walking on foot followed by bicycle. However, a poor may travel by public transport. The main mode of transport of middle poor is walking on foot followed by bicycle and private car, motorcycle and public transport. The main mode of transport of rich is private car, followed by bicycles, walking on foot, public transport and motorcycle. The main mode of transport of very rich is private car followed by public transport, motorcycle and walking on foot.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

This study investigated the relationship between income levels and modes of transport in Kigali City. Because the relationship may differ from one region to another, the study covered three regions of Kigali City including rural, interurban and urban region of Kigali. The relationship was determined by a generalized linear model where transport elements were taken as covariates within the model while the capabilities were taken as factors influencing income level. The study showed that there are no statistically significant differences among rural, interurban and urban in terms of transport elements.

In rural regions of Kigali, there are significant differences among income levels about speed used per day when walking, number of bicycles owned, number of trips using bicycle per day, number of trips made using public transport per day, travel time by public transport per day, speed used when using public transport and money spent on public transport while there are no statistically significant differences for other transport elements.

In interurban regions of Kigali, there are statistically significant differences among income levels on transport elements since their significance level is less than 0.05. Those differences are about the modes of transport used, number of trips by using all modes of transport, distance travelled using each mode of transport, time used, speed used and the amount of money spent using each mode of transport.

In urban regions of Kigali City, there are statistically significant differences among income levels on transport elements except on number of trips by walking per day, distance by walking per day in km, travel time per day by walking in minutes, speed by walking in km/h, distance travelled per day using public transport in km, speed used by public transport per day in km/h, problem caused by transport, problems of transport which do not differ among five categories of income levels.

Generally in the entire Kigali City, there are statistically significant differences among income levels on the following transport elements: the number of means of transport owned, number of trips made by all modes of transport used, distance travelled, travel time, speed used and money spent on transport are different across all categories except on problems of transport which do not differ among five categories of income levels.

The relationship was found among income levels and modes of transport in Kigali City where the number of trips by walking per day, distance travelled by walking per day, distance travelled using public transport and purpose of travelling have a statistically significant negative relationship with being very rich while the number of motorcycles owned, number of trips by motorcycles, distance travelled by motorcycles in km, speed used by walking per day, number of trips using public transport and problems caused by transport, indicate a statistically significant positive relationship with being very rich in Kigali.

6.2 RECOMMENDATIONS

Based on the collected data and on the observation, we do recommend the following recommendations:

- Further researches are recommended to find out the relationship between income levels and modes of transport in Kigali City by using other models.
- The government should provide transport infrastructures in all locations of kigali City, especially in rural areas therefore the people can travel in good conditions.
- More modes of transport should be provided in all locations of Kigali City therefore all people can use the best one for them, not using the available however it is not confortable for them.
- The transport cost should be reduced therefore the poor people can use other modes of transport like public transport isntead of using walking.

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APPENDICES

Appendix 1: Questionnaire survey for interview

HAGENIMANA Emmanuel
University of Rwanda
College of Science and Technology
Cell phone: 0788298131/0722298131
Email:hagenema@gmail.com

Dear Respondent,

I am HAGENIMANA Emmanuel, student at University of Rwanda, College of Science and Technology (CST), in Post graduate engineering programme, Transportation Engineering and Economics. In order to get Master's degree, I am conducting a research project entitled: **Analysis of the Relationship between Income Levels and Modes of Transport in Kigali City.**

The objective of this questionnaire is to collect data about the link between income levels and modes transport. All collected data from the questionnaire will be only used for the research purpose and academic purpose. You can complete this questionnaire by ticking one or more answers when applicable.

HAGENIMANA Emmanuel

Appendix1-1: Personnel information and living condition

1. Nationality: a) Rwandan ☐ b) Foreign resident in Rwanda ☐ c) Foreign ☐

2. Is this region? a) Rural area ☐ b) Interurban area ☐ c) Urban area ☐

3. Sex: a) Male ☐ b) Female ☐

4. Age a) 0-5 ☐ b) 6-10 ☐ c) 11-15 ☐ d) 16-20 ☐ e) 21-25 ☐

f) 26-30 ☐ g) 31-35 ☐ h) 36-40 ☐ i) 41-45 ☐ j) 45-50 ☐

k) More than 50 ☐

5. Marital status: a) married ☐ b) Divorced ☐ c) widow/widower ☐ d) Single ☐

6. How many people are you in your household?

a) 1-2 ☐ b) 3-4 ☐ c) 5-6 ☐ d) 7-8 ☐ e) 9-10 ☐

More than 10 ☐

7. Is your life in good conditions? a) Yes ☐ b) No ☐

8. What are the factors that influence your living conditions?

a. Heredity illness ☐ b) parents heritage/support ☐ C) My working conditions ☐

9. Do you have medical insurance? a) Yes ☐ b) No ☐

10. If yes who pay for your medical insurance?

a) None ☐ b) Myself ☐ c) Employer ☐ d) Government ☐

e) Other ☐

11. Do you suffer from a disability? a) Yes ☐ b) No ☐

12. If yes is it a) Non disability ☐ b) Visual disability ☐

c) Mental disability ☐ d) Deaf and / mute ☐ e) disability in arms ☐

f) Disability in legs ☐ g) very old ☐

13. How long have you suffer from this disability?

a) From birth ☐ b) about a month ☐ c) between 1 month and 6 months ☐

d) Between 6months and a year ☐ e) More than a year ☐

14. How much do you earn per month in your household (in Rwf)?

a) Below 20,000 ☐ b) 20,001-50,000 ☐ c) 50001-100,000 ☐

d) 100,001-500,000 ☐ e) Above 500,000 ☐

15. What are the building materials of the house you live in?

a) Mainly wood ☐ b) metal sheet ☐ c) mainly brick ☐ d) concrete ☐

d) Other solid construction ☐

16. How many rooms does your household occupy excluding bathrooms, toilets and kitchen?

a) 1-2 ☐ b) 3-4 ☐ c) 5-6 ☐ d) more than 6 ☐

17. How many people per room?

a) 1-2 ☐ b) 3-4 ☐ c) 4-5 ☐ d) More than 5 ☐

18. How much do you spend for your living house per a month (in Rwf)?

Category	Amount	Category	Amount	Category	Amount
a	0-10000	e	40001-50000	i	80001-90000
b	10001- 20000	f	50001-600000	j	90001-100000
c	20001-30000	g	600001-70000	k	100001-110000
d	30001-40000	h	70001-80000	l	More than 110000

19. Does disability cause problems to you? a) Yes ☐ b) No ☐

20. If yes which one or more of these?

a) None ☐ b) Humiliation ☐ c) Violence ☐ d) Lack ☐ job

e) Inability to move well ☐

21. Do you meet any problem when doing your daily activities normally?

a) Yes ☐ b) No ☐

22. If yes what are those problems?

a) I did not get to school ☐ b) I do not have economic means ☐

c) I have mental problem ☐ d) I am unable to work ☐

23. Which highest level of studies do you have?

a) None ☐ b) Primary level ☐ c) Ordinal level ☐

d) Advanced level ☐ e) Undergraduate level ☐ f) Postgraduate level ☐

24. At which highest level of education can you be able to pay for your children?

a) None ☐ b) Primary school ☐ c) Secondary school ☐

d) Undergraduate university level ☐ e) Postgraduate level ☐

25. Do you have a job? a) Yes ☐ b) No ☐

26. If yes is it a) Permanent ☐ b) Casual ☐ c) season ☐

27. In which category are you classified?

a) Unskilled labour ☐ b) Semi-skilled labour ☐ c) Skilled labour ☐

d) Technician ☐ e) Professional ☐ f) Middle manager ☐

g) Senior executive ☐

28. Are you interest in entertainment activities? a) Yes ☐ b) No ☐

29. If yes, do you get the time for (them) entertainments? a) Yes ☐ b) No ☐

30. If yes, which one or more of these do you prefer?

a) Watching moves (cinema) ☐ b) Watching matches ☐ c) Music concert ☐

d) Playing football ☐ e) playing Tennis ☐ f) other ☐

31. Do you have a critical sprit in your daily live? a) Yes ☐ b) No ☐

32. If yes, what are its objectives to the society? a) For improving the society ☐

b) For my own interest ☐ c) for disturbing other ☐ d) for dialogue purpose ☐

33. Do you like to live in society with many people? a) Yes ☐ b) No ☐

34. If yes, what is its objective? a) For sharing with others ☐

b) To increase the number of friends ☐ c) For my own business ☐

35. Do you benefit from living in the community with many people?

a) Yes ☐ b) No ☐

36. If yes what are those benefits?

a) Good cooperation ☐ b) Being informed ☐ c) Economic benefits ☐

37. Do you have a land parcel? a) Yes ☐ b) No ☐

38. If yes how big is it in hectares?

a) 0-0.5 ☐ b) 0.6-1 ☐ c) 1.1-1.5 ☐ d) more than 1.5 ☐

39. Do you own livestock? a) Yes ☐ b) No ☐

40. If yes, how many

A. How many cattle do you have?

a) 1-2 ☐ b) 3-4 ☐ c) 4-6 ☐ d) More than 6 ☐

B. How many sheep do you have?

a) 1-2 ☐ b) 3-4 ☐ c) 4-6 ☐ d) More than 6 ☐

C. How many goats do you have?

a) 1-2 ☐ b) 3-4 ☐ c) 4-6 ☐ d) More than 6 ☐

D. How many pigs do you have?

a) 1-2 ☐ b) 3-4 ☐ c) 4-6 ☐ d) More than 6 ☐

E. How many rabbits do you have?

a) 1-2 ☐ b) 3-4 ☐ c) 4-6 ☐ d) More than 6 ☐

F. How many chickens do you have?

a) 1-2 ☐ b) 3-4 ☐ c) 4-6 ☐ d) More than 6 ☐

41. Do you use them (livestock) for earn money? a) Yes ☐ b) No ☐

42. Do you have electricity power? a) Yes ☐ b) No ☐

43. If yes, how much money do you spend on it per a month (in Rwandan francs)?

a) 0-5000 ☐ b) 5001-10000 ☐ c) 10001-15000 ☐ d) 15001-20000 ☐

e) 20001-25000 ☐ f) 25001-30000 ☐ g) More than 30000 ☐

44. Are you able to play any kind of game? a) Yes ☐ b) No ☐

45. If yes, which one or more of these?

a) Football ☐ b) Volleyball ☐ c) Basketball ☐ d) Handball ☐

e) Tennis ☐ f) Rugby ☐ g) Other ☐

46. Do you enjoy playing one or more of those games? a) Yes ☐ b) No ☐

47. Are you comfortable for living in Kigali? a) Yes ☐ b) No ☐

48. If yes, what make you to be comfortable?

a) I am protected ☐ b) I have freedom of speech ☐

c) I do my business in security ☐ d) I have the right of participating in associations I want ☐

