INTEGRATING MOTORCYCLE TRANSPORT IN THE URBAN TRANSPORTATION PLANNING IN NAIROBI COUNTY: CASE STUDY OF THIKA SUPER HIGHWAY

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DECLARATION

This thesis project report is my original work and has not been presented for a degree in any other university

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This thesis project report has been submitted for examination with my approval as the University Supervisor.

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DEDICATION

This research project report is dedicated to my beloved sister Rhoda Wachira for her support and belief that I could make it. It is also dedicated to my friend Stephen Wambugu for his moral support.

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ACRONYMS

AfDB	African Development Bank
ADF	African Development Fund
CC	Cubic Centimeters
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CODES	Crash Outcome Data Evaluation System
CBT	Compulsory Basic Training
CKD	Completely Knocked Down
EPA	Environmental Protection Agency
GDP	Gross Domestic Product
GSU	General Service Unit
HC	Hydro Carbons
HGVs	Heavy Goods Vehicles
HHS	Heavy/ High Speed
ICIPE	International Centre of Insect Physiology and Ecology
JICA	Japan International Corporation Agency
KNBS	Kenya National Bureau of Statistics
KURA	Kenya Urban Roads Authority
LLS	Light-low speed
MoTI	Ministry of Transport and Infrastructure
MSF	Motorcycle Safety Foundation

NMIMT	Non-Motorized and Intermediate Means of Transport
NO_X	Nitrogen Oxides
NTSA	National Transport and Safety Authority
PTC	People's Transport Company
PTW	Powered Two Wheelers
RCMRD	Regional Centre for Mapping of Resources for Development
TRM	Thika Road Mall
UNECA	United Nations Economic Commission for Africa
USA	United States of America
UTC	Uganda Transport Company
WHO	World Health Organization

ABSTRACT

The study focusses on motorcycle transport in Kenya with emphasis on integrating their use and functioning in the urban areas in line with urban transportation planning. Motorcycle transport industry in the country has been growing at a high rate (KNBS, 2013); which has not gone hand in hand together with modifications in standards and policies and infrastructural considerations in transportation planning to try accommodate motorcycle transport and allow it to work with other forms of transport.

This study was guided by the following objectives; to find out the existing operational practices and opportunities of motorcycle transport, to find out the level of infrastructure provisions for motorcycle transport along Thika Super Highway, to evaluate standards and regulations established for enhancing motorcycle transport on the Super Highway; and to recommend a strategies for integration of motorcycle transport to existing public transportation system along development nodes on Thika Super Highway.

The study adopted a non-experimental research design. A sample size of 82 motorcyclists was interviewed and the questionnaires analysed. Data was also collected using observation and key informant interviews. Simple random sampling and purposive sampling were employed in this study.

Some of the areas looked into by this paper include the operational practices of motorcycle transport, the legistlation and standard that govern motorcycle transport and the infrastructural provision in place.

The study highlights findings that include the lack of and need for infrastructure provision for motorcycle transport, a gap in the standards and legislation in place and also highlights various opportunities in the operational practices of motorcycle transport.

The study provides various recommendations to include the revision of the Traffic Act, utilization of the existent societies and motorcycle groupings in the management of the operational practices of motorcycle transport, integration of motorcycle speeds in different environments for safety, carrying out of road safety campaigns, the embracing of four stroke engine types as compared to the two stoke engines, and the taking on of

motorcycle friendly designs and infrastructure in the maintenance and the construction of roads.

CHAPTER ONE: INTRODUCTION

1.0 Introduction

The introduction highlights the background and context of the research, and its purposes, it goes ahead to describe the statement of the research problem, the research objectives, and the scope of the study and finally conclude on the significance and scope of the research.

1.1 Background of the Study

In many Asian cities, motorcycles and three-wheeled vehicles are the primary modes on urban roads. In China, the use of motorcycle taxis can be traced to the late 1980s and early 1990s. The motorcycle taxis are present throughout China, including Beijing, Shanghai and Guangzhou. Their popularity is based primarily on their low price (Pucher et al, 2007). In Phnom Penh and other cities in Cambodia, motorcycle taxis are the primary form of public transport. Motorcycle taxi drivers are called *motodups*.[1] They form in queues outside major tourist attractions, office buildings, public markets and near corners of residential streets.

Motorcycle taxis are a licensed form of transport in Goa, India. They are much cheaper than other taxis. Motorcycle taxis in Goa are driven by men called 'Pilots'. Other countries using motorcycle taxis are Indonesia where they are called *Ojek*[2]; In Bangkok motorcycle taxi are often considered as the cheaper forms of taxis and are strong competitors to the bus services. In some of the cities, for instance Vientiane (Laos) and Mandalay these informal services are the primary public transport modes (Chin, 2013).

In the United Kingdom, 3 firms currently offer a taxi bike service based in London. The bikes are now licensed by Transport for London and the Public Carriage Office, who also license London's black, cabs (Aderamo et al, 2013). In the United States, a motorcycle for hire service began in California and New York City in 2011. Passengers are provided with helmets, airbag vests, and bluetooth in-helmets cell phones (Autoblog, 2013). In

1 Motorcycle taxi drivers in Cambodia are referred to as motodups

2 Motorcycle taxis in Indonesia (ojek)

Vietnam, motorcycle service, locally known as *xe ôm*,[3] a lightweight mode of transportation, is one of the most popular (Aderamo etal, 2013).

Studies in Africa have shown that the use of motorcycles for commercial transport has grown very rapidly in recent years in Lagos, Douala and Kampala (Kumar, 2011). In Nigeria, motorcycles popularly called *okada* [4]are used as an alternative mode of transport in urban centres, (Gbadamosi, 2002). In Southern Cameroon, the most common way to get around is by motorcycle taxis (West, 2011).

In East Africa motorcycle transport as a commercial means is a Ugandan innovation that has grown from small beginnings in the 1960s in the border region with Kenya. These motorcycles provided a taxi service used to move goods and passengers across the two borders which earned it the name *boda boda* [5]which is a corruption of the English 'border border'. The original services were provided on a man's bicycle, equipped with a padded cushion fitted over the rear carrier. Over the recent years the bicycle transport has evolved to motorcycle transport. The substitution is out of obvious comparative advantages that the motorcycles have over the bicycles (Howe, 2004).

1.2 The Statement of the Research Problem

Motorcycle transport industry in the country has been growing at a high rate (KNBS, 2013). This has not gone hand in hand together with modifications in standards and policies and infrastructural considerations in transportation planning to try accommodate motorcycle transport and allow it to work with other forms of transport. This has led to the uncontrolled and unsafe motorcycle riding in the city. The popularity of motorcycles has been growing therefore posing safety challenges to a growing population of passengers while creating conflict with other vehicles (MoT, 2010).

In 2010 a total of 3,055 road traffic deaths were reported by the Kenya Traffic Police, of this, approximately 215 were motorcyclists which put a heavy burden on families, communities and the health system in general (WHO, 2011). A total of 1,984 road traffic accidents involving motorcycles were recorded in the year 2012. From these fatalities were recorded at 430 while serious injuries at 1359 and slight injuries at 195 (KNBS, 2013).

3 Motorcycle taxi drivers, called xe om in Vietnam

4 Okada, refers to commercial motorcycle in Nigeria.

5 Boda Boda Refers to Motorcycle taxis in Kenya

This study aims to evaluate the current situation and working with a baseline of success stories all around the world to recommend integrative approaches that would work in the study area.

1.3 Research Questions

The study has the following four research questions.

1. What are the existing operational practices and opportunities of motorcycle transport on Thika Super Highway?
2. What are the infrastructure provisions for motorcycle transport along Thika Super Highway?
3. What are the standards and regulations established for enhancing motorcycle transport on Thika Super Highway?
4. What strategies would integrate motorcycle transport to the existing public transportation system along development nodes on Thika Super Highway?

1.4 Research Objectives

The study has the following four objectives

1. To find out the existing operational practices and opportunities of motorcycle transport on Thika Super Highway;
2. To find out the level of infrastructure provisions for motorcycle transport along Thika Super Highway;
3. To evaluate standards and regulations established for enhancing motorcycle transport on Thika Super Highway; and
4. To recommend strategies for integration of motorcycle transport to existing public transportation system along development nodes on Thika Super Highway.

1.5 Scope of the Study

This study focuses on various development nodes on Thika Super Highway and specifically along a 15Km road stretch from GSU to Roysambu, from Roysambu to Warren and Roysambu to Zimmerman.

1.6 Justification and Significance of the Study

In the last five years, the number of registered motorcycles has remained high in comparison to other vehicles. According to the Economic Survey 2013, motorcycle sales in 2012 were at 93,970 units which made up 54% of all registered vehicles and In 2011 140,215 made up 68% of the registered vehicles (KNBS, 2013).

According to WHO, 2011 the fatalities from motorcycle accidents in 2010 stood at 215 while according to KNBS, 2013 report fatalities stood at 430 indicating a 50% fatality increase per year. If the factors remain constant a projection of mere 5years will mean a 250% increase in motorcycle fatalities unless intervention is made.

The study will bring in interventions that will be crucial in creating an environment that will be conducive for the passengers, the operator and other users of the road.

CHAPTER TWO: EXISTING EQUIPMENT FOR PUBLIC ROAD TRANSPORT IN NAIROBI

2.0 Introduction

The Nairobi urban transport is composed of various modes. The modes mentioned include; private cars, taxi, matatus, two wheeled modes, three wheeled modes, walking, and school buses.

The modal split as of 2005 found that 49% of residents chose non-motorized transport (walking or bicycles), followed by 42% opting for public transport and 9% of the residents using private transport (KIPPRA, 2005).

Some of the major transport challenges in the city as identified by Omwega, 2011 are:

2.0.1 Inadequate Integration of City Development Planning

The Nairobi City County has not received adequate attention in respect to having a long term plan or master plan. The last master plan for Nairobi County was prepared in 1948. A Draft Nairobi Integrated Urban development Plan has also been developed in 2014. Considering the massive growth in the population and spatial size of the city, the development of the city has not been effectively planned and integrated.

This means that the County transport system has not been well planned and integrated into the overall County growth and development structure.

The result is that today the city development and growth is not integrated with the transport system. The County experiences transport challenges in respect to poor network, inadequate car parking, congestion, high cost of transport, pollution.

2.0.2 Inadequate Public Transport System to Meet the Rising Travel Demand

The County's population in 2013 is estimated at 4 million people. At a travel demand rate of 2.5 trips per person per day (King'ori, 2014), the total travel demand in Nairobi is 7.5 million trips per person per day.

The main public transport service in Nairobi is by mini-buses and Omni buses (matatus), taxis, tuktuks, bodaboda and other private bus operators. The capacity of commuter train service is low and limited to only a few areas. The public transport system is totally

inadequate to meet the rising demand. This is evident from the common heavy congestion and long delays in the public transport system.

2.0.3 Long Commuter Distance and Travel Time

Nairobi County has experienced rapid urban sprawl. In 1970, the average commuter distance was 0.8km and this increased to 25 km in 1998. The present commuter distance is over 30-40 km.

The long commuter distances and heavy traffic congestion on the road has led to long travel time. It takes about 2 hours to cover 30 to 40 km commuting distance. In the 5 to 10 km central area, travel time is about 1 -2 hours long because of the heavy traffic congestion.

2.0.4 High Cost of Transport Compared To Low Level of Income

The cost of transport in the County is very high compared to the average per capita income. In the 0 to 10 km and 10 to 20 km, the average bus fare is Ksh 50 and Ksh 100 respectively, at peak hour. This cost of public transport is indeed very high considering that the minimum employee wage is Ksh. 7, 334 (GOK, 2011) per month.

The cost of motor vehicle fuel in Nairobi is also quite high at Ksh. 116 per litre of petrol (Kenya National Bureau of Statistics, 2011).

2.1 Matatu Public Transport Sub Sector

Matatu is taken from the Kikuyu term mang-otore matatu which translates into “thirty cents,” which was the standard fare when matatus emerged on the transport scene in the late 1950s. Matatus comprise the informal paratransit industry in Kenya that provides service to millions of people a day and are essentially the backbone of the transportation system in Nairobi. There are five broad categories of matatus as equipment for mobility in public transport as classified by Kenya Bureau of Standards.

Class I Micro-buses with a seating capacity of up to 14 passengers;

Class II Mini-buses with a seating capacity of 15 to 25 passengers;

Class III Medium-buses with a seating capacity of 26 to 40 passengers;

Class IV Buses with a seating capacity of over 40 passengers;

Class V Urban buses with a capacity of over 40 seated passengers;

Over the past few years, and motivated by need to reduce the number of vehicles within the city centre, the government had put in place public transport policies to gradually eradicate the 14 seaters in the city. This move, although well intentioned has been associated with massive favoritism, corruption, vested interested among other challenges at the government level. The main motive was to create some form of order in the public transport sector, a goal that has always seemed a bit farfetched for an informal sector activity. This intended shift has achieved little, and the one thing that has been constant is the "matatu culture" which has been transferred into the Class II to Class IV. The urban urban culture synonymous with matatus is a recipe for the sectors productivity.

What describes a matatu is not usually the size, but the mode of operation (however size still has its unique associated benefits such as freedom to drop and pick passengers, overlapping and using shortcuts to avoid traffic jams). Physical characteristics of a matatus mainly comprise of customized seats, powerful sound systems, blended with screens and filled with slogans on the body frame, borrowed from the trending global events. This denotes the level of investment in making the matatus as competitive and attractive as possible. Such matatus have the luxury to overcharge, and their customers; mostly high school and college youths, are always willing to pay higher fares. The more decorated a matatu is, the highly regarded it is. As most other informal activities in the city, the operation and fabrication activities around the matatu industry employ hundreds of youths and does indeed promote talent.

2.1.1 Challenges of the Matatu Industry

The following are the major challenges of this subsector.

2.1.1.1 Police Bribes

Matatu owners and drivers often complain that the police harass them and pull them over even though they have broken the law. To avoid having vehicles pulled off the road, the crews pay off the officers (Graeff, 2010).The police are often also believed to be working with the gangs on certain routes, which allow them to conduct their business with impunity (Ibid).

2.1.1.2 Lack of Data and Transport Knowledge

It is problematic that there is no consistent data available regarding matatus. Either there is no central database or there is extremely limited access to the database that tracks the various characteristics of matatus operating in Nairobi. The best way to obtain this information is through the SACCOs but not all the SACCOs are registered and overall information is scarce (Kolossa, 2008). The National Transport and Safety Authority is also starting out and is yet to provide data and information on the same.

2.1.1.3 General Dislike of Industry Behavior

Commuters believe the behavior of the matatu driver creates a dangerous driving environment. There are always complaints of rude and unprofessional crews and loud music.

2.1.1.4 Congestion

The matatus are prone to congestion around the city. In majority of the instances they are the main causative of these congestions as they pick up and drop off passengers in non-designated areas. The vehicles also overlap in an effort to increase the number of trips they ferry passengers.

2.2 Taxi Public Transport Sub Sector

Taxis are initially congregated in the street around hotels but currently are spread all around the County. Nairobi taxis are marked with a yellow line along the side of the vehicle. The taxi service is considered the safest mode of transport in Nairobi. It is however not affordable to everyone. The service also creates employment to thousands of youth.

2.3 Tuk Tuk Public Transport Sub Sector

The number of three wheelers, commonly referred to as tuktuks, registered in Kenya hit a record high in April, 2014 as they gain popularity for their ability to access areas where ordinary vehicles cannot reach. Data from the Kenya National Bureau of Statistics shows there were 413 three wheelers registered in April, 2014 compared to 173 in April 2013 and 276 a month earlier in March, 2014.

Car and General sells the Piaggio brand of tuktuks. The three wheelers are gaining popularity as they are perceived to be safer than the motorcycles, commonly referred to as boda bodas.

The tuktuks are also more commercially attractive to investors as it has a higher passenger and luggage capacity and can also do rough terrain. Distribution firms have taken up the three wheelers to transport goods to areas close to their centres.

Whereas the price is considerate the main challenge for the tuktuks is the market competition from motorcycles. Motorcycles and tuktuks target the same niche of passengers. This in some way has determined their rate of growth.

2.4 Motorcycle Public Transport Sub Sector

The motorcycle transport grew due to higher demand for transport needs in Nairobi. These transport needs were specific to a flexible, cheap and convenient means that was not influenced by normal conventional challenges of the other modes of transport.

CHAPTER THREE: DEVELOPMENT OF MOTORCYCLE AS EQUIPMENT FOR MOBILITY

3.0 Introduction

This various aspect of motorcycle transport discussed include, at an introduction into motorcycles and their development into equipment for mobility; their historical development, the growth of their popularity, their development and use as a means for urban transport, the various users of motorcycles and their opportunities and challenges and the ideal situations around the world that have integrated motorcycle transport through different approaches. These discussions then form the basis for the development of the conceptual framework.

3.1 History of the Motorcycle

Motorcycles evolved from the "safety" bicycle; bicycles with front and rear wheels of the same size, with a pedal crank mechanism to drive the rear wheel (Plate 1). The first motorcycle was built in 1868 by Sylvester Howard Roper. This motorcycle was powered by a steam engine (TMW, 2013).

Plate 1: Sylvester Ropers Steam Cycle

Source: TMW, 2013

The safety bicycle in 1885 was then strapped with an internal combustion engine by Gottleib Daimler who is credited with building the first motorized bicycle or motorcycle. The next notable motorcycle was designed in 1892 by Alex Millet. Millet incorporated the basic safety bicycle design, but added pneumatic tires and a five-cylinder rotary engine built into the rear wheel. The cylinders rotated with the wheel, while the crankshaft formed the rear axle. In 1894 the Hildebrand & Wolfmueller was the first successful production of the two-wheeler, their design included a cooling system which required a water tank and radiator. In 1895, DeDion-Buton introduced a small, light, high-revving four-stroke engine that could generate half a horsepower, this design was easily copied and reproduced around the world (How Stuff Works, 2013).

The motorcycle evolution was greatly developed during World War I and II; they filled the gaps as dependable, reliable vehicles. In the war, their utilitarian nature was put to good use. American and European armies used motorcycles extensively to gather reconnaissance, deliver messages and, in some cases, engage in combat (How Stuff Works, 2013). One of the models used is as show in Plate 2.

Plate 2: Harley Davidson Motorcycle Model

Source: Howstuffworks, 2013

3.2 Types of Motorcycles

There are off-road motorcycles and street motorcycles as discussed below.

3.2.1 Street Motorcycles

These are motorcycles designed to ride on paved roads. They are:

3.2.1.1 Touring Type

These are much more bulky and heavy compared to other motorcycles types. These cycles are likely to be used for long extended trips, and offer additional comforts and conveniences that might not be normally found on other models. The first major difference is the larger motor and additional hard-shelled luggage compartments, found just above the rear wheel, and also on the right and left back quarter (Autohub 360, 2013).

3.2.1.2 Cruisers Type

They are typically lower and have a narrower turning range, which is mainly due to the stretched out elongated front forks. They have a wider rear wheel (Autohub 360, 2013).

3.2.1.3 Sport Type

These bikes are small, light and extremely powerful, offering plenty of upper end torque. Sport bikes also offer specially streamlined contours, and less obtrusive motor covers and fairing designs, which can lower wind resistance (Autohub 360, 2013).

3.2.1.4 Standard Type

These motorcycles are cheap and appropriate for beginners. They range in size and style but are often not built for either extreme speed or maximum comfort. Designs are simple and often have more steel and less plastic, which makes them more durable in the event of crash (Autohub 360, 2013).

3.2.2 Off-Road Motorcycles

Off-road motorcycles include both motocross bikes and dirt bikes machines designed to handle jumps, bumps and other obstacles found on closed racing courses or woodland trails (How Stuff Works, 2013).

3.3 Main Components of a Motorcycle

Various components of a motorcycle relevant to this study and that influence motorcycle riding and operations are discussed as follows.

3.4 Suspension

The suspension system is a collection of springs and shock absorbers that helps keep the wheels in contact with the road and cushions the rider from bumps and jolts. A swingarm design is the most common rear suspension. On one end, the swing arm holds the axle of the rear wheel. On the other end, it attaches to the frame via the swing arm pivot bolt. A shock absorber extends upward from the swing arm pivot bolt and attaches to the top of the frame, just beneath the seat. The front wheel and axle are mounted on a telescoping fork with internal shock absorbers and internal or external springs.

3.5 The Engine of a Motorcycle

They consist of pistons, a cylinder block and a head, which contains the valve train. The pistons move up and down in the cylinder block, driven by explosions of a fuel-air mixture that has been ignited by a spark. Valves open and close to allow the fuel-air mixture to enter the combustion chamber. As the pistons move up and down, they turn a crankshaft, which transforms the energy from the pistons into rotary motion. The rotational force of the crankshaft is transmitted, via the transmission, to the rear wheel of the motorcycle (How Stuff Works, 2013).

3.5.1 Capacity of Motorcycle Engine

The size of the combustion chamber in a motorcycle engine is directly related to its power output. The upper limit is about 1500 cubic centimeters (cc), while the lower limit is about 50 cc. The latter engines are usually found on small motorcycles (mopeds) that offer 40 Kilometers per litre of fuel economy but only reach top speeds of 50 kilometres per hour (How Stuff Works, 2013). The capacity is as well determined by the type of motorcycle engine in place which is related to the combustion chamber size.

There are two types of motorcycle engines classified by their functionality.

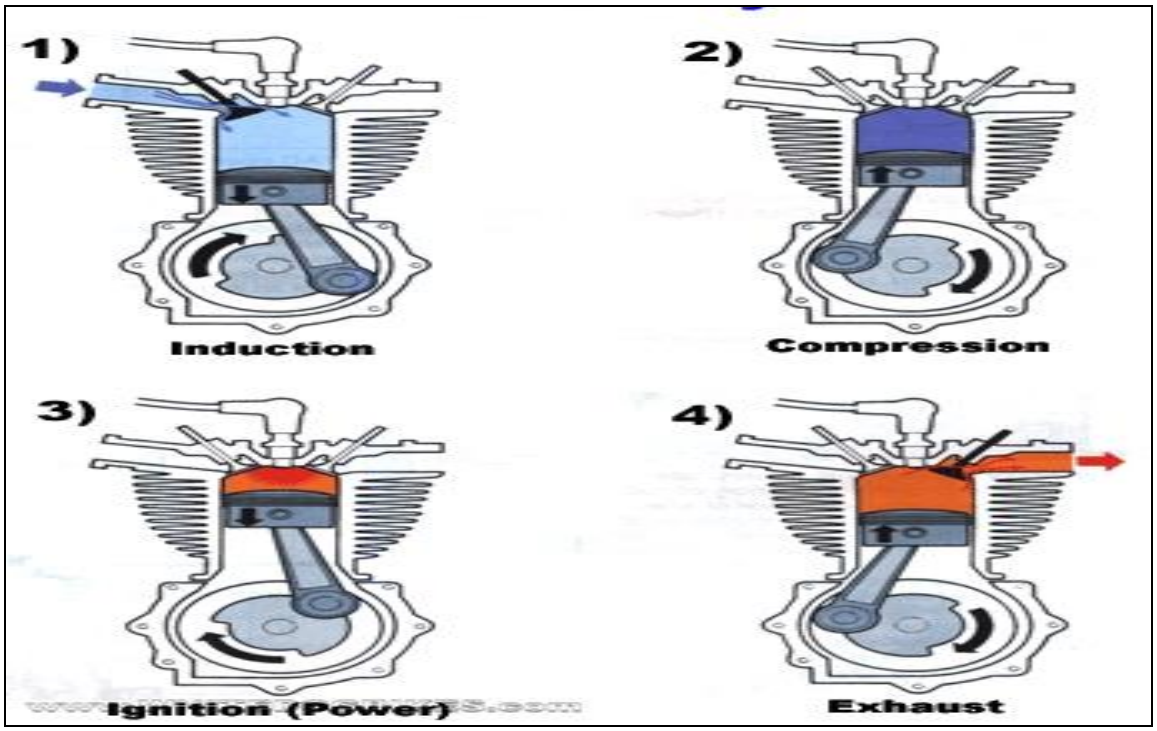
3.5.1.1 Four Stroke Engine

During the intake stroke, the piston goes down from the top of the cylinder to the bottom, reducing the pressure inside the cylinder. It then draws a mixture of fuel and air into the cylinder through the intake port, ready for the compression stroke. With both intake and exhaust valves closed, the piston goes back up to the top of the cylinder compressing the

fuel-air mixture. This is what happens during the compression stroke (Dan's Motorcycle Repair Web Page, 2014).

The compressed air–fuel mixture is then ignited by a spark. The pressure from the fuel-air mixture combustion drives the piston back down with humongous force, keeping the crankshaft turning. This is the power stroke phase, which is the main source of the engine's torque and power. Finally, during the exhaust stroke, the piston again goes up and pushes the burned gas from the cylinder out the exhaust valve. Another thing worth mentioning is that the spark plug only fires once every two revolutions (Ibid). Figure 1 shows the above described functioning.

Figure 1: Four Stroke Motorcycle Engine



Source: Partnership for Clean Fuels and Vehicles (2006); pg. 13

3.5.1.2 Two Stroke Engine

Unlike the four stroke engine, a two stroke engine has three strokes combined into one action; meaning the intake and exhaust are both integrated into the compression movement of the piston, therefore eliminating the need for valves. This is thanks to an inlet and exhaust port integrated into the wall of the combustion chamber (Autoevolution, 2014).

The piston goes down, compressing the fuel mixture under the piston and blowing it into the cylinder. As this mixture blows in, it also blows the burnt exhaust gases out. The fuel

mixture is blown into the cylinder through passages (Ports) in the cylinder walls. The piston comes up, covering the ports in the cylinder walls and compressing or squeezing the mixture. This also creates a vacuum in the crankcase under the piston, sucking the fuel mixture into the crankcase. The spark then ignites the mixture and the burning gases push the piston down. The spark plug fires and the process starts over. The engine fires on every revolution (Ibid).

A two stroke engine can produce twice the amount of power (and makes twice as much noise) than a four stroke engine of the same size. This is because it fires once every revolution, giving it twice the power of a four stroke, which only fires once every other revolution. Significantly, it also has a higher weight-to-power ratio because it is much lighter (Autoevolution, 2014).

Due to the specifics of the two-stroke engine design, some of the fuel/airmixture escapes directly out of the exhaust. This results in 10-15% higher fuel consumption with a two-stroke engine compared to a four-stroke, and consequently 10-15% higher emissions of carbon dioxide (CO_2[6]) as well. Two–stroke engines also need more maintenance. They typically need to be overhauled every 30,000 km and decarbonised (due to high emissions of hydrocarbons) every 6,000 km. However, the maintenance of a four-stroke engine can be more complicated due to it having more moving parts such as valves (Partnership for Clean Fuels and Vehicles 2006). Four stroke engines are more fuel efficient and environmentally friendly when compared to two stroke engines. Two stroke engines are responsible for much more pollution due to the combustion of oil. Two stroke units may also exceed legal noise limits in some areas[7] .

Two stroke engines are simpler and cheaper to manufacture compared to four stroke engines because of their simpler design. Four stroke engines are longer lasting than two stroke engines that don't have a dedicated lubricating system. However, the spark plugs in a two stroke engine last longer than those in a four stroke engine (Autoevolution 2014).

3.6 Motorcycle Transport

Roads are public space, and in modern societies public space is generally open and accessible to all. This right of access is critical to ensure that people can travel efficiently between their own homes and places of work and commerce. This customary access right

6 Carbon dioxide

7 See Dan's Motorcycle Repair Web Page 2014

does not historically extend to the right to free access by any mode of travel in any type of vehicle, and it should not compromise the safe, healthful, and efficient functioning of that public space (Institute for Transportation and Development Policy, 2009). Personal mobility is one of democracy's most valued freedoms and it is, therefore, not surprising that high proportion of man's income is devoted to his own movement and that of his goods. The importance is very crucial to the socio economic, political and cultural development (Gbadamosi, 2002).

In Kenya road transport is the dominant sector, currently accounting for 54.6% of total output value seconded by air transport that accounts for 14% while rail accounts for 0.82%. The passenger traffic in road transport accounts for 205 billion Kshs (KNBS, 2013).

Urbanization in Kenya has been developing rapidly since independence. During the two inter-censal periods (1969-1989) and the (1989-1999), the rate of growth of urban population increased from 8% in 1980s to over 34% in 2003 and is projected to reach over 50% by 2020. The population of Nairobi alone has reached about 3.2 million residents with a day time population of 4.5 million people (KNBS, 2009).

This development has not been met with commensurate growth in urban transport infrastructure and services. In major cities and urban areas, especially in Nairobi, Mombasa, Nakuru, Kisumu and Eldoret, urban transport is still characterized by inadequate supply of public transport (mostly buses and matatus), a large number of cars and Heavy Goods Vehicles (HGVs), heavy traffic congestion during peak hours, and stiff competition for limited road space among motorists, pedestrians and cyclists (Ministry of Transport, 2009).

Traffic congestion is further manifested in long queues of slow-moving vehicles and long waiting times, particularly in Nairobi and Mombasa. Due to the inefficiency of urban transport owing to poor infrastructure and high transport costs for both passengers and goods. The majority of low-income urban workers currently find public transport costly and financially inaccessible and hence meet most of their transport needs through walking. Some of them, however, risk their lives by utilizing non-motorized and intermediate means of transport (NMIMTs) (especially bicycles, motorcycles and mikokoteni[8] for which there is no appropriate infrastructure. Given that about 50 per cent

[8] Mikokoteni are hand-carts commonly used to transport luggage's and foodstuffs

of the country's total GDP is generated in the urban areas, the adverse consequences of the above scenario on worker's efficiency and productivity, fuel consumption, education, health and the environment cannot be overemphasized (Ministry of Transport, 2009).

3.7 Personal Mobility

The uses of motorcycle for personal mobility serve various purposes and are characterized differently from those for intra urban transport.

