DEMAND FOR BICYCLE TRANSPORT SERVICES IN BUSIA DISTRICT: A CASE STUDY

BY

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Demand for bicycle transport services in
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This Research paper is my original work. It has not been presented for a degree in any other University.

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(iv) My husband Robert Nyongesa and brother David Munyendo for their moral support and continuous encouragement.

(v) Last but not least, my little daughter, Beryl Nekesa for her love.

MAY GOD BLESS YOU ALL
DEDICATION

I dedicate this research work to my mother Jacinta Atsieno Ouma and my daughter Beryl Sabina Nekesa for they are a blessing in my life.
ABSTRACT

The general objective of this study was to determine the factors that affect the demand for bicycle transport (passenger-carrying) services in Busia District. More specifically, the objectives were to identify the main factors; estimate the demand function and measure the corresponding elasticities and use the study findings to generate policy recommendations. Both linear and log-linear regression functions were analysed with the later giving a better fit of 79.13% compared to 71.79% for the former. Own price elasticity of demand was found to be less than unity. Income elasticity was also found to be less than unity and cross-price elasticity between demand for bicycle transport services and the "matatu" fare was negative and less than unity.

The findings of the study can be summarized as follows:

(i) Own price, income of the household head and bicycle ownership were found to be significant determinants of demand for bicycle transport services. Distance, age, sex of the household head, occupation and price of matatu transport services insignificantly determine this demand.

(ii) Bicycle transport service is a necessity and it is complementary to "matatu" transport service.

The policy recommendation generated from the results of the study is that integration of bicycle transport services in the rural transport system is viable. Therefore the study recommends that policy measures should be taken to ensure the spread of the use of bicycles as one of the low cost measures to satisfy rural mobility needs.
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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND INFORMATION

Transportation is a necessary concomitant of the exchange economy and is indispensable to economic development. Specialization and the generation of surplus for exchange on the basis of comparative advantage are not possible without the ability to move resources and goods from one place to another. Therefore transport is of particular importance to the rural economy of developing countries, providing rural people with access to the range of goods and services that they require to meet their daily needs and for economic and social development (World Bank, 1972, Barwell et al, 1993).

Transport service facilitates the movement of both people and goods from one place to another. People (producers and consumers) travel to satisfy certain economic and social needs (Osundwa, 1986, Khayesi, 1990).

For many people in the developing world, the more affordable alternative to walking is public transport, which is inadequate both in the rural and urban areas (World Watch, 1989). Whereas urban transport is characterized by inadequate supply and high vehicle operating cost, leading to low levels and poor service quality, the rural public transport service is so sparse that concern is more as to whether it exists at all (Kenya Development Plan 1994-1996, Faulks 1990).

Provision of public transport in rural areas has always been a problem (Nash 1982). According to the World Bank (1993), this is so in Sub-Saharan Africa due to two major rural transport gaps existing, namely:
(i) The rural feeder roads which connect villages and farming areas to the market centres are usually inadequate, poorly maintained and costly to use.

(ii) Poor and inadequate rural transport service caused by lack of Intermediate Means of Transport (I.M.T.) and appropriate infrastructure for their use. Therefore, in view of these gaps, there is a need to identify the most readily available mode of transport service that can stand these conditions.

In an effort to improve communication and transportation in rural areas, the Kenya government initiated the Rural Access Road Programme (RARP) and the Minor Road Programme (MRP) to facilitate Rural economic development (Republic of Kenya 1989-1993). Since motorized transport is inadequate both in rural and urban areas, the government is determined to promote, develop and encourage greater utilization of non-motorized transport (in particular bicycle use) to supplement the existing motorized transport (Development Plan 1994-1996).

Bicycles are suitable for paved and unpaved roads and narrow footpaths. Since in rural areas many people live far from the motor-vehicle system and much of their travel takes place on earth tracks and footpaths, bicycle transport is a possible and a viable alternative to motorized transport and walking in these areas.

In Asia and some parts of Africa, bicycles and their modification have widely been used. The tricycle (rickshaw) for instance is widely used in Asian cities as passenger carrier. In Bangladesh, it provides rural transport services being operated on hire basis. In Malawi, Ghana and Nigeria bicycles are rural ambulances (Kaira, 1983, Amegbletor, 1990).