49. Do you have right of holding property (land and movable goods)? a) Yes ☐ b) No ☐

50. Do you have a job? a) Yes ☐ b) No ☐

51. If yes, does your employer treat you as he/she does for others? a) Yes ☐ c) No ☐

Appendix1-2: About transport information

52. A) How many average trips do you make by walking per day?

a) 0 ☐ b) 1-2 ☐ c) 3-4 ☐ d) 5-6 ☐ e) 7-8 f) 9-10 ☐

g) More than 10 ☐

B) How long do you travel by walking per day in Kilometres?

a) 0 ☐ b) 0-1 ☐ c) 1.1-1.5 ☐ d) 1.6-2 ☐ e) 2.1-2.5 ☐

f) 2.6-3 ☐ g) 3.1-3.5 ☐ h) 3.6-4 ☐ i) 4.1-4.5 ☐ j) More than 4.5 ☐

C) What is your average travel time per day by walking in minutes?

a) 0 ☐ b) 1-20 ☐ c) 21-40 ☐ d) 41- 60 ☐ e) 61-80 ☐

f) 81-100 ☐ g) 101-120 ☐ h) More than 120 ☐

D) By which speed do you travel by walking in km/hour?

a) 0 ☐ b) 0-2 ☐ c) 2.1-4 ☐ d) 4.1-6 ☐ e) More than 6 ☐

53. A) How many bicycles do you own?

a) 0 ☐ b) 1-2 ☐ c) 3-5 ☐ d) More than 5 ☐

B) How many average trips do you make by bicycle per day?

a) 0 ☐ b) 1-2 ☐ c) 3-4 ☐ d) 5- 6 ☐ e) 7-8 ☐

f) 9-10 ☐ g) More than 10 ☐

C) How long do you travel by bicycle per day in Kilometres?

a) 0 ☐ b) 0-2 ☐ c) 2.1-4 ☐ d) 4.1-6 ☐ e) 6.1-8 ☐

f) 8.1-10 ☐ g) 10.1-12 ☐ h) more than 12 ☐

D) What is your average travel time per day by bicycle in minutes?

a) 0 ☐ b) 1-20 ☐ c) 21-40 ☐ d) 41-60 ☐ e) 61-80 ☐

f) 81-100 ☐ g) More than 100 ☐

E) By which speed do you travel by bicycle in km/hour?

a) 0 ☐ b) 1-5 ☐ c) 5.1-10 ☐ d) 10.1- 15 ☐

e) 15.1-20 ☐ f) 20.1-25 ☐ g) More than 25 ☐

F) How much do you spend on bicycle per day in Rwandan francs?

a) 0 ☐ b) 0-200 ☐ c) 201-400 ☐ d) 401-600 ☐

e) 601-800 ☐ f) 801-1000 ☐ g) 1001-1200 ☐

h) More than 1200 ☐

54. A) How many Motorcycles do you own?

a) 0 ☐ b) 1-2 ☐ c) 3-5 ☐ d) More than 5 ☐

B) How many average trips do you make by motorcycle per day?

a) 0 ☐ b) 1-2 ☐ c) 3- 4 ☐ d) 4-6 ☐ 7-8 ☐

f) 8-10 ☐ g) More than 10 ☐

C) How long do you travel by motorcycle per day in Kilometres?

a) 0 ☐ b) 0-2 ☐ c) 2.1-4 ☐ d) 4.1-6 ☐

e) 6.1-8 ☐ f) 8.1-10 ☐ g) 10.1-12 ☐ h) More than 12 ☐

D) What is your average travel time per day by motorcycle in minutes?

a) 0 ☐ b) 1-10 ☐ c) 11-20 ☐ d) 21-30 ☐

e) 31-40 ☐ f) 41-50 ☐ g) 51-60 ☐ h) 61-70 ☐

i) 71-80 ☐ j) More than 80 ☐

E) By which speed do you travel by motorcycle in km/hour?

a) 0 ☐ b) 1-20 ☐ c) 21-40 ☐ d) 41-60 ☐

e) 61-80 ☐ f) More than 80 ☐

F) How much do you spend on motorcycle per day in Rwandan francs?

a) 0 ☐ b) 0-300 ☐ c) 301-600 ☐ d) 601-900 ☐ 901-1200 ☐

f) 1201-1500 ☐ g) 1501-1800 ☐ h) 1801-2100 ☐

i) More than 2100 ☐

55. A) How many Cars do you have?

a) 0 ☐ b) 1-2 ☐ c) 3-5 ☐ d) More than 5 ☐

B) How many average trips do you make by car (private car) per day?

a) 0 ☐ b) 1-2 ☐ c) 3-4 ☐ d) 5- 6 ☐ e) 7-9 ☐

f) 9-10 ☐ g) More than 10 ☐

C) How long do you travel by car (private) per day in Kilometres?

a) 0 ☐ b) 1-10 ☐ c) 11-20 ☐ d) 21-30 ☐

e) 31-50 ☐ f) 51-70 ☐ g) 71-100 ☐ h) More than 100 ☐

D) What is your average travel time per day by car (private car) in minutes?

a) 0 ☐ b) 0-10 ☐ c) 10.1-20 ☐ d) 20.1-30 ☐

e) 30.1-40 ☐ f) 40.1-50 ☐ g) 50.1-60 ☐ h) 60.1-70 ☐

i) 71-80 ☐ j) More than 80 ☐

E) By which speed do you travel by car (private car) in km/hour?

a) 1-20 ☐ b) 21-40 ☐ c) 41-60 ☐ d) 61-80 ☐

e) More than 80 ☐

F) How much do you spend on car per day in Rwandan francs?

a) 0-2000 ☐ b) 2001-4000 ☐ c) 4001-6000 ☐

d) 6001- 8000 ☐ e) 8001-10000 ☐ f) More than 10000 ☐

56. A) How many vehicles do you have for doing public transport?

a) 0 ☐ b) 1-2 ☐ c) 3-5 ☐ d) More than 5 ☐

B) How many average trips do you make by public transport (bus or hiace) per day?

a) 0 ☐ b) 1-2 ☐ c) 3- 4 ☐ d) 4-5 ☐ e) 6-7 ☐

f) 7-10 ☐ g) more than 10 ☐

C) How long do you travel by public transport (bus or hiace) per day in Kilometres?

a) 0 ☐ b) 0 -4 ☐ c) 4.1-8 ☐ d) 8.1-12 ☐

e) 12.1-16 ☐ f) 16.1-20 ☐ g) 20.1-24 ☐ h) 24.1-28 ☐

i) More than 28 ☐

D) What is your average travel time per day by public transport (bus or hiace) in minutes?

a) 0 ☐ b) 0-10 ☐ c) 11-20 ☐ d) 21-30 ☐ e) 31-40 ☐

f) 41-50 ☐ g) 51-60 ☐ h) 61-70 ☐ i) 71-80 ☐

j) More than 80 ☐

E) By which speed do you travel by public transport (bus or hiace) in km/hour?

a) 1-20 ☐ b) 21-40 ☐ c) 41-60 ☐ d) 61-80 ☐

e) More than 80 ☐

F) How much do you spend on public transport (bus or hiace) per day in Rwandan francs?

a) 0 ☐ b) 0-200 ☐ c) 201-400 ☐ d) 401-600 ☐

e) 601-800 ☐ f) 801-1000 ☐ g) 1001-1200 ☐

h) More than 1200 ☐

57. What are the factors that influence you to choose the mode of transport to be used?

a) Its availability ☐ b) Good for my life ☐ c) Its affordability ☐

d) Reliability ☐ e) Travel time ☐

58. For which purpose do you travel?

a) To place of work ☐ b) To school or college ☐

c) To visit friends or relatives ☐ d) to shops/market ☐

e) To personal business ☐ f) to recreation ☐

g) For other reason ☐

59. Does transport cause problems to you or to society? a) Yes ☐ b) No ☐

60. If yes, what are they?

a) Environment problems ☐ b) Safety problems ☐

c) Delay ☐ d) Other ☐

Thank you very much for your participation

Appendix 2: RESULTS FROM SPSS

Table 2-1: Description of capabilities among citizens of Kigali City

Descriptive Statistics

	N	Mean	Std. Deviation
Income_Level	394	2.64	1.471
Money_consumed_per_Person_per_month	394	25190.55	25487.767
Nationality	394	1.03	.199
Residence	394	2.06	.813
Sex	394	.38	.486
Age	394	35.13	9.425
Marital_status	394	2.34	1.378
Number_ of_ people_in_ HH	394	4.41	1.640
Condition_of_ life	394	.25	.434
Factors_influencing_living_conditions	394	2.67	.594
Possesion_of_medical_insurance	394	.09	.285
payment_of_medical_insurance	394	1.68	1.128
Suffering_from_disability	394	.91	.285
Kind_of_disability	394	.43	1.418
Problems_Caused_by_disabilities	394	.91	.285
Those_problems_caused_by_disability	394	.35	1.127
Number_of_People_per_room	394	2.88	.994
Money_spend_on_house_per_month	394	28083.76	29190.880
Number_of_rooms_per_HH	394	3.34	1.387
meeting_problems_in_daily_activities	394	.39	.488
Those_problems_met_in_daily_activities	394	1.28	1.245
level_of_studies_attended	394	3.35	1.341
Highest_level_that_can_be_paid_for_his/her_children	394	2.78	1.510
Possession_of_job	394	.34	.473
kind_of_job	394	.95	.846
Category_of_labour	394	2.01	1.923
like_of_entertainment	394	.08	.266
Time_for_entertainment	394	.20	.403
Prefered_entertainment	394	2.05	1.432
critical_sprit	394	.04	.192
Objective_of_critical_sprit	394	2.07	1.369
likeness_of_living_with_many_people	394	.02	.123
Objectives_of_living_with_many_people	394	1.76	.797
Benefits_of_living_with_many_people	394	.02	.132
Those_benefis_of_living_with_many_people	394	1.82	.878
possession_of_land_parcel	394	.60	.490