3.7.1 Purpose of the Motorcycle

According to Watson et al motorcycle for personal mobility is related to the broadening social demographics of motorcyclists. An increase in popularity over recent years has seen people of all ages and social strata taking up motorcycling either as a hobby or as a mode of transport (de Rome & Stanford, 2002). Although motorcycles make up only around 3% of the registered vehicles on Australian roads, the number of kilometres travelled is comparatively lower than other forms of transport, lending weight to evidence that motorcycle riding is more of a recreational pursuit than a primary mode of transport for many people (Krige, 1995).

Krige's 1995 study identified 5 distinct groups of motorcyclists which are generally described as follows:

3.7.1.1 The 'Outlaws'

Usually a member of an organised criminal-type 'patch' gang. They ride in groups and ride for the lifestyle, not necessarily for the love of riding. They reflect the stereotypical bikie' image and usually ride Harleys or large European bikes;

3.7.1.2 "Boy Wonders"

Often young and inexperienced they do not usually belong to a club, but ride because they love the challenge and push their limits, race their peers and often do not consider the consequences of their behaviour. They usually ride fast, high powered, Japanese bikes;

3.7.1.3 "Dirts"

They often belong to a club, and it is not uncommon for the activity to be a family event with involvement of siblings.

3.7.1.4 “Commuters”

Ride for practical reasons (economy, easy parking etc.) rather than the love of riding. They often have conservative bikes, do not belong to a group, and drive the family car on weekends.

3.7.1.5 “Weekend Warriors”

Club enthusiasts, often new to riding. They are typically older, with higher incomes, and looking for a hobby. They are made up of many sub-groups such as the HOGS (Harley Owners Group).

Krige’s 1995 concludes that if the description of these groups is even generally accurate, then it is clear that each of these groups has a different social profile in their use of a motorcycle for personal mobility.

According to the U.S. Department of Transportation, 2007 motorcycles are becoming more and more prevalent in the vehicle fleet mix. Their popularity is attributed to the low initial cost of a motorcycle, its used as a recreational vehicle, and, for some models, fuel efficiency. While motorcycles were once thought to be primarily warm weather vehicles, the motorcycle industry is also now expecting the increased price of fuel to not only further increase sales, but to extend the riding season into the winter months. These variables, as well as worsening congestion, the increase of light trucks and sport utility vehicles, and the appeal of motorcycling to middle-aged, new, and former riders with increased disposable income, influence the growing involvement in riding, demographics of riders, and the potential for increased fatalities and injuries due to crashes. All of these factors present significant challenges to reducing motorcycle deaths and injuries.

According to Minju, 2011 riders opt for a personal two wheeler as a cost efficient alternative to infrequent and expensive public transport systems, or as a means of avoiding or reducing the effects of urban congestion. In some countries motorcycles are exempt from congestion charges usually levied to other vehicles, they are also exempt from toll charges, motorcycles are also allowed to park on foot paths allowing them to park easily in central business districts. In places where it is permitted, lane splitting also known as filtering allows motorcycles to use space between vehicles to move through stationary or slow traffic. In other cities motorcycles are not charged for parking and are

generally allowed to park on the sidewalk, rather than occupy a space which might otherwise be used by a car.

In Hanoi the personal motorcycle's popularity is a function of density and road space. Motorcycles offer individualized mobility in areas where only 9 percent of urban land cover is used by roads and residential population densities exceed 300 people per hectare in other words, areas where streets are narrow and crowded. As a point of comparison, the residential population density of Midtown Manhattan is 196 people per hectare and 32 percent of the area is devoted to roads (Bertaud, 2013).

Another personalized form of motorcycle transport is those used for para transit transport that has been embraced in the United Kingdom. The motorcycles are licensed by Transport for London and the Public Carriage Office, who also license London's black, cabs (Aderamo et al, 2013). In the United States, a motorcycle for hire service began in California and New York City in 2011. Passengers are provided with helmets, airbag vests, and bluetooth in-helmets cell phones (Autoblog, 2013).

3.8 Intra-Urban Passenger Transport

Various other diverse factors have brought about motorcycle transport in different countries around the world.

Information regarding the growth of informal motorized modes in South-Eastern Asia, their evolution, existence and growth depend on a number of factors. Principally these modes came about because of a lack of adequate formal or organized public transport services. However, other factors such as ease of access, affordability, flexibility and convenience have made the business viable. The lack of rules and enforcement has provided easy employment opportunities to many; because these, transit modes often operate with little or no regulations, the service quality can be poor and the operations can be unsafe and polluting. In Jakarta (Indonesia), the slower and smaller vehicles are confined to the peripheral parts of the city and on narrow roads, out of concern for safety and traffic discipline (Chin, 2013).

In Indian, the cities have grown in population, and also spread outward. A lack of effective planning and land use controls has resulted in rapid, rampant sprawl extending beyond old city boundaries and into the distant countryside. This has greatly increased the number and length of trips for most Indians, forcing further reliance on motorized transport. Longer trips make walking and cycling less feasible, while increased motor

vehicle traffic makes walking and cycling less safe. As well most public policies in India encourage sprawl and new commercial development often takes place in distant suburbs. In most cases, there is inadequate transport infrastructure to serve these new suburban developments and the residences located around them. The suburban areas are decentralized and this causes enormous problems for public transport. It generates less focused trips along well traveled corridors and, thus, is more difficult for transport to serve. Sprawling low density development around Indian cities makes motorcycle increasingly necessary given the unsatisfactory alternative of slow overcrowded, undependable and dangerous public transport. Coupled with rising incomes, among India's middle and upper classes make motorcycle ownership affordable (Innovative Transport Solutions, 2009).

The rapid growth and decentralization of Chinese cities has dramatically increased demand for land and travel in urban areas, thus putting enormous pressure on transport. In addition, an increase in the average incomes has also seen growth in ownership of two wheeled vehicles (Chin, 2013).

In Victoria, Australia Powered Two Wheelers (PTW) offer the potential to contribute to a reduction in traffic congestion, air pollution, fossil fuel use and greenhouse gas emissions. The use of a PTW for commuting may be more environmentally friendly than driving in a car without passengers, which represents the majority of cars that account for traffic congestion during peak times (State Government of Victoria, 2009).

In Africa various countries had various diverse reasons for the introduction of motorcycle transport. In Nigeria the introduction of motorcycle as an alternative mode of transport in urban centres was prompted by the high cost and unenviable transport service provision which impacted negatively on economic activities and mobility of the urban populace. Of particular interest was the fact that increasing demand for public transport had not been able to match the level of provision of transport services. The situation was also worsened by the increasing level of poverty of urban residents in Nigeria (Gbadamosi, 2002). Oladipo, 2002, however associates the growth of motorcycle transport in Nigeria to two factors.

1. Rapid rate of urbanization in the face of inadequate means of transport. Commuters often struggle at peak periods for commercial vehicles; and

2. The high rate of unemployment prevalence in the time (1979-1983) where 6,000 federal workers were racked across the nation.

In Liberia motorcycle transport emerged immediately after the civil war. The illiteracy levels were really high and public transport was unreliable and insufficient. It provided employment to these unemployed youths as riders and mechanics (Czeh et al, 2012).

The colonial masters in Cameroon introduced motorcycle transport. The relative cheap price of a motorbike as compared to other vehicles favored its widespread use. Also the government withdrawal from the public transport sector in 1995 gave way for private public transport, which is a less controlled sector, operators of vehicles of great capacities (cars, buses and mini-buses) are more and more in competition with engines of smaller sizes which cover most often take up a greater share of collective transport.

In Kampala the failure of the public provision of transport services by two monopoly companies led to the emergence of a para-transit system operated by the private sector. The main mode of transport shifted from high capacity buses to minibuses, operated by individual private operators and managed by an association. However, private buses were not able to meet the growing demand and substantial unmet demand remained, particularly in the outlying areas and during off-peak periods. This led to growth of non-conventional means of transport, the most dominant being the motorcycle, which today is the most common form of informal public transport system on most secondary roads in the city (Kumar, 2011).

The motorcycle provides a convenient and relatively inexpensive alternative to automobiles. They are more maneuverable than automobiles and they deliver higher fuel economy. Riding a motorcycle has many advantages over other vehicles. Motorcycles are cheaper to run, easier to repair, easier to park, more flexible in traffic, less boring and can stop anywhere thus providing a door-to-door service (Aderamo et al, 2013).

Kemtsop, 2007 highlights that motorcycle taxis can generally be amortised in a few months, depending on the level and the quality of maintenance. When these, motorbikes are amortised they can be sold at half the initial price. Kemtsop, 2007 notes that this makes the motorbikes affordable for the lower income groups that cannot afford new ones. Generally, they buy these second hand motorbikes and struggle for a new one after some months. He notes that this is however only possible when the owner is the one driving the engine.

According to Howe, 2004 motorcycles provide a short-distance, low-capacity service that is able to serve low-density demands or those areas where access is restricted by the width or quality of the route. Hire taxis which are limited to major cities and limited outside the city do not find it profitable to go to many villages due to insufficient demand. Equally they physically cannot use the footpaths and tracks that provide access to many low-income urban settlements. In isolated areas they may be the only alternative to walking. As compared to hire taxis, motorcycles are flexible and can operate from 'stands' in towns, in trading centres, and at the bulk public passenger service and vehicle stops along main roads that provide access to feeder routes. Howe, 2007 suggests that their absence from some villages may be due to the lack of repair facilities and the capital and technical knowledge to set them up. Motorcycles also have a not insignificant goods carrying function in the industrial parts of the main cities. One estimate is that this function comprises 30% of urban and rural operations.

The Integrated Transport Policy, 2009 from the Ministry of Transport Kenya estimates that in the rural areas 85% of the movements usually take place off the main roads (using tracks and paths) to support rural mobility needs between homes and work, meeting grounds, schools, dispensaries, churches, local and administrative offices. The trips are made through Non-Motorized and Intermediate Means of Transport (NMIMTs) which include walking and head loading, on bicycles, motor cycles, or through animal transport. These journeys facilitate the production of goods and their movement to markets and their supply to urban areas. Ideally, inter-urban passenger and freight transport serve rural transport needs.

3.9 Operators of Motorcycles

Over 70 per cent of the operators of motorcycles possess junior or secondary/technical education, and have been operating a motorcycle for over six years. With high unemployment, no entry requirements and no technical expertise required, the incentives to get into the market are high. This is especially made more attractive because of high returns (Kumar, 2011).

The average revenue of an operators in Liberia is around US$20 a day. Most operators cannot afford to purchase motorbikes but rent them from people with more financial resources. The cheapest motorcycles are imported from China and in some cases do not cost more than US$ 500, which offers the creditor a return of investment within a few

months After subtracting the daily fee paid to the owner of the motorcycles approximately US$ 7) and the purchase of gasoline (about US$ 5 a day), in average around US$ 8 Per day remain as income for the driver (Czeh et al, 2012). According to Howe in Uganda motorcycle earnings for operators differ for owners and hirers, and by location. The owner earnings in Kampala are US$56, almost double those of hirers US$30, but they do have additional costs, especially vehicle depreciation and major repairs. Peri-urban areas yield substantially lower earnings for owners which is US$30. Contrary to logic, hirers appear to earn US$33[9] per week which is more. In Lagos, motorcycle operators earn an average of $25-$30 per day. Excluding daily rental (about $4) and operating expenses (about $5 including fuel and maintenance), net daily earning is about $16-$20 (Kumar, 2011).

The Liberia Ministry of Transport estimates that motorcycle transport offers daily income for more than half a million drivers and their families. Additional jobs are provided for mechanics who service the motorcycles. With high unemployment and illiteracy rates in Liberia, the motorcycle businesses are an important part of the service sector and highly relevant for poverty reduction (Ibid).

According to Nyachieo, 2013 the average income per day varied but on average, majority of the motorcyclists went home with between Kshs 400-600 (52%). Only (4%) of the motorcyclists indicated they got above Kshs 1000 while (32%) of the respondents got between Kshs 100-300 per day.

According to Queensland Department of Transport, 2003, the licence data shows that 6% of licence holders are over 70 years old, whilst only 3% are under the age of 25. Evidence as well clearly shows that young riders are at a higher risk of crashing than older riders.

Fatality data from 2000 to 2005 in Australia showed that 30% of motorcyclists or pillions killed were aged 25 years or under (Tunnicliff, 2006). A New Zealand study found that riders over the age of 25 years had less than half the risk of younger riders to be moderately to fatally injured (Mullin et al, 2000).

According to Howe motorcycles are mostly driven by male operators of between 20 and 39 years of age. Howe attributes this to the physical demands. He as well highlights that there is no obvious reason why women should not operate motorcycles other than custom, culture and that the long working hours away from home must also be a deterrent. The

9 US $ = KShs 82 as at 15th March 2014

harassment that operators complain of from some customers and their professed and very real fear of being robbed may be ancillary reasons that deter women from operating such services. According to Czeh, 2012 the reason as to why women are not involved is that there is lack of awareness and training of women.

Personal motorcycles are ridden predominantly by males (de Rome & Stanford, 2002). Examining the 2003 gender data, males travelled approximately 88% of the total kilometres travelled by motorcycles, whilst females travelled approximately 12%. These data correspond with Queensland licensing records which indicate approximately 12% of all motorcycle licences in Queensland (excluding learners permits) are held by females, and 88% by males (Queensland Department of Transport, 2003).

3.9.1 Challenges Associated with Operators

The motorcycle-taxi is usually regarded as an unreliable transport means notably due to the bad driving of the riders, which leads to a high rate of accidents involving motorcycle-taxis (Trans-Africa Consortium. 2008). Motorcyclists are 23 times more likely to be killed per kilometre travelled than car occupants and 41 times more likely to be seriously injured. The number of riders aged over 45 year's accounts for most of the upward trend in the numbers of rider deaths (Motorcycle Safety Consultative Committee, 2008).

3.9.1.1 Training

Many motorcycle training courses in the USA use the motorcycle safety foundation (MSF) course materials. Completion of such courses often results in lower insurance rates. In Kenya the government is yet to publish a curriculum for training motorcyclists (Minju, 2011). An important cause for reckless riding is the lack of riding education. Nearly no motorcycle operator in Liberia has a riders license or rides a registered motorcycle (Czeh et al, 2012).

Majority of the motorcyclists undergo formal motorcycling classes while minority the motorcyclists do not undergo riding lessons. These few are the main causes of accidents in Kenya (Nyachieo, 2013).

3.9.1.2 Lack of Protective Gear for Riders

Safety is the biggest challenge with commercial motorcycle transport. Due to a lack of protective clothing, motorcycle operators are much more vulnerable than users of other transport modes like cars or buses. Furthermore, most operators wear flip-flops instead of

properly fitted boots. In combination with reckless driving and over speeding they are more prone to crash injuries (Czeh et al, 2012).

3.9.1.3 Accidents

The main causes according to motorcycle safety consultative committee include:

1. Human factors accounting for 88.5 per cent of the cases;
2. Road environment factors accounting for 9 per cent of primary causes of crashes; and
3. Vehicle factors such as engine size and motorcycle type account for 0.7 per cent of accident cases.

According to the Hallo AF, 2013 motorcycle accidents in Kenya are mainly caused due to lack of training of the motorcyclists, greed as the motorcyclists ride fast in order to ferry as many passengers as possible and alcohol; drunk riding.

3.10 Motorcycle Passengers

According to Howe, 2004 in Uganda most of the passengers for motorcycles are male, drawn mainly from workers, the business community, students, and health facility patients. He also notes that for both men and women it is the speed and convenience of motorcycles that seems to be most prized is when, there are no taxis available, when a door-to-door service is required, or the user is in a hurry. Some operators are equipped with mobile phones and hence can be summoned.

The number of passengers is dependent on the location of the stage and competition, with the relatively wealthy city centers generating proportionately more, but shorter, trips than small towns or rural feeder routes that have fewer but longer journeys. Also, not all operators work continuously, many take time off for other activities and occupations (Howe, 2004).

In the United States newly licenced riders cannot carry passengers until they carry an M2 [10]class licence (Riders Plus Insurance, 2012).

3.10.1 Challenges Associated with Passengers

In Liberia the motorcycle operator carries in average two passengers on one motorcycle and sometimes even more. In rural areas all kinds of goods are transported, including

[10] The licence is awarded on the basis of years of experience.

heavy and/ or hazardous goods like petrol, which further compromises safety (Czeh et al, 2012).

As well there is no difference between the safety requirements for operator and passenger when it comes to riding attire. Full coverage of the body with the most tear-resistant special fabrics, full face helmets, fitted properly, are ideal as well; it must be emphasized that one size of helmet does not fit all. A poorly fitted helmet is simply improper, unsafe gear, and appropriate gloves and riding boots should always be worn by passengers (Riders Plus Insurance, 2012).

3.11 Motorcycle Owners Associations

According to Gbadamosi, 2002 one of the most important steps towards the realization of better urban transportation system for urban centres is the effective management and coordination of motorcycle passenger transport services. The association of motorcycle operators must be recognized to provide basis for dialogue and coordination. This must be supported by central legislation to regulate their operations at various level of governance in the country particularly at state and federal levels. The current practice where anyone can just put motorcycle on the road for commercial services should be stopped.

According to Kumar, 2011 there is some evidence that associations are changing from their original character of a welfare service for members, to important business and political entities. This has already happened in the taxi industry where the main purpose of their associations now is to collect money from the industry, on behalf of the civic authorities, rather than to put resources into its development.

In some cases the association also has a semi-banking (savings) and credit role for members. They offer their members loans of motorcycles with comparatively favourable conditions. The associations as well hire out motorcycles to operators (Czeh et al, 2012)

In Douala, only 7% of motorcycle taxis owners belong to an association others prefer collective action through neighbourhood associations or other kind of organizations (Kumar, 2011). Members of an association pay an annual entry fee in the range US$3.3-5.6. The association acts as the operators mouthpiece, representing them in cases of harassment by security personnel, tracing members in cases of theft, or their relatives if there is an accident, and through their stage committees' enforce discipline and hygiene through fines, suspension of membership and the right to operate, and other sanctions.

Some have also tried to ensure that members wear protective clothing. However, compliance has been mixed, mainly for cost reasons. (Howe, 2004).

3.12 Selected Practices in Legislation for Motorcycle Transport

Various countries around the world have managed to tame and manage various aspects of motorcycle transport in diverse ways. Most of these places long struggled with motorcycle as both a means for service provision and passenger transport as well as for private use

Governments retain ownership of right of way so they can fully regulate the use of that public space for the greater social good, and so that they can fully control the nature of public investment made on that space. Some cities have banned various types of powered two wheelers on specific roads and under specific conditions. Some of these bans have been based on legitimate concerns, and others have been made based on lack of understanding and prejudice towards certain modes. Any restrictions on vehicle use should be linked to the road classification system and based on optimizing the social benefits of the roads usage. Restraints on private car and taxi ownership and use are typical in cities around the world, and are generally accepted as a traffic demand management measure (ITDP[11], 2009).

3.12.1.1 United Nations Standards for Helmets and Visors

The United Nations Uniform Provisions Concerning the Approval of Protective Helmets and their Visors for Drivers and Passengers of Motor Cycles and Mopeds, Regulation No. 22 of 2002 specifies the sizes of helmets, materials appropriate for helmets, internal padding, visors, chin straps, goggle types. It also specifies the characteristics of the appropriate types and behaviours of these helmets parts. It also recommends various tests for the optimal production of the safest yet comfortable helmets.

3.12.1.2 United States of America

In 1967, the federal government of the United States required states to enact universal motorcycle helmet laws to qualify for certain highway safety funds. By 1975, all but three had complied. In 1976, Congress revoked federal authority to assess penalties for noncompliance, and states began to weaken helmet laws to apply only to young or novice riders (Governor Highway Safety Association, 2014).

[11]ITDP means Institute for Transportation and Development Policy

According to Traffic Safety Fact Laws of 2004, head injury is a leading cause of death in motorcycle crashes. An unhelmeted motorcyclist is 40 percent more likely to suffer a fatal head injury and 15 percent more likely to suffer a nonfatal injury than a helmeted motorcyclist when involved in a crash. National Highway Transport and Safety Authority estimates that motorcycle helmets reduce the likelihood of a crash fatality by 37 percent. The Crash Outcome Data Evaluation System (CODES) study found that motorcycle helmets are 67 percent effective in preventing brain injuries and that unhelmeted motorcyclists involved in crashes were three times more likely to suffer brain injuries than those wearing helmets.

In the United States, 47 states have a helmet law for motorcyclists. Ninteen states including Nevada, Mississippi, California and Georgia have helmet laws that require that all riders on highways and public roads should have crash helmets approved and inspected by the American Association of Motor vehicle Administration (Bikers Rights, 2013). Twenty eight States such as Florida and Colorado have requirements for wearing helmets only for specific riders for instance. riders of particular ages; in Colorado 18 years and below riders and passengers are required to wear a helmet while in Florida a person over 21 years of age may operate or ride a motorcycle without wearing protective headgear securely fastened upon his or her head if such person is covered by an insurance policy providing for at least $10,000 in medical benefits for injuries incurred as a result of a crash while operating or riding a motorcycle riding on a motorcycle (Traffic Safety Fact Laws, 2004). Only 3 states (Illinois, Iowa and New Hampshire) do not have a motorcycle helmet law (Governor Highway Safety Association, 2014).

Regulations in the State of Minnesota require that all motorcycle operators must have a motorcycle instruction permit or endorsement. The regulations require that a motorcycle is registered and a valid license plate is displayed. The riders is also requires to carry liability insurance and when riding to wear eye protection, face shield, goggles or glasses. The regulation requires motorcycle permits operators to wear a helmet approved by the Department of Transport and makes it mandatory for operators under the age of 18 years to wear a helmet. The operators are restricted from riding on interstate freeways and riding at night.

Government regulations in California limit three byproducts of internal combustion motors: hydrocarbons (HC), nitrogen oxides (NOx[12]), and carbon monoxide (CO). Starting in the late 1970s, emissions regulations were developed by the Environmental Protection Agency, or EPA for motorcycles. The original EPA restrictions, which went into effect in 1980, eliminated two-stroke motorcycles from street use. The new regulations of 2010 will force most motorcycles to use catalytic converters (Table 1) (Riderzlaw, 2014).

Table 1: Environmental Protection Agency (EPA) Emission Standards

Emission Standards
HC (g/km) NOx (g/km) CO (g/km)
1980 EPA Limits 5.0 NA 12.0
2006 - 1.4 (HC+NOX) 12.0
2010 - 2 0.8 (HC+NOX) 12.0

Source: Riderzlaw, 2014

The maximum permissible noise level for a motorcycle manufactured on or after January 1, 1979 ranges from 78 dB to 84 dB, depending on the motorcycle's speed and the road surface on which it travels (Frisman, 2003).

3.12.1.3 The Republic of Philippines

In the Philippines Republic Act No. 10054 makes it mandatory for motorcycle riders, including drivers and back riders to wear standard protective motorcycle helmets at all time. The helmets should comply with the standards set by the Bureau of Product Standards and shall be made available every time a new motorcycle unit is purchased. The Bureau of Product Standards is also mandated to test all manufactured and imported motorcycle helmets and issue a periodic list of motorcycle helmets manufacturers and importers and the brands which pass the standard.

3.12.1.4 The Kingdom of Cambodia

According to the Law on Land Traffic of the Kingdom of Cambodia the riders of motorcycles, tricycles and the motorcycles with trailers are required to wear safety helmets. The law provides for 2 types of driving license for motorcycles as follows:

[12] NOx to mean Nitrogen Oxides

1. A1 : For the motorcycle with the cylindrical size from 49 to 125 cm^3. Those issued with this type of licence should be at least 16 years old; and
2. A2 : For the motorcycle with the cylindrical size over 125 cm3. Those issued with this type of licence should be at least 18 years old.

The above licences are valid until the holders reaches the age of 65, and to extend the licencing medical check-up should be conducted every 5 years. The law also requires brand new motorcycles to bear a certificate of technical check-up which is valid for four years. Afterward, the vehicles shall have technical check-up every two years. It also requires for second hand motorcycles to have technical check-up every two years.

3.12.1.5 The United Kingdom

The Road Traffic Act Cap 52 of 1988 of the United Kingdom requires persons driving or riding on motor cycles to wear protective headgear of such description as may be so specified. The act as well makes it an offence to sell or distribute head gear that is not according to the regulations under this act. The act provides for carriage of not more than one person in addition to the driver on a motorcycle and only allows for the rider and the passenger sitting astride the motor cycle and on a proper seat securely fixed to the motor cycle behind the driver's seat. The act also makes it an offence for the sale of a motorcycle without a Vehicle Excise Registration.

Motorways rule No. 253 states that motorways must not be used by holders of provisional motorcycle licences, riders of motorcycles under 50 cc except by special permission. Rule No. 83 for motorcyclists requires that the rider and the passenger wear helmets while No 84 recommends the rider to wear eye protectors, ear protection, strong boots, gloves. No 87 requires the rider to make themselves as visible as possible from the side as well as the front and rear during the day and at night to wear reflective clothing. General Rules No. 2 specifies the requirements and age for a rider to have a provisional motorcycle license. The interested party must satisfactorily complete a Compulsory Basic Training (CBT) course. You can then ride a motorcycle up to 125 cc with a power output not exceeding 11 kW on the public road, with L plates. To obtain your full motorcycle license you must pass a motorcycle theory test and then a practical test (Legislation, 2013).

3.12.1.6 New Zealand

Land Transport (Road User) Rule 2004 for New Zealand provides some of the approved standards for motorcycle helmets and requires all motorcyclists to have a motorcycle

helmet with exceptions made to a holder of a certificate of exception or while riding at below 30km/h. It also requires that a driver or passenger produce a helmet on the demand of an enforcement officer. The rule makes it an offence to operate a motorcycle while carrying more than two persons. It also stipulates lighting and reflector requirements for a motorcycle and motorcyclists. The rule also makes it an offence for a person to ride a cycle on a footpath or on a lawn, garden, or other cultivation forming part of a road.

3.12.1.7 Australia

According to Northern Territory Consolidated Regulations of Australia learners riding motor cycles must not drive a motor cycle unless it is of a class that the learner is permitted by the learner licence to drive. A learner must not drive a motor cycle unless there is an L-plate displayed conspicuously so as to be clearly visible from the rear of the motor cycle. A learner must not drive a motor cycle at a speed greater than 80 km/h unless permitted to do so or while under the direct supervision of, a person conducting a driving course approved by the Registrar. Provisional drivers riding motor cycles must not drive a motor cycle unless there is a P-plate displayed conspicuously so as to be clearly visible from the rear of the motor cycle. A provisional driver must not drive a motor cycle at a speed greater than 100 km/h unless permitted to do so by, and while under the direct supervision of, a person conducting a driving course approved by the Registrar. A person who has not held a licence to drive a motor cycle for a continuous period of 12 months must not drive a motor cycle with a person seated on a pillion seat (Northern Territory Consolidated Regulations, 2013).

3.12.1.8 Nigeria

Lagos State Road Traffic Law, 2012 provides a list of streets that are no riding zones for motorcyclists. In the other streets the motorcycles can only operate between the hours of 6.00a.m-8.00p.m. The law as well makes it an offence to ride a motorcycle without a Rider's Card issued by the Lagos State Motor Vehicle Administration Agency. It as well makes it an offence to operate a motorcycle either as a rider or a passenger without wearing a standard protective crash helmet and both the rider and the passenger are as well liable to the same penalty if this section is not complied with as long as the passenger is not a child. The act makes it an offence for a person to drive or ride or carry a passenger on a motorcycle unless the motorcycle is comprehensively insured under the prescribed insurance policy. Also it stipulates that no motorcycle operator shall carry more than one passenger at a time, provided that a pregnant woman, a child below the age

of 12 years, or an adult with a baby or heavy/large load placed on the head or which obstruct normal sitting on the motorcycle shall not be carried as passenger. It also restricts the driver of a motorcycle from carrying a person in front of him on the motorcycle but allows that a firmly affixed frame to carry one person at the rear of the cycle.

The act stipulates that motorcycles below 200cc engine capacity shall not be used or operated on bridges and carriage road with two or more lanes in opposite directions. Also a motorcycle for mail distribution or courier services may be exempted from route restriction granted by the ministry, provided that such a motorcycle shall:

1. Have a minimum engine capacity of 200cc;
2. Carry prescribed vehicle number plate and or identification;
3. Be fitted with properly fixed mail cabin on the pillion; and
4. Not carry passenger.

Other motorcycle traffic offences include:

1. Riding motorcycle without approved crash helmet for rider and passenger;
2. Riding a motorcycle with non-functional lamps;
3. Riding a motorcycle against traffic and on the kerb, median or road setbacks;
4. Installation of musical gadget on a motorcycle;
5. Alteration of manufacturer's specification on motorcycle (for example. Handle bar/leg) ;
6. Motorcyclist resisting arrest ;
7. Operating a motorcycle without side mirrors, trafficators, break light or rear lights;
8. Motorcycle operator carrying pregnant or adult with baby or a child below the age of twelve (12) years; and
9. Motorcycle operating using horn designed for motor vehicles.

The Traffic and Road Safety Act provides for training for driving motorcycles for people above 18 years of age. The act also makes it illegal for registered practitioners to carry out training. The act as well confers powers to police officers to take riders to registered practitioners or the police station for further tests on suspicion of being drunk. The act also makes it an offence to carry more than one person in addition to the driver and recommends for a securely fixed seat for the passenger.

3.12.1.9 Cameroon

In Cameroon a Prime Ministerial decree of December 31, 2008 requested motorcyclists to meet several conditions including: they should be at least 18 years of age, they should obtain a valid driver's permit and public transport card; a certificate of aptitude; a matriculation number from the council concerned; a certificate showing proof of the technical safety of the motorbike and an insurance policy. They are also expected to paint the motorcycles tanks yellow, have helmets for both the rider and passenger (Fon, 2009).