In Busia district of Western Province, the relatively flat terrain is suitable for bicycle
use since they are non-motorized. Until very recently (early 1990s) bicycle use was restricted to household activities. Since then, bicycle transport has been commercialized being used for hire. However, commercial use of bicycle transport is not only found in Busia district but also in other districts of the province, for instance Bungoma and Kakamega. There has been a phenomenal establishment of this mode of transport in the district to an extent that they (bicycles) are referred to as the ‘taxis’ of Busia. The empirical research work covered concentrated on the commercial use of bicycle transport in Butula Division of Busia District. All the information presented in this paper about Busia District is applicable to the old district before it was split into Busia and Teso Districts.

1.1.1 ROAD NETWORK AND ECONOMIC DEVELOPMENT IN BUSIA DISTRICT.

Busia district has an existing road network of 791.0Km of which 41.1Km is bitumen road, 399.4Km is gravel road and 350.5Km is earth road. The road network serves 90% of the land most suitable for agricultural production. The district has also a high potential for fish production, trade and other economic activities, (Busia District Development Plan 1989-93).

According to the 1989-1993 Goverment Development plan the deterioration of the existing road network due to poor maintenance has been the major constraint to the economic development in the district. There are several service centres in the district, most of which provide trading and marketing services. However, these centres have reduced in number e.g in 1978, there were forty (40) service centres but by 1988 they had reduced to thirty two
Although most of the abandoned centres sprang up along the transit route of coffee boom of around 1978 from Uganda, poor communication and transportation have also contributed to this decline.

Poor road conditions have resulted in high fuel consumption and operating costs, discouraging potential motor-vehicle operators. As such, the only primary road with adequate traffic in the district is the one connecting Busia town to the provincial headquarters (Kakamega Town) via Mumias. Otherwise, other primary, secondary and minor roads remain underutilized (Busia Development Plan 1994-96). Given the inadequate supply of motorized transport in the district, efficiency in production, distribution and thus consumption of basic goods and services has been curtailed. For instance it is difficult for agricultural extension officers, health officers and local producers to deliver their commodities to consumers.

To alleviate part of the transportation problem in this area, the residents resorted to the use of bicycle transport services to access various destinations and the basics of life.

1.2 STATEMENT OF THE PROBLEM:

According to the current Development Plan, the Kenya government is determined to promote, develop and encourage greater utilization of bicycles to supplement the existing motorized transport both in rural and urban areas. The government is also determined to reduce the costs of road transport to lower income persons. To meet these objectives, tariff rates on bicycles were reduced from 30% to 15% during the 1995/96 Fiscal year. This shows the government’s commitment to the alleviation of transportation problem existing
both in rural and urban areas.

Inadequate provision of public transport services in rural areas, however, is attributed to insufficient traffic offered by small communities to sustain regular service. On the contrary, Busia district has a fairly large community. According to the Busia District Development plan for 1994-1996, the population is approximated at 534,504 people. The distance between homes, market places, hospitals and other facilities makes transport services essential, which unfortunately are inadequately supplied in this area.

There is demand for transport services in Busia district because of its population and the economic activities carried out. This demand is however not adequately met by motorized transport due to inadequate supply of the same. Bicycle transport on the other hand, is meeting a crucial part of the transport needs of the households of Busia district that is not met by motorized transport.

Thus the study investigated factors that influence the demand for bicycle transportation (passenger-carrying services) in Busia district.

1.3 OBJECTIVES OF THE STUDY

The general objective of this study was to determine factors that affect the demand for bicycle transport (passenger carrying) services in Busia District. Specifically the study sought to:

a) Identify the factors that influence the demand for bicycle transport services in Busia district.
b) Estimate the demand function for bicycle transport services and measure the responsiveness of demand to changes in prices and income.

c) Draw up policy recommendations in the light of the study findings.

1.4 SIGNIFICANCE OF THE STUDY

Transport is seen as exerting a major influence on the quality of the lives of both producers and consumers. Provision of suitable transportation facilities in the rural areas constitute a vital prerequisite for rural economic development. Such facilities need to be designed to facilitate adequate movement of producers, consumers and commodities at prices affordable to the rural population.

Transport studies have so far concentrated on urban areas ignoring rural areas. The current study is part of the research thrust towards rural transport service with special reference to an efficient and low-cost transport mode- the Bicycle.