Size_of_land_percel_in_hectares	394	.27	.609
Possession_of_livestock	394	.82	.387
Number_of_cattle	394	.06	.436
Number_of_sheeps	394	.00	.000
Number_ of_goats	394	.19	.822
Number_of_pigs	394	.00	.000
Number_of_rabbits	394	.46	1.462
Number_of_chickens	394	.27	1.202
Use_of_liverstock_for_earning_money	394	.84	.367
Possession_of_electricity_power	394	.27	.444
Electricity_consumption_per_a_month	394	3743.65	4792.941
Ability_to_play_game	394	.31	.462
Played_game	394	1.47	1.678
Enjoy_to_play_game	394	.35	.476
Comfortably_of_living_in_your_neighbourhood	394	.20	.397
Causes_of_ Being_comfortable_in_your_neighbourhood	394	1.99	1.374
Right_of_holding_property	394	.12	.322
Treatment_on_work	394	.32	.466
Valid N (listwise)	394		

Appendix2-2: Relationship between income levels and modes transport in the interurban region of Kigali City when very rich is taken as reference

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income_Level=1]	4.699	2.1449	.495	8.903	4.800	1	.028
	[Income_Level=2]	6.127	2.1780	1.858	10.396	7.914	1	.005
	[Income_Level=3]	7.606	2.2288	3.237	11.974	11.645	1	.001

[Income_Level=4]	9.993	2.3555	5.377	14.610	17.999	1	.000
Number_of_trips_by_walking_per_day	-.235	.1655	-.559	.090	2.013	1	.156
Distance_by_walking_per_day_in_Km	-.117	.1392	-.390	.155	.712	1	.399
Travel_time_per_day_by_walking_in_minutes	-.017	.1852	-.380	.346	.008	1	.927
Speed_by_walking_in_Kmh	.298	.2978	-.285	.882	1.004	1	.316
Number_of_bicycles_owned	-.845	.8126	-2.438	.748	1.081	1	.298
Number_of_trips_by_bicycle_per_day	.275	.4384	-.584	1.134	.394	1	.530
Distance_traveled_by_bicycle	.399	.4522	-.487	1.285	.778	1	.378
Travel_time_per_day_by_bicycle_in_minutes	-1.233	.8677	-2.933	.468	2.017	1	.156
Speed_by_bicycle_in_kmh	-.030	.4116	-.837	.776	.005	1	.941
Money_spend_on_bicycle_per_day_in_Rwf	.221	.3542	-.473	.916	.391	1	.532
Number_of_motorcycles_owned	3.459	.8485	1.796	5.122	16.615	1	.000
Number_of_trips_by_motorcycle	1.391	.5639	.286	2.496	6.083	1	.014
Distance_traveled_by_motorcycle_per_day_in_km	.310	.2479	-.175	.796	1.568	1	.211
Travel_time_by_motorcycle_per_day_in_minutes	-.048	.3505	-.735	.639	.018	1	.892
Speed_of_motorcycle_in_kmh	-.352	.3558	-1.050	.345	.982	1	.322

Money_spend_on_motorcycle_per_day	-.146	.2601	-.656	.364	.315	1	.575
Number_of_car_owned	1.727	1.1373	-.502	3.956	2.306	1	.129
Number_of_trips_by_car	-.422	1.1329	-2.642	1.798	.139	1	.710
Distance_traveled_by_car_per_day_in_km	-1.066	1.5085	-4.023	1.890	.500	1	.480
Travel_time_by_car_per_day_in_minutes	.957	.9762	-.956	2.870	.961	1	.327
Speed_of_car_per_day_in_kmh	-.018	.7645	-1.517	1.480	.001	1	.981
Money_spend_on_car_per_day_in_Rwf	1.969	1.0899	-.167	4.105	3.265	1	.071
Number_of_trips_made_using_PT	.217	.3630	-.495	.928	.356	1	.551
Distance_traveled_per_day_using_PT_in_km	-.241	.1611	-.557	.075	2.236	1	.135
Travel_time_by_PT_per_day_in_minutes	.545	.2575	.040	1.050	4.478	1	.034
Speed_of_PT_per_day_in_kmh	-.479	.3866	-1.237	.279	1.535	1	.215
money_spend_on_PT_per_day_in_Rwf	.246	.4465	-.629	1.122	.305	1	.581
purpose_of_travelling	-.238	.1179	-.469	-.007	4.064	1	.044
Problem_caused_by_transport	-.379	.9142	-2.170	1.413	.172	1	.679
Those_problems_of_transport	-.125	.1517	-.422	.172	.679	1	.410
(Scale)	1[a]						

Dependent Variable: Income Level
Model: (Threshold),
a. Fixed at the displayed value.

Appendix2-3: Relationship between income levels and modes transport in the interurban region of Kigali City when very poor is taken as reference

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=5]	-9.993	2.3555	-14.610	-5.377	17.999	1	.000
	[Income _Level=4]	-7.606	2.2288	-11.974	-3.237	11.645	1	.001
	[Income _Level=3]	-6.127	2.1780	-10.396	-1.858	7.914	1	.005
	[Income _Level=2]	-4.699	2.1449	-8.903	-.495	4.800	1	.028
Number_of_trips_by_walking_per_day		.235	.1655	-.090	.559	2.013	1	.156
Distance_by_walking_per_day_in_Km		.117	.1392	-.155	.390	.712	1	.399
Travel_time_per_day_by_walking_in_minutes		.017	.1852	-.346	.380	.008	1	.927
Speed_by_walking_in_Kmh		-.298	.2978	-.882	.285	1.004	1	.316
Number_of_bicycles_owned		.845	.8126	-.748	2.438	1.081	1	.298
Number_of_trips_by_bicycle_per_day		-.275	.4384	-1.134	.584	.394	1	.530

Distance_traveled_by_bicycle	-.399	.4522	-1.285	.487	.778	1	.378
Travel_time_per_day_by_bicycle_in_minutes	1.233	.8677	-.468	2.933	2.017	1	.156
Speed_by_bicycle_in_kmh	.030	.4116	-.776	.837	.005	1	.941
Money_spend_on_bicycle_per_day_in_Rwf	-.221	.3542	-.916	.473	.391	1	.532
Number_of_motorcycles_owned	-3.459	.8485	-5.122	-1.796	16.615	1	.000
Number_of_trips_by_motorcycle	-1.391	.5639	-2.496	-.286	6.083	1	.014
Distance_traveled_by_motorcycle_per_day_in_km	-.310	.2479	-.796	.175	1.568	1	.211
Travel_time_by_motorcycle_per_day_in_minutes	.048	.3505	-.639	.735	.018	1	.892
Speed_of_motorcycle_in_kmh	.352	.3558	-.345	1.050	.982	1	.322
Money_spend_on_motorcycle_per_day	.146	.2601	-.364	.656	.315	1	.575
Number_of_car_owned	-1.727	1.1373	-3.956	.502	2.306	1	.129
Number_of_trips_by_car	.422	1.1329	-1.798	2.642	.139	1	.710
Distance_traveled_by_car_per_day_in_km	1.066	1.5085	-1.890	4.023	.500	1	.480
Travel_time_by_car_per_day_in_minutes	-.957	.9762	-2.870	.956	.961	1	.327
Speed_of_car_per_day_in_kmh	.018	.7645	-1.480	1.517	.001	1	.981
Money_spend_on_car_per_day_in_Rwf	-1.969	1.0899	-4.105	.167	3.265	1	.071

Number_of_trips_made_using_PT	-.217	.3630	-.928	.495	.356	1	.551
Distance_traveled_per_day_using_PT_in_km	.241	.1611	-.075	.557	2.236	1	.135
Travel_time_by_PT_per_day_in_minutes	-.545	.2575	-1.050	-.040	4.478	1	.034
Speed_of_PT_per_day_in_kmh	.479	.3866	-.279	1.237	1.535	1	.215
money_spend_on_PT_per_day_in_Rwf	-.246	.4465	-1.122	.629	.305	1	.581
purpose_of_travelling	.238	.1179	.007	.469	4.064	1	.044
Problem_caused_by_transport	.379	.9142	-1.413	2.170	.172	1	.679
Those_problems_of_transport	.125	.1517	-.172	.422	.679	1	.410
(Scale)	1[a]						

Dependent Variable: Income _Level

Model: (Threshold),

a. Fixed at the displayed value.

Appendix2-4: Differences among income levels on transport elements in interurban regions of Kigali City

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Number_of_trips_by_walking_per_day	Between Groups	23.963	4	5.991	2.512	.045
	Within Groups	305.271	128	2.385		
	Total	329.233	132			
Distance_by_walking_per_day_in_Km	Between Groups	86.570	4	21.642	4.129	.004
	Within Groups	670.949	128	5.242		
	Total	757.519	132			
Travel_time_per_day_by_walking_in_minutes	Between Groups	36.042	4	9.010	3.966	.005
	Within Groups	290.771	128	2.272		
	Total	326.812	132			
Speed_by_walking_in_Km/h	Between Groups	25.924	4	6.481	8.578	.000
	Within Groups	96.707	128	.756		
	Total	122.632	132			
Number_of_bicycles_owned	Between Groups	1.169	4	.292	2.510	.045
	Within Groups	14.906	128	.116		
	Total	16.075	132			

Number_of_trips_by_bicycle_per_day	Between Groups	14.996	4	3.749	3.635	.008
	Within Groups	132.027	128	1.031		
	Total	147.023	132			
Distance_traveled_by_bicycle	Between Groups	44.519	4	11.130	3.323	.013
	Within Groups	428.729	128	3.349		
	Total	473.248	132			
Travel_time_per_day_by_bicycle_in_minutes	Between Groups	12.680	4	3.170	3.016	.020
	Within Groups	134.523	128	1.051		
	Total	147.203	132			
Speed_by_bicycle_in_km/h	Between Groups	28.114	4	7.028	2.815	.028
	Within Groups	319.556	128	2.497		
	Total	347.669	132			
Money_spend_on_bicycle_per_day_in_Rwf	Between Groups	30.873	4	7.718	2.646	.036
	Within Groups	373.413	128	2.917		
	Total	404.286	132			
Number_of_motorcycles_owned	Between Groups	3.807	4	.952	8.538	.000
	Within Groups	14.268	128	.111		
	Total	18.075	132			