3.12.1.10 Kenya

The Traffic Act Cap 403 of 2009 of Kenya requires a person riding a motorcycle to have a valid driving licence issued in accordance with the provisions of the Act. The act makes it an offence for a person to ride on a motor cycle of any kind, class or description without wearing a helmet and a jacket that has reflectors and requires the person who rides a motor cycle to provide a helmet and a jacket that has reflectors to be worn by the passenger. The rider is as well required to carry only one passenger at a time. The act requires that every motor cycle be insured against third party risks in accordance with the Motor Vehicle (Third Party) Insurance Act.

The Draft National Transport and Safety Authority (Operation of Motorcycles) Regulations 2014 will require that the transfer and registration of motorcycles to be done with two helmets and two jackets with reflective properties. The regulations give responsibility to owners of motorcycles to provide the rider and pillion passenger with helmets, to not permit any person to ride the motorcycle unless he/she is a holder of a valid driving licence endorsed in respect of the class of motorcycle, to ensure that the motorcycle is insured against third party risks and ensure that the motorcycle does not carry more than one passenger at a time. The responsibility of the rider according to the regulation will include ensuring that they obey all traffic rules, ensuring that the headlights of the motorcycle are on at all times, ensuring that only one passenger is transported at a time, ensuring that the pillion seat is securely fitted when carrying a pillion passenger and ensuring they have a valid driving licence issued by the authority. Responsibilities to motorcycle passengers according to the regulations include wearing of a helmet and reflector jacket whenever being carried on a motorcycle, not allowing to be carried as an additional passenger and sitting astride on a motorcycle.Courier companies according to the regulations are required to ensure that no passengers are ferried and that proper carrier boxes are used. The regulation also requires for a bodaboda operating in a

particular county to register with the County Transport and Safety Committee and no owner should be registered in two County Transport and Safety Committees. Boda Bodas are also allowed to operate between 5am and 11pm. Anyone who contravenes these regulations is liable to a fine not exceeding twenty thousand shillings or to a term of imprisonment not exceeding six months.

The Kenya Bureau of Standards through specifications KS 77:2012 on Protective Helmets for Motorcyclists gives methods of test for the fundamental performance requirements and the minimum results required from a satisfactory helmet. It sets out the general principles of design whilst leaving the manufacturer as much freedom as possible in respect of the materials used, the actual design and the methods employed to provide the required levels of protection. The standards ensure that the helmet shall be as light in weight as possible both for the comfort of the wearer and to limit certain effects in the event of an accident and ensure the helmet is a good fit.

In 2008 Council of Ministers of the East African Community approved the importation of Completely Knocked Down (CKDs) Motorcycles at a duty rate of 10% (East African Community, 2009). In 2013 a regulation, however, imposed a condition that manufacturers will continue enjoying the 10% duty rate only if they source motorcycle parts from any of the EAC member states and turn their back on imports from outside the bloc. The notice identifies the various Completely Knocked Down parts to be obtained in the region as main frame, suspension, seat frame, mudguard, wheel rim, break gear and exhaust pipe (Ibid).

Road design and construction in Kenya are done based on the following manuals

Road Design Manuals Part (I-V)

- Road Design Manual Part I-Geometric design of Rural Roads-1979;
- Draft-Road Design Guidelines for Urban Roads-2001;
- Road Design Manual Part III-Materials and Pavement Design for New Roads;
- Road Design Manual Part IV-Bridge Design-1982; and
- Road Design Manual Part V-Pavement Rehabilitation and Overlay Design-1988

Other manuals include; manual on Traffic Control Devices namely Part I-Road markings and Traffic Signs. The manuals define the different types of road markings and their

meanings on the road; they also contain the different types of signs including informatory, warning and regulatory signs.

3.13 Other Management Practices

Various approaches have been used world over to integrate motorcycles with other types of vehicles as discussed below.

3.13.1 Restriction and Ban of Motorcycles

Different roads serve different social and economic functions. Optimizing road use for the greater social good must begin by first understanding the different functions of different roads. For this reason, municipalities reserve the right to regulate access to different roads for different types of vehicles. Ideally, this regulatory process should be based on a careful analysis and clearly defined road classification system and a vehicle classification system. In Asia, it has been more common to ban both motorized and non-motorized two and three wheelers. Bans on access by motorized and non-motorized rickshaws, bicycles and motorcycles in entire cities or in entire zones or on major arterials are quite common (Institute for Transportation and Development Policy, 2009).

Motorcycles are legal in most of Asia, but recently most Chinese cities have begun the progressive implementation of outright bans on motorcycles, including in many cases light weight electric bicycles, or e-bikes. Guangzhou is ahead of other Chinese cities, banning motorcycles entirely throughout the city from 1 January 2007. The motorcycle ban was implemented gradually over many years, with the first restrictions imposed more than 15 years earlier, in October 1991, with new motorcycle registrations limited to 500 per month. Restrictions on new registrations and usage of motorcycles were gradually extended, temporally and geographically in different districts and roads, culminating in the complete citywide ban (Zhu, 2009).

Most of these bans are baseless or based on a political view of causing traffic congestion. Whenever a category of vehicle is banned on specific routes, the existing passengers are forced to choose an alternative mode to reach their destination, shifting them to an alternative mode that is going to be less optimal from the point of view of generalized cost, adding to their travel time and travel cost. Guangzhou is the only city for which we have data on the modal shift patterns that resulted from banning motorcycles. In Guangzhou, two years before motorcycles were banned they constituted 20% of total

trips. At the same time, walking accounted for 25%, buses for 30%, bicycles for 10%, cars for 5%, taxis for 5%, and other modes 5% of trips. After the ban, of the 20% motorcycle trips, 51% shifted to the bus, 18% shifted to the bicycle, 18% shifted to cars or taxis, 9% shifted to walking, 2%shifted to the metro, and 2% shifted to something else. Traffic speeds on several major arterials that were measured before and after the ban showed a sharp decline in average traffic speeds. In the view of local traffic engineers, the motorcycle ban combined with gradual increasing car use to push the corridor close to the 80% saturation level that leads to sudden deterioration of road speeds. In general, then, we can conclude that banning motorcycles as a traffic congestion mitigation measure will not be successful (Institute for Transportation and Development Policy, 2009).

3.13.1.1 Sharing of Lanes

The United States has experienced a large increase in motorcycle endorsements and registrations. This influx, coupled with growing concerns over traffic congestion and limited resources, has created interest in the potential use of motorcycle lane sharing. While mostly prohibited in the United States, with the exception of California, motorcycle lane-sharing, also known as lane-splitting or filtering, is a common practice in many countries around the world. Lane-sharing allows motorcycles to take advantage of parts of the road not being utilized by allowing them to pass between lanes of stopped or slower-moving vehicles (Sperley et al, 2010) (Plate 3**)**.

Plate 3: Lane Splitting by Motorcyclists

Source: Motorcycle Industry Council, 2013

Allowing motorcycles to move more freely through traffic could help reduce overall congestion, and potentially reduce some types of motorcycle crashes. In some cases, it may also reduce motorcycle riders' travel times and create an incentive for people to switch travel modes. This switch could be environmentally beneficial as motorcycles have much greater fuel efficiency than automobiles, emit less greenhouse gasses, and also contribute less wear to the roads and infrastructure (Sperley et al, 2010).

Critics of the technique cite the possibility of a car changing lanes, cutting off the motorcyclist and causing a collision. However, most riders will only split lanes when traffic is moving slowly, limiting the speed at which a driver can make a lateral move and giving the rider ample opportunity to avoid a collision. However, motorcycle Lane Splitting is no more hazardous than maintaining a normal lane position, because a car driver might sideswipe a motorcyclist or cross the motorcyclist's path whether the rider is situated within a lane or between lanes (Motorcycle Industry Council, 2008)

According to Motorcycle Industry Council riders can manage the risks of lane splitting by being extra cautious and alert and following a few guidelines:

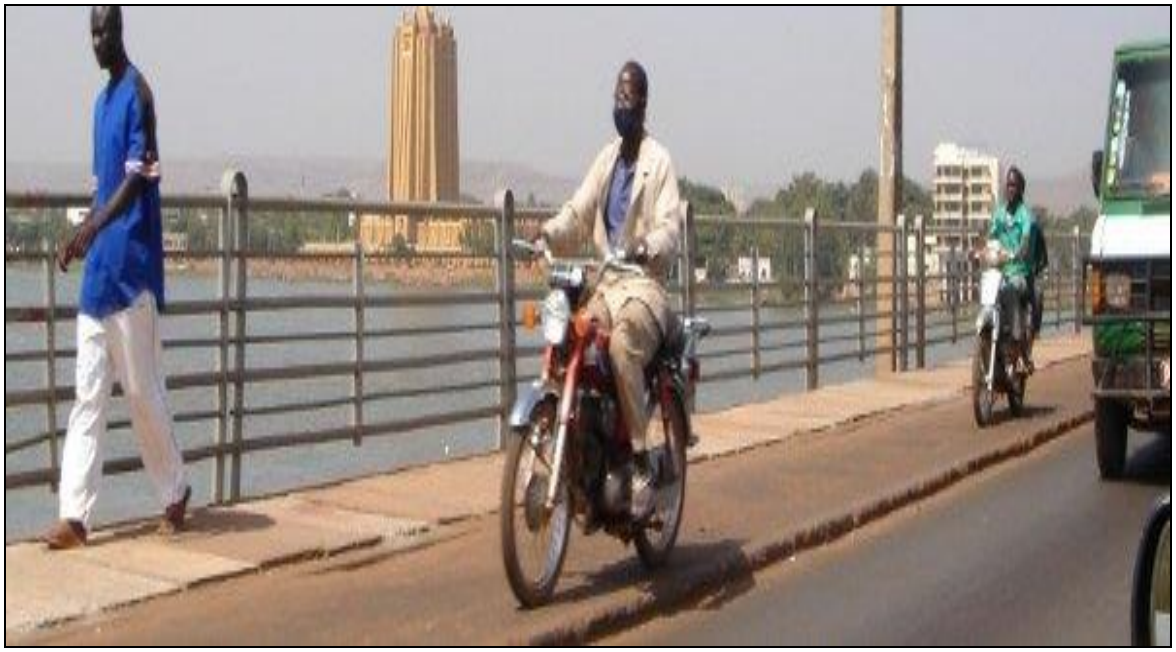
(a) Only split between the two left most traffic lanes. This consistency of location helps car drivers in those lanes learn to expect motorcyclists;
(b) Only split when there is ample space between the lines of cars;
(c) Do not split lanes when traffic is at or near the speed limit. The goal of splitting lanes is to keep moving at a reasonable speed through slow or stopped traffic, not to pass cars that are already moving at reasonable speeds;
(d) Do not ride substantially faster than the adjacent lines of cars, and never exceed the speed limit; and
(e) To minimize risk, the speed differential between the motorcyclist and surrounding traffic should be kept to a reasonable level.

3.13.1.2 Motorcycle Dedicated Lanes

On roads with high level of traffic, conflicts between vehicles may be created when heavy commercial vehicles and fast moving cars have to share the same roadway facility with the less protected and slower vehicles such as motorcycles, mopeds and bicycles. A major risk for motorcyclist is their interaction with larger, heavier vehicle, particularly if the

motorcycles are small and relatively slow. One way of addressing this problem is to segregate motorcycles from heavier vehicles through the provision of motorcycle lanes **(**Plate 4). Just the same as separating for bicycles and pedestrians the limitation would be how many motorcyclists would actually utilize the lanes, other challenges are lack of commitment to plan safety strategies and financial constraints (Institute for Transportation and Development Policy, 2009).

Plate 4: Motorcycle Dedicated Lanes in Nigeria



Source: Global Road Safety Partnership, 2013

In Malaysia, motorcyclist contributes to almost 60% or the fatal accidents. A pilot project introducing exclusive motorcycle lanes showed reductions up to 39% in the number of crashes. Analysis suggests that the benefit to cost ratio for providing an exclusive motorcycle lanes ranges from about 3 to 5 depending on the estimates of cost used. Further research has shown also that 3.80 meters is the safe control width in Malaysia to ensure that the lane is safe for all motorcycle riders and comfortable to do overtaking maneuvers (Global Road Safety Partnership, 2013). In Brazil an exclusive lane was included, it however did not reduce accidents mainly because pedestrians did not cross in the correct places and were hit by motorcycles in the lane, cars were also prohibited from turning left but did so, causing accidents (Institute for Transportation and Development Policy, 2009). Most motorcyclists mistake bicycle lanes and utilize them as motorcycle lanes especially during the peak hours. Plate 5, Plate 6 and Plate 7 shows motorcycle control devices.

Plate 5: Motorcyclist Restrictive Barriers in Guangzhou

Source: Zhu, 2009; page 29

Plate 6: Bollards Used to Separate Different Road Users in Guangzhou

Source: Zhu, 2009; page 31

Plate 7: Metallic Barriers to Restrict Motorcyclist

Source: Zhu, 2009; page 32

Although these physical designs and devices which can be employed to restrict motorbike access to bikeways and pedestrian areas are effective they create a nuisance for cyclists, pedestrians, and particularly for disabled people, shoppers with carts, and parents with children in strollers (Institute for Transportation and Development Policy, 2009).

3.13.1.3 Integration of Motorcycle

For roads with an intended operational speed of 40kph or less, the road should be designed for safe integration of traffic at slow speeds rather than through special designated lanes for different forms of traffic (Institute for Transportation and Development Policy, 2009). Traffic encounter with high speed difference can be avoided through separation of high speed traffic or by homogenizing traffic speeds. Implementing homogenized design components and separation of vulnerable road users ultimately forces road users to use the roads in a safe way. Vehicles categorization in terms of allowed speed and mass is needed to implement a system with a separate lanes for cars, trucks, heavy, light motorcycle, bicycles and pedestrians or with limited access for certain types of vehicle. Road pavement programmes should focus on designing roads in residential areas, where low speed vehicles safely meet pedestrians and playing children (Godthelp, 2010).

The system proposed in Malaysia according to Godthelp, 2010 that describes integrating motorcycles according to the type of road that is in use and categorizes motorcycles to either Light-Low (LLS) Speed or Heavy-High (HHS) Speed. It also describes their speeds in the particular types or roads in built up areas and outside built up areas (Table 2). Plate 8 shows the application of the proposal in inside a built up area in Taiwan.

Table 2: Motorcycle Speed Integration Model

Motorcycles Light-Low (LLS) Speed	**Motorcycles Heavy-High (HHS) Speed Cars, Trucks, Buses**
1) The model describes the recommended model for Light-Low Speed motorcycles in through roads, distributor roads and access roads.	1) The model describes the recommended model for Heavy High Speed motorcycles in through roads, distributor roads and access roads.
Through Roads:	**Through Roads**
1) Separated motorcycle LLS lanes inside built-up areas on high volume roads. Through the use of one way roads and traffic management, physical space is made available for separate lanes of a) Motorcycle HHS/cars/trucks/buses and b) Motorcycles LLS l/tuk-tuks. 2) Max speed 30k/h. Separated entrance facilities. Max speed at crossings 30km/h. 3) Outside built-up areas motorcycles LLS use separated lanes. Max speed 50km/h.	1) Within built-up areas: along the road: separated, max 70 km/h. 2) Outside built-up areas: Along the road: separated and physical separation of opposite driving directions, max 100 km/h.
Distributor Roads:	**Distributor Roads**
1) Separated motorcycle LLS lanes inside built-up areas on high volume roads. Max speed 30km/h. One-way roads with separated lanes for a) Motorcycle HHS/cars/trucks/buses	1) Within built –up areas: along the road: separated, max 50 km/h crossing: roundabout, traffic lights, max 30 km/h. 2) Outside built-up areas: along the road: separated or mix with motorcycles LLS

Motorcycles Light-Low (LLS) Speed	Motorcycles Heavy-High (HHS) Speed Cars, Trucks, Buses
and b) Motorcycles LLS/tuktuks. 2) Outside built-up areas motorcycles LLS use separated lanes or mix with other motorized traffic, dependent on traffic volume. Max speed 50km/h.	dependent on traffic volume, max 70 km/h.
Access Roads	**Access Roads**
1) At residential areas: motorcycles LLS mix with other motorized traffic both in- and outside built-up areas. Max 30km/h.	1) Within built –up areas: along the road: mix with motorcycles LLS, max 30 km/h 2) Outside built-up areas: along the road: mix with motorcycles LLS, max 50 km/h

Notes: LLS means Light Low Speed Motorcycles

HHS Means Heavy High Speed Motorcycles

Source: Godthelp, 2010

Plate 8: Homogenization of Motorcycle Transport with other Modes of Transport in Taiwan

Source: Phedonos, 2013.

3.13.1.4 The Use of Bus Lanes

When considering whether to permit other types of vehicle to use a bus lane, authorities should consider an assessment in each case, measuring the potential impact on road safety; the operation of the bus lane, including potential delays to buses; delays to other traffic; the legality of the definition of the vehicle class; enforcement; and any impact on modal split (Butcher, 2010). In areas where the bus lanes are not to be utilized by motorcycles, the lower the bus frequency, the more difficult it is to maintain the exclusivity of the bus way. On bus ways with frequencies below one bus every 2 minutes, keeping motorcycles and bicycles out of the bus way is likely to be quite difficult. This is particularly difficult in the off-peak, when bus frequencies will tend to drop. (Institute for Transportation and Development Policy, 2009). Trials of bus ways in London recorded a fall in cyclist collision rate and 51% of motorcyclists switching from riding on the outside of the road to the bus lanes (Butcher, 2010) (Plate 9).

Plate 9: Use of Bus Lanes by Motorcyclists in London

Source: The Use of Bus Lanes by Motorcycles, 2007: page 1

According to the Use of Bus Lanes by Motorcycles, 2007 various additional considerations are fundamental before allowing motorcycles in bus lanes.

3.13.1.4.1 Policy:

The safety implication involved in restricting motorcyclist to general traffic lanes against the possible problems of allowing motorcyclist into the bus lane.

The safety implications involved in restricting motorcyclists to general traffic lanes, against the possible problem of allowing motorcyclists into the bus lane; the effect of other vulnerable users especially pedestrians and cyclist additional traffic in the bus lane; the potential for overall improvements in transport efficiency; the reduction in congestion for other traffic on route currently used by motorcyclist; and the potential for modal shift if motorcycling is seen as a more convenience means of transport.

3.13.1.4.2 Assessment and Audits of safety needs of Passengers and Riders

In the course of operation of the two modes a safety audit must be carried out to secure long term viability of the motorcycle and bus transport. Monitoring in the early days of their operation is essential for secure and safe operation

3.13.1.4.3 Visibility

Presence of other road vehicle and road side obstruction such as street furniture and vegetation can add to difficulty in visibility. Remedial design work may be required to ensure maximum inter-visibility especially at junction.

Bus stops are a possible source of problem as pedestrians cross between traffic to board or alight a bus may not expect to take into account an overtaking motorcycle in the bus lane.

3.13.1.4.4 Turning Vehicles

Turning vehicles are general risk both to other vehicle and to pedestrians who are crossing. Examine accidents records which show collision types and probable cause which will help assess whether there will be a change if motorcyclist are to be allowed into bus lane.

Bus lanes are more difficult to enforce in cities with high volumes of motorcycles. Using solid barriers without gaps would help keep motorcycles out (Institute for Transportation and Development Policy, 2009). In areas where bus lanes pass through a pedestrianized area they are provided with access control or a bus gate facility or bus pre-signals. At sites such as these, buses equipped with a transponder pass over detectors in the carriageway causing bollards to retract or the traffic signals to change to or stay on green.

Motorcyclists attempting to gain access through an access control or bus gate will not be given a green signal as the signals will not detect them. This could result in motorcyclists having to make potentially dangerous maneuvers to continue their journey (Department of Transport, 2007).

3.14 Infrastructure for Motorcycle Transport

3.14.1 Introduction

Various infrastructural provisions are discussed and their influence on motorcycle ridership; stability, visibility, and safety. This is also reflected on in relevance to other vehicles using the same infrastructure.

3.14.2 Road Design

The engineering of the road surface and environment can have a significant impact on the likelihood of a crash, the ability of a rider to recover and avoid a crash, and on the severity of injury to riders and pillion passengers should a crash occur. Hazards in the road environment can be reduced through the use of more Powered Two Wheelers (PTW) friendly engineering products and practices, and road maintenance procedures. It is important that all those involved in the design, construction and maintenance of the road environment are more aware of the specific needs of PTWs (State Government of Victoria, 2009).

According to Motorcycle and Scooter Safety Advisory Group, 2012 combinations of factors are generally at play in any crash. These include the behaviour of the drivers of other vehicles, the riders themselves, whether excessive speed is involved and other factors such as the influence of fatigue, alcohol or other drugs. However, the engineering of the road surface and environment can have a significant impact on both the possibility of avoiding a crash, and on the severity of injury to a motorcyclist, should a crash occur.

3.14.3 Construction and Maintenance of Roads

Relevant maintenance practices and standards should be reviewed and the appropriateness of these standards for motorcyclists investigated. In most instances there is evidence that the road condition standards specified in contracts and the standards specified in the Road Management Plan are substantially achieved in practice. However, it is frequently the attention to detail within such standards which is important for the safety of motorcyclists, example, cleaning of road surfaces where a small amount of residual oil or gravel remains. One of the recommendations from the Motorcycle Advisory Council was to implement a statewide program of education and training for all personnel involved in road construction, maintenance and reinstatement works so that assessment of hazards

and the safety of completed works can be assessed from a motorcyclist's perspective (Victorian Motorcycle Advisory Council, 2008).

3.14.4 Marking of Pavement

Markings can pose a significant threat to motorcyclists who are especially at risk when cornering and braking, and when roads are wet. Skid resistant pavement markings should be used to allow motorcycle tires to have a better grip on the road (Transport for New South Wales, 2013).

For maintenance purposes renewed skid resistant paint should be used, and old makings should be removed markings on roads such as for pedestrian and children's crossings can often be more slippery than the surrounding road. Consideration needs to be given to ensure motorcycle tires have sufficient grip on the road. (Motorcycle and Scooter Safety Advisory Group, 2012).

3.14.5 Loose Surfaces

These can be created on roads due to gravel and other material being deposited by vehicles or being washed across the road. This can come from unsealed road shoulders, roadside parking areas or at intersections with gravel roads and driveways. Consideration should be given during design and construction to sealing shoulders especially on curves and sealing such intersections. Sealing road shoulders in rural areas has been shown to be effective in reducing the incidence of run-off-road crashes. Where sealing road shoulders is not practical, motorcycle specific warning signs should be installed until cleanup is done, this can improve safety (Motorcycle and Scooter Safety Advisory Group, 2012).

3.14.6 Raised Points

There are a number of raised points on roads; these road surfaces can be very hazardous for motorcycles. For example, a small roundabout with a low profile, can have edges that are difficult to detect and could cause a rider to lose control if they run over these; an issue that is not experienced by cars and other larger vehicles. Plate 10 shows a steel utility that can be hazardous to the rider (Transport for New South Wales, 2013). Where practical such utility should be located off the road. Where they need to be located on the road, covers with textured surfaces or skid resistant coatings should be used. These surfaces such as rails on the pavement should be at the same level as the pavement surface to reduce traction (Motorcycle and Scooter Safety Advisory Group, 2012).

Plate 10: Steel Utility Cover in New South Wales

Source: Transport for New South Wales, 2013; page 6

3.14.7 Provision of Kerbs

Kerbs can create a hazard for motorcycles, when immediately adjacent to the travel lane, as it creates a lip that can snag a foot peg and can cause a crash if ridden over. Semi-mountable kerbing should be considered for use in situations where the kerb is deemed hazardous, particularly along popular motorcycle routes. Kerbs should also allow for recovery (Transport for New South Wales, 2013).

3.14.8 Guard Rails for Safety

Crash barriers are reactive rather than proactive measures, based on survivability in the event of a crash rather than preventing the collision in the first place. Crash barriers are designed with only the majority of road-users in mind – cars, and to a lesser extent, heavy vehicles. While the barriers protect vehicle occupants, they can be lethal to riders Hitting a crash barrier is a factor in 8-16 per cent of rider deaths. In collisions with crash barriers, riders are 15 times more likely to be killed than a car occupant. Barrier support posts are particularly aggressive, irrespective of the barriers' other components, causing a five-fold increase in injury severity compared to the average motorcycle crash (European Road Assessment Programme, 2008). The nature of impacts with barriers is such that riders are

more likely to suffer injuries to lower extremities and vital regions of the body, such as the spine, head and thorax (ACEM, 2004).

Crash barriers are designed to turn a large uncontrolled collision into a small controlled event, absorbing impact energy and reducing injury severity. While this is a good central tenet, designing for PTWs requires a very different approach from that used for other transport modes. A car hitting a barrier is in a controlled collision designed to redirect it away from hazards such as trees, lampposts or lighting columns, slowing it down over a short distance. The car's rigid external structure and secondary safety technology does the rest to minimise injury. Riders currently have no secondary safety systems to cushion the impact or to protect from aggressive components. The most part, of their bodies take the full force (European Road Assessment Programme, 2008).

A comparison of the barriers shows the safety they provide. With steel guard rails during an impact the rider slides alongside and onto the steel guard rail. Here, the rider would have suffered severe injuries especially to the shoulder, the chest and the pelvis corresponding to aggressive contacts and snagging. With a concrete guard rail the barrier does not effectively decelerate the rider. As a result there is risk of being deflected by the barrier into oncoming traffic on the road which is clearly higher than for a barrier protection system made from steel. Another disadvantage of concrete barriers is that during an impact they do not dissipate as much kinetic energy via deformation as the systems made from steel. With the motorcycle crashing into the guard rail at an angle, immediately after the first impact the motorcycle was stopped and remained stuck under the guard rail, while on a concrete rail the decelerations for the first impact were high indicating a risk of severe and life threatening injuries. With a modified steel guard rail (Plate 11) an additional under run protection board was mounted near to the ground to prevent both the direct impact onto a post and movement of the motorcyclist underneath the barrier protection system. The results indicate that the risk of injury for a motorcycle rider is much lower when impacting the modified system. The additional under run protection board eliminated snagging while also absorbing kinetic energy as a result of its deforming during impact (Berg et al, Undated).

Plate 11: Modified Guard Rail in Victoria, Australia

Source: Motorcycle and Scooter Safety Advisory Group, 2012

3.14.9 Installation of Drainage

This needs to be able to cope with poor weather conditions to minimize the amount of water running across the road or pooling on the surface. It is also important to ensure that roadside drains and pits are maintained to prevent any debris from being spread across the road. Poor drainage on roads could create slipperiness on the pavement surface (Transport for New South Wales, 2013).

The Motorcycle and Scooter Safety Advisory Group, 2012 as well recommends various road repairs, maintenance and reinstatement works to avoid creating significant hazards for motorcyclists. These include:

3.14.10 Provision of Road Shoulders

Road shoulders provide a recovery area for any vehicle that runs off the sealed roadway. If road edges are broken or contain loose gravel surfaces this can create a serious hazard and make recovery more difficult, especially for motorcycles. Line-marking of road edges is also important and needs ongoing maintenance. Line-marking may reduce the likelihood of a motorcyclist running off the road, especially when visibility is poor such as at night, in rain or fog.

3.14.11 Potholes

Potholes can be a significant hazard for motorcyclists, and can cause a loss of stability and control. Regular inspections and prompt repairs should be undertaken according to road maintenance plans. It is also important to respond to public reports of potholes.

3.14.12 Ruts and Corrugation

Deep wheel ruts and corrugations on the road surface can present difficulties for riders and lead to a loss of stability and control. Ruts and corrugations can collect water during rainfall. Appropriate warning signs should be used until repairs are carried out.

3.14.13 Sealing of Cracks on Road Pavement

There is a need to ensure that a slippery surface is not created for motorcyclists as a result of crack sealing work, especially by avoiding wide areas of sealant. Bleeding bitumen/flushing seals Excess bitumen on the road surface can provide a slippery hazard for motorcyclists in wet and dry conditions. In this situation resurfacing or removal of the excess bitumen should be carried out. Prior to this, signs warning of the slippery surface should be installed.

3.14.14 Maintenance of Ornamental Vegetation

Any overhanging vegetation should be trimmed to ensure a clear view of all traffic, especially for motorcyclists. Care should be taken to clean up all debris following any maintenance work because this material on the road surface can create a hazard for motorcycles.

3.14.15 Clean Up of Pavement Surface

In heavily trafficked areas, at locations such as roundabouts and intersections, a build-up of oil and grease deposits can occur on the road. This is generally in the centre of the lane, where some motorcycles tend to travel, and requires on-going maintenance. These liquid spills on the road can lead to a loss of traction and stability for a motorcycle. A rapid response to cleaning up any spills is vital and warning signs should be installed.

Loose material on road surfaces should be cleaned up during and after road works. Loose gravel and other material can be scattered on the road surface, and mud and other debris

can be dropped from construction vehicles onto the road. This loose material needs to be swept from the road as it can lead to a motorcycle losing traction.

When cleaning the road after a crash all debris should be removed from the road. This may consist of sharp objects and liquids that may be spread across the road surface, and present a serious hazard to motorcyclists and other road users. Priority must be given to fixing damage to any barriers, fences, poles or signs on the roadside at a crash site to ensure that there are no protruding sharp edges and fittings.

3.14.15.1 Provision of Parking Bays

In Victoria motorcycles are allowed to park on footpath as long as they do not obstruct pedestrian doorways, delivery vehicles, public transport users or access to parked cars. In this state motorcyclists are allowed to park as long as they park at least a motorcycle wheel back from the road kerb to allow free access to and from the road and parked vehicles. Areas restricted from this sort of parking are where signs indicate that motorcycles may not park. The may include areas of private property, areas reserved for access points such as manhole covers, rubbish bins and post boxes (Victorian Motorcycle Advisory Council, 2008).

In Chicago the motorcycles are prohibited from parking on sidewalks 90 Degrees to the Kerb as long as the motorcycle does not extend to the road (City of Chicago, Undated[13]).

Rochford District Council, 2010 proposes that a car park of 130 spaces should provide for motorcycle parking (Table 3).