A study on demand for transportation is seen as a fundamental basis of explanation for the supply of both network facilities and vehicle capacity. Since the study provides a transport travel demand analysis specifically in rural areas, the information will provide a framework for sound rural transport policies which would serve as a guide revitalizing the rural economy in particular and the national economy in general. The policies generated would guide the evolution of an efficient and effective rural transport system in Kenya.
1.5 CHOICE OF THE STUDY AREA (BUSIA DISTRICT)

Busia District was chosen as the study area on the following accounts.

a) It is believed that the district was the first region in Kenya to adopt bicycle transportation on hire basis (passenger-carrying service), having borrowed the idea from Uganda. The bicycles offering these services are known in the area as ‘boda boda’. The term ‘boda boda’ is widely used in Uganda which means bicycles used for carrying passengers (Howe and Dennis, 1993).

b) The researcher is familiar with the mode of transportation (bicycle-passenger carrying services) under study.

1.6 ORGANIZATION OF THE REMAINING PART OF THE RESEARCH PAPER

This paper is divided into five chapters. Chapter Two reviews Literature on travel demand. Chapter Three develops the theoretical framework upon which the empirical analysis is based. It also presents the model specification and, definition and measurement of the variables in the model. Chapter Four describes the methodology used in data collection and analysis, and presents the empirical results. Chapter Five summarizes and concludes the paper.
CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

Studies on rural transport in Less Developed Countries have concentrated on issues pertaining to Non-Motorized Transport, (NMT) and Intermediate Means of Transport (IMT). They have particularly concentrated on rural transport problems, the potential for adopting new approaches to these problems and transport technology for rural areas (Kaira, 1993, National council of Applied Economic Research, 1990). Literature on bicycles tends to be one of advocacy for their use.

Due to lack of hard data on the subject (demand for bicycle transportation), this chapter reviews past studies on travel demand for public transport both in rural and urban areas irrespective of the model used and the discipline in which the study was done. The review will distinguish the present study from past ones.

2.1 Review of general literature.

Fouracre et al (1977) investigated the travel characteristics of road users in Malawi. The objective of the study was to provide a foundation for predicting future usage of road transport facilities. This was because travel characteristics of the travellers are related to their land-use and the socio-economic background.
The factors examined were broadly defined as socio-economic, land-use and transport supply factors. Fouracre and Sayer utilized gravity model and regression analysis to examine the relationship between total trips made and the above factors. The model developed explained the relationship between the total trips made between Blantyre or Lilongwe (i) and a rural zone (j) and the travel characteristics of the traveller. The model was of the form,

\[ t_{ij} = kA_i A_j d_{ij}^n \]

where,

- \( t_{ij} \) is the total number of daily person trips made by road transport between i and j.
- \( A_i A_j \) is the function of socio-economic, land-use and transport supply parameters at i and j.
- \( d_{ij} \) is the distance between i and j in Km.
- \( k \) and \( n \) are constants.

In establishing the functional form of \( A_i A_j \) and the values of \( k \) and \( n \), multiple regression analysis was used with the data expressed in natural logarithmic form. The model developed combined trip generation and distribution for all person trips by vehicle at zone level. The multiple regression analysis showed that the independent variables explained 93% and 79% of the variations in the total trips that originated from Blantyre and Lilongwe respectively.

The study was highly exhaustive because of the detailed analysis of the determinants of travel demand given. However, the study examined rural-urban trips only with emphasis placed on motorized transport (cars and buses). Moreover, the model used originated from the gravity model. On the other hand, the current study examines rural-based trips with reference to non-motorized transport mode (the bicycle) and the model used originates from
the consumer theory of utility maximization. The current study however, is similar to Fouracre’s study in that in both cases, regression analysis was employed.

Domencich et al (1975) studied urban travel demand in Pittsburg (USA). The primary objective of the study was to provide a theoretical foundation and statistical methodology for the analysis of travel behaviour.

The study analysed modal attributes of the modes of transport used by commuters and their (commuters’) socio-economic characteristics. This study was based on a behavioural model which described the decisions that commuters made when faced with alternative transport choices. The assumption was that the commuter as a decision maker was able to rank possible alternative modes of travel in order of preference given time and income constraints.

The study utilised regression analysis to explore alternative measures of a variable or numerous alternative specifications of the model. Both linear probability models estimated by ordinary least squares regression analysis and binary choice logit models estimated by maximum likelihood method were explored in the statistical estimation.