Number_of_trips_by_motorcycle	Between Groups	20.337	4	5.084	7.535	.000
	Within Groups	86.369	128	.675		
	Total	106.707	132			
Distance_traveled_by_motorcycle_per_day_in_km	Between Groups	97.607	4	24.402	7.400	.000
	Within Groups	422.062	128	3.297		
	Total	519.669	132			
Travel_time_by_motorcycle_per_day_in_minutes	Between Groups	67.387	4	16.847	6.411	.000
	Within Groups	336.343	128	2.628		
	Total	403.729	132			
Speed_of_motorcycle_in_km/h	Between Groups	15.878	4	3.970	3.227	.015
	Within Groups	157.430	128	1.230		
	Total	173.308	132			
Money_spend_on_motorcycle_per_day	Between Groups	91.705	4	22.926	6.119	.000
	Within Groups	479.603	128	3.747		
	Total	571.308	132			
Number _of_car_owned	Between Groups	3.248	4	.812	10.333	.000
	Within Groups	10.060	128	.079		
	Total	13.308	132			

Number_of_trips_by_car	Between Groups	34.371	4	8.593	17.438	.000
	Within Groups	63.072	128	.493		
	Total	97.444	132			
Distance_traveled_by_car_per_day_in_km	Between Groups	51.233	4	12.808	18.047	.000
	Within Groups	90.842	128	.710		
	Total	142.075	132			
Travel_time_by_car_per_day_in_minutes	Between Groups	83.487	4	20.872	19.395	.000
	Within Groups	137.746	128	1.076		
	Total	221.233	132			
Speed_of_car_per_day_in_km/h	Between Groups	35.840	4	8.960	18.335	.000
	Within Groups	62.551	128	.489		
	Total	98.391	132			
Money_spend_on_car_per_day_in_Rwf	Between Groups	41.511	4	10.378	18.595	.000
	Within Groups	71.437	128	.558		
	Total	112.947	132			
Number_of_trips_made_using_PT	Between Groups	30.699	4	7.675	6.382	.000
	Within Groups	153.932	128	1.203		
	Total	184.632	132			

Distance_traveled_per_day_using_PT_in_km	Between Groups	105.607	4	26.402	4.653	.002
	Within Groups	726.272	128	5.674		
	Total	831.880	132			
Travel_time_by_PT_per_day_in_minutes	Between Groups	80.036	4	20.009	5.281	.001
	Within Groups	484.957	128	3.789		
	Total	564.992	132			
Speed_of_P T_per_day_in_km/h	Between Groups	48.562	4	12.140	8.151	.000
	Within Groups	190.641	128	1.489		
	Total	239.203	132			
money_spend_on_PT_per_day_in_Rwf	Between Groups	30.956	4	7.739	3.443	.010
	Within Groups	287.750	128	2.248		
	Total	318.707	132			

Appendix2-5: Relationship between income levels and modes of transport in rural regions of Kigali City when very rich is taken as reference

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income_Level=1]	4.227	2827.9006	-5538.357	5546.810	.000	1	.999
	[Income_Level=2]	6.101	2827.9006	-5536.482	5548.685	.000	1	.998
	[Income_Level=3]	7.615	2827.9005	-5534.968	5550.198	.000	1	.998
	[Income_Level=4]	10.272	2827.9006	-5532.311	5552.856	.000	1	.997
Number_of_trips_by_walking_per_day		-.295	.1939	-.675	.085	2.314	1	.128
Distance_by_walking_per_day_in_Km		-.234	.1504	-.529	.061	2.421	1	.120
Travel_time_per_day_by_walking_in_minutes		.271	.1998	-.121	.662	1.835	1	.176
Speed_by_walking_in_Kmh		1.025	.3743	.291	1.759	7.498	1	.006
Number_of_bicycles_owned		-.540	.7448	-1.999	.920	.525	1	.469
Number_of_trips_by_bicycle_per_day		2.093	.7153	.691	3.495	8.561	1	.003
Distance_traveled_by_bicycle		-1.045	.4817	-1.989	-.100	4.702	1	.030
Travel_time_per_day_by_bicycle_in_minutes		-1.933	.9245	-3.745	-.120	4.369	1	.037
Speed_by_bicycle_in_kmh		.705	.3525	.014	1.396	3.998	1	.046

Money_spend_on_bicycle_per_day_in_Rwf	.142	.6912	-1.212	1.497	.042	1	.837
Number_of_motorcycles_owned	.275	1.0543	-1.792	2.341	.068	1	.795
Number_of_trips_by_motorcycle	1.717	1.0156	-.274	3.708	2.858	1	.091
Distance_traveled_by_motorcycle_per_day_in_km	-1.219	.6187	-2.431	-.006	3.880	1	.049
Travel_time_by_motorcycle_per_day_in_minutes	.261	.5757	-.867	1.389	.205	1	.650
Speed_of_motorcycle_in_kmh	-1.179	.8882	-2.920	.562	1.763	1	.184
Money_spend_on_motorcycle_per_day	1.759	.6598	.466	3.052	7.105	1	.008
Number_of_car_owned	7.023	4241.8507	-8306.852	8320.897	.000	1	.999
Number_of_trips_by_car	-19.294	6127.1151	-12028.219	11989.631	.000	1	.997
Distance_traveled_by_car_per_day_in_km	32.887	9190.6722	-17980.499	18046.274	.000	1	.997
Travel_time_by_car_per_day_in_minutes	-7.103	1885.2662	-3702.156	3687.951	.000	1	.997
Speed_of_car_per_day_in_kmh	11.214	3534.8741	-6917.012	6939.440	.000	1	.997
Money_spend_on_car_per_day_in_Rwf	-18.928	6127.1151	-12027.853	11989.997	.000	1	.998
Number_of_trips_made_using_PT	.843	.4226	.015	1.671	3.979	1	.046
Distance_traveled_per_day_using_PT_in_km	-.356	.2215	-.790	.078	2.579	1	.108
Travel_time_by_PT_per_day_in_minutes	-.012	.2266	-.456	.432	.003	1	.958
Speed_of_PT_per_day_in_kmh	.714	.3400	.048	1.380	4.411	1	.036
money_spend_on_PT_per_day_in_Rwf	-.702	.3385	-1.366	-.039	4.304	1	.038

purpose_of_travelling	-.387	.1390	-.660	-.115	7.766	1	.005
Problem_caused_by_transport	-3.004	.9662	-4.898	-1.110	9.667	1	.002
Those_problems_of_transport	-.040	.2221	-.475	.395	.032	1	.857
(Scale)	1[a]						

Dependent Variable: Income _Level
Model: (Threshold),
a. Fixed at the displayed value.

Appendix2-6: Relationship between income levels and modes of transport in rural regions of Kigali City when very poor is taken as reference

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=5]	-10.272	2827.9012	-5552.857	5532.312	.000	1	.997
	[Income _Level=4]	-7.615	2827.9011	-5550.200	5534.969	.000	1	.998
	[Income _Level=3]	-6.101	2827.9011	-5548.686	5536.483	.000	1	.998
	[Income _Level=2]	-4.227	2827.9011	-5546.811	5538.358	.000	1	.999
Number_of_trips_by_walking_per_day		.295	.1939	-.085	.675	2.314	1	.128

Distance_by_walking_per_day_in_Km	.234	.1504	-.061	.529	2.421	1	.120
Travel_time_per_day_by_walking_in_minutes	-.271	.1998	-.662	.121	1.835	1	.176
Speed_by_walking_in_Kmh	-1.025	.3743	-1.759	-.291	7.498	1	.006
Number_of_bicycles_owned	.540	.7448	-.920	1.999	.525	1	.469
Number_of_trips_by_bicycle_per_day	-2.093	.7153	-3.495	-.691	8.561	1	.003
Distance_traveled_by_bicycle	1.045	.4817	.100	1.989	4.702	1	.030
Travel_time_per_day_by_bicycle_in_minutes	1.933	.9245	.120	3.745	4.369	1	.037
Speed_by_bicycle_in_kmh	-.705	.3525	-1.396	-.014	3.998	1	.046
Money_spend_on_bicycle_per_day_in_Rwf	-.142	.6912	-1.497	1.212	.042	1	.837
Number_of_motorcycles_owned	-.275	1.0543	-2.341	1.792	.068	1	.795
Number_of_trips_by_motorcycle	-1.717	1.0156	-3.708	.274	2.858	1	.091
Distance_traveled_by_motorcycle_per_day_in_km	1.219	.6187	.006	2.431	3.880	1	.049
Travel_time_by_motorcycle_per_day_in_minutes	-.261	.5757	-1.389	.867	.205	1	.650
Speed_of_motorcycle_in_kmh	1.179	.8882	-.562	2.920	1.763	1	.184

Money_spend_on_motorcycle_per_day	-1.759	.6598	-3.052	-.466	7.105	1	.008
Number_of_car_owned	-7.023	4241.85516	-8320.899	8306.853	.000	1	.999
Number_of_trips_by_car	19.294	6127.1163	-11989.634	12028.221	.000	1	.997
Distance_traveled_by_car_per_day_in_km	-32.887	9190.6740	-18046.277	17980.503	.000	1	.997
Travel_time_by_car_per_day_in_minutes	7.103	1885.2665	-3687.952	3702.157	.000	1	.997
Speed_of_car_per_day_in_kmh	-11.214	3534.8748	-6939.441	6917.013	.000	1	.997
Money_spend_on_car_per_day_in_Rwf	18.928	6127.1163	-11989.999	12027.855	.000	1	.998
Number_of_trips_made_using_PT	-.843	.4226	-1.671	-.015	3.979	1	.046
Distance_traveled_per_day_using_PT_in_km	.356	.2215	-.078	.790	2.579	1	.108
Travel_time_by_PT_per_day_in_minutes	.012	.2266	-.432	.456	.003	1	.958
Speed_of_PT_per_day_in_kmh	-.714	.3400	-1.380	-.048	4.411	1	.036
money_spend_on_PT_per_day_in_Rwf	.702	.3385	.039	1.366	4.304	1	.038
purpose_of_travelling	.387	.1390	.115	.660	7.766	1	.005

Problem_caused_by_transport	3.004	.9662	1.110	4.898	9.667	1	.002
Those_problems_of_transport	.040	.2221	-.395	.475	.032	1	.857
(Scale)	1[a]						

Dependent Variable: Income _Level

Model: (Threshold),

a. Fixed at the displayed value.