Table 3: Recommended Number of Motorcycle Parking's Per Car Parking

Number of Car Parking Spaces	**Motorcycle Parking Space**
1 space provided regardless of car park size	1
1 space per 20 car parking spaces for first 100 spaces	5
1 space for the remaining 30 car parking spaces	1
Total	**7**

[13] Means the source is not a published document

Citing signage and securing as key in motorcycle parking areas. The special needs for motorcycle parking include provision of lockers to allow storage of clothing and equipment including crash helmets (Plate 12).

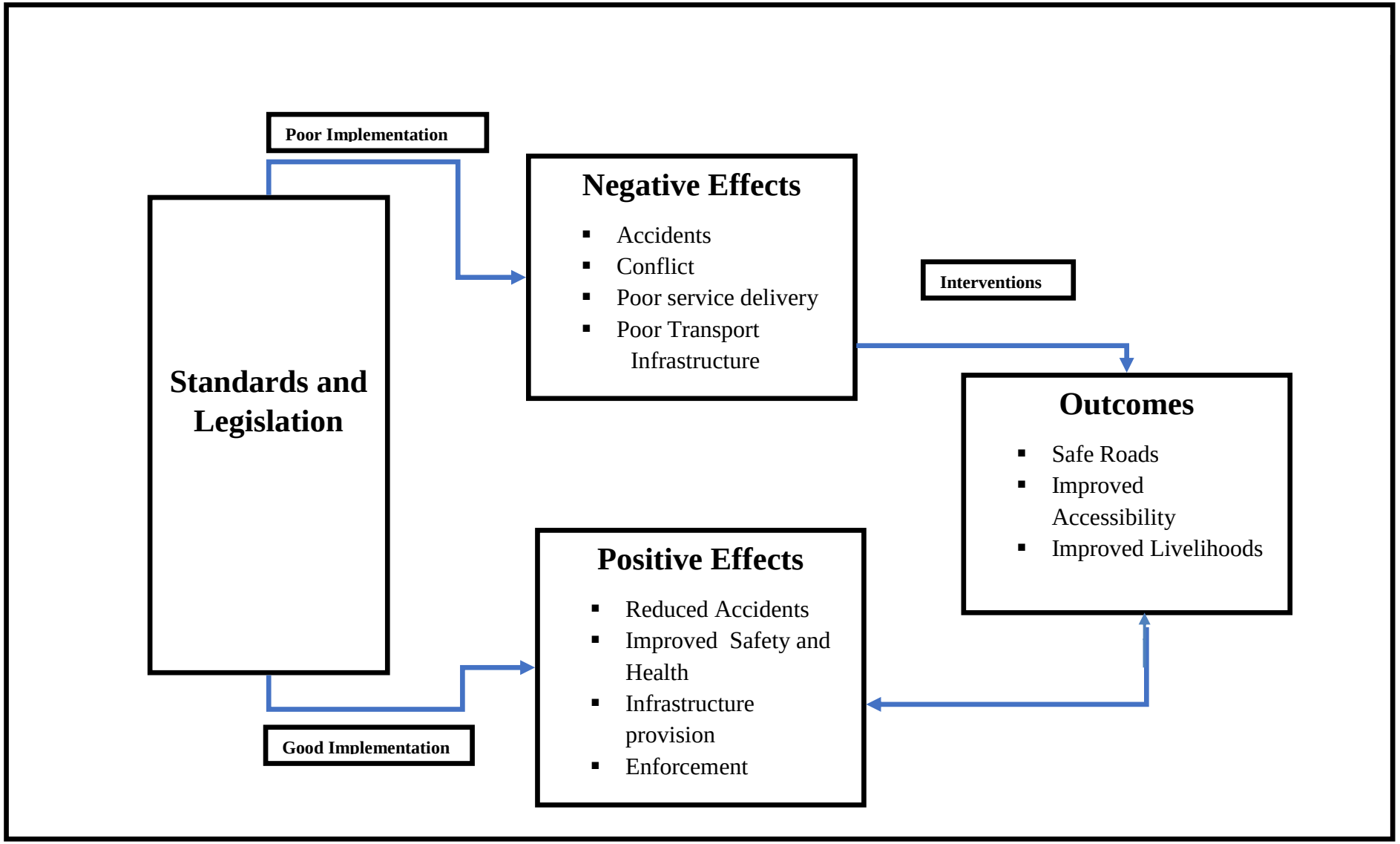
Plate 12: Design Provision for Motorcycle Parking in Rochford, England.

Source: Rochford District Council, 2010; page 18

3.15 Conceptual Framework

The policies laws, standards, and regulations form the basis for safe riding and the operational practices of the motorcycle transport sector, poor implementation and enforcement of these standards leads to various negative effects in the motorcycle transport sector whereas with various interventions and the proper implementation of these interventions as well as installation of proper standards regulations and practice would lead to the ideal situation for the operation of motorcycle transport as shown by Figure 3.

Figure 2: Conceptual Framework



3.16 Conclusion

Two types of motorcycle engines are identified and their contribution to emission levels and the environmental friendly approaches that have been adopted around the world to ensure the sustainability of motorcycle transport. The use of motorcycle transport around the world is also attributed to various factors including the complete collapse of public transport, while in others it's the rapid rate of urbanization that allows the motorcycle transport to come in and fill the gap in provision of transport and in other area motorcycle transport was noted to complement other modes of transport.

Various challenges are identified unique to the various users; operators identified the lack of training in motorcycle transport, lack of protective clothing and frequent accident incidences, the operators identified the lack of protective clothing and ferrying of more than one passenger as their main deficiency. Motorcycle associations were also discussed and their role in management of the operational practices of motorcyclists

Motorcycle friendly approaches adopted world over are discussed including the complete ban and partial ban of motorcycle transport in urban areas, the use of motorcycle lane sharing approach, motorcycle dedicated lanes and approaches for integrating motorcycle speeds. These approaches are then coupled with legislation that are motorcycle friendly to include helmet laws, emission laws, laws on protective clothing and their standards and also regulations and laws on motorcycle riders training curriculum and licensing.

The design, maintenance and infrastructural approaches that are motorcycle friendly are discussed and their influence on ridership.

A conceptual framework is then developed with a backbone of standards and legislation that determines the infrastructural provision which determine the operational practices of motorcycle transport.

CHAPTER FOUR: METHODOLOGY

4.0 Introduction

The literature review highlights the various attributes, factors and approaches that influence motorcycle transport (the operational practices, legislation and standards and infrastructural provision). This chapter therefore discusses the approaches towards collecting and compilation of data in regards to motorcycle transport in the study area; this methodology plays an important role in implementing this research study accordingly.

4.1 Target Population

The research will target motorcycle transport along Thika Super Highway. These include motorcycle operators involved in passenger transport, those involved in goods transportation and the private motorcycle riders. Passengers of the motorcycles for public transport will also form the target population.

Regulatory agencies involved in motorcycle transport will provide information relating to regulations and standards in motorcycle transport as well as further evaluation into the weaknesses of the current regulations and standards. These institutions will are, the Traffic Police Department, Kenya Urban Roads Authority- Traffic Department and National Transport Safety Authority.

Transport associations will also be relevant in providing information in relation to the study; these include the Motorcycle Associations which include, Garden Estate Motorcycle Association.

Other institutions directly and indirectly affected by motorcycle transport that will form part of the target institutions are, Neema Hospital, St Francis Hospital and Kasarani Hospital.

4.2 Sampling Plan

The sampling area is a stretch from GSU to Roysambu, from Roysambu to Warren and, Roysambu to Zimmerman. The sample sites have motorcycle bays at GSU, Roasters,

Safari Park, Roysambu, Zimmerman and Warren. The criterion for the selection of this stretch was dependent on two factors:

4.2.1 Classes of Roads and Motor Vehicle Traffic

Thika Super Highway is a National Trunk Road with a high proportion of traffic travelling through or between two major urban areas. This section portrays a modern road setting that will depict its challenges and opportunities in relation to motorcycle transport and transportation planning.

The road sections from Roysambu to Zimmerman and Warren are deteriorated road section; a representation of most roads in the Country, these are as well a local road of lesser class and traffic composition.

4.2.2 Socio-Economic Status and Settlement Pattern

The section from GSU to Safari Park presents low density residential land use while the sections from Roysambu to Zimmerman and Roysambu to Warren present high density residential land use.

4.3 Sampling Method

From the target groups discussed earlier in this project report the researcher intends to categorize his sampling method according to the various categories of the target population.

Motorcycle for public transport and those for goods transportation will be sampled using simple random sampling. For the public transport motorcycles that do not have association's purposive non random sampling will be used. Purposive non random sampling will also be used to collect data on private motorcycle riders and passengers

The motorcycle associations will be requested to provide a list of motorcyclist that are registered with them and from the list simple random sampling can be used to get a representative sample from this list.

4.4 Sample Size

According to the Traffic Survey Analysis and forecast, 2007 the study area was found to have a motorcycle population of 454. According to Israel, 2013 with a confidence interval of +-10% and a confidence level of 95% now using the formula.as shown in Appendix 8, **a** sample size of 82 motorcyclists will be taken. A sample size of 20 passengers will be representative. A sample size of 6 tally sheet of each type will be representative to each bay/node as informed by the pilot study.

4.5 Method of Data Collection

Various data collection methods were utilized including interviews, focused group discussions as discussed below.

4.5.1 Primary Data

Data collected for the first time mainly from the source.

4.5.1.1 Interviews

This will include both closed and open ended questions. The instrument to be utilized will be mostly questionnaires. These will contain structured questions to guide the interview session. Two types of questionnaires will be utilized to include questionnaires for motorcyclist (Appendix 1) and questionnaires for passengers (Appendix 2).

4.5.1.2 Focused Group Discussion

Focused Group Discussion will be utilized to try understand the interactions and strategies that have been achieved this far in integrating motorcycle transport and mitigation measures that have been used in addressing some of the issues affecting the sector. This will involve engaging the motorcyclists and their relevant associations.

4.5.1.3 Field Observations

The study will utilize photographs and video recording to capture the observed behavior. An observation guide (Appendix 3) will also be used to guide the field observation. Tally sheet will include tally sheets for motorcycle helmet (Appendix 5) and tally sheet for passenger (Appendix 4) carried per trip.

4.5.2 Secondary Data

4.5.2.1 National Transport and Safety Authority

Find out the regulations or information regarding motorcycle transport that is underway to ensure safety.

4.5.2.2 Traffic Data on Urban Roads from Kenya Urban Roads Authority

Find out the information regarding motorcycle transport and traffic in the urban roads.

4.6 Data Collection

The researcher mobilized, hired and trained individuals to assist in the data collection and data entry. The assistants were also involved in a test run to ensure everyone understands and can play their role effectively. At every step the research assistants shall be supervised in order to minimize laxity and errors.

4.7 Data Analysis and Presentation

Data inputting and analysis will be done on SPSS and Excel spreadsheet. Presentation will be done with the use of Tables, Bar Graphs and Pie Charts.

4.8 Ethical Consideration

A research permit will be obtained from the Department of Urban and Regional Planning (Appendix 8). The respondents were informed of their rights before carrying out any engagements.

4.9 Conclusion

Now that the research methodology in the form of, data-collection methods, measuring instruments, sampling and data analysis sets the stage for the implementation of data-collection and analysis process.

CHAPTER FIVE: STUDY AREA

5.0 Introduction

The study area provides a detailed understanding of the background, the current situation and the future of the study area. This will bring out the attributes that constitute the study area.

5.1 National and International Context

The Nairobi-Thika Super Highway is a dual-carriageway highway of about 45 km. The road is part of the classified international trunk road A2. The super highway begins in downtown Nairobi and extends to Moyale. The highway forms part of the Trans-African Highway network which comprises transcontinental road projects in Africa being developed by the United Nations Economic Commission for Africa (UNECA), the African Development Bank (ADB), and the African Union in conjunction with regional international communities.

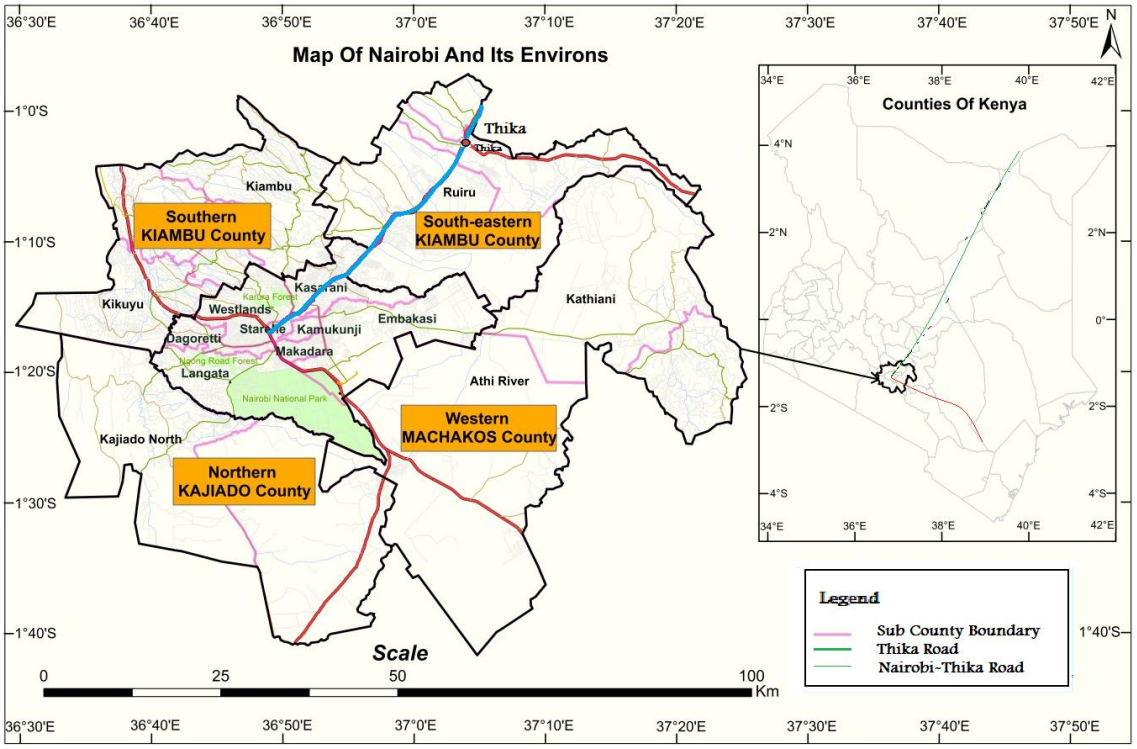
This transport infrastructure lies along the Cairo-Gaborone-Capetown Corridor. The total length of the highways in the network is 56,683 km (African Development Fund, 2008)

They aim is to promote trade in Africa through highway infrastructure development and the management of road based trade corridors.

5.2 Regional Metropolitan Context

Thika Super Highway runs across two Counties. The road begins in Nairobi County and ends in Kiambu County (Figure 3). The road is a major trunk road that allows for traffic across Nairobi County to other parts of the country including to and from Mombasa County to Kirinyaga, Laikipia, Muranga and various other counties in the Country.

Figure 3: Regional Metropolitan Context



Source: NIUPLAN, 2014: Page 1-8

5.3 Thika Super Highway Improvement Project

The Government of Kenya (GOK) in 2006 solicited the financial assistance of the African Development Bank (AfDB) for the rehabilitation and upgrading of the Nairobi-Thika Highway. This component was a follow-up to the Nairobi Urban Transport Master Plan study funded by Japan International Corporation Agency (JICA).

The road is part of the classified international trunk road A2 which originates in downtown Nairobi and extends to Moyale at the Ethiopian border. The section of highway that was considered for rehabilitation and upgrading was constructed to bitumen standard in the early 1970's and the economic life of the road had long expired.

This section operated beyond capacity, carrying more than 30,000 vehicles per day. Therefore to accommodate the existing and future traffic, the highway needed substantial improvements to increase its capacity which entailed the construction of additional lanes and the removal of at grade intersections at six locations to be replaced by interchanges.

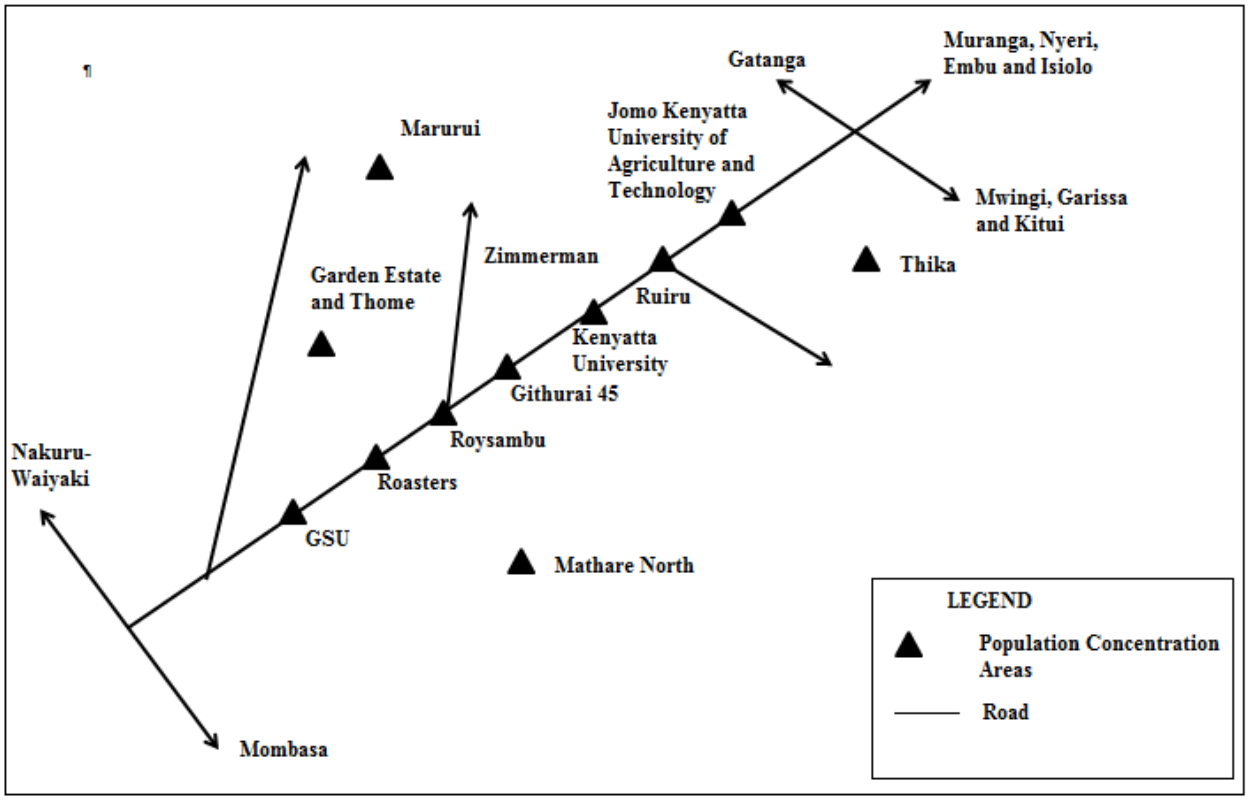
The Nairobi Thika Highway improvement works involved the provision of additional capacity through construction of additional lanes (from four-lane to a six-lane highway),

and reconstruction of the existing carriageway pavement; the construction of services roads to segregate through traffic from local traffic; the construction of cycle lanes footbridges and walkways to segregate non-motorized traffic from motorized; the construction of traffic interchanges at six (6) locations to replace the existing roundabouts at Pangani, Muthaiga, GSU, Kasarani, Githurai, and Eastern Bypass; and the rehabilitation of some existing bridges, execution of drainage structures, and road safety devices.

5.3.1 Population Concentration Areas

Thika Super Highway serves various high population concentration areas that provide high volumes of both human and vehicular traffic. These areas include Allsops/General Service Unit, Mathare North, Thome/ Garden Estate, Roysambu, Zimmerman, Kasarani, Githurai, Kahawa Barracks, Kenyatta University, Juja and Jomo Kenyatta University of Agriculture and Technology (Figure 4).

Figure 4: Population Concentration Areas

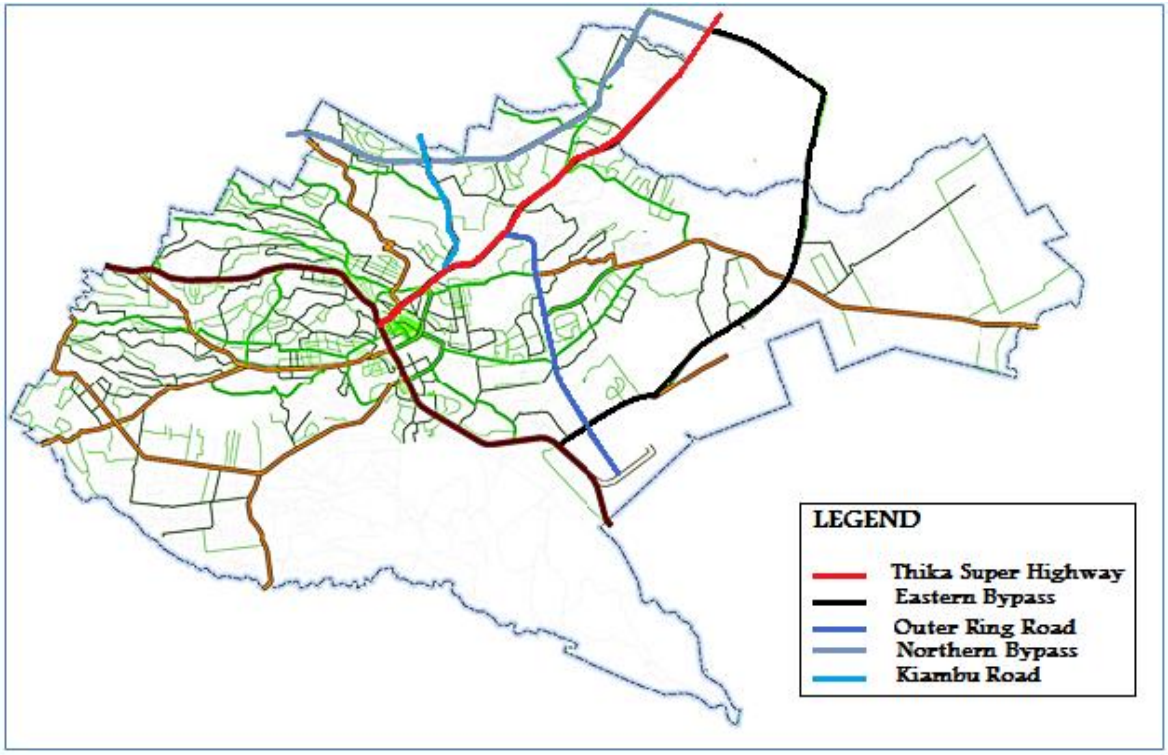


5.4 Nairobi County Context

Thika Super Highway originates in Nairobi County; Starehe Sub-County as shown in Figure 3.The road then further runs through Kasarani and Embakasi Sub Counties in Nairobi County.

Thika Super Highway collects and channels traffic to carious other major roads in Nairobi County to include Kiambu Road, Outer Ring Road, Eastern Bypass and Northern Bypass (Figure 5).

Figure 5: Thika Super Highway in Relation to Other Roads



Source: NIUPLAN, 2014: Page 5-56

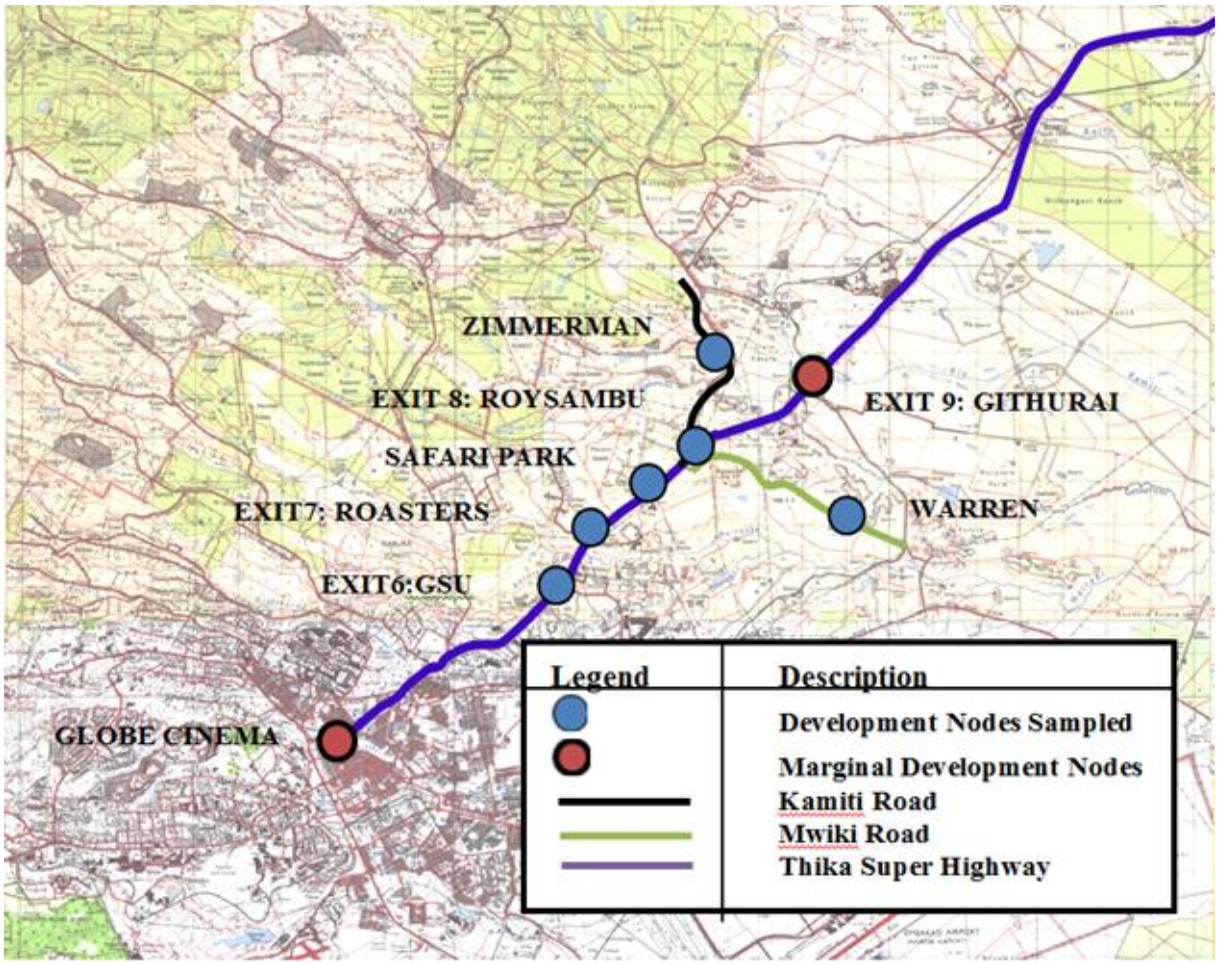
5.5 Study Development Nodes

The improvements had two objectives; to contribute to the improved performance of the economic sectors and the delivery of social services in Kenya; to improve land transport communication between Kenya and Ethiopia and thereby contribute to regional integration.

Besides regional development the road construction has also brought about major development at various nodes along the road. Most of these development nodes are

characterized by recent infrastructural and social growth. The various development nodes are areas that have experienced rapid growth in the recent past (Figure 6).

Figure 6: Selected Development Nodes along Thika Super Highway



Source: Survey of Kenya, 2014

5.5.1 Exit 6: General Service Unit

The General Service Unit (GSU) is a major intersection between Outer Ring Road and Thika Super Highway (A9). Outer Ring Road begins at Eastern Bypass and ends at Thika Super Highway. Outer Ring Road collects traffic from three major arteries; Eastern Bypass, Jogoo Road and Juja Road and channels the traffic to Thika Super Highway.

The General Service Unit area comprises of various high density residential areas to include Mathare Slums, Baba Dogo Estate and Kariobangi North Estate. Part of Baba Dogo and the GSU area is of industrial land use with major human and vehicle traffic

especially during the peak hours. Some of the industries in the area include, Kenafric Industries Limited, Export Processing Zone Ruaraka, Premier Industries Limited and Pro Pack Industries. The area also hosts the headquarters for the General Service Unit Police and their living quarters.

5.5.2 Exit 7: Roasters to Garden Estate Road

The area has been rapidly developing since the completion of the Thika Super Highway. The area is characterized by low density residential land use with various estates including Ridgeways Estate, Garden Estate, Thome Estate Safari Park Estate the recently constructed Tusker Village Estate and the ongoing construction of the Garden City Village; comprising of a gated community set up with a mall and residential housing. The area also comprises Gumba Estate a high density residential estate.

The area is also served by various hotels and inns to include Safari Park Hotel and Casino, Jambo Grill, Amazon Hotel, Salama Hotel, Homeland Inn, Blue Spring Hotel and Roasters Hotel. Various other hotels have come up recently to include the Sagas Motel, Upways Hotel, Natives Bar and Grill and Hagon Hotel.

The area has also seen the development of a various shopping centers that include Uchumi Jipange and Mountain Mall; a retail and entertainment complex.

Further the area hosts the East African Breweries Limited subsidiaries companies and partners that include Kenya Breweries Limited, Kenya Wine Agency Limited and East Africa Maltings.

5.5.3 Exit 8: Kasarani and Roysambu

This development node is zoned as a mixed land use of commercial and residential land uses according to the Nairobi Integrated Urban Plan (NIUPLAN), 2014. The node is evolving to an entertainment and commercial district serving the needs of the high density residential estates around that include Mwiki Estate, Githurai 44 Estate, Roysambu Estate, Warren Estate Kahawa West Estate and Zimmerman Estate. The development node has seen major growth in housing attributable to by the high demand especially after the construction of Thika Super Highway.