Three alternative measures of goodness of fit were compared. These were; likelihood ratio index, \( R^2 \) index and the prediction success table. The likelihood ratio index was a more satisfactory index of goodness of fit from the point of view of statistical theory.

This study revealed that time and the money cost of travel were the most important modal attributes, while income, family size, vehicle ownership, occupation, sex and age were important socio-economic characteristics.

The above study examined urban transport problem focussing the attention on motorized transport. Although the study employed utility maximization theory, the utility
functions defined attributes of the various travel commodities. The models used were discrete choice models. Hence these factors basically form the basis for the difference between the urban travel demand study and the current one.

2.2 Review of Literature Specific to Kenya

A study by Kapila et al (1982) examined the "matatu" mode of transport in Nairobi. The concern of the study was to provide efficient and sufficient public transport in this town. Data on socio-economic characteristics of the residents, proportion of their incomes used on transportation, mode of transport preferred and their utilization patterns was collected.

The study examined four modes of transport. Apart from walking, the other three were motorized transport modes. The results revealed that 57 per cent of the household heads used public transport. 'Matatus' were found to be commonly used during peak time and from work places. Their speed, availability and flexibility were the factors favouring the demand for their service.

The above study differs from the current one in that it focused on the provision of efficient, safe and adequate public transport in Nairobi while the current study's focus is on the provision of efficient and effective (low-cost) transport mode in a rural set-up. Moreover the former study focused on modal choice and failed to analyse how each determinant affected the travellers' choice of one mode over the alternative.

Osundwa (1987) examined the demand for transport service in Kibera (Nairobi). Commuter travel decisions were analysed in relation to socio-economic characteristics of commuter and attributes of the transport mode (KBS buses, Government city buses - Nyayo
buses, "Matatu", Commuter train and Walking). A Multivariate Logit model was developed and estimated to study the effect of variables on the odds of one mode of transport being chosen over another.

Both discrete and continuous choice models were utilized. The discrete choice model was of the form:

\[
\ln \frac{P_k}{P_m} = \beta_1 \ln P + \beta_2 \ln T + \beta_3 \ln Y + \beta_4 \ln A + \beta_5 \ln ED + \beta_6 Sx \\
+ \beta_7 S + \beta_8 C + \beta_9 CN + \beta_{10} Av + e_i
\]

The continuous choice model took the form:

\[
\ln D_m = \beta_1 \ln P + \beta_2 \ln T + \beta_3 \ln Y + \beta_4 \ln A + \beta_5 \ln ED + \beta_6 Sx \\
+ \beta_7 S + \beta_8 C + \beta_9 CN + \beta_{10} Av + e_i
\]

Where:

- \( P_k/P_m \) is the probability that a commuter will choose one transport mode (k) over another (m)

- \( D_m \) - The total number of trips made using mode m,

\( m = 1, \ldots, 5 \)

where:

- \( P \) - fare (shillings)
- \( T \) - Travel time in minutes.
- \( Y \) - Actual income (shillings).
- \( A \) - Age (number of years).
- \( ED \) - Education (number of years).
- \( Sx \) - Sex, 1 if male, 0 otherwise.
S - Safety, 1 if safe, 0 otherwise.

C - Comfort, 1 if comfortable, 0 otherwise.

CN - Convenience, 1 if convenient, 0 otherwise.

Av - Availability of alternative mode when a particular mode was chosen. 1 if another mode was available, 0 otherwise

$e_i$ - error/stochastic term.

The results showed that trip fare, income, safety, comfort and availability of the mode were the most important determinants of the probability that a commuter will choose one transport mode over another. Personal attributes like age, sex and education did not significantly affect commuter’s choice.

The study was very exhaustive in that it considered modes of transport that were available in Nairobi. The focus of the study was however modal choice.

Studies carried out by Kapila (1982) and Osundwa (1986) are similar in that they both examined modal choice with an aim of enhancing knowledge on how transport problems faced by commuters in the city would be solved. The present study is similar to Osundwa’s in the following aspects:

(a) Both studies concentrated on the demand side of the transport problem and

(b) Each factor determining travel demand was empirically analysed. The method of estimation in the present study is similar to the continuous choice model in the former one.

Ogonda (1976) studied transportation in Nairobi area. The purpose of the study was to examine the spatial structures and patterns of transportation networks and traffic flows along them. The study utilized graph theoretic analyses of the road network systems, simple
correlation and regression analyses. The correlation and regression analyses in this study were used to measure the strength and form of relationship between road network distribution and building density.