Appendix 2-7: Differences among income levels on transport elements in rural regions of Kigali City

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Number_of_trips_by_walking_per_day	Between Groups	39.402	4	9.850	3.589	.009
	Within Groups	312.884	114	2.745		
	Total	352.286	118			
Distance_by_walking_per_day_in_Km	Between Groups	89.224	4	22.306	3.714	.007
	Within Groups	684.624	114	6.005		
	Total	773.849	118			
Travel_time_per_day_by_walking_in_minutes	Between Groups	22.605	4	5.651	2.622	.038
	Within Groups	245.714	114	2.155		
	Total	268.319	118			
Speed_by_walking_in_Km/h	Between Groups	9.021	4	2.255	2.229	.070
	Within Groups	115.332	114	1.012		
	Total	124.353	118			
Number_of_bicycles_owned	Between Groups	.886	4	.222	1.009	.406
	Within Groups	25.046	114	.220		
	Total	25.933	118			
Number_of_trips_by_bicycle_per_day	Between Groups	4.162	4	1.041	1.124	.349

	Within Groups	105.569	114	.926		
	Total	109.731	118			
Distance_traveled_by_bicycle	Between Groups	60.330	4	15.083	3.138	.017
	Within Groups	547.888	114	4.806		
	Total	608.218	118			
Travel_time_per_day_by_bicycle_in_minutes	Between Groups	14.825	4	3.706	3.835	.006
	Within Groups	110.167	114	.966		
	Total	124.992	118			
Speed_by_bicycle_in_km/h	Between Groups	38.518	4	9.629	2.814	.029
	Within Groups	390.121	114	3.422		
	Total	428.639	118			
Money_spend_on_bicycle_per_day_in_Rwf	Between Groups	34.750	4	8.687	3.948	.005
	Within Groups	250.830	114	2.200		
	Total	285.580	118			
Number_of_motorcycles_owned	Between Groups	1.100	4	.275	3.748	.007
	Within Groups	8.363	114	.073		
	Total	9.462	118			
Number_of_trips_by_motorcycle	Between Groups	4.501	4	1.125	3.136	.017
	Within Groups	40.911	114	.359		
	Total	45.412	118			
Distance_traveled_by_motorcycle_per_day_in_km	Between Groups	16.803	4	4.201	3.138	.017
	Within Groups	152.592	114	1.339		
	Total	169.395	118			
Travel_time_by_motorcycle_per_day_in_minutes	Between Groups	24.846	4	6.212	3.716	.007
	Within Groups	190.549	114	1.671		
	Total	215.395	118			

Speed_of_motorcycle_in_km/h	Between Groups	18.190	4	4.548	4.809	.001
	Within Groups	107.793	114	.946		
	Total	125.983	118			
Money_spend_on_motorcycle_per_day	Between Groups	26.830	4	6.707	3.769	.006
	Within Groups	202.868	114	1.780		
	Total	229.697	118			
Number _of_car_owned	Between Groups	2.413	4	.603	8.698	.000
	Within Groups	7.906	114	.069		
	Total	10.319	118			
Number_of_trips_by_car	Between Groups	12.564	4	3.141	8.257	.000
	Within Groups	43.368	114	.380		
	Total	55.933	118			
Distance_traveled_by_car_per_day_in_km	Between Groups	28.819	4	7.205	10.253	.000
	Within Groups	80.105	114	.703		
	Total	108.924	118			
Travel_time_by_car_per_day_in_minutes	Between Groups	39.880	4	9.970	7.732	.000
	Within Groups	146.994	114	1.289		
	Total	186.874	118			
Speed_of_car_per_day_in_km/h	Between Groups	15.897	4	3.974	10.009	.000
	Within Groups	45.263	114	.397		
	Total	61.160	118			
Money_spend_on_car_per_day_in_Rwf	Between Groups	15.218	4	3.805	8.350	.000
	Within Groups	51.942	114	.456		
	Total	67.160	118			
Number_of_trips_made_using_PT	Between Groups	7.246	4	1.811	1.274	.284

	Within Groups	162.049	114	1.421		
	Total	169.294	118			
Distance_traveled_per_day_using_PT_in_km	Between Groups	55.610	4	13.902	2.471	.048
	Within Groups	641.264	114	5.625		
	Total	696.874	118			
Travel_time_by_PT_per_day_in_minutes	Between Groups	10.271	4	2.568	.415	.798
	Within Groups	705.376	114	6.188		
	Total	715.647	118			
Speed_of_P T_per_day_in_km/h	Between Groups	2.252	4	.563	.305	.874
	Within Groups	210.185	114	1.844		
	Total	212.437	118			
money_spend_on_PT_per_day_in_Rwf	Between Groups	3.273	4	.818	.214	.930
	Within Groups	436.693	114	3.831		
	Total	439.966	118			

Appendix2-8: Relationship between income and modes of transport in urban regions of Kigali City when very rich is taken as reference category

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=1]	-1.141	3009.7556	-5900.154	5897.872	.000	1	1.000
	[Income _Level=2]	.864	3009.7557	-5898.149	5899.877	.000	1	1.000
	[Income _Level=3]	1.969	3009.7557	-5897.044	5900.982	.000	1	.999
	[Income _Level=4]	4.563	3009.7558	-5894.450	5903.576	.000	1	.999
Number_of_trips_by_walking_per_day		-.033	.1702	-.367	.300	.038	1	.845
Distance_by_walking_per_day_in_Km		.043	.1531	-.257	.343	.080	1	.777
Travel_time_per_day_by_walking_in_minutes		-.154	.2073	-.560	.253	.549	1	.459
Speed_by_walking_in_Kmh		.155	.2963	-.426	.735	.272	1	.602
Number_of_bicycles_owned		1.872	1.2396	-.558	4.302	2.280	1	.131
Number_of_trips_by_bicycle_per_day		-3.124	752.4393	-1477.878	1471.630	.000	1	.997
Distance_traveled_by_bicycle		1.122	752.4395	-1473.632	1475.876	.000	1	.999

Travel_time_per_day_by_bicycle_in_minutes	-4.600	2257.3167	-4428.859	4419.660	.000	1	.998
Speed_by_bicycle_in_kmh	-11.352	5267.0715	-10334.623	10311.918	.000	1	.998
Money_spend_on_bicycle_per_day_in_Rwf	9.950	4514.6328	-8838.568	8858.467	.000	1	.998
Number_of_motorcycles_owned	1.304	.6215	.086	2.523	4.404	1	.036
Number_of_trips_by_motorcycle	.766	.4690	-.153	1.685	2.667	1	.102
Distance_traveled_by_motorcycle_per_day_in_km	.015	.2854	-.545	.574	.003	1	.959
Travel_time_by_motorcycle_per_day_in_minutes	.175	.4498	-.707	1.057	.151	1	.697
Speed_of_motorcycle_in_kmh	.392	.3102	-.216	1.000	1.594	1	.207
Money_spend_on_motorcycle_per_day	-.402	.3394	-1.067	.263	1.401	1	.237
Number_of_car_owned	1.883	.8475	.222	3.544	4.935	1	.026
Number_of_trips_by_car	-.942	.3834	-1.694	-.191	6.043	1	.014
Distance_traveled_by_car_per_day_in_km	.263	.8616	-1.425	1.952	.093	1	.760
Travel_time_by_car_per_day_in_minutes	.162	.5891	-.993	1.316	.075	1	.784
Speed_of_car_per_day_in_kmh	.118	.5107	-.883	1.119	.053	1	.818
Money_spend_on_car_per_day_in_Rwf	1.020	.5083	.024	2.016	4.028	1	.045
Number_of_trips_made_using_PT	.591	.3396	-.074	1.257	3.032	1	.082
Distance_traveled_per_day_using_PT_in_km	-.340	.1952	-.723	.042	3.037	1	.081
Travel_time_by_PT_per_day_in_minutes	.081	.2340	-.378	.539	.119	1	.730
Speed_of_PT_per_day_in_kmh	.343	.2446	-.137	.822	1.962	1	.161
money_spend_on_PT_per_day_in_Rwf	-.032	.2666	-.555	.490	.015	1	.904

purpose_of_travelling	-.069	.0947	-.255	.116	.536	1	.464
Problem_caused_by_transport	.159	.8645	-1.536	1.853	.034	1	.854
Those_problems_of_transport	-.137	.1605	-.451	.178	.724	1	.395
(Scale)	1[a]						

Dependent Variable: Income _Level

Model: (Threshold),

a. Fixed at the displayed value.

Appendix2-9: Relationship between income levels and modes transport in urban regions of Kigali City when very poor is taken as reference category

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=5]	-4.563	3009.7553	-5903.575	5894.449	.000	1	.999
	[Income _Level=4]	-1.969	3009.7552	-5900.981	5897.043	.000	1	.999
	[Income _Level=3]	-.864	3009.7551	-5899.876	5898.148	.000	1	1.000
	[Income _Level=2]	1.141	3009.7551	-5897.871	5900.153	.000	1	1.000

Number_of_trips_by_walking_per_day	.033	.1702	-.300	.367	.038	1	.845
Distance_by_walking_per_day_in_Km	-.043	.1531	-.343	.257	.080	1	.777
Travel_time_per_day_by_walking_in_minutes	.154	.2073	-.253	.560	.549	1	.459
Speed_by_walking_in_Kmh	-.155	.2963	-.735	.426	.272	1	.602
Number_of_bicycles_owned	-1.872	1.2396	-4.302	.558	2.280	1	.131
Number_of_trips_by_bicycle_per_day	3.124	752.4392	-1471.630	1477.877	.000	1	.997
Distance_traveled_by_bicycle	-1.122	752.4394	-1475.876	1473.632	.000	1	.999
Travel_time_per_day_by_bicycle_in_minutes	4.600	2257.3163	-4419.659	4428.858	.000	1	.998
Speed_by_bicycle_in_kmh	11.352	5267.0706	-10311.916	10334.621	.000	1	.998
Money_spend_on_bicycle_per_day_in_Rwf	-9.950	4514.6320	-8858.466	8838.567	.000	1	.998
Number_of_motorcycles_owned	-1.304	.6215	-2.523	-.086	4.404	1	.036
Number_of_trips_by_motorcycle	-.766	.4690	-1.685	.153	2.667	1	.102
Distance_traveled_by_motorcycle_per_day_in_km	-.015	.2854	-.574	.545	.003	1	.959