The growing population required commensurate provision of services; this has seen the development of Thika Road Mall (TRM) and Naivas Supermarket. There has also been

introduction of financial institutions that include Cooperative Bank of Kenya, Barclays Bank, Unaitas Bank, Kenya Women Finance Trust and Equity Bank.

Various entertainment spots have developed that include Monaco Restaurant, Sports Veiw Hotel, Dormans Restaurant and Seasons Restaurant. Kasarani also hosts the countries national stadium which hosts various major sport and social events.

Roysambu section of Kasarani hosts a majority of students from the United States International University and Pan African University. Other schools in the development node include Institute of Advanced Technology, Mahamaim International High School and Mountain View Schools.

Commercial enterprises in the development node include a majority of retail and wholesale businesses trading in household goods and various construction industry items. There are also international and regional organizations that include the Regional Center for Mapping and Resource Development (RCMRD) and the International Centre of Insect Physiology and Ecology (ICIPE).

The Thika Super Highway Improvement Project created ease of access to this estates and this also further informed the development of various roads in Kasarani which included the Construction of the Eastern Bypass, the Periodic Maintenance of Kasarani Mwiki Road and the Construction of a Link to Kasarani Mwiki Road which further opened up accessibility and provision of services to the development node.

5.5.4 Exit 9: Githurai 45

Githurai 45 is predominantly middle and low income residential land use. The area is unplanned and the growth is characterized by dense settlements, pollution and other urbanization issues. Githurai is located at the peri urban and therefore presents affordable housing to people working in both Nairobi County and Kiambu County

The economic activities of the area are also influenced by land uses such as residential, educational, public purpose and agricultural. Major employers include schools and other educational institutions, commercial centers, petrol filling stations, garages, construction sites, security firms and residents. In addition, informal trading along the major roads such as furniture displays and building materials, among others, offer significant levels of employment.

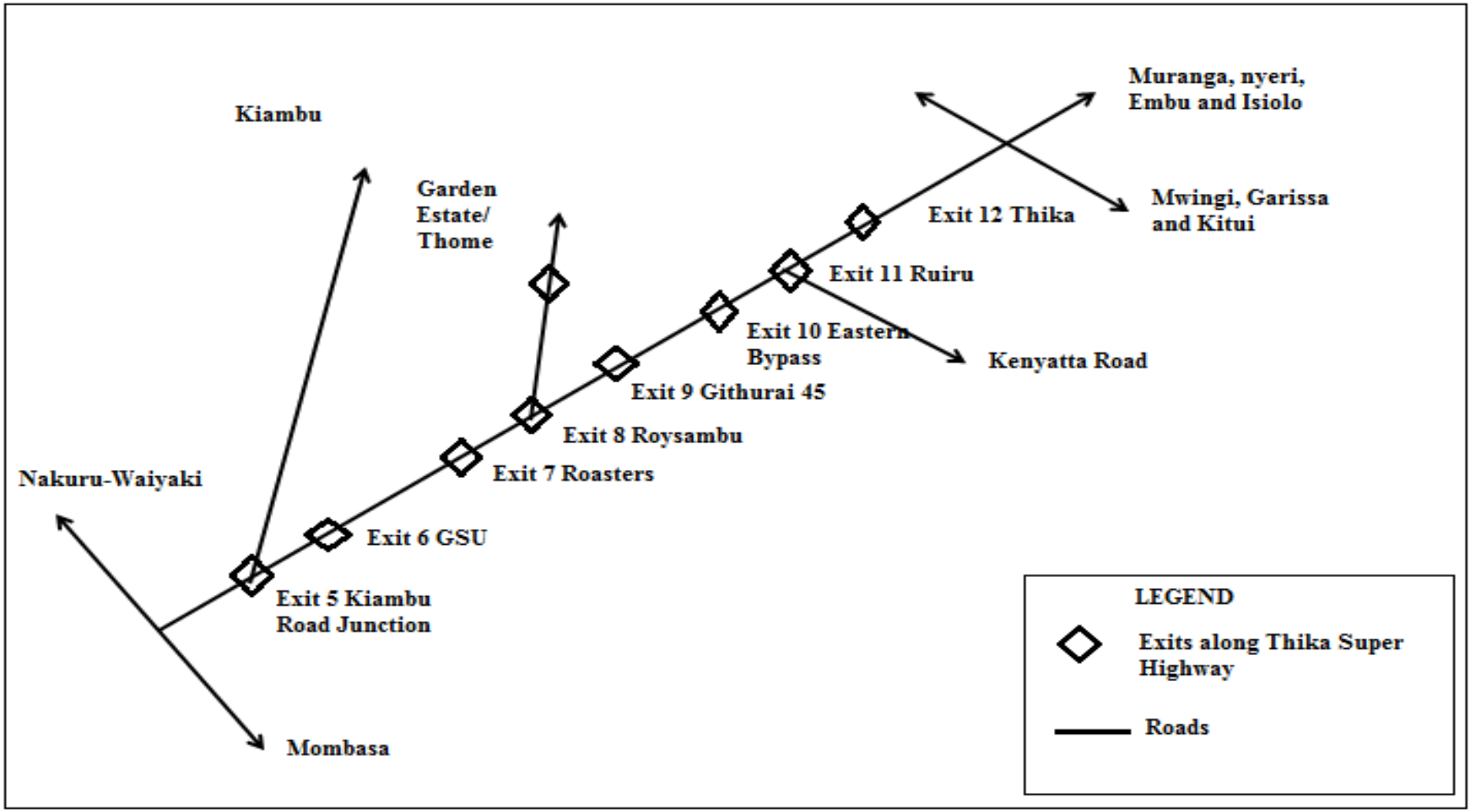
Githurai Market offers sale of fresh produce from the rest of the country. The market is the largest in the North of Nairobi serving majority of the estates along Thika Super Highway.

Thika Super Highway opened up access to Githurai and enhanced safety and was a trigger for development that included establishment of various financial institutions that included Cooperative Bank, Equity Bank and Family Bank. Various primary, secondary and tertiary facilities are also at these development nodes that include: Blessed Hands High School, St Lucie Kiriri Girls High School, Kiriri Women's University of Science and Technology and Lily Academy.

Githurai is served by the Thika Road Super Highway and a branch of the Kenya-Uganda Railway from Nairobi to Thika via Ruiru. Githurai can also be accessed through the Githurai-Kimbo-Mwihoko Road that is currently under construction.

Other exits along the Thika Super Highway are as shown (Figure 7).

Figure 7: Super Highway Exits



5.6 Conclusion

The development nodes along Thika Super Highway have all developed uniquely since the improvement of Thika Super Highway. This has created an influx in the growth of population and therefore a demand for more convenient means of transport in the access of the social and economic facilities.

CHAPTER SIX: DATA ANALYSIS AND FINDINGS

6.0 Introduction

The following information includes survey results analysed based on the data from questionnaires administered to the riders and the passengers, tally sheets, key informant interviews and a focused group discussion. These are discussed below.

A total of 78 respondents from the six motorcycle bays participated in this survey, four of the questionnaires got spoilt. Twenty (20) motorcycle passengers questionnaires were administered and twelve (12) tally sheets were utilised.

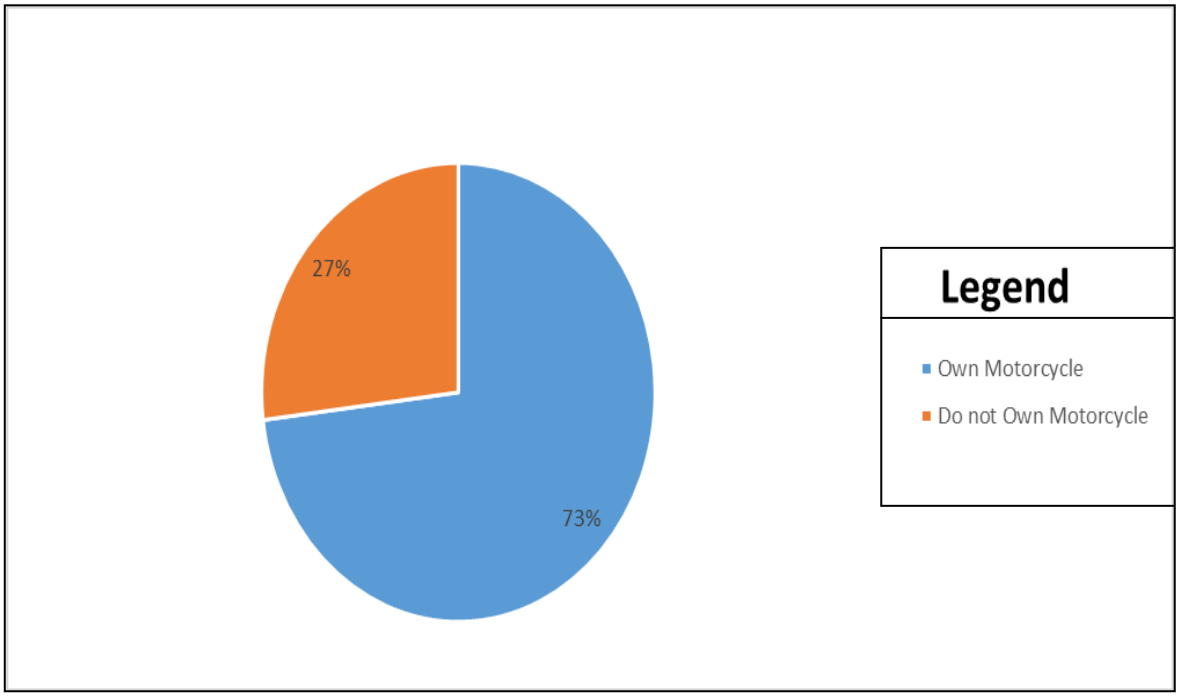
6.1 Motorcycle Operational Practices

This provides a description of the existing motorcycle operational practice centered on the motorcycle, the operators and the passengers.

6.1.1 Motorcycle Ownership

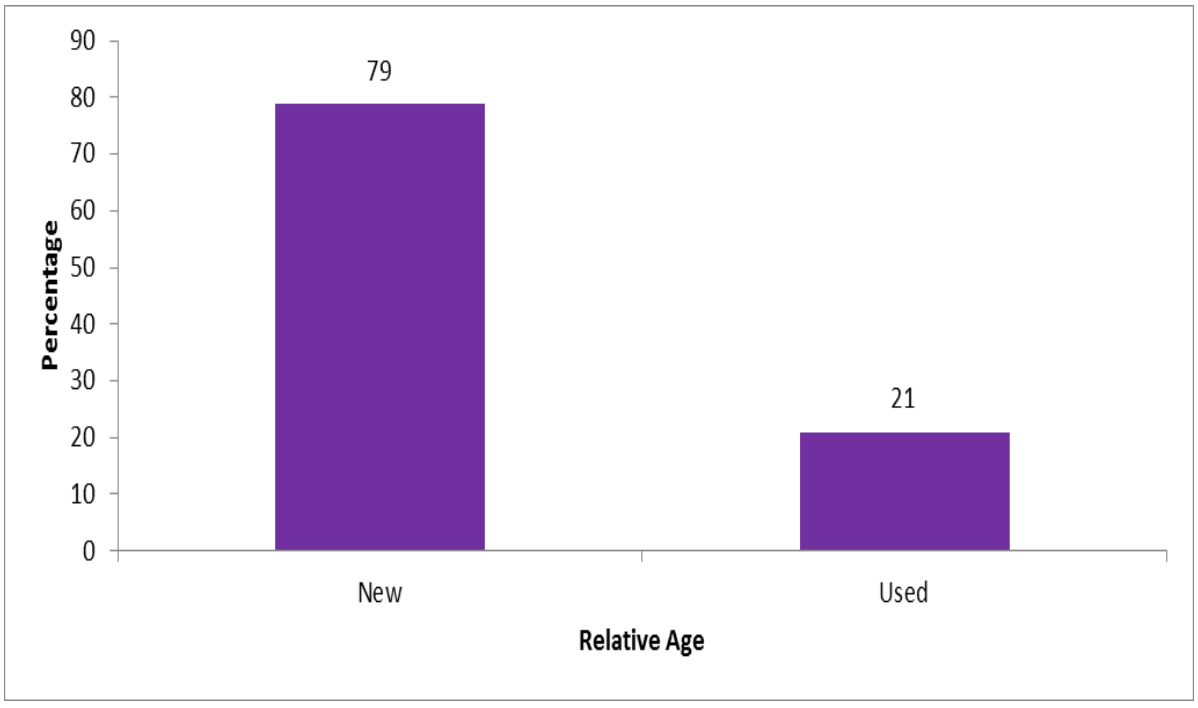
There is a clear distinction in the pattern of ownership of motorcycles. A large number of the motorcycle operators operate their own motorcycle, this comprised 73% of the respondents while 27% were either employed or hired to operate the motorcycles at a daily fee of Ksh.300 (Figure 8). The operators that hire motorcycles acquire from either private proprietors or motorcycle associations. Those who had hired the motorcycles had used 1, 2 or three different motorcycle makes with the past one year at the time of the field study.

Figure 8: Ownership of Motorcycle



Of the 73% who indicated they owned the motorcycles (79%) had bought the motorcycles new while (21%) of them bought them used (Figure 9). There is a preference for new motorcycles but this is dependent on the financial stability of an individual.

Figure 9: The Relative Age of Motorcycle when Purchased



6.2 Types of Motorcycle

The various motorcycle nodes surveyed had standard motorcycle types with Chinese brands comprising 81%, Indian brands comprising 12% and Japanese brands comprising 6%. Sixteen different brands of motorcycles were operating in the motorcycle bays along the study area. Boxer Bajaj make was the most commonly used motorcycle with a frequency of 39.7% with most responses indicating that there was preference due to its low fuel consumption. The second most popular motorcycle was Bm with 14.1% and the least popular included TVS, Lion and Tygo which had a frequency of 1.3 % (Table 4).

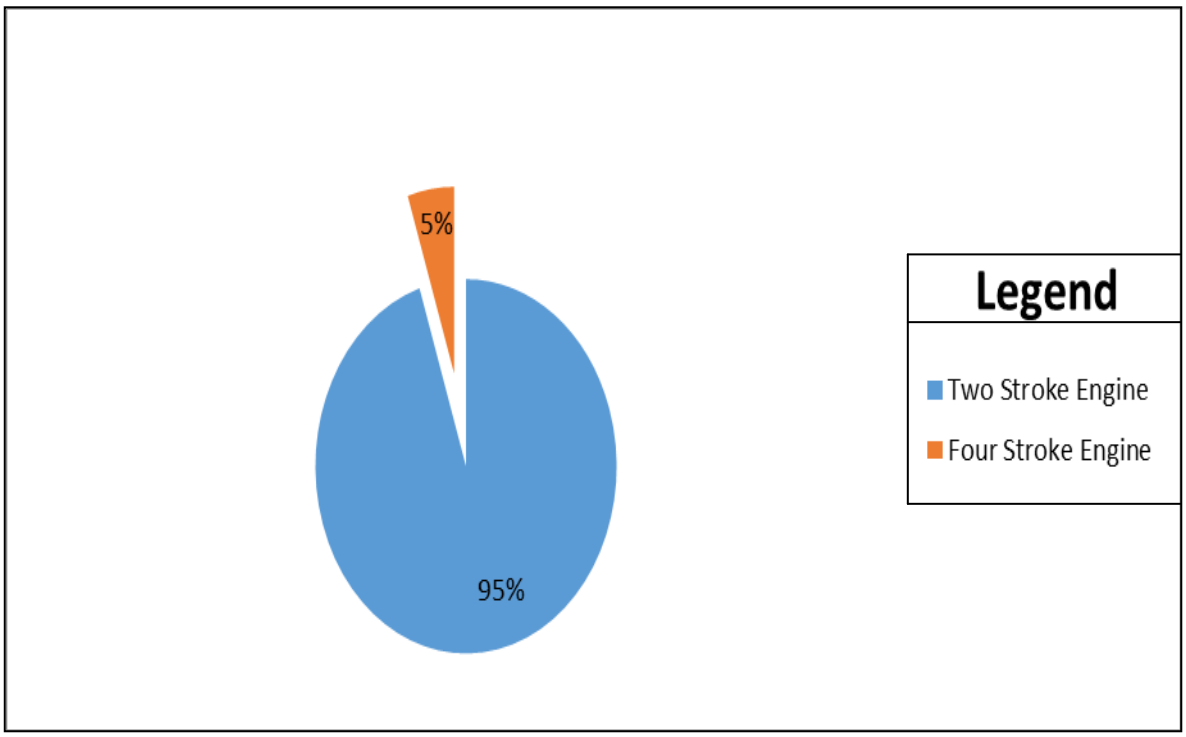
Table 4: The Types of Motorcycle and Country of Origin

Motorcycle Make	Frequency	Percent (%)	Country of Origin
Boxer Bajaj	31	39.7436	India
BM	11	14.1026	
Yamaha	1	1.28205	Japan
Gincheng	1	1.28205	China
Racer	1	1.28205	
Ranger	3	3.84615	
Tvs	1	1.28205	
Lion	1	1.28205	
Skygo	1	1.28205	
Focin	1	1.28205	
Shineray	8	10.2564	
Premier	5	6.41026	
Captain	5	6.41026	
Dayun	3	3.84615	
Tiger	3	3.84615	
Super Star	1	1.28205	
Total	**77**	**98.7179**	
No response	1	1.28205	
Grand Total	**78**	**100**	

The Bajaj is considered the most expensive at Kshs 100,000 as compared to most other brands that range between Kshs 80,000 to 85,000 when new. The motorcycles brands included different engine carrying capacities; they comprised 100cc, 125cc and 150cc.

The survey identified that 95% of the motorcycles were two stroke engine motorcycles as compared to 5% four stroke engine motorcycles (Figure 10) an indication of very high pollution of volatile organic compounds and particulate matter.

Figure 10: Rating of Motorcycle Engine



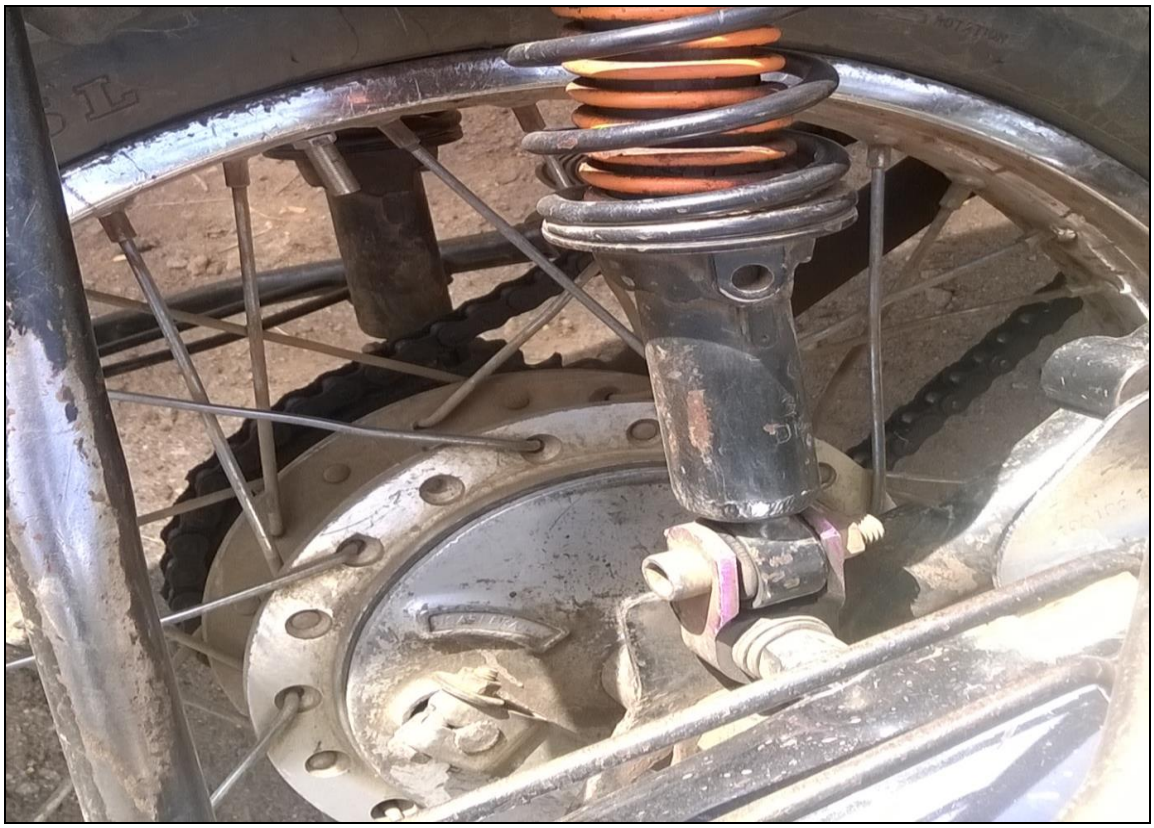
6.3 Types of Modification on Motorcycles

According to the field survey 75.6% of the operators had not modified their motorcycles while 14.6% of the motorcycle operators had put in various modifications on their motorcycle. The various modifications and the reasons for installation are as discussed below:

6.3.1 Shock Absorbers

The operators indicated that increasing the length of the shock increases the span between the seat and the back wheel which therefore allows them to carry more weight or passengers as compared to the 'manufacturers height'. Although this compromises the stability of the motorcycle the modification is quite common. The modification in purple (Plate 13) extends the length of the shock absorbers.

Plate 13: Modification of Shock Absorbers



Source: Field (2014)

6.3.2 Installed Visor

The visor (Plate 14) act as protective gear as well as protection from the cold when the operator is riding especially during the evenings or when riding on a dusty road they protect the eyes from pebbles and dust particles.

6.3.3 Installed Side Guards

The side guards act as protective gear when the motorcycle is maneuvering in narrow streets or filtering through traffic or when the motorcycle is traversing through thickets or bushes. They protect the knee cap to heel of the leg of the motorcyclist.

Plate 14: Visors and Side Guard Installed on a Motorcycle

Source: Field (2014)

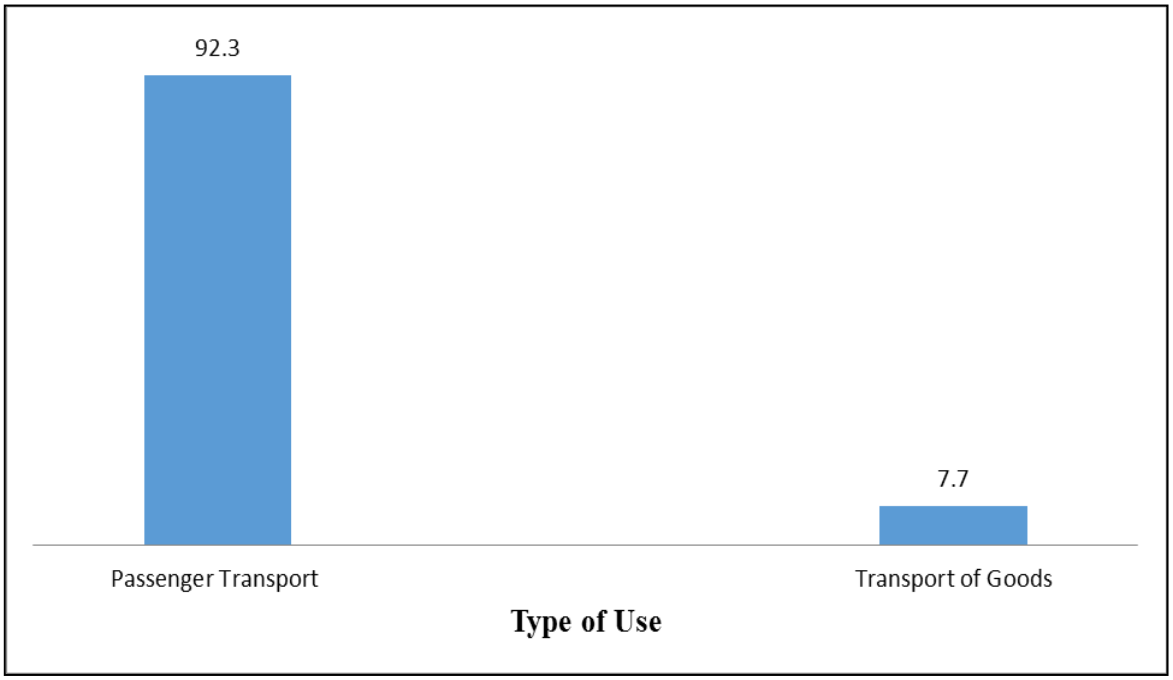
Other modifications put on the motorcycles include placing a radio for entertainment as well as attracting potential customers, light boosters to enhance visibility which also act as back up incase lights fail and installation of grills to protect indicator lights and also to strengthen the body.

6.4 Type of Service

Motorcycle for passenger transport comprised 92.3% of the respondents with 7.7% representing those with motorcycles for transport of goods. The motorcyclist for

passenger transport indicated that they used for either their personal transport or commercial transport. Motorcycles for transport of goods mainly comprised of goods delivery and distribution including meat delivery, parcel deliverly and clothes delivery. Figure 11 shows the above description.

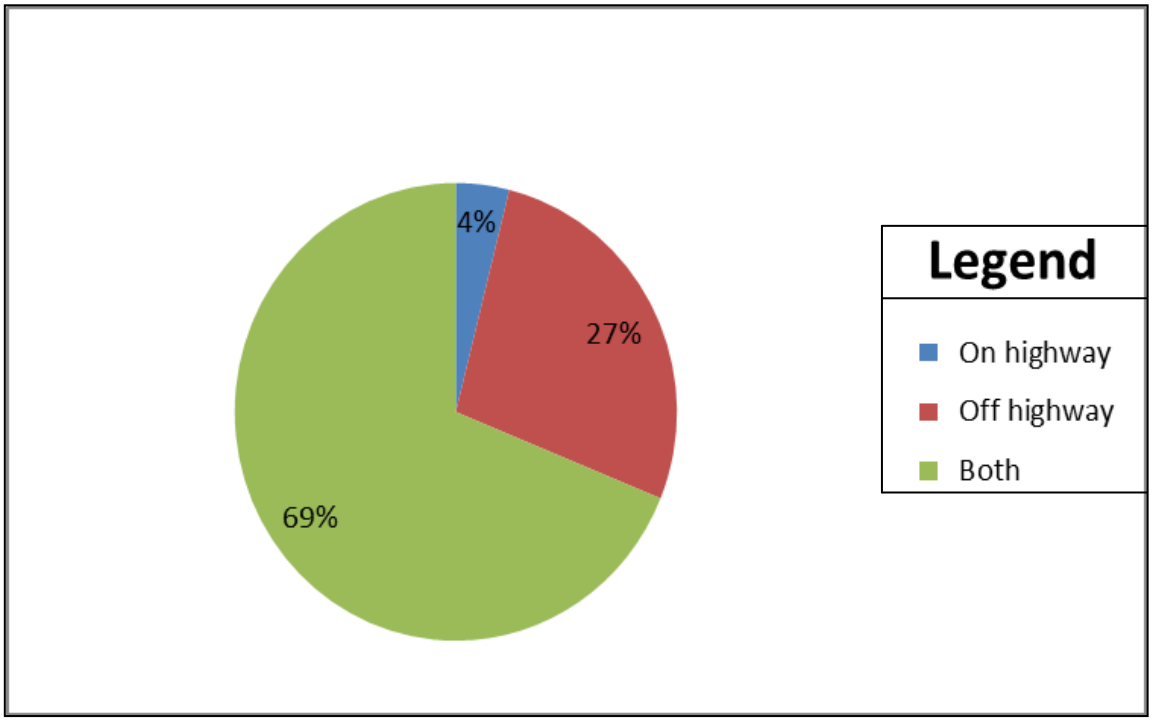
Figure 11: Main Categories of Motorcycle Uses



The motorcycles for passenger transport indicated that they were used to serve both residential and commercial land use while those for transport of goods mainly served commercial land uses.

The motorcycle operators indicated that 69% often ride on both the highway and off the highway while 27% indicated that they most often ride off the highway and 4% indicated that they ride on the highway only (Figure 12**)**. This shows that the motorcycle is used to serve both short distances and long distances while others only serve the residential estates only.

Figure 12: Main Routes of Motorcycle Transport



The majority of motorcycle operators indicated that that their average riding distance per day was 50 to 80 kms and 81 to 110 kms (Table 5). The least distances covered were above 200 kms and below 20 kms at 1.3% and 2.6%, respectively.