Travel_time_by_motorcycle_per_day_in_minutes	-.175	.4498	-1.057	.707	.151	1	.697
Speed_of_motorcycle_in_kmh	-.392	.3102	-1.000	.216	1.594	1	.207
Money_spend_on_motorcycle_per_day	.402	.3394	-.263	1.067	1.401	1	.237
Number_of_car_owned	-1.883	.8475	-3.544	-.222	4.935	1	.026
Number_of_trips_by_car	.942	.3834	.191	1.694	6.043	1	.014
Distance_traveled_by_car_per_day_in_km	-.263	.8616	-1.952	1.425	.093	1	.760
Travel_time_by_car_per_day_in_minutes	-.162	.5891	-1.316	.993	.075	1	.784
Speed_of_car_per_day_in_kmh	-.118	.5107	-1.119	.883	.053	1	.818
Money_spend_on_car_per_day_in_Rwf	-1.020	.5083	-2.016	-.024	4.028	1	.045
Number_of_trips_made_using_PT	-.591	.3396	-1.257	.074	3.032	1	.082
Distance_traveled_per_day_using_PT_in_km	.340	.1952	-.042	.723	3.037	1	.081
Travel_time_by_PT_per_day_in_minutes	-.081	.2340	-.539	.378	.119	1	.730
Speed_of_PT_per_day_in_kmh	-.343	.2446	-.822	.137	1.962	1	.161
money_spend_on_PT_per_day_in_Rwf	.032	.2666	-.490	.555	.015	1	.904
purpose_of_travelling	.069	.0947	-.116	.255	.536	1	.464

Problem_caused_by_transport	-.159	.8645	-1.853	1.536	.034	1	.854
Those_problems_of_transport	.137	.1605	-.178	.451	.724	1	.395
(Scale)	1[a]						

Dependent Variable: Income _Level

Model: (Threshold),

a. Fixed at the displayed value.

Appendix2-10: Differences among income levels on transport elements in urban regions of Kigali City

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Number_of_trips_by_walking_per_day	Between Groups	13.586	4	3.397	1.308	.270
	Within Groups	355.709	137	2.596		
	Total	369.296	141			
Distance_by_walking_per_day_in_Km	Between Groups	51.669	4	12.917	2.121	.082
	Within Groups	834.451	137	6.091		
	Total	886.120	141			
Travel_time_per_day_by_walking_in_minutes	Between Groups	19.678	4	4.919	2.171	.075
	Within Groups	310.442	137	2.266		
	Total	330.120	141			
Speed_by_walking_in_Km/h	Between Groups	4.475	4	1.119	1.284	.279
	Within Groups	119.391	137	.871		
	Total	123.866	141			
Number_of_bicycles_owned	Between Groups	1.904	4	.476	5.303	.001
	Within Groups	12.294	137	.090		
	Total	14.197	141			

Number_of_trips_by_bicycle_per_day	Between Groups	6.716	4	1.679	4.550	.002
	Within Groups	50.559	137	.369		
	Total	57.275	141			
Distance_traveled_by_bicycle	Between Groups	18.651	4	4.663	3.388	.011
	Within Groups	188.568	137	1.376		
	Total	207.218	141			
Travel_time_per_day_by_bicycle_in_minutes	Between Groups	6.423	4	1.606	3.088	.018
	Within Groups	71.239	137	.520		
	Total	77.662	141			
Speed_by_bicycle_in_km/h	Between Groups	18.137	4	4.534	4.890	.001
	Within Groups	127.025	137	.927		
	Total	145.162	141			
Money_spend_on_bicycle_per_day_in_Rwf	Between Groups	17.528	4	4.382	4.588	.002
	Within Groups	130.838	137	.955		
	Total	148.366	141			
Number_of_motorcycles_owned	Between Groups	7.408	4	1.852	12.771	.000
	Within Groups	19.867	137	.145		
	Total	27.275	141			

Number_of_trips_by_motorcycle	Between Groups	28.849	4	7.212	7.604	.000
	Within Groups	129.947	137	.949		
	Total	158.796	141			
Distance_traveled_by_motorcycle_per_day_in_km	Between Groups	99.981	4	24.995	8.227	.000
	Within Groups	416.216	137	3.038		
	Total	516.197	141			
Travel_time_by_motorcycle_per_day_in_minutes	Between Groups	84.417	4	21.104	7.482	.000
	Within Groups	386.407	137	2.820		
	Total	470.824	141			
Speed_of_motorcycle_in_km/h	Between Groups	58.890	4	14.722	9.617	.000
	Within Groups	209.730	137	1.531		
	Total	268.620	141			
Money_spend_on_motorcycle_per_day	Between Groups	119.994	4	29.998	7.127	.000
	Within Groups	576.689	137	4.209		
	Total	696.683	141			
Number _of_car_owned	Between Groups	31.260	4	7.815	43.675	.000
	Within Groups	24.514	137	.179		
	Total	55.775	141			

Number_of_trips_by_car	Between Groups	72.032	4	18.008	18.006	.000
	Within Groups	137.017	137	1.000		
	Total	209.049	141			
Distance_traveled_by_car_per_day_in_km	Between Groups	247.632	4	61.908	42.057	.000
	Within Groups	201.664	137	1.472		
	Total	449.296	141			
Travel_time_by_car_per_day_in_minutes	Between Groups	359.110	4	89.777	37.515	.000
	Within Groups	327.855	137	2.393		
	Total	686.965	141			
Speed_of_car_per_day_in_km/h	Between Groups	139.376	4	34.844	45.464	.000
	Within Groups	104.997	137	.766		
	Total	244.373	141			
Money_spend_on_car_per_day_in_Rwf	Between Groups	178.914	4	44.728	43.104	.000
	Within Groups	142.164	137	1.038		
	Total	321.077	141			
Number_of_trips_made_using_PT	Between Groups	22.605	4	5.651	4.405	.002
	Within Groups	175.761	137	1.283		
	Total	198.366	141			

Distance_traveled_per_day_using_PT_in_km	Between Groups	11.473	4	2.868	.586	.673
	Within Groups	670.759	137	4.896		
	Total	682.232	141			
Travel_time_by_PT_per_day_in_minutes	Between Groups	37.673	4	9.418	2.534	.043
	Within Groups	509.116	137	3.716		
	Total	546.789	141			
Speed_of_P T_per_day_in_km/h	Between Groups	10.506	4	2.627	1.577	.184
	Within Groups	228.226	137	1.666		
	Total	238.732	141			
money_spend_on_PT_per_day_in_Rwf	Between Groups	42.105	4	10.526	3.468	.010
	Within Groups	415.867	137	3.036		
	Total	457.972	141			
purpose_of_travelling	Between Groups	224.419	4	56.105	11.639	.000
	Within Groups	660.370	137	4.820		
	Total	884.789	141			
Problem_caused_by_transport	Between Groups	.503	4	.126	1.423	.230
	Within Groups	12.116	137	.088		
	Total	12.620	141			

Those_problems_of_transport	Between Groups	21.205	4	5.301	1.830	.127
	Within Groups	396.886	137	2.897		
	Total	418.092	141			

Appendix2-11: Relationship between income levels and modes of transport in Kigali City when very rich is taken as reference category

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=1]	2.826	.8991	1.064	4.588	9.880	1	.002
	[Income _Level=2]	4.255	.9127	2.466	6.044	21.737	1	.000
	[Income _Level=3]	5.397	.9323	3.570	7.224	33.512	1	.000
	[Income _Level=4]	7.466	.9948	5.516	9.416	56.323	1	.000
Number_of_trips_by_walking_per_day		-.204	.0832	-.368	-.041	6.041	1	.014
Distance_by_walking_per_day_in_Km		-.135	.0666	-.266	-.004	4.109	1	.043
Travel_time_per_day_by_walking_in_minutes		.146	.0908	-.032	.324	2.595	1	.107
Speed_by_walking_in_Kmh		.482	.1492	.189	.774	10.424	1	.001
Number_of_bicycles_owned		-.271	.3991	-1.054	.511	.463	1	.496
Number_of_trips_by_bicycle_per_day		.314	.2294	-.136	.764	1.873	1	.171
Distance_traveled_by_bicycle		-.134	.2130	-.552	.283	.398	1	.528
Travel_time_per_day_by_bicycle_in_minutes		-.282	.3137	-.897	.333	.806	1	.369

Speed_by_bicycle_in_kmh	.020	.2007	-.373	.414	.010	1	.919
Money_spend_on_bicycle_per_day_in_Rwf	-.060	.1988	-.450	.330	.091	1	.763
Number_of_motorcycles_owned	1.666	.3690	.943	2.389	20.384	1	.000
Number_of_trips_by_motorcycle	.938	.2640	.420	1.455	12.612	1	.000
Distance_traveled_by_motorcycle_per_day_in_km	.275	.1325	.015	.534	4.301	1	.038
Travel_time_by_motorcycle_per_day_in_minutes	-.161	.1627	-.480	.158	.979	1	.322
Speed_of_motorcycle_in_kmh	-.101	.1713	-.437	.235	.349	1	.555
Money_spend_on_motorcycle_per_day	-.133	.1562	-.439	.173	.722	1	.396
Number_of_car_owned	.740	.5264	-.292	1.772	1.976	1	.160
Number_of_trips_by_car	-.418	.2858	-.978	.142	2.139	1	.144
Distance_traveled_by_car_per_day_in_km	.600	.5072	-.394	1.594	1.399	1	.237
Travel_time_by_car_per_day_in_minutes	-.227	.3329	-.879	.426	.464	1	.496
Speed_of_car_per_day_in_kmh	.456	.3148	-.161	1.073	2.100	1	.147
Money_spend_on_car_per_day_in_Rwf	.657	.3677	-.064	1.377	3.188	1	.074
Number_of_trips_made_using_PT	.496	.1626	.177	.815	9.299	1	.002
Distance_traveled_per_day_using_PT_in_km	-.200	.0782	-.353	-.046	6.513	1	.011
Travel_time_by_PT_per_day_in_minutes	-.007	.1000	-.203	.189	.005	1	.942
Speed_of_PT_per_day_in_kmh	.182	.1393	-.091	.455	1.714	1	.190
money_spend_on_PT_per_day_in_Rwf	-.149	.1419	-.427	.129	1.101	1	.294
purpose_of_travelling	-.153	.0482	-.248	-.059	10.119	1	.001
Problem_caused_by_transport	-.963	.4104	-1.767	-.159	5.508	1	.019

Those_problems_of_transport	.013	.0760	-.136	.162	.028	1	.867
(Scale)	1[a]						

Dependent Variable: Income Level
Model: (Threshold)

Appendix2-12: Relationship between income level and modes transport in Kigali City when very poor is taken as reference category

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=5]	-7.466	.9948	-9.416	-5.516	56.323	1	.000
	[Income _Level=4]	-5.397	.9323	-7.224	-3.570	33.512	1	.000
	[Income _Level=3]	-4.255	.9127	-6.044	-2.466	21.737	1	.000
	[Income _Level=2]	-2.826	.8991	-4.588	-1.064	9.880	1	.002
Number_of_trips_by_walking_per_day		.204	.0832	.041	.368	6.041	1	.014
Distance_by_walking_per_day_in_Km		.135	.0666	.004	.266	4.109	1	.043
Travel_time_per_day_by_walking_in_minutes		-.146	.0908	-.324	.032	2.595	1	.107
Speed_by_walking_in_Kmh		-.482	.1492	-.774	-.189	10.424	1	.001

Number_of_bicycles_owned	.271	.3991	-.511	1.054	.463	1	.496
Number_of_trips_by_bicycle_per_day	-.314	.2294	-.764	.136	1.873	1	.171
Distance_traveled_by_bicycle	.134	.2130	-.283	.552	.398	1	.528
Travel_time_per_day_by_bicycle_in_minutes	.282	.3137	-.333	.897	.806	1	.369
Speed_by_bicycle_in_kmh	-.020	.2007	-.414	.373	.010	1	.919
Money_spend_on_bicycle_per_day_in_Rwf	.060	.1988	-.330	.450	.091	1	.763
Number_of_motorcycles_owned	-1.666	.3690	-2.389	-.943	20.384	1	.000
Number_of_trips_by_motorcycle	-.938	.2640	-1.455	-.420	12.612	1	.000
Distance_traveled_by_motorcycle_per_day_in_km	-.275	.1325	-.534	-.015	4.301	1	.038
Travel_time_by_motorcycle_per_day_in_minutes	.161	.1627	-.158	.480	.979	1	.322
Speed_of_motorcycle_in_kmh	.101	.1713	-.235	.437	.349	1	.555
Money_spend_on_motorcycle_per_day	.133	.1562	-.173	.439	.722	1	.396
Number_of_car_owned	-.740	.5264	-1.772	.292	1.976	1	.160
Number_of_trips_by_car	.418	.2858	-.142	.978	2.139	1	.144
Distance_traveled_by_car_per_day_in_km	-.600	.5072	-1.594	.394	1.399	1	.237
Travel_time_by_car_per_day_in_minutes	.227	.3329	-.426	.879	.464	1	.496

Speed_of_car_per_day_in_kmh	-.456	.3148	-1.073	.161	2.100	1	.147
Money_spend_on_car_per_day_in_Rwf	-.657	.3677	-1.377	.064	3.188	1	.074
Number_of_trips_made_using_PT	-.496	.1626	-.815	-.177	9.299	1	.002
Distance_traveled_per_day_using_PT_in_km	.200	.0782	.046	.353	6.513	1	.011
Travel_time_by_PT_per_day_in_minutes	.007	.1000	-.189	.203	.005	1	.942
Speed_of_PT_per_day_in_kmh	-.182	.1393	-.455	.091	1.714	1	.190
money_spend_on_PT_per_day_in_Rwf	.149	.1419	-.129	.427	1.101	1	.294
purpose_of_travelling	.153	.0482	.059	.248	10.119	1	.001
Problem_caused_by_transport	.963	.4104	.159	1.767	5.508	1	.019
Those_problems_of_transport	-.013	.0760	-.162	.136	.028	1	.867
(Scale)	1[a]						

Dependent Variable: Income _Level

Model: (Threshold),

a. Fixed at the displayed value.

Appendix2-13: Differences among income levels on transport elements in Kigali City

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Number_of_trips_by_walking_per_day	Between Groups	46.254	4	11.564	4.326	.002
	Within Groups	1039.901	389	2.673		
	Total	1086.155	393			
Distance_by_walking_per_day_in_Km	Between Groups	164.539	4	41.135	6.965	.000
	Within Groups	2297.443	389	5.906		
	Total	2461.982	393			
Travel_time_per_day_by_walking_in_minutes	Between Groups	38.057	4	9.514	4.129	.003
	Within Groups	896.289	389	2.304		
	Total	934.345	393			
Speed_by_walking_in_Km/h	Between Groups	29.130	4	7.282	8.122	.000
	Within Groups	348.779	389	.897		
	Total	377.909	393			
Number_of_bicycles_owned	Between Groups	3.080	4	.770	5.498	.000
	Within Groups	54.476	389	.140		
	Total	57.556	393			
Number_of_trips_by_bicycle_per_day	Between Groups	23.794	4	5.949	7.717	.000

	Within Groups	299.843	389	.771		
	Total	323.637	393			
Distance_traveled_by_bicycle	Between Groups	125.579	4	31.395	9.983	.000
	Within Groups	1223.284	389	3.145		
	Total	1348.863	393			
Travel_time_per_day_by_bicycle_in_minutes	Between Groups	28.654	4	7.164	8.401	.000
	Within Groups	331.711	389	.853		
	Total	360.365	393			
Speed_by_bicycle_in_km/h	Between Groups	86.223	4	21.556	9.456	.000
	Within Groups	886.795	389	2.280		
	Total	973.018	393			
Money_spend_on_bicycle_per_day_in_Rwf	Between Groups	72.843	4	18.211	8.919	.000
	Within Groups	794.263	389	2.042		
	Total	867.107	393			
Number_of_motorcycles_owned	Between Groups	10.287	4	2.572	22.179	.000
	Within Groups	45.106	389	.116		
	Total	55.393	393			
Number_of_trips_by_motorcycle	Between Groups	37.633	4	9.408	12.958	.000

	Within Groups	282.438	389	.726		
	Total	320.071	393			
Distance_traveled_by_motorcycle_per_day_in_km	Between Groups	155.600	4	38.900	13.874	.000
	Within Groups	1090.684	389	2.804		
	Total	1246.284	393			
Travel_time_by_motorcycle_per_day_in_minutes	Between Groups	113.322	4	28.330	10.995	.000
	Within Groups	1002.285	389	2.577		
	Total	1115.607	393			
Speed_of_motorcycle_in_km/h	Between Groups	70.053	4	17.513	13.199	.000
	Within Groups	516.170	389	1.327		
	Total	586.223	393			
Money_spend_on_motorcycle_per_day	Between Groups	170.931	4	42.733	12.054	.000
	Within Groups	1379.079	389	3.545		
	Total	1550.010	393			
Number _of_car_owned	Between Groups	31.610	4	7.902	57.748	.000
	Within Groups	53.233	389	.137		
	Total	84.843	393			
Number_of_trips_by_car	Between Groups	120.578	4	30.144	46.707	.000

	Within Groups	251.059	389	.645		
	Total	371.637	393			
Distance_traveled_by_car_per_day_in_km	Between Groups	310.789	4	77.697	71.504	.000
	Within Groups	422.695	389	1.087		
	Total	733.485	393			
Travel_time_by_car_per_day_in_minutes	Between Groups	457.617	4	114.404	65.246	.000
	Within Groups	682.088	389	1.753		
	Total	1139.706	393			
Speed_of_car_per_day_in_km/h	Between Groups	185.627	4	46.407	75.231	.000
	Within Groups	239.957	389	.617		
	Total	425.584	393			
Money_spend_on_car_per_day_in_Rwf	Between Groups	222.366	4	55.592	71.176	.000
	Within Groups	303.827	389	.781		
	Total	526.193	393			
Number_of_trips_made_using_PT	Between Groups	46.910	4	11.728	8.946	.000
	Within Groups	509.932	389	1.311		
	Total	556.843	393			
Distance_traveled_per_day_using_PT_in_km	Between Groups	79.138	4	19.785	3.605	.007

	Within Groups	2134.590	389	5.487		
	Total	2213.728	393			
Travel_time_by_PT_per_day_in_minutes	Between Groups	65.027	4	16.257	3.568	.007
	Within Groups	1772.407	389	4.556		
	Total	1837.434	393			
Speed_of_P T_per_day_in_km/h	Between Groups	30.327	4	7.582	4.450	.002
	Within Groups	662.803	389	1.704		
	Total	693.129	393			
money_spend_on_PT_per_day_in_Rwf	Between Groups	43.557	4	10.889	3.556	.007
	Within Groups	1191.042	389	3.062		
	Total	1234.599	393			
purpose_of_travelling	Between Groups	227.162	4	56.790	11.605	.000
	Within Groups	1903.582	389	4.894		
	Total	2130.744	393			
Problem_caused_by_transport	Between Groups	1.260	4	.315	3.308	.011
	Within Groups	37.047	389	.095		
	Total	38.307	393			
Those_problems_of_transport	Between Groups	21.434	4	5.359	1.826	.123

Within Groups	1141.604	389	2.935		
Total	1163.038	393			

Appendix2-14: Relationship between Income levels and modes of transport in Kigali City when all data are considered as covariates

Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=1]	6.314	2.8391	.749	11.878	4.945	1	.026
	[Income _Level=2]	8.466	2.8557	2.869	14.063	8.790	1	.003
	[Income _Level=3]	10.264	2.8753	4.628	15.900	12.743	1	.000
	[Income _Level=4]	13.629	2.9454	7.856	19.402	21.410	1	.000
Nationality		-3.173	1.1312	-5.390	-.955	7.865	1	.005
Residence		-.017	.1984	-.406	.372	.007	1	.934
sex		.399	.2867	-.163	.961	1.940	1	.164
Age		-.001	.1125	-.222	.219	.000	1	.992
Marital_status		.293	.1325	.034	.553	4.904	1	.027
Number_of_people_in_HH		.529	.3257	-.110	1.167	2.635	1	.105
Condition_of_life		-.211	.4874	-1.166	.744	.188	1	.665
Factors_influencing_living_conditions		.791	.3549	.096	1.487	4.969	1	.026