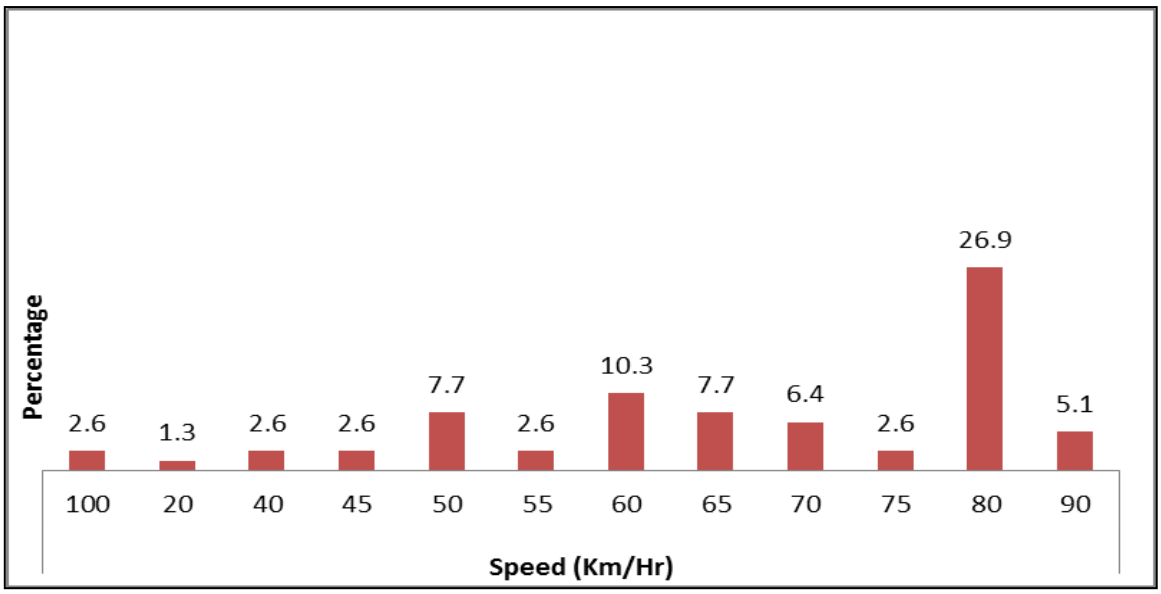
Table 5: Average Riding Distance per Day

Distance (Km/hr)	Percentage (%)
Less than 20 Kms	2.6
21-50 Kms	16.7
51-80 Kms	29.5
81-110 Kms	28.2
111-140 Kms	11.5
141-170 Kms	5
171-200 Kms	5.2
Above 200 Kms	1.3
Total	**100**

On highway, the larger bulk of motorcyclist ride at a speed of 60 km/hr and above. Figure 13 shows 26.9% of motorcyclists ride at an average speed of 80km/hr, while 10.3% ride at an average of 60km/hr. Some of the motorcyclists also ride at considerably high speeds with 5.1% and 2.6% riding at an average speed of 90 km/hr and 100 km/hr. respectively. These speeds are quite high for the motorcycles especially when riding on the highway which puts most of the riders at increased accident risk. A small percentage of the riders

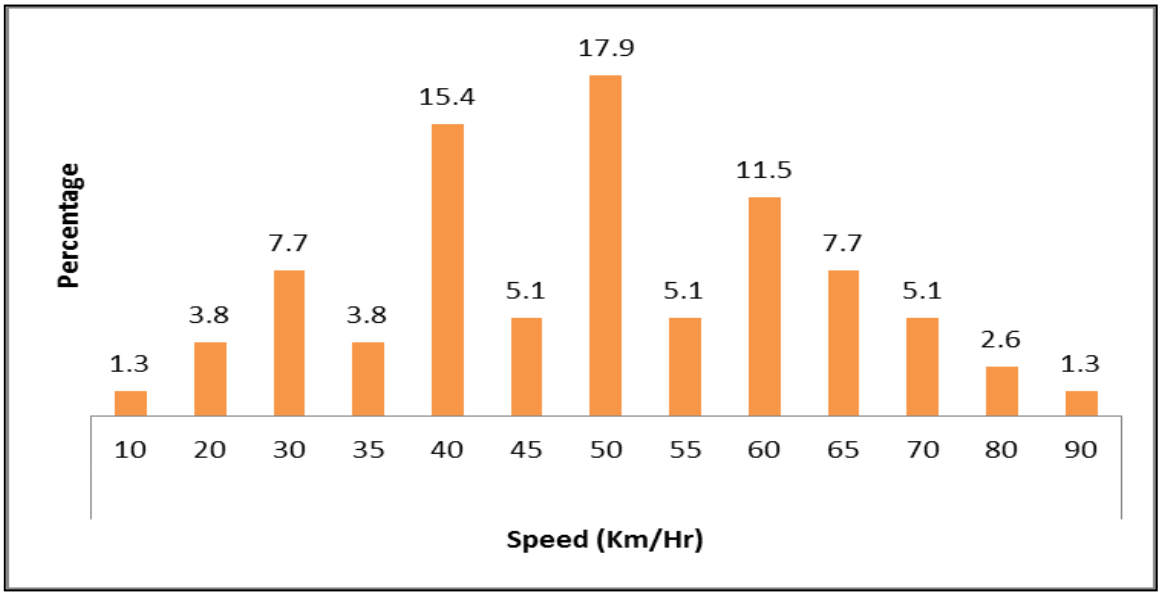
operate at safer speeds with 2.6% and 1.3% riding at speeds of 40 km/hr. and 20 km/hr. respectively.

Figure 13: Average Speed on Thika Super Highway



Off highway motorcycle riding is mostly done on local streets serving residential areas. Majority of the motorcyclists at 17.9% ride at an average speed of 50km/hr while the minority ride at speeds of below 60km/hr (Figure 14).

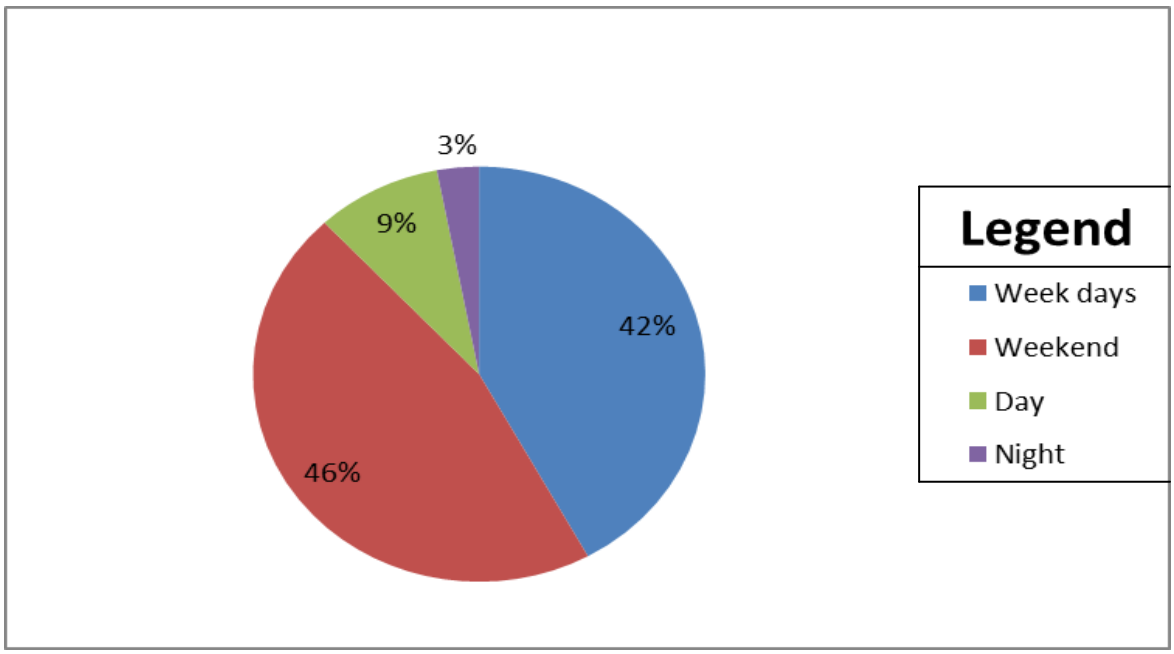
Figure 14: Average Speed off Thika Super Highway



The motorcyclists are most active during the weekends probably due to the increased passengers as compared to the weekdays. The operators indicated 46% spent their

weekend riding as compared to 42% who felt that the weekdays were busier. 9% and 3% felt that Day and Night operations were busier (Figure 15).

Figure 15: Distribution of Motorcycle Ridership

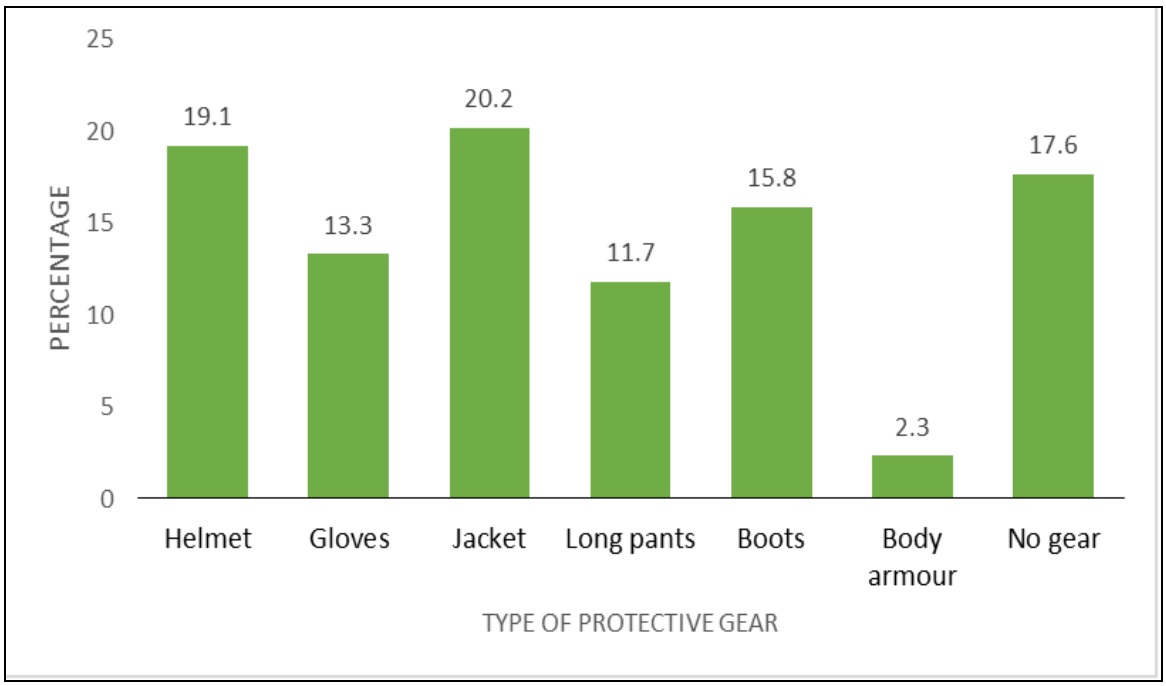


6.5 Safety

The motorcycle operators have no much restriction on the number of passengers to carry. The survey indicated that 86% of the respondents carry one passenger while 14% carry two passengers a clear violation of the Traffic Act.

The protective gear worn by the motorcyclists include; helmet, gloves, jacket, long pants, boots and body armour. The most commonly worn protective gears are Jacket, helmet, and boots with 20.2%, 19.1% and 15.8% respectively. Other operators never wore any protective gear and they comprised 17.6 % of the respondents (Figure 16). Body armour was the least worn protective gear at 2.3%.

Figure 16: Distribution of Protective Gear Worn



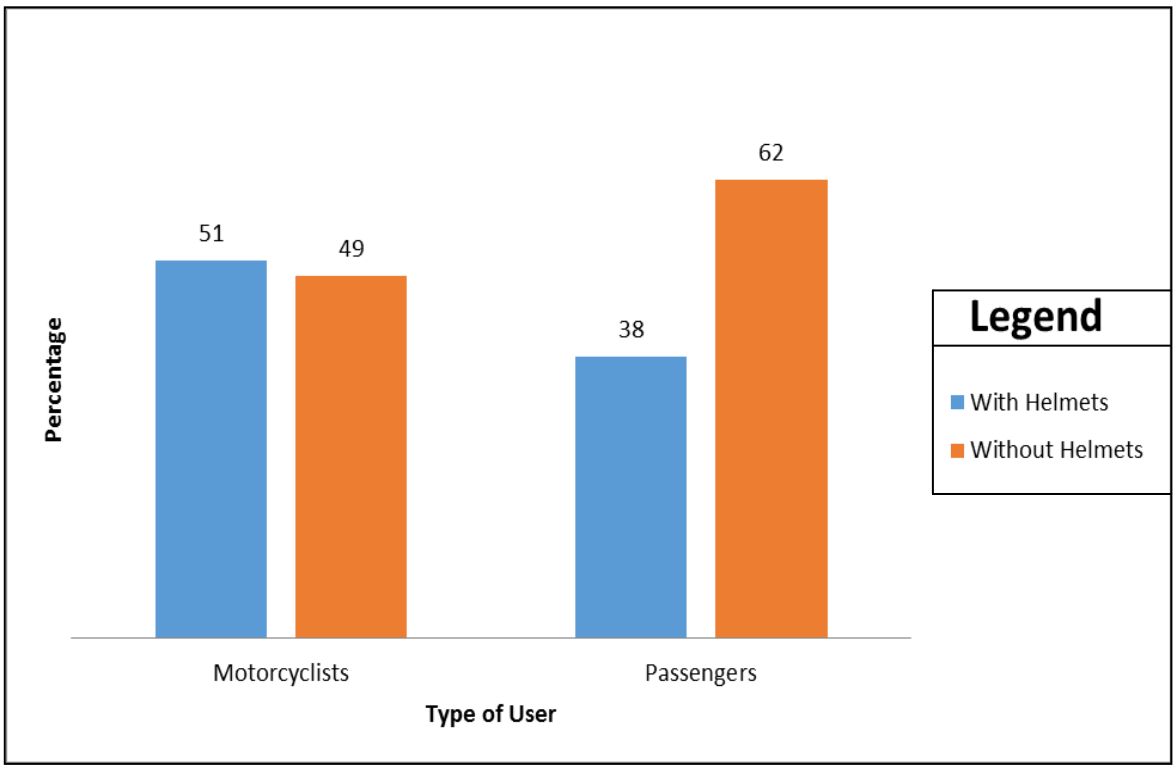
The motorcycle operators indicated that they all wear reflective protective gear. This however meant that one of the protective gears that they wore had a reflective property rather than all the gear. They therefore informed the survey that 91% wore reflective jackets; making the jacket to be the most used reflective gear followed by long pants at 7.7% and helmet at 1.3% (Table 6). The jackets are more common due to their availability in the local second hand markets and also because of their relatively cheap price.

Table 6: Type of Reflective Protective Gear

Type of Reflective Clothing	Frequency	Percent
Jacket	71	91.0
Long pants	6	7.7
Helmet	1	1.3
Total	**78**	**100.0**

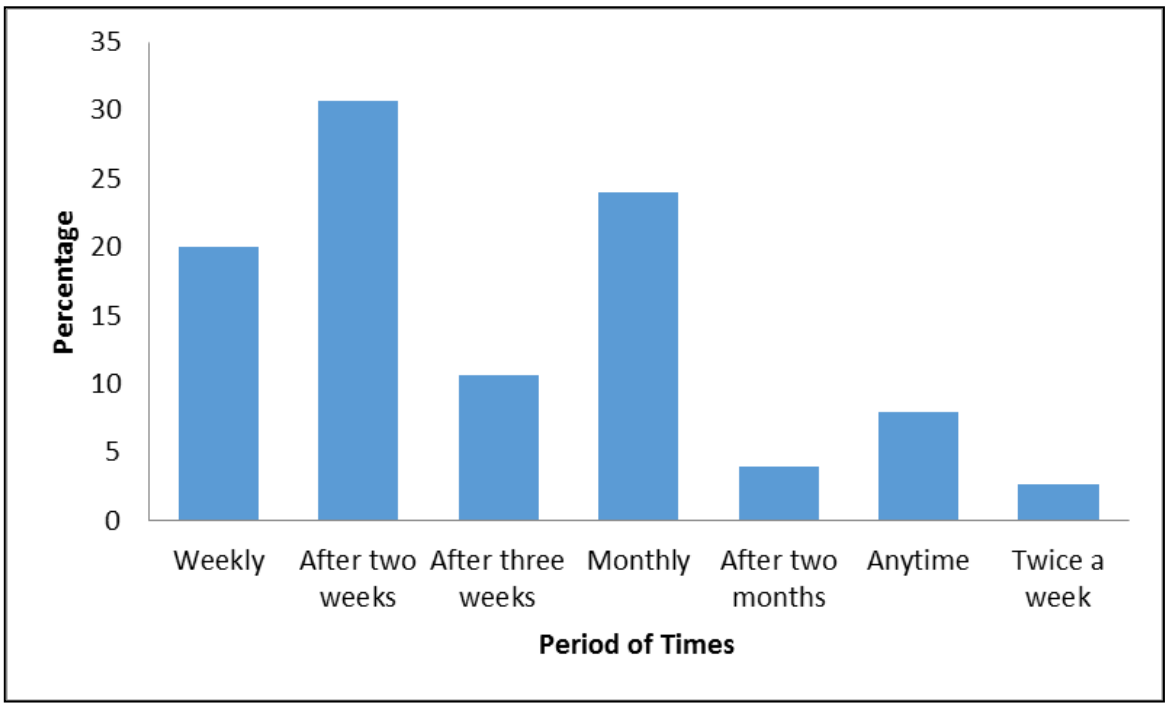
Helmet use was found to be more common in motorcycle riders as compared to the passengers. The motorcycle riders with helmets comprised 51% while those without helmets comprised 49% whereas the passengers with helmets comprised 38% while those without helmets comprised 62% (Figure 17). A clear indication that majority of the motorcycles have only one helmet. This is clear that the helmet would be either worn by the rider or the passengers but in most instances the riders is wearing the helmet. While this would be secure for the wearer, the other is at risk in case of an accident or injury.

Figure 17: Distribution of Helmet Usage by Passengers and Motorcyclists



How often a motorcycle operator takes his motorcycle for maintenance/ repair is inversely proportional to risk of conflict with other vehicles. Negligence of the motorcycle could lead to knocking of the engine or breaking of the wheel chain, all of which are extreme risks to running vehicles. The survey found that 30.7% of the operators take their motorcycles for repair/maintenance after every two weeks followed by the operators who repair monthly and weekly at 24% and 20% (Figure 18). The operators who took their motorcycles for repair/ maintenance least often were after two months and twice a week at 4% and 2.7% respectively. Two weeks is the advisable period of time to take before you take your motorcycle for repair, therefore a majority of the riders are riding motorcycles that are not roadworthy.

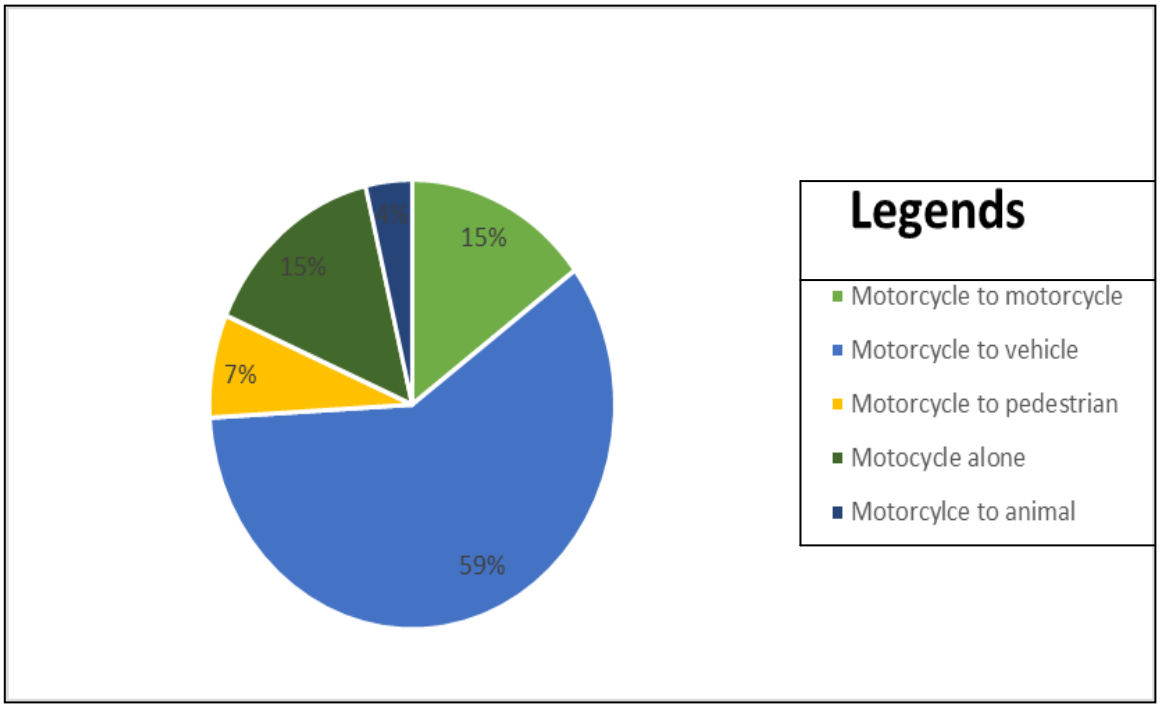
Figure 18: Repair Period Taken for Motorcycles



According to the study 64.1% of the operators indicated that they have never been involved in a crash over the last one year. The operators involved in 1 to 2 times and those who were involved more than five times followed at 24.4% and 6.4% respectively. The least involved in crashes were the operators who had crashes 3 to 5 times at 5.1%.

Those involved in accidents over the last one year were found to have had various forms of conflict with other modes of transport. The operators involved in motorcycle to vehicle conflict comprised 59.3%, while motorcycle to motorcycle conflict and motorcycle crashing on its own both followed at 14.8% each. The least conflict recorded was that of motorcycle to pedestrian and motorcycle to animal at 7.4% and 3.7% respectively (Figure 19).

Figure 19: Motorcycle Conflict



The study identified three types of motorcycle insurance cover taken up by the operators. These are; Comprehensive Insurance and Third Party Insurance Cover. The most commonly used type of insurance cover was the Comprehensive Insurance Cover which was taken up by 79.5% of the operators. This was followed by the Third Party Insurance cover with 16.7% of the operators having subscribed to the cover while 3.8% of the operators had no insurance cover (Plate 15).

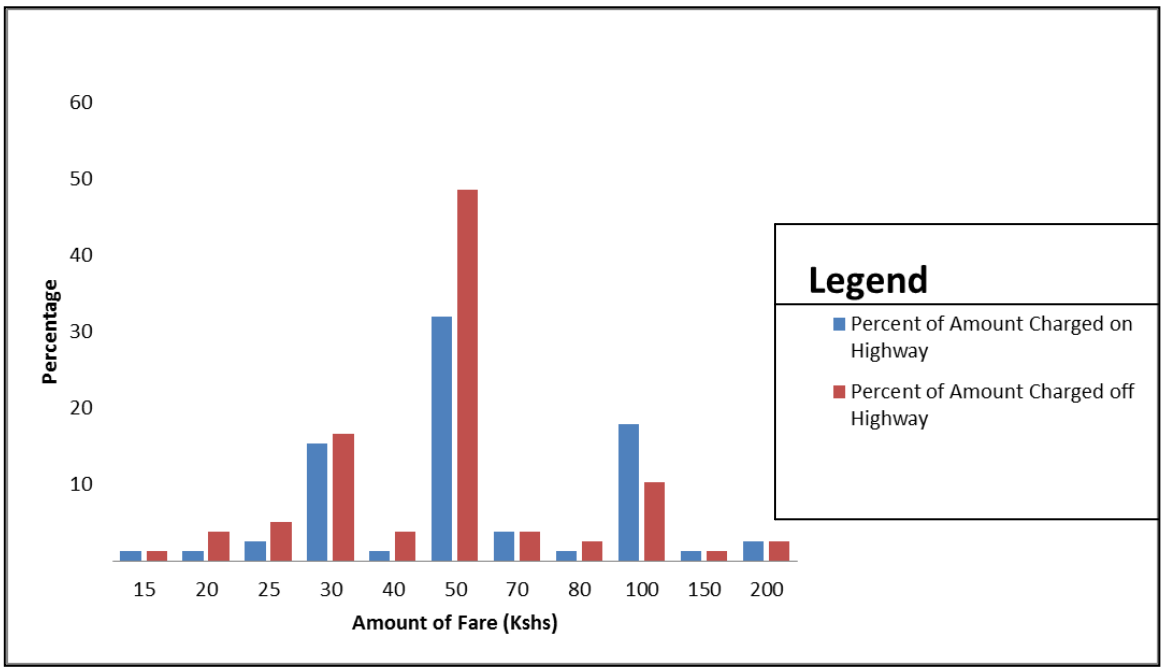
According to the National Transport and Safety Authority the majority of the conflict in motorcycle transport is between pedestrians and motorcyclists. In 2014 the authority has recorded more than 95 fatalities by this form of conflict in Nairobi. The Authority cited some of the factors contributing to these fatalities among them, the lack of adequate and clearly marked zebra crossings and poorly lit foot bridges making them unsafe to use at night. The Authority also cited the accenting of the draft National Transport and Safety Authority (Operation of Motorcycles) Regulations, 2014 would greatly boost enforcement and the refining of motorcycle transport in the country.

Plate 15: Certificate of Insurance

6.6 Fares

The motorcycle fares were highly dependent on various aspects; the time of travel (day or night), the destination of travel i.e. fares in low density residential areas are higher than fares in high density residential areas, the season of travel i.e. rainy seasons are charged more than in dry seasons due to the terrain. Most operators (30%) charged Kshs 50 per kilometre travelled on the highway as compared to 48% of operators who charged Kshs 50 per Km travelled off the highway. There is also very minimal disparity between the various other fares in comparison between on the highway and off the highway (Figure 20).

Figure 20: On and Off Peak Fares for Passenger Transport

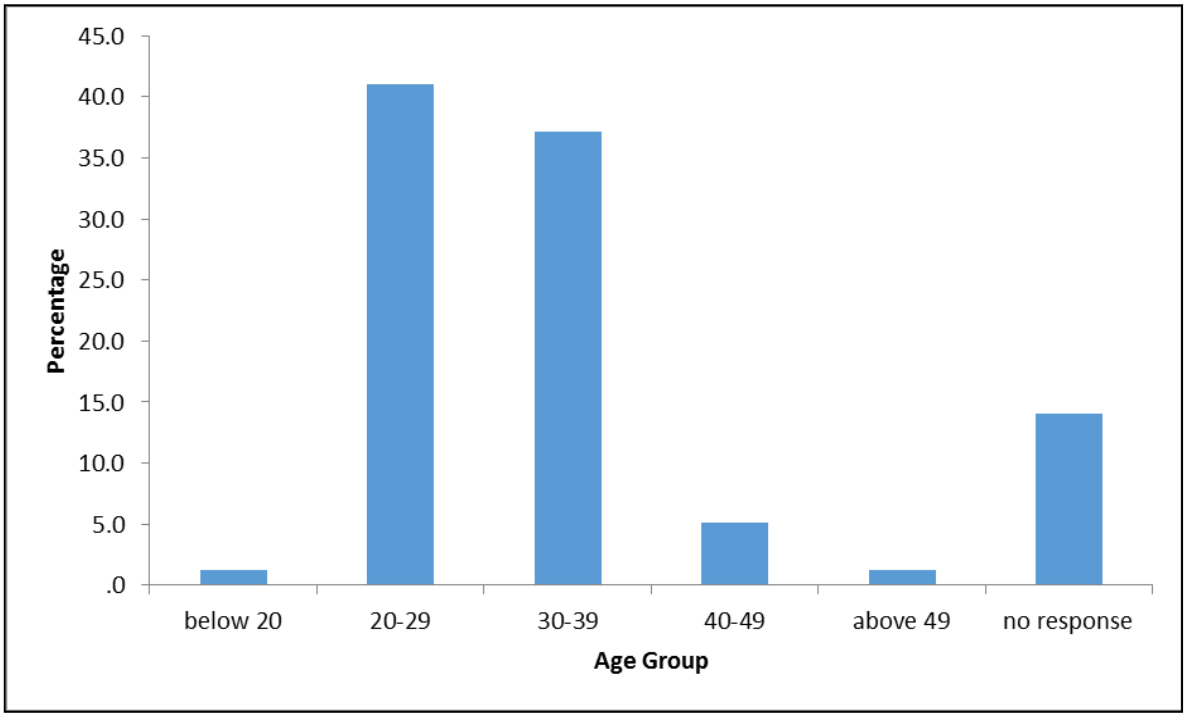


6.7 Motorcycle Operators

The findings of the survey indicated that 100 percent of those interviewed were male motorcycle riders. This should however not be construed to mean that the industry is 100 percent male dominated. There is no apparent reasons why women should not operate other than cultural acceptance in a male dominated enterprise and the long working hours away from home coupled with insecurity especially in the night.

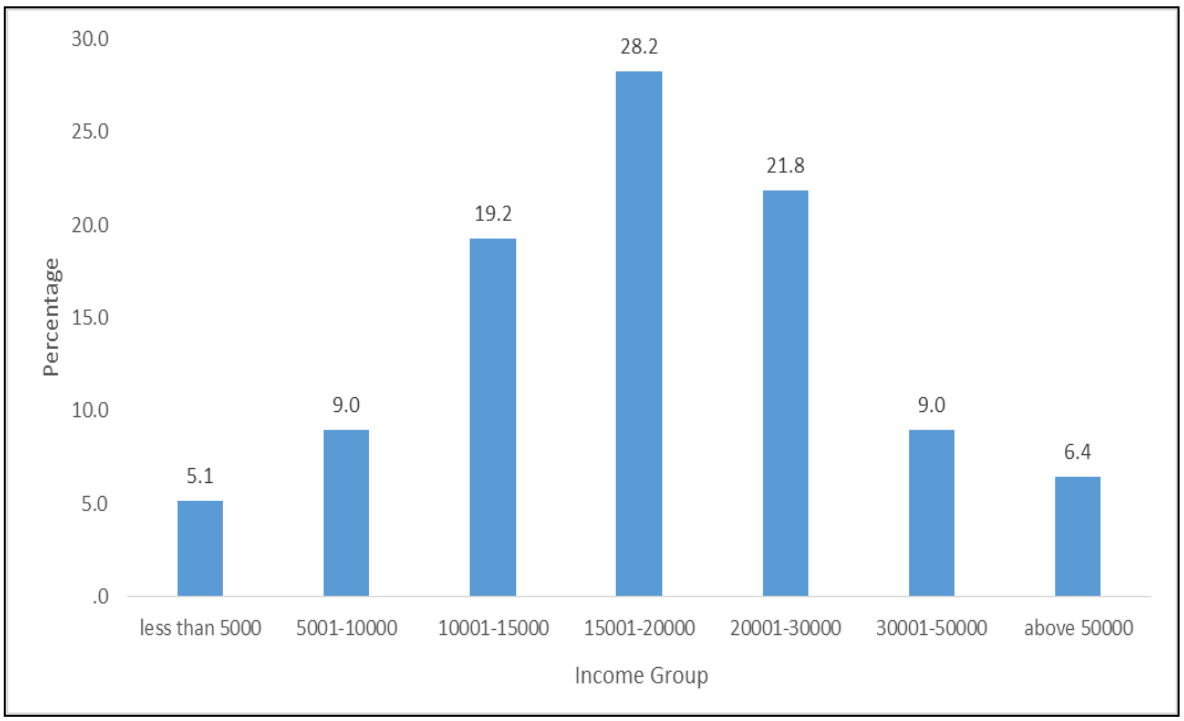
The youth are considered to dominate the motorcycle transport industry and true to this 41% of the operators are aged between 20 to 29 years and 37.2% were aged 30 to 39 years (Figure 21). These age groups are considered youthful to handle the physical demands of motorcycle transport as compared to those between 40-49 years and above 49 years at 5.1% and 1.3% respectively. The operators below 20 years; 1.3% are not considered financially stable and hence are not in a position to purchase a motorcycle; these could however be operating on a hired motorcycle or as employees of the motorcycles for business.

Figure 21: Surveyed Respondents by Age Categories



The income in operating motorcycle transport is considered high among the youth as compared to casual labour with some of the operators insisting that 'a wife to a *boda boda* operator is a very fat woman' to emphasize what they consider the business financial stable. The monthly income earned by the majority of the operators (28.2%) is between Kshs 15,001- 20,000. This directs that they make at least Kshs 300-500 a day. Other operators indicated that they earn more. Those that earn Kshs 20,001-30,000 were 21.8% and those that earn Kshs 30,001-50,000 were 9%. Above Kshs 50,000 were 6.4%. The operators who earn Kshs 15,000 are considered to be involved in motorcycle hiring. (Figure 22)

Figure 22: Motorcyclist Income



6.7.1 Marital Status and Dependants

Among the motorcycle operators 93% are married while 6% are single. Only one percent are divorced and none of the operators are widowed. The operators have dependants with majority (38%) having 3 to 4 dependants, an indication that their income is comfortably supporting their livelihood. The operators with 5 to 6 dependants, 1 to 2 dependants and 7 and above dependants were 32%, 20% and 11%, respectively.

6.7.2 Education

Contrary to the belief that the motorcycle operators are uneducated most of the motorcycle operators (68%) have attained secondary level of education while 23% and 7% have attained primary level education and tertiary level respectively. The operators that do not have any educational background comprise only 2%.

6.8 Training and Licensing

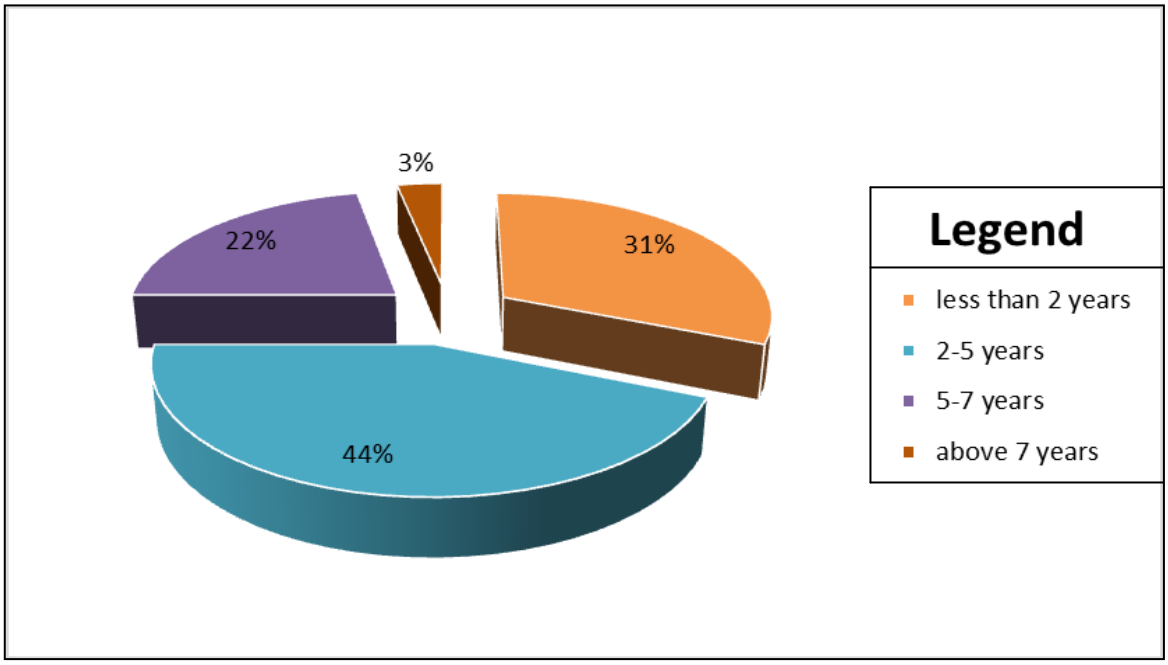
Due to their riding habits most motorcyclists are considered not to have undertaken any motorcycling training course. However 91% of the motorcyclist cited that they had undertaken a motorcycling training course while 9% cited not to have undergone any

motorcycle training course. Of the 91%, 82% cited that they undertook formal training courses while 18% were informally taught how to ride.

The motorcyclists who undertook formal training 98% had motorcycle license while 2% did not while for those that had undergone informal training cited that 71% had motorcycle licenses while 29% did not have the license. Those that did not undertake any motorcycle training (9%) also did not have licenses.

Majority of the operators (44%) with licenses indicated have had their motorcycle license for a period of 2-5 years while 31% had the license for less than 2 years. The most experienced were 22% with 5-7 years with the licenses and those above 7 years formed 3%. An indication that majority of the riders were relatively experienced (Figure 23).

Figure 23: Number of Years with Motorcycle License



6.9 Passengers of Motorcycles

The passengers gave various reasons as to why they use motorcycle transport (Table 7). Most (39%) indicated that motorcycles were a fast means of getting to their destination as compared to other means of transport while 28% cited that motorcycles were convenient since they are available at bays close to the homes and they only need a passenger to take you to your destination. Some passengers (7%) cited motorcycle transport services as being cheap as compared to vehicle taxis while 7% also felt that motorcycles were

flexible in terms of the direction to ply and the route to take. While 14% cited that there were no vehicles to the estates and they had to rely on motorcycles 3% indicated that they are safer than walking in the areas with no public transport means.

Table 7: Reasons for Use of Motorcycles as a Means of Transport

Reasons	Percent (%)	Cumulative Frequency
Cheap	7.142857	7.142857
Fast	39.28571	46.428567
Convenient	28.57143	75
Flexible	7.142857	82.142854
No Public Transport Means to the Estates	14.28571	96.428564
Safe	3.571429	99.999993

Majority 75% of the motorcycle passengers prefer a distance of 1-3 kms on a motorcycle while 15% and 10% preferred distances of kms 3.1 to 4 and 4.1 kms, respectively.

The passengers that indicate that their destination was residential land use comprised 65% and those that cited their destination of travel as commercial land use were 38% confirming that the motorcycles are mostly used to serve residential estates. No motorcyclist indicated that their area of destination was industrial land use despite the existence of some industries at Ruaraka.

6.10 Organisation of Motorcycle Transport Sub sector

Motorcycle operators are organized into motorcycle associations. These associations in the study area are not registered or legally recorgnisable. They are referred to as chamas[14]. The chamas are responsible for the organization and registration of motorcyclists at motorcycle bays. This ensures that external motorcyclists do not use a particular chama's bay to carry passengers. This is also a secure structure to deter thieves and also track the thieves or those riding recklessly.

The chama has also the responsibility of ensuring that all the motorcyclists operating or registered under them have motorcycle licenses and are renewing their insurance covers once they expire. This ensures that the riders at a bay are proper riders and that their customers are safe and satisfied with the service.

[14] Refers to merry go round financial groups now modified to manage motorcycle operations.

The chama has a chairman and a secretary; preferably the learned among the motorcyclists who will push for the agendas of the members and their general interests. Some of the agendas may include welfare for the motorcyclists especially those in hospital or who have passed on. Other agendas may include investment in land and property; Garden Estate Motorcycle Chama through their chairman have a daily contribution of kshs 100 which over the years has allowed them to purchase four motorcycles that now earn money that is either invested or shared during holidays.

6.11 Challenges in the Operation of the Road

The following are some of the challenges in the operation of Thika Super Highway.

6.11.1 Design

Safety an important component in construction of modern roads was largely disregarded in the design of the road. The eight lane road was designed without safe passageways for pedestrians. The location of the footbridges in relation to their function was not clearly assessed. Various areas including Exit 6 and Exit 7 require footbridges but these areas were not provided with the same. Whereas some of these sections have zebra crossings which should be a short term measure.The speed bumps were also installed to cater for the lack of pedestrian crossings.

The highway section between Exit 6 and Exit 7 is a three lane section whereas the rest of the road to town and towards Thika is a four lane. This physical bottleneck which probably was considered due to the size of rock on this section. The implication of this however under estimated or the traffic forecasting was poorly done. In addition to the bottleneck these sections have speed bumps on either side of the road which further aggravates the traffic congestion.

It is now general knowledge in the transport world that speed itself does not cause accidents, it is the stopping that does. That is why in some countries, there are roads with minimum, not maximum, speeds. It follows therefore that should one suddenly stop to turn off the highway or join the highway from a stationary position, then one is likely to be hit by another motorist. The entry or exit points along the highway have poor acceleration and deceleration lanes for anyone intending to access either the service lanes or highway or even an exit point along the highway. An example is the Exit 6 and Exit 7 that are jammed on peak hours due to this.

6.11.2 Maintenance

The road has been in operation for two years and no clearing of vegetation or rehabilitation activities been carried out. The guard rails that have been ramped into are left to the bulglars on the road side. Neither are these vandals and those responsible for the damage on these guard rails and infrastructure followed up on.

Road markings along the road are faded probably due to the poor quality of the paint, leaving drivers to guess who is in their right lane. The road studs on majority of the road are either broken or non-functional; no longer providing the reflective property.

Sections of the road flood in the rainy seasons and this has gone on for a while without repair or maintenance. Water damages the state of the bitumen on the road, apart from this it endangers the safety of the users on the road. The drainage is also poorly maintained with some sections of the drain having filled with waste and sediment.

6.12 Standards and Legislation in Kenya

This sub chapter analyses the various legislation and standards that govern the operation of motorcycles.

6.12.1 Traffic Act Cap 403

Traffic Act CAP 403 of 2009 has various requirements for motorcyclists including making it an offence to ride a motorcycle without a helmet and jacket that has reflectors, the act provides for the provision of a jacket and helmet with reflectors to be worn by a motorcycle passenger. The act requires the motorcycle to be insured against third party risks in accordance with the Motor Vehicle (Third Party) Insurance Act. It also requires a rider to have a valid driving licence. This act is generic in nature and lacks regulations and standards to further stipulate the specifics of the act. This generic nature makes it difficult for enforcement.

The diversity and mutative nature of motorcycle transport is not captured in the Act including restrictions in the use of cycle lanes, and lacks details of managing their operational practices to include ownership, details on leasing or renting out a motorcycle, transferability and the role of *chamas* in their management

Besides the use of helmets and reflector jackets all other aspects of safety on a motorcycle are largely ignored including issues of carrying out modifications on the motorcycle, the state and condition of the pillion seat, details on inspection of these motorcycles in terms of their riderbility which include the service condition and their safety of operation.

6.12.2 The Draft National Transport and Safety Authority (Operation of Motorcycles) Regulations 2014

The Draft National Transport and Safety Authority (Operation of Motorcycles) Regulations 2014 will require that the transfer and registration of motorcycles to be done with two helmets and two jackets with reflective properties. The regulations give responsibility to owners of motorcycles to provide the rider and pillion passenger with helmets, to not permit any person to ride the motorcycle unless he/she is a holder of a valid driving licence endorsed in respect of the class of motorcycle, to ensure that the motorcycle is insured against third party risks and ensure that the motorcycle does not carry more than one passenger at a time. The responsibility of the rider according to the regulation will include ensuring that they obey all traffic rules, ensuring that the headlights of the motorcycle are on at all times, ensuring that only one passenger is transported at a time, ensure that the pillion seat is securely fitted when carrying a pillion passenger and ensuring they have a valid driving licence issued by the authority. Responsibilities to motorcycle passengers according to the regulations include wearing of a helmet and reflector jacket whenever being carried on a motorcycle, not allowing to be carried as an additional passenger and sitting astride on a motorcycle. Courier companies according to the regulations are required to ensure that no passengers are ferried and that proper carrier boxes are used. The regulation also requires for a bodaboda operating in a particular county to register with the County Transport and Safety Committee and no owner should be registered more than one County Transport and Safety Committee. Boda bodas are also allowed to operate between 5am and 11pm. Anyone who contravenes these regulations is liable to a fine not exceeding twenty thousand shillings or to a term of imprisonment not exceeding six months.

6.12.3 Kenya Standards 77:2012 on Protective Helmets for Motorcyclists

The Kenya Bureau of Standards (KEBs) through specifications KS 77:2012 on Protective Helmets for Motorcyclists gives methods of test for the fundamental performance

requirements and the minimum results required from a satisfactory helmet. It sets out the general principles of design whilst leaving the manufacturer as much freedom as possible in respect of the materials used, the actual design and the methods employed to provide the required levels of protection. The standards ensure that the helmet shall be as light in weight as possible both for the comfort of the wearer and to limit certain effects in the event of an accident and ensure the helmet is a good fit.

6.12.4 Road Design and Construction Manuals

Road design and construction in Kenya are done based on the following manuals

Road Design Manuals Part (I-V)

- Road Design Manual Part I-Geometric design of Rural Roads-1979;
- Draft-Road Design Guidelines for Urban Roads-2001;
- Road Design Manual Part III-Materials and Pavement Design for New Roads;
- Road Design Manual Part IV-Bridge Design-1982; and
- Road Design Manual Part V-Pavement Rehabilitation and Overlay Design-1988

The design for roads in Kenya is done with the assumption that the auto two-wheelers are part of the larger capacity motorized traffic. There are no special lanes for motorcycle riders, forcing them to shove for space with other motorized vehicles. The Road Design Manual Part I show only one element in its guidance for geometric design which is lane capacity as shown in **Table 8**. This means that the motorcycles are supposed to compete with other modes for space. Tuk Tuks[15] are not in the manual.

Table 8: Conversion Factors for Different Terrains

Vehicle Type	Level Terrain	Rolling Terrain	Mountainous Terrain
Passenger Cars	1.0 P.C.U	1.0 P.C.U	1.5 P.C.U
Light Goods Vehicles	1.0 P.C.U	1.5 P.C.U	3.0 P.C.U
Medium Goods Vehicles	2.5 P.C.U	5.0 P.C.U	10.0 P.C.U
Heavy Goods Vehicles	3.5 P.C.U	8.0 P.C.U	20.0 P.C.U
Buses	2.0 P.C.U	4.0 P.C.U	6.0 P.C.U
Motorcycle, Scooters	1.0 P.C.U	1.0 P.C.U	1.5 P.C.U

[15] Also referred to as Auto Rickshaw

Vehicle Type	Level Terrain	Rolling Terrain	Mountainous Terrain
Pedal Cycles	0.5 P.C.U	0.5 P.C.U	

Source: Road Design Manual Part I (1979); pg. 3.9

Other manuals include; manual on Traffic Control Devices namely Part I-Road markings and Traffic Signs fail to provide the standards and quality of road markings. These markings should have traction as well as being long lasting. The informatory, warning and regulatory signs do not include any signs that warn, inform or regulate motorcycles specifically.

6.13 Infrastructural Provision for Motorcycle Transport

Various infrastructural provisions essential for motorcycle transport operation were assessed and are discussed below.

6.13.1 Influence of Walk Ways and Cycle Lanes on Ridership

The cycle lanes on the road are utilized by motorcyclists as parking bays and as areas where they can ride on when ferrying passengers as they avoid using the carriage way or having to use the service lanes (Plate 16). The cycle lanes are specifically designed for bicycles; the bicycles are of low speed and are able to integrate with pedestrians that are also walking at lower speeds while avoiding conflict. The use of the walkways by motorcyclists poses a risk of conflict with pedestrians crossing to access the bus bays and also causes conflict with the cyclists that are supposed to use the same space since they are heavier and of higher speed. The barriers on the walkways are also quite spacious to allow the motorcyclists to go past the barriers.

The walkways are for use by pedestrians, however the motorcycles are parked on some of these walkways and cycle lanes (Plate 17), this forces the pedestrians to juggle between the cycle lanes, the carriage way and the walkways which poses a risk on their safety. Motorcyclists attributed the parking on the pavement and the walkways to the lack of motorcycle bays where they would wait for the passengers citing that previously the motorcyclists operated at various convergence points especially at intersections, roundabouts and close to the bus stops which they cited as a risk.

The rise in conflict with other vehicles on the carriage way was provided as the reason why the motorcyclists rode on cycle lanes which they considered safer.

Plate 16: Use of Pedestrian Walk Ways for Motorcycle Parking at Blue Springs Hotel

Plate 17: Use of Non Designated Sites for Parking at Roasters

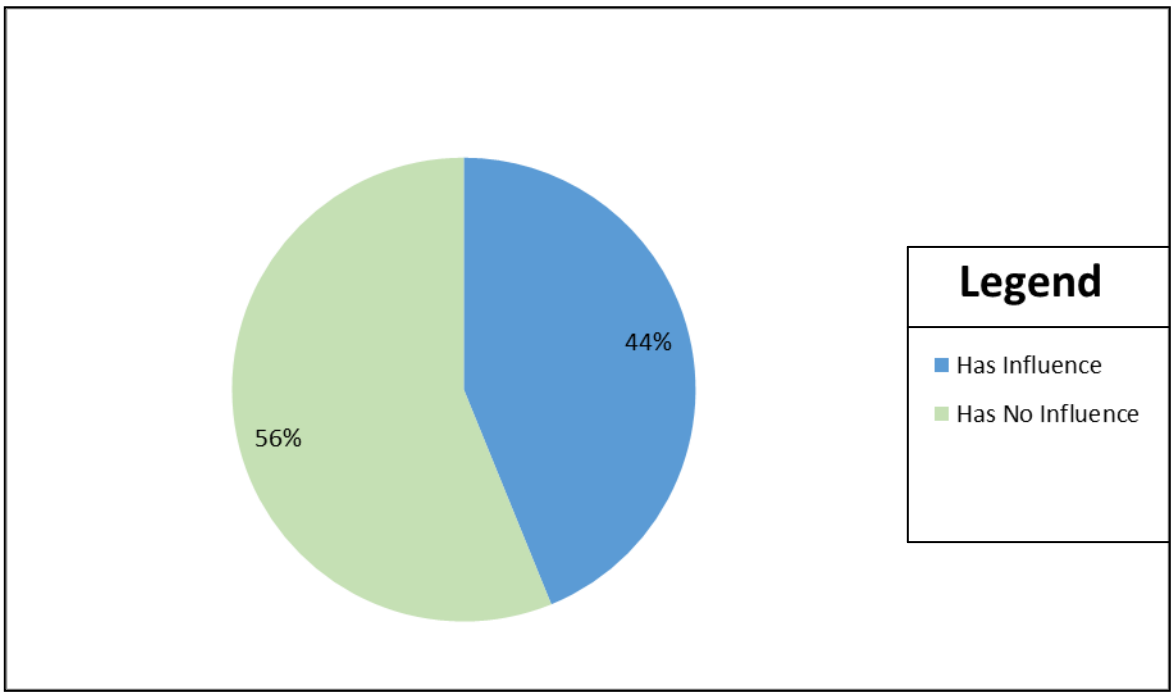
6.13.2 Influence of Guard Rails on Ridership and Susceptibility to Accidents

The eight lane road is fitted with guard rails on either side of the road that function to soften and protect against accidental falls. The guard rails installed on the road are characterized by vandalized sections that are opened up which compromise and further endanger the riders and users of the road (Plate 18). Further the guard rails lack reflective ability for proper visibility during the night and in foggy weather.

Plate 18: Guard Rails along Thika Super Highway at Blue Springs Hotel

When the respondents were asked their opinion on the guard rails and their influence on riding, 56% of the motorcyclists felt that they had no influence on their riding, operation or susceptibility to accidents while 44% cited that it influenced their ridership and susceptibility to accidents (Figure 24). For those of the opinion that the guard rails did influence riding cited both positive and negative influences. The negative influences noted were that the estate roads where they operated most lacked the guardrails while those that felt the guard rails had positive influence on their riding cited that the guard rails are protective especially during accidents. The guardrails were also identified as hiding sites for thieves who hijack motorcyclists.

Figure 24: Influence of Guard Rails on Ridership and Susceptibility to Accidents



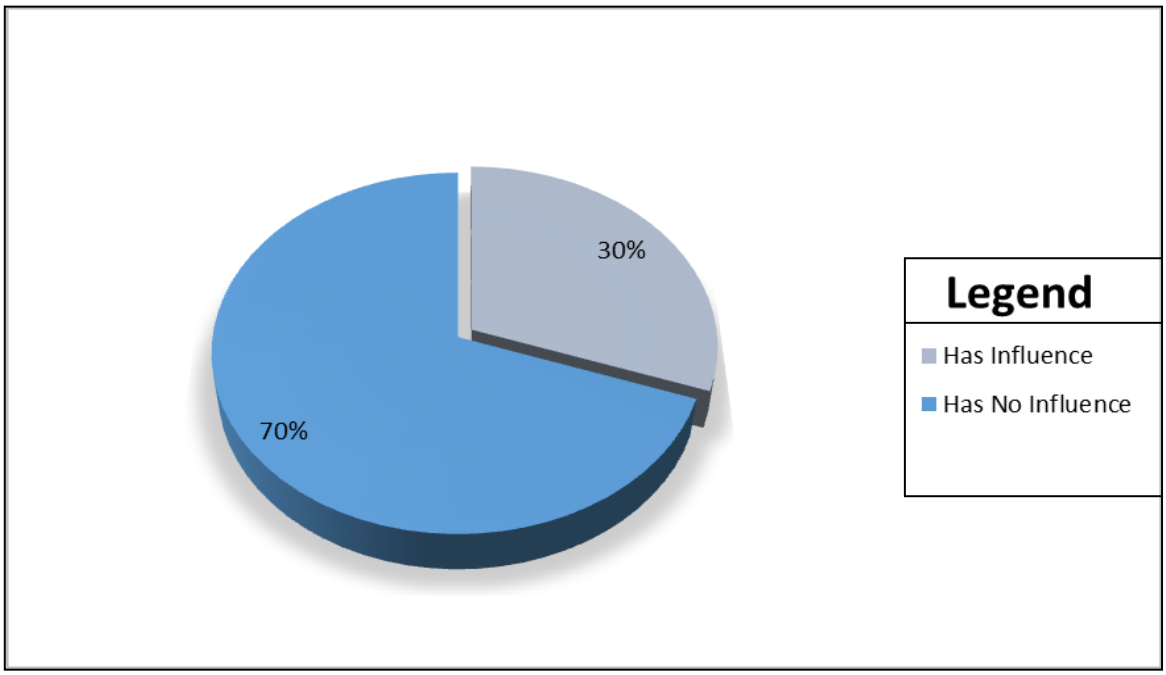
6.13.3 Influence of Kerbs on Ridership and Susceptibility to Accidents

The road has raised kerbs separating the two lanes and the service lanes. The walkways and the cycle lanes are also separated by the raised kerbs (Plate 19).

Plate 19: Raised Kerbs along Thika Super Highway at Safari Park Hotel

The Kerbs were noted by 70% of the motorcyclists to influence motorcycle riding and operation while 30% noted that they did not influence (Figure 25). For those that cited influence they gave both positive and negative effects. The positive influences included that the kerbs provided separation of lanes which reduces conflict with oncoming vehicles. The kerbs also separate various road users, such as pedestrians and other vehicles. Those that noted negative influences cited that the kerbs were a great cause of accidents and damage to the motorcycles since they are raised. Those that cited that there was no influence from the kerbs noted that there were no kerbs on the roads they operated on.

Figure 25: Influence of Kerbs on Ridership and Susceptibility to Accidents



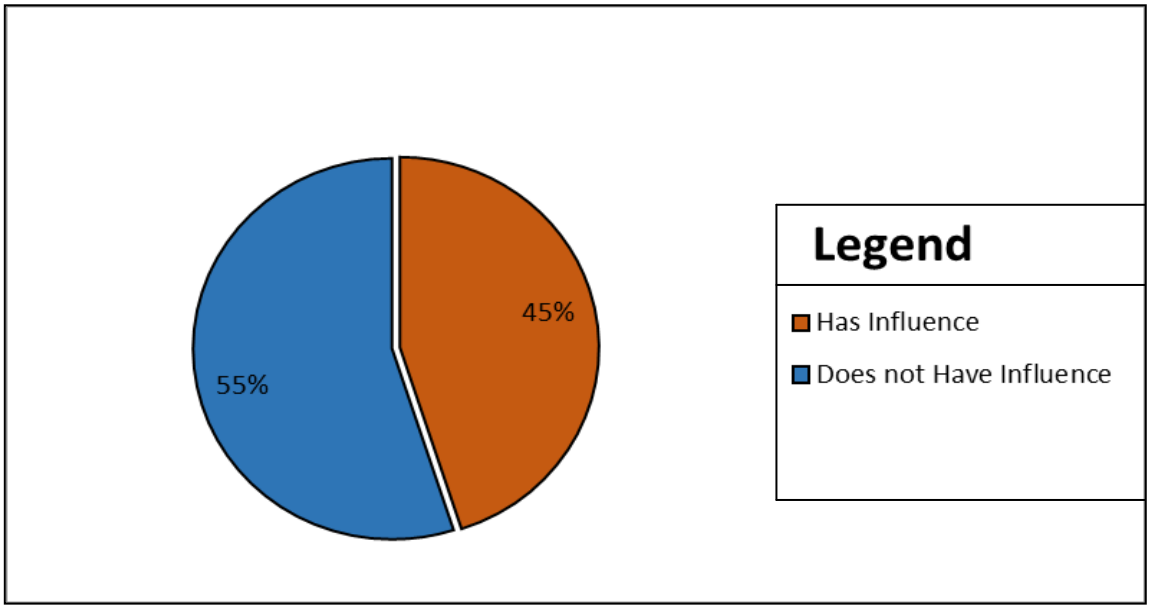
6.13.4 Influence of Road Marking on Ridership and Susceptibility to Accidents

Road markings along the road include those used to delineate traffic lanes, inform motorists and pedestrians and zebra crossings (Plate 20). Majority of these road markings on Thika Super Highway lack reflective ability while others are wearing off and not clearly visible especially during the evening. It is clear when observed closely that all these road markings are not skid resistant; the road markings are glossy.

Plate 20: Road Markings along Thika Super Highway at Utalii Hotel to the Left and National Youth Service to the Right

The road markings were identified by 45% of the operators (Figure 26) as having influence on their riding and susceptibility to accidents some citing that pavement markings inform while overtaking, they also guide during the night or when visibility is compromised. Others also cited that the markings are key to ensure other vehicles are also on their lanes to avoid conflict with motorcyclists. Some of the roads were noted not to have road markings and others also lacked reflective ability. The majority of the motorcyclists (55%) felt that the markings did not influence their riding at all. They also did not provide reasons as to why they did not see the need for the markings.

Figure 26: Influence of Road Marking on Ridership and Susceptibility to Accidents



6.13.5 Influence of Loose Surface on Ridership and Susceptibility to Accidents

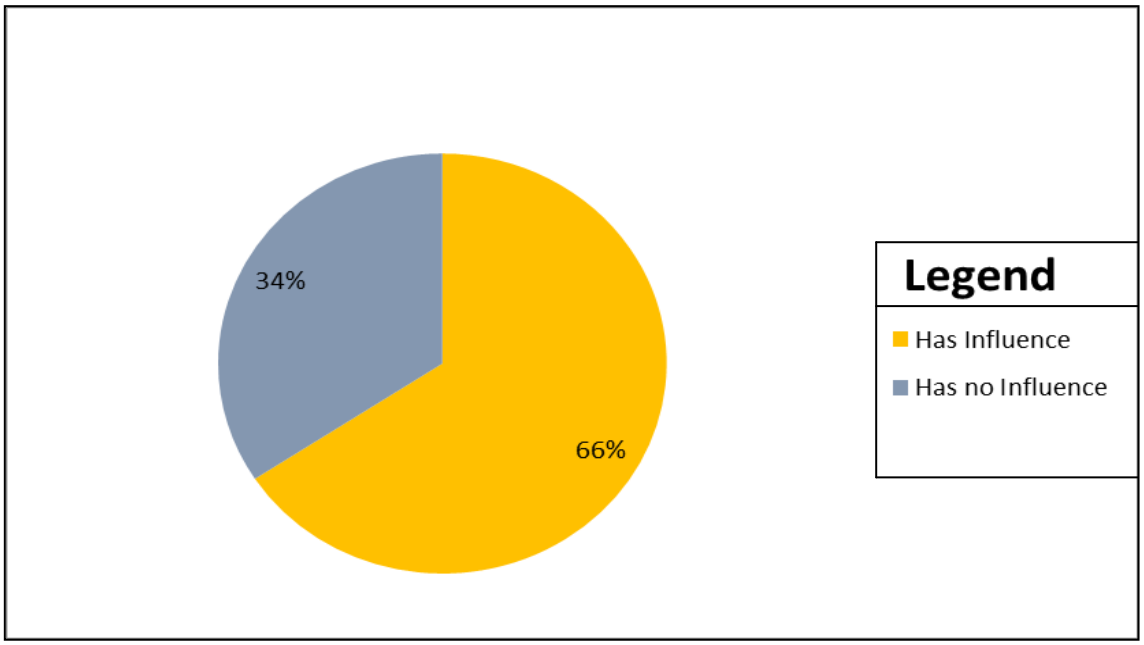
Loose surfaces are mainly from wearing out pavement or fresh rehabilitation that was not properly cleared away (Plate 21) or lack of clean up after accidents.