Possesion_of_medical_insurance	.077	.6612	-1.219	1.373	.013	1	.908
payment_of_medical_insurance	.044	.1556	-.261	.349	.080	1	.778
Suffering_from_disability	6.303	2.6965	1.018	11.588	5.463	1	.019
Kind_of_disability	-.087	.5475	-1.160	.986	.025	1	.873
Problems_Caused_by_disabilities	0[a]	.	.	.	.	.	.
Those_problems_caused_by_disability	-1.323	.9510	-3.187	.541	1.935	1	.164
Number_of_People_per_room	-1.409	.4437	-2.278	-.539	10.077	1	.002
Money_spend_on_house_per_month	.068	.0733	-.076	.212	.863	1	.353
Number_of_rooms_per_HH	.417	.3454	-.260	1.094	1.460	1	.227
meeting_problems_in_daily_activities	.865	.6560	-.421	2.151	1.739	1	.187
Those_problems_met_in_daily_activities	-.719	.2990	-1.305	-.133	5.788	1	.016
level_of_studies_attended	.697	.1821	.341	1.054	14.671	1	.000
Higest_level_that_can_be_paid_for_hisher_children	.772	.1706	.437	1.106	20.468	1	.000
Possession_of_job	-1.178	.7916	-2.730	.373	2.216	1	.137
kind_of_job	.766	.3193	.140	1.392	5.751	1	.016
Category_of_labour	-.052	.1813	-.407	.303	.083	1	.774
like_of_entertainment	-.611	.7584	-2.097	.876	.649	1	.421
Time_for_entertainment	-.803	.4831	-1.750	.144	2.764	1	.096

Prefered_entertainment	.163	.1217	-.076	.401	1.787	1	.181
critical_sprit	-1.605	.9475	-3.462	.252	2.870	1	.090
Objective_of_critical_sprit	.029	.1245	-.215	.273	.054	1	.816
likeness_of_living_with_many_people	.118	2.1323	-4.061	4.297	.003	1	.956
Objectives_of_living_with_many_people	-.504	.2137	-.923	-.085	5.567	1	.018
Benefits_of_living_with_many_people	1.361	2.1201	-2.794	5.517	.412	1	.521
Those_benefis_of_living_with_many_people	-.984	.2061	-1.388	-.580	22.796	1	.000
possession_of_land_parcel	.683	.6029	-.499	1.865	1.283	1	.257
Size_of_land_percel_in_hectares	-.338	.3276	-.980	.304	1.067	1	.302
Possession_of_livestock	-.438	.9194	-2.240	1.364	.227	1	.633
Number_of_cattle	1.685	.6772	.358	3.012	6.192	1	.013
Number_of_sheeps	0[a]	.	.	.	.	.	.
Number_of_goats	.329	.5111	-.673	1.331	.415	1	.520
Number_of_pigs	0[a]	.	.	.	.	.	.
Number_of_rabbits	.464	.2842	-.093	1.021	2.662	1	.103
Number_of_chickens	.790	.2955	.211	1.369	7.147	1	.008
Use_of_liverstock_for_earning_money	-.642	.9929	-2.588	1.304	.418	1	.518
possession_of_electricity_power	1.397	.5535	.312	2.482	6.367	1	.012
Electricity_consumption_per_a_month	.648	.3648	-.067	1.363	3.154	1	.076

Ability_to_play_game	.030	.5269	-1.002	1.063	.003	1	.954
Played_game	.343	.1314	.085	.600	6.803	1	.009
Enjoy_to_play_game	-.716	.5436	-1.781	.350	1.734	1	.188
Comfortably_of_living_in_your_neighbourhood	.914	.5411	-.146	1.975	2.855	1	.091
Causes_of_being_comfortable_in_your_neighbourhood	-.137	.1560	-.443	.168	.775	1	.379
Right_of_holding_property	1.023	.5611	-.077	2.123	3.322	1	.068
Treatment_on_work	-2.062	.5262	-3.094	-1.031	15.362	1	.000
Number_of_trips_by_walking_per_day	-.094	.1223	-.333	.146	.589	1	.443
Distance_by_walking_per_day_in_Km	-.202	.0988	-.395	-.008	4.166	1	.041
Travel_time_per_day_by_walking_in_minutes	.122	.1347	-.142	.386	.827	1	.363
Speed_by_walking_in_Kmh	.521	.2176	.095	.948	5.738	1	.017
Number_of_bicycles_owned	1.314	.5570	.222	2.405	5.561	1	.018
Number_of_trips_by_bicycle_per_day	.432	.3159	-.187	1.051	1.868	1	.172
Distance_traveled_by_bicycle	-.416	.3029	-1.009	.178	1.886	1	.170
Travel_time_per_day_by_bicycle_in_minutes	-.907	.4135	-1.717	-.096	4.807	1	.028
Speed_by_bicycle_in_kmh	.044	.2959	-.536	.624	.022	1	.881
Money_spend_on_bicycle_per_day_in_Rwf	.292	.2688	-.235	.819	1.180	1	.277
Number_of_motorcycles_owned	.927	.4469	.051	1.803	4.302	1	.038
Number_of_trips_by_motorcycle	.576	.3394	-.089	1.242	2.885	1	.089

Distance_traveled_by_motorcycle_per_day_in_km	.662	.1751	.319	1.005	14.310	1	.000
Travel_time_by_motorcycle_per_day_in_minutes	-.177	.2068	-.582	.228	.732	1	.392
Speed_of_motorcycle_in_kmh	-.266	.2231	-.703	.171	1.423	1	.233
Money_spend_on_motorcycle_per_day	-.396	.1959	-.780	-.012	4.083	1	.043
Number_of_car_owned	-.042	.7326	-1.478	1.394	.003	1	.955
Number_of_trips_by_car	-.200	.3804	-.945	.546	.276	1	.600
Distance_traveled_by_car_per_day_in_km	1.108	.6652	-.195	2.412	2.776	1	.096
Travel_time_by_car_per_day_in_minutes	-.709	.4489	-1.589	.171	2.493	1	.114
Speed_of_car_per_day_in_kmh	-.030	.4107	-.835	.775	.005	1	.941
Money_spend_on_car_per_day_in_Rwf	.637	.5136	-.369	1.644	1.540	1	.215
Number_of_trips_made_using_PT	.267	.2178	-.160	.694	1.505	1	.220
Distance_traveled_per_day_using_PT_in_km	-.040	.1054	-.246	.167	.142	1	.706
Travel_time_by_PT_per_day_in_minutes	-.153	.1329	-.413	.108	1.319	1	.251
Speed_of_PT_per_day_in_kmh	.188	.1982	-.200	.577	.903	1	.342
money_spend_on_PT_per_day_in_Rwf	-.341	.1937	-.720	.039	3.092	1	.079
purpose_of_travelling	-.028	.0664	-.158	.102	.177	1	.674
Problem_caused_by_transport	-.681	.5555	-1.770	.407	1.505	1	.220
Those_problems_of_transport	.136	.1120	-.083	.356	1.481	1	.224
(Scale)	1[b]						

Dependent Variable: Income _Level

Model: (Threshold)

a. Set to zero because this parameter is redundant.

b. Fixed at the displayed value.

Appendix2-15: Relationship between income levels and modes of transport in Kigali City after removing the some elements which are not significant

Parameter Estimates

Parameters		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
				Lower	Upper	Wald Chi-Square	df	Sig.
Threshold	[Income _Level=1]	1.399	1.5997	-1.737	4.534	.764	1	.382
	[Income _Level=2]	3.170	1.6072	.020	6.320	3.890	1	.049
	[Income _Level=3]	4.454	1.6137	1.291	7.617	7.618	1	.006
	[Income _Level=4]	6.457	1.6345	3.254	9.661	15.606	1	.000
Nationality		-.877	.6469	-2.145	.391	1.838	1	.175
Marital_status		-.076	.0918	-.256	.104	.688	1	.407
Factors_influencing_living_conditions		.550	.2430	.074	1.027	5.131	1	.024
Suffering_from_disability		2.570	.5726	1.448	3.693	20.147	1	.000
Problems_Caused_by_disabilities		0[a]	.	.	.	.	.	.
Number_of_People_per_room		-1.439	.2678	-1.964	-.914	28.868	1	.000
Those_problems_met_in_daily_activities		-.361	.1270	-.610	-.112	8.075	1	.004
level_of_studies_attended		.480	.1080	.268	.692	19.765	1	.000
Higest_level_that_can_be_paid_for_hisher_children		.729	.1168	.500	.958	38.973	1	.000
kind_of_job		.175	.1558	-.130	.481	1.267	1	.260
Objectives_of_living_with_many_people		-.299	.1526	-.599	.000	3.850	1	.050

Benefits_of_living_with_many_people	.375	.9242	-1.436	2.186	.165	1	.685
Those_benefis_of_living_with_many_people	-.638	.1528	-.938	-.339	17.441	1	.000
Number_of_sheeps	0[a]	.	.	.	.	.	.
Number_of_pigs	0[a]	.	.	.	.	.	.
Number_of_chickens	.542	.1825	.184	.899	8.813	1	.003
possession_of_electricity_power	1.353	.3146	.736	1.969	18.490	1	.000
Played_game	-.065	.0798	-.222	.091	.664	1	.415
Comfortably_of_living_in_your_neighbourhood	-.262	.3222	-.894	.369	.663	1	.415
Treatment_on_work	-.968	.3378	-1.631	-.306	8.217	1	.004
Distance_by_walking_per_day_in_Km	-.117	.0552	-.225	-.009	4.487	1	.034
Speed_by_walking_in_Kmh	.378	.1434	.097	.658	6.935	1	.008
Number_of_bicycles_owned	.545	.4171	-.273	1.362	1.705	1	.192
Travel_time_per_day_by_bicycle_in_minutes	-.417	.1735	-.757	-.077	5.775	1	.016
Number_of_motorcycles_owned	.959	.3292	.314	1.605	8.489	1	.004
Number_of_trips_by_motorcycle	.015	.2376	-.451	.481	.004	1	.950
Distance_traveled_by_motorcycle_per_day_in_km	.331	.1144	.106	.555	8.352	1	.004
Money_spend_on_motorcycle_per_day	-.2051	.1313	-.462	.052	2.443	1	.118
(Scale)	1[b]						

Dependent Variable: Income _Level

Model: (Threshold),

a. Set to zero because this parameter is redundant.

b. Fixed at the displayed value.