Plate 21: Loose Gravel on the Surface of the Road along Kasarani, Warren Road

A majority of the respondents comprising 66% identified loose materials as having influence on their operations. The loose material could be hurled to the motorcyclist

riding close to a vehicle travelling at a high speed; the risk of this is poor visibility and even injury to the motorcyclist. During the rainy season these material compromise traction on the surface of the road further increasing the risk of accidents. Other motorcyclists comprising 34% were also of the opinion that loose surfaces do not influence their riding. They informed the study that if the motorcyclist was travelling at the right speed these loose surfaces had very minimal influence on the operation of the motorcycle (Figure 27).

Figure 27: Influence of Loose Surface on Ridership and Susceptibility to Accidents

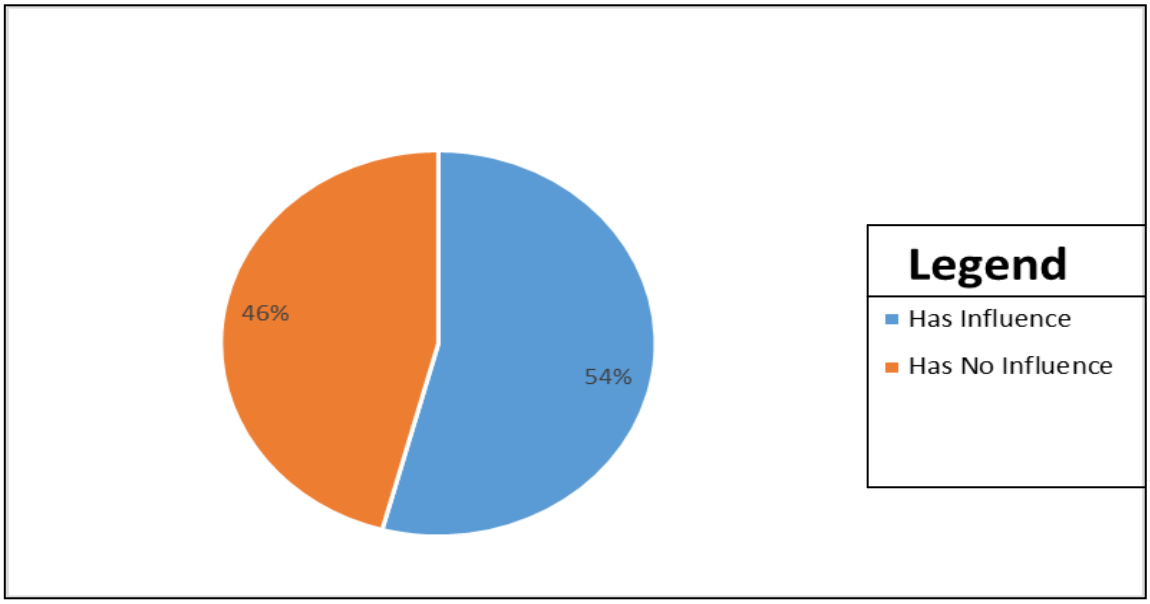


6.13.6 Influence of Road Signage on Ridership and Susceptibility to Accidents

Thika Super Highway only has informatory signs indicating the entry and exit points to the service lanes and into the highway, speed signs of 80km/ hr are however spread periodically along the road.

Majority of the respondents comprising 54% indicated that installation of road signage influences their riding by providing guidance on speeds limits, direction, visibility and indication of the surface condition of the roads. This was construed to mean that proper signage reduces the incidents of motorcycle conflict. There was however those that felt that road signage did not have influence on their riding; these comprised 46% who alluded their reason to the fact that the roads did not have motorcycle friendly signage therefore they did not influence their riding and operation in any way. Figure 28 illustrates the above.

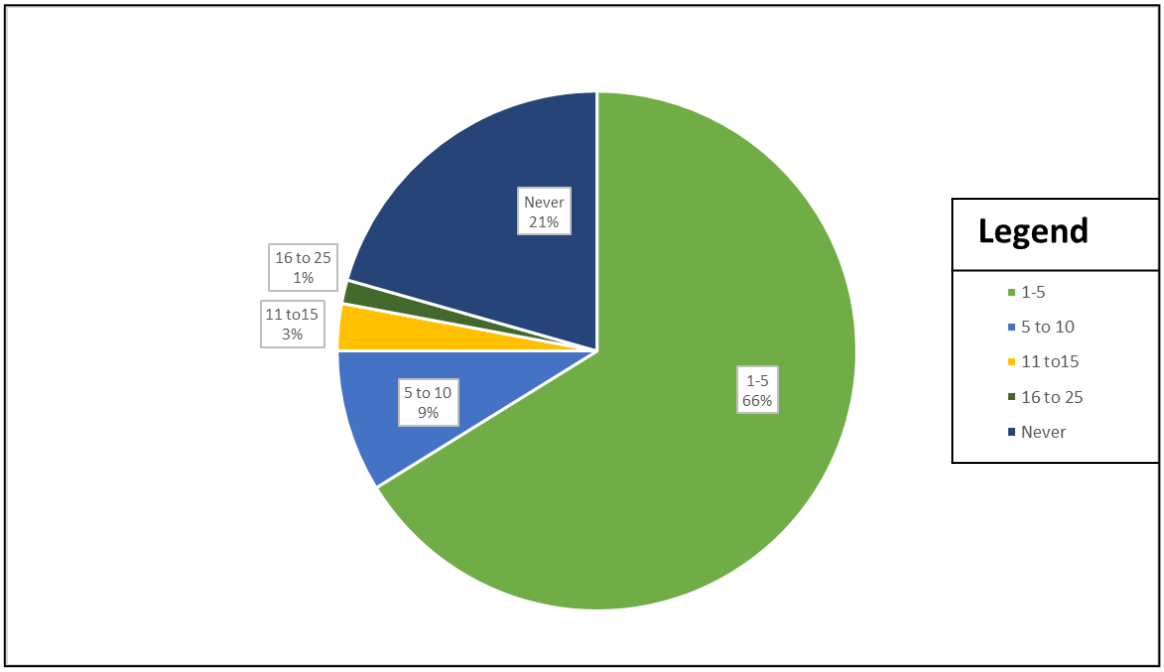
Figure 28: Influence of Road Signage on Ridership and Occurrence of Accidents



6.13.7 Frequency of Traffic Rules Violation

The violation of traffic rules and regulations was found to be rampant with only 20.6% indicating that they had never violated any traffic offences while 79.4% violated but at different intervals (Figure 29). Those who violated 1-5 times a day comprised of 66% while those who violated 6-10 times comprised 9% while those who violated 11-15 times and 16-25 times were 3% and 1%, respectively.

Figure 29: Frequency of Traffic Rules Violation



6.14 Findings of the Study

The following are a summary of the findings of the study.

6.15 Study Finding 1: Opportunities in the Operational Practices of Motorcycle Transport

The following are the findings on the opportunities in the operational practices of motorcycle transport.

6.15.1 Type of Service

Majority of the areas served by the motorcycles are either not profitable for public transport or the roads are in such poor state that the motorcycle is the only vehicle that can access these areas. In Garden Estate, Safari Park Estate and Thome there are restrictions on the use of public transport vehicles and therefore the only means to these areas is either through personal vehicles or by walking, the motorcycles have therefore come in to substitute this gap in provision of transport.

Motorcycle transport is found to be cheap, fast, convenient, flexible and safe by the users. The service is majorly used for accessing short distances and largely servicing residential

land uses. This preference can be utilized in planning for their integration and transportation planning.

The motorcycles in the market and those that operated were two stroke engine and those of engine carrying capacity that comprised of 100cc, 125cc and 150cc.

6.15.2 Employment

Motorcycle transport is providing employment opportunities to the youth in the country. This is supporting large families and providing for their needs. Encouraging more youth in the industry ensures more financially empowered youth which accounts partly for the increase in jobs created from 887.2 thousand in 2011 to 591.4 thousand in 2012.

6.15.3 Management of Motorcycle Operation

The motorcycles for public transport are organized into groups referred to as *chamas* which regulate and determine the operations of the motorcycles that operate under each chama. The *chama's* are also utilized for investment and welfare issues.

6.15.4 Safety

The motorcyclists are not recognized by other vehicles as having right of way on the highway and off the highway and are therefore harassed by especially overlapping public service vehicles on the roads. This has now even forced some of the motorcyclists to use the cycle lanes that are now not in as much use by the cyclists.

The larger group of motorcyclists also hardly uses protective gear while riding and the protective clothing is also not provided to their passengers. On average every motorcycle has one helmet that is shared between the rider and the passenger.

Insecurity was highlighted as a major challenge with most motorcyclists citing that there is ready market for the sale of stolen motorcycles and there have been lots of cases of motorcyclist being killed and hijacked and their motorcycles stolen. Stolen parts are also on sale in repair shops and their market is quite good since they are in most instances original spares as compared to other spares considered 'fake'. Insecurity associated with motorcyclists has also led to the banning of their operation in certain estate roads beyond particular points.

Although majority of the motorcyclists and their passengers are well educated they lack information on the safety and operation of motorcycles. It was clear that some of the motorcyclists did not understand that the cycle lanes were meant for the cyclists other than the motorcyclist.

The conflict noted mainly was that of vehicle to motorcyclists followed by that of motorcyclist to motorcyclist and that of motorcyclist to pedestrians. There were also instances of motorcycle alone accidents.

6.16 Study Finding 2: There is Lack of and a Need for Infrastructure Provisions for Motorcycle Transport

The Road Design Manual Part I offers only one element in its guidance for geometric design which is lane capacity. This means that the motorcycles are supposes to compete with other modes for space.

The infrastructure therefore laid has is inflexible and un-accommodative of the new infrastructural requirements of the motorcycle and its operational needs, this was hence considered as a major risk for motorcyclists considering the road design manuals are the policy guidelines for laying of infrastructure in the country.

Following discussion with the Manager Traffic in Kenya Urban Roads Authority, it was evident that the Road Design Manuals, traffic signs manuals used in the country have no inclusion of motorcycles in their recommendations in the type of infrastructure to be laid and the various components that encompass on the safety of motorcycle transport. He however cited that there was still so much that could be done through other legal instruments to enhance their safety.

Motorcyclist interviewed indicated that one of their challenges included harassments by police on the pretense of arrest even if they did not commit any particular offence. Most of the instances highlighted included demanding of bribes from the enforcement officers, harassment also from Nairobi City County Officials for parking fees also featured widely although this group does not have any designated parking areas.

The motorcyclists as well expressed their comfort on riding on the cycle lanes as compared to the carriage way. Reasons provided included that the motorcyclists felt harassed especially by public service vehicles on the carriage way and coupled by

increased motorcycle-vehicle conflict. Riding on cycle lanes felt safer for the motorcyclist.

Various other aspects of the carriage way and the road laid was noted as influencing ridership. These included, the faded road markings and the use road markings that are not skid resistance. The median barriers on the road lack reflective properties posing a risk to the riders and their passengers. The raised kerbs were also cited as the leading cause of accidents and damages to the motorcycles. Thika Super Highway was noted to have informatory signs indicating the entry and exit points to the service lanes speed signs of 80km/ hr were however spread periodically along the road. There was clear lack of motorcycle friendly signs; the speed sign was noted to only cater for other vehicles other than motorcycles. Also there were no warning signs to address the unique needs of a motorcycle.

Road maintenance began two years after construction and this was noted as inadequate in addressing the needs of motorcyclist, enhancing ridership and safety.

6.17 Study Finding 3: There is a Gap in the Standards and Legislation

The motorcycle operators cited that they had understanding of legislations that govern motorcycle transport. They cited various rules in relation to the use of protective clothing and riding of a motorcycle. These included carrying of one passenger, keeping left unless overtaking, keeping safe distance from the closest vehicle, no overlapping, no overloading, always have your headlights on, a motorcyclists must have a license and must subscribe to an insurance cover and must wear appropriate protective clothing. The knowledge of the regulation and standards was good however the compliance was low.

Although the Kenya Bureau of Standards (KEBs) through specifications KS 77:2012 on Protective Helmets for Motorcyclists standards provide the right standards for the helmets, there are however helmets in the markets that do not meet these standards. These are preferred by the consumers due to demand for cheaper product vis a vis their purchasing power. This is a clear indication of either lack of enforcement or supervision from KEBs.

The Traffic Act Cap 403 was determined as inadequate in addressing the emerging issues in motorcycle transport. The act addresses motorcycles only in terms of safety and requires for a rider to have a valid licence whereas other aspects as the management of the

motorcycles as a mode of passenger transport is not looked into, requirements of a motorcyclists and requirements of a rider including matters of protective clothing in relation to passenger transport, riding speeds, conditions of a motorcycle that should be considered safe (restriction or allow ability for modifications of a motorcycle), and enforcement. The act is also short in addressing the unique needs of motorcycles that offer courier services including the number of passengers that should ride a courier service motorcycle and standards of the courier box.

According to the Kenya Traffic Police motorcyclists are mobile while most of them operate in the estates which are hardly patrolled by the police. The traffic commandant however noted that the department was grossly understaffed and underfunded thus curtailing efficiency in accomplishing its mandate. For example, each of the 14 highway patrol units only had four litres of fuel daily and had old vehicles that were procured in 2004/2005. Furthermore, there was no central transportation system for the officers from their residences to their place of deployment and so they daily had to depend on goodwill of motorists or use their meager resources to get to and from their work stations.

The challenge raised also was that the rules and regulations were not as broad to encompass the diversity of the motorcycle operation. More often, the traffic police ignore motorcycle operators breaking the law and focus on other vehicles, and only intervene after serious accidents occur.

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

7.0 Introduction

This provides the conclusions of the findings of the study and puts forward the recommendations to address these findings.

7.1 Conclusion

Motorcycle transport is found to be complementing other forms of transport either since the infrastructure is poor for other types of vehicles or since there are restrictions on the type of vehicles that can access the particular areas or because it's the only transport service that finds it profitable to operate.

The motorcycles operating are of two stroke engine and these are considered less environmentally friendly as compared to the four stroke engines. In addition the two stroke engines of 100cc, 125cc and 150cc's are light and quite unstable at very high speeds as compared to the four strokes that can manage higher engine capacity and fuel efficiency.

A majority of the youth find employment in the transport sector. Motorcycle transport has employed a majority of who are involved in servicing and repair and riding the motorcycles. It is critical that this work force remains employed in this sector.

The motorcycle operators are well organised into chama's that ensures proper functioning of a motorcycle bay proper behaviour among motorcyclists, ensuring that they are compliant with the traffic rules and generally considering the safety and the welfare of the motorcyclists and the passengers. These motorcycle chama's have opportunity for investment and growing the livelihoods of the motorcyclist.

The safety of motorcyclist riding on the road would be considered low since the motorcyclists do not feel safe riding on the carriage way as compared to riding on the cycle lanes.

The protective clothing worn by the motorcyclists are also not adequate in guaranteeing the safety of the rider and the motorcyclists in terms of quality of for example, helmets worn and the number of helmets worn or clothing with reflective properties.

The study found out that the infrastructure provided was inadequate to cater for the unique needs of a motorcyclist. This is specifically because of various aspects including the kerbs installed do not allow for recovery when the rider loses control, the road maintenance practises are not accommodative of motorcyclist needs, the signages provided are not specific to motorcycle needs or issues that would affect these specific vehicles, there are no parking or picking up or drop off points for motorcyclists carrying passengers and the road design manual does not make any special consideration to motorcyclists when designing and even in the construction of roads.

Although there is compliance with the existing standards and legislations with regard to motorcycle transport there are areas still not addressed by these standards in the management of the operational practices of motorcycle transport and the design of motorcycle friendly infrastructure.

7.2 Recommendations

The following are some of the recommendations to address the findings of the study.

7.2.1 Updating of the Traffic Act

Subsidiary legislations, including regulations and rules should be put in place with the aim of enhancing ridership and the operational practises of motorcycle for passenger transport in the urban areas will augment safety and security of the operators and the passengers. These subsidiary legislations should be specific on the management practices of the operation of motorcycle for passenger transport and those for personal use, the restrictions and bans of motorcycle operation, the safety requirements of a motorcyclists, the safety requirements of a motorcycle passenger, the operational condition of a motorcycle, the relationship between motorcycle experience and type of motorcycle ridden in terms of carrying capacity, have rules specifying the standards and quality of modifications allowed on the motorcycles. These should therefore form basis for inspection, enforcement and compliance.

7.2.2 Management of Motorcycle Transport Subsector

Further to the enactment of a motorcycle legislation regarding the management and operation of motorcycles every motorcycle should be required to be registered in a motorcycle association/ cooperative society/ the *chama*. The motorcycle society will be subject to compliance with labour laws and regulations in respect to statutory deductions and health and safety of the work places. The Draft National Transport and Safety Authority (Operation of Motorcycles) Regulations, 2014 should also embrace the functioning of the motorcycle associations and the unique role they would play in enhancing management of motorcycle operations. The *chama's* could be the channels through which the government can reach out and manage the motorcycle industry since they are already structured and they are indeginious in managing this form of transport. In addition financial institutions could play a critical role in investment and financial management through these *chama's* to further empower the motorcycles and assist them invest and better their lives.

7.2.3 Integrating Motorcycle Speeds in different Environments

As a short term strategy there is need bring the speed of motorcycles in various urban setting to a uniform speed which will enhance the safety of the rider and the passenger and also that of the pedestrian. This will be monitored and enforced by the National Transport and Safety Authority to ensure safety. The model shown in **Table 9** describes the light-low speed motorcycles and the heavy high speed motorcycles in different types of roads and built up environments and the speeds at which they are recommended to ride on. The model is a modification of the model developed by Godthelp, 2010.

Table 9: Motorcycle Speed Integration Model

Motorcycles Light-Low (LL) Speed	**Motorcycles Heavy-High(HH) Speed /Cars, Trucks, Buses**
1) The model describes the recommended model for Light-Low Speed motorcycles in through roads, distributor roads and access roads.	1) The model describes the recommended model for Heavy High Speed motorcycles in through roads, distributor roads and access roads.

Motorcycles Light-Low (LL) Speed	**Motorcycles Heavy-High(HH) Speed /Cars, Trucks, Buses**
Through Roads	**Through Roads**
1) Use of service lanes ***inside built-up areas*** on high volume roads. In one way one lane roads traffic management should be carried out. 2) Where applicable physical space should be made available for separate lanes of 3) Motorcycle HH/cars/trucks/buses and 4) Motorcycles LL/tuk-tuk. 5) Max speed in build-up areas 30km/h. Max speed on service lanes 50km/h. 6) Max speed in outside built-up areas 80km/h. Max speed on service lanes 80km/h.	1) ***Within built-up areas:*** along the road: separated, max 70 km/h. 2) ***Outside built-up areas:*** Along the road: Max 100 km/h.
Distributor Roads:	**Distributor Roads**
1) Use of service lanes ***inside built-up areas*** on high volume roads. In one way one lane roads traffic management should be carried out. Where applicable physical space should be made available for separate lanes of 2) Motorcycle HH/cars/trucks/buses and 3) Motorcycles LL/tuktuks. 4) Max speed in build-up areas 30km/h. Max speed on service lanes 50km/h. 5) Max speed in outside built-up areas	1) ***Within built-up areas***: along the road: separated, max 70 km/h. 2) ***Outside built-up areas****:* Along the road: Max 100 km/h.

Motorcycles Light-Low (LL) Speed	**Motorcycles Heavy-High(HH) Speed /Cars, Trucks, Buses**
80km/h. Max speed on service lanes 80km/h.	
Access Roads	**Access Roads**
1) At residential areas: motorcycles LL mix with other motorized traffic both in- and outside built-up areas. Max 30km/h.	1) ***Within built –up areas****:* along the road: mix with motorcycles LL, max 30 km/h 2) ***Outside built-up areas****:* along the road: mix with motorcycles LL, max 50 km/h

Consideration should also be made to separate motorcycle from the other vehicles since the research indicates that the conflict is mainly motorcycle to vehicle conflict.

7.2.4 Road Safety Campaigns

Safety campaigns aimed at reducing motorcycle casualties while advocating for safe riding. 'Share the road' campaigns should be embraced including the use of leaflets to address frequently asked questions by motorcyclists and other users of the roads in regards to the motorcyclists. Public sensitization through media campaigns and road shows should also be embraced to inform the passengers and motorcyclist on their requirements by law to ensure adherence.

7.2.5 Type of Motorcycle Engines

Given that four-stroke engines are inherently cleaner, more fuel efficient and enable further emission reductions, it is suggested that all new motorcycles produced and imported into Kenya should be of the four-stroke engine type. This should be legislated in policy to ensure its continued implementation.

7.2.6 Motor Cycle Designs for Road Transport Integration

Road construction designs and standards that are accommodative of the features unique to motorcycle transport should be developed and used in the construction of the various infrastructure. This will enhance the safety and ridership of motorcycle transport in the

country. This will allow for proper integration in terms of speeds, friendly infrastructure which includes; proper road furniture, motorcycle friendly median barriers and proper integration with other users of the road.

7.3 Areas for Further Studies

1. Research on the best type of parking areas or service bays for the operation of motorcycles for commercial transport;
2. The relationship between the use of walkways and foot bridges by the pedestrians on the reduction in pedestrian to motorcycle conflict; and
3. Possible ways to reduce pollution in motorcycles.

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APPENDICES

Appendix 1: Motorcycle Rider Questionnaire

1 Preliminary

1.1	Date		1.2	Name of Enumerator	
1.3	Checked by Supervisor		1.4	Serial No	

2 Personal Data

2.1	Name (As on I.D)				
2.2	National ID No.				
2.3	Telephone No.				
2.4	Postal Address				
2.5	Age				
2.6	No. of Dependents				
2.7	Gender		Male		Female
2.8	Marital Status	Single	Married	Divorced	Widowed
2.9	Highest Education Level	None	Primary	Secondary	Tertiary

2.10	Income (Kshs)	Tick as appropriate
2.11	Less than 5,000.00	
2.12	5,001-10,000	
2.13	10001-15000	
2.14	15000-20,000	
2.15	20001-30,000	
2.16	30,000-50,000	
2.17	above 50,000	

2.10 Location of Motorcycle Bay

GSU(Alssops)	Roasters	Safari Park	Roysambu	Warren	Zimmerman	Other

3 Motorcycle Description

3.1.What is the Motor Cycle used for?

3.11.	Commercial Transport	
3.12.	Social/domestic /pleasure	
3.13.	own business/profession	

3.14. If used for business, please provide details of the nature of business undertaken

……

3.1.5.	Make & Model	Year of Manufacture	Rating		Carrying Capacity	Estimated Value Including accessories) Other (specify)
			One Stroke	Two Stroke		

3.1.6 Is the Motor Cycle absolutely owned and duly registered in your name?

Yes	
No	

If yes, did you purchase this motorcycle?

New	
Used	

3.1.7 If not, how many different motorcycles have you ridden regularly in the last 12 months? Give particulars of ownership.

……
……

3.1.8 If yes how long have you owned/operated a motorcycle

Less than 1 year	
1-3 years	
3-5 years	
5-7 years	
More than 7 years	

3.1.9 What extra modification have you done on your motorcycle?

Exhaust/muffler modification	
Suspension Modification	
Other (specify)	
No modification	

3.1.10 Why did you put the modifications in 3.1.9 above

……

……

4 Training and Experience

4.1 Have you taken a motorcycle training course?

Yes	
No	

4.2 If yes was this a formal or informal driving school?

……

4.2.1 If formal do you have a motorcycle license?

Yes	
No	

4.2.2 what are the number of years with a Motorcycle License

Less than 2years	
2-5 years	
5-7years	

4.2.3 If informal do you have a license?

Yes	
No	

5 Trip Variety and Typical Trip Description

5.1 What is your average riding distance per day?

Distance (Km)	Tick
Less than 20km	
21-50km	
51-80km	
81-110km	
111-140km	
141-170km	
171-200km	
201 km and above	

5.2 What route do you ride often?

On Highway (On Thika Road)	
Off Highway (Serving the Estate)	
Both	

5.3 What is your average speed per trip

On Highway (On Thika Road)	
Off Highway (Serving the Estate)	
Both	

5.4 How many passengers do you carry?

1	
2	
3	
4	

5.5 What are your charges per person per kilometer?

On Highway (On Thika Road)	
Off Highway (Serving the Estate)	
Both	

5.6 How much fuel do you use per day in litres?

……

5.7 How much is fuel per litres (Ksh)

……

5.8 When do you spend more time riding?

Weekdays	
Weekends	
Night	
Day	

6 Safety

6.1 Which personal protective gear do you wear when you ride? (Check all that apply)

Helmet	Gloves	Jacket	Gloves	Long Pants	Boots	Body Amour	Don't wear any Gear

6.2 Does any of your gear currently have any high visibility or reflective properties?

Yes	
No	

6.2.1 If yes, which piece of your gear? (check as appropriate)

Helmet	Gloves	Jacket	Gloves	Long Pants	Boots	Body Amour	Don't wear any Gear

6.3 How often do you take your motorcycle for repair/maintenance?

……

……

7 How many times have you been involved in any crash while you were riding a motorcycle in the last one year?

Never	
1-2 times	
3-5 times	
More than 5 times	

8 What type of accidents were they

Motorcycle to Motorcycle	
Motorcycle to a Vehicle	
Motorcycle to Pedestrian	

Motorcycle Alone	
Other (specify)	

9 What motorcycle insurance cover have you taken?

Comprehensive	
Third Party	
Fire & Theft	
Third Party Only	
None	

10 How often do you violate traffic rules in a day?

1-5	
5-10	
10-15	
15-25	
More than 25 times	

11 What Laws and Regulations do you know, that govern motorcycle transport

……

……

12 Do the following infrastructural provisions influence your riding and susceptibility to accidents?

a) Pavement markings

Yes	
No	

If yes, how

……

……

b) Loose Surface

Yes	
No	

If yes, how

……

……

c) Guard Rails

Yes	
No	

If yes, how

……

……

d) Road Markings

Yes	
No	

If yes, how

……

……

e) Kerbs

Yes	
No	

If yes, how

……

……

13 Any other comments

……

……

Appendix 2: Motorcycle Passenger Questionnaire

1) Do you use motorcycle as a mode of transport?

Yes	
No	

If yes, why?

……
……
……
……
……

If no, why?

……
……
……
……
……

2) What is your destination when using the motorcycle?

Land Use	Tick Appropriately
Residential	
Commercial	
Industrial	

3) What is your preferred distance when using a motorcycle?

Distance (Kms)	Tick Appropriately
1-3 Kms	
3.1-4Kms	
4.1-5 Kms	
5Kms and above	

Thanks

Appendix 3: Observation Guide

1. Observation of motorcycles at the various spots and the infrastructural provisions made for their efficient functioning.
2. Observation of the different routes used.
3. Observation of the riding patterns, passengers and way and type of loading goods.
4. Observation of the activities of the population centred around the use of motorbike taxis.
5. Quality, standards and size of the helmets vis a vis the users.
6. Observation of the type and condition of infrastructure (motorcycle friendly and motorcycle unfriendly).

Appendix 4: Tally Sheet for Passengers per Trip

Use the following numbers to indicate number of passengers

1) 0 for no passenger
2) 1 for one passenger
3) 2 for two passengers
4) 3 for three passengers
5) 4 for four passengers

Motorcycle No.	Rider	Passenger	No Passenger
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

Appendix 5: Tally Sheet for Helmet Use

Use X to indicate rider has no helmet on

Use √ to indicate helmet use.

Motorcycle No.	Rider	Passenger
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

Appendix 6: Work Plan

NO.	ACTIVITIES	START	FINISH	DURATION
1	Research proposal writing	Sep-13	Jan-14	8 Weeks
2	Proposal Presentation	October, 2013	October, 2013	1 Day
3	Proposal improvement	November, 2013	Nov-13	2 Weeks
4	Travelling to the field and making contacts	November, 2013	November, 2013	2 Weeks
5	Field Data Collection	Feb-14	Feb-14	4 Weeks
6	Data Analysis	Mar-14	Mar-14	2 Weeks
10	Thesis Submission	Apr-14	Apr-14	1 Week
11	Preparation for Defense	April, 2014	April, 2014	1 Day
12	Submission of the thesis Final Copy	April, 2014	April, 2014	1 Day

Appendix 7: Research Budget

S/No.	Items	Cost
1.	Stationery	6,000.00
2.	Research Assistants (5 * 5days * Kshs. 1050)	26,250.00
3.	Data entry & Analysis (5 * 5 * Kshs. 1050)	26,250.00
4.	Communication	3,000.00
5.	Contingency	10,000.00
TOTAL		**71,500.00**

Appendix 8: Sample Frame Derivation Technique

Size of Population	Sample Size (n) for Precision (e) of:			
	±3%	±5%	±7%	±10%
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100

a = Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled.

$n= N/1+N (e)^2$

Where

N= population

n=sample size

e=desired level of precision

Therefore n= 454/1+454(0.01)

n= 82

Appendix 9: Research Permit

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Ref: UON/CAE/DURP/B63/82437/12 **Date**: 7th February 2014

TO WHOM IT MAY CONCERN

RE: WACHIRA LAWRENCE MUHORO- B63/81793/2012

This is to Confirm that Wachira Lawrence Muhoro (B63/81793/2012) is a Postgraduate student in this department for M.A in Urban and Regional Planning. Mr. Wachira joined this department for the degree programme in October 2012 as a Part-time Student (evening class). He Completed his first year courses succesfully and proceeded to second year of study. He has completed all coursework and presently he is undertaking the research Project/Thesis entittled " Integrating Motorcycle Transport in the Urban Transportation Planning in Nairobi County: Case Study of Thika Super Highway." Any assistance extended to him in this regard will be highly appreciated.

DR. SAMUEL OBIERO
CHAIRMAN
DEPARTMENT OF URBAN & REGIONAL PLANNING

SO/mao