However, trip patterns and travel characteristics were discussed in terms of trip mode, purpose, length and distribution. The study used descriptive analysis to examine the relationship between total daily trip distribution by mode, and for different trip purposes and distances.

Four modes of transport (walking, cycling, private and public transport) were considered. It was found that while 38 per cent of the trips were made by private transport (cars and vans) only 14 per cent were generated by public transport. The majority of the trips (44 per cent) were made on foot. Bicycles and motor-cycles accounted for 2.6 per cent of the trips. It was observed that most of the people made a choice between walking and the use of public transport depending on their financial capability.

The findings revealed that city buses, matatu and hired taxis are important public carriers within the city. The study established that city buses and matatu are in competition and that the bulk of passengers are carried by city buses. Matatu passenger service however, was found to be significant to the members of the public since it complements and supplements the city bus service.

This study did not statistically examine the factors that determined the passengers' choice of modes of transport. It descriptively analysed passengers' travel characteristics.

Khayesi (1990) examined the road network patterns and household travel characteristics in Kakamega district. The purpose of the study was to provide an analysis of the
structure and pattern of the road network and examine the rural household travel characteristics.

The study utilized statistical (correlation and regression) and dominant flow analyses. The study used the gravity model and regression analysis to establish the relationship between trips generated (attracted) and the population of the trip origins (destinations) and the distances separating them.

The model was of the form,

\[ T_{ij} = K P_i P_j d_{ij}^{-2} \]

When linearized the model became

\[ \log T_{ij} = a + b_1 \log(P_i P_j) - b_2 \log d_{ij} \]

where \( T_{ij} \) = total number of daily trips recorded between Kakamega town and the divisions.

\( P_i P_j \) = Population densities of i and j

\( d_{ij} \) = air distance between i and j

\( b_1, b_2 \) = partial regression coefficients

\( a \) = \( \log K \) (intercept)

The framework of this study was based on the demand for travel (travel characteristics being a component) and the underlying factors. The factors were broadly covered under environmental system. The system refers to physical and human characteristics which directly or indirectly have an impact on the provision of transport services. Environmental system consists of inter-related factors which include physical, political, economic, technological and social components. The economic component influences demand for
transport to serve agricultural, industrial, commercial and other services activities in the economy.

Socio-economic characteristics of the travellers were examined. The study revealed that the mode of transport used depended on the nature of the route, distance covered and trip purpose.

The study did not consider the modal attributes as determinants of travel demand. Further, the study did not statistically analyse the effects of the socio-economic variables examined on the demand for transport services which the current study did.

Ogonda (1976) and Khayesi (1990) gave highly descriptive analyses of the factors determining travel demand. The studies were geographically analysed.

From the literature already reviewed, it can be noted that most transport demand studies have focused on motorized transport. These studies had been carried out to examine the determinants of demand for motor vehicle services. To the best of the author’s knowledge, therefore, no study in Kenya has considered the demand for bicycle (passenger-carrying service) transport.

The following chapter concerns modelling. It is specifically concerned with theoretical framework, model specification and, the definition and measurement of variables.
3.0 Introduction

This chapter is divided into three sections. Section 3.1 presents the theoretical framework upon which the empirical analysis in chapter four is based. In section 3.2, the model used in the estimation is specified. Definition and the measurement of variables is given in section 3.3.

3.1 THEORETICAL FRAMEWORK

Unitary model of household behaviour was adopted and the theory of consumer behaviour then applied.

According to the Unitary Model of Household behaviour, a household is viewed as a collection of individuals who behave as if they agreed on how best to combine their time, goods and services purchased in the market and income to be spent. The model assumes that the household acts as one, by assuming that they have common preference. The model further assumes that all household resources are pooled together. This requires that at least one member of the household is able to monitor the other members,(Alderman,et al 1995). In this context, the head of the household monitors and controls the household.

The unit of analysis is the consumer (household head). The basic assumption is that a rational consumer will always choose the amount of a good or service to consume from the most preferred bundle from the set of affordable and available alternatives. The set of
all bundles must satisfy the budget constraint.

The set of affordable bundles and the budget set of the consumer is given by:

$$B = \{x \in X: Px \leq Y\}$$

Where $Y$ is the set of income available to the consumer.

$P$ is the vector of prices of transport services.

$x$ is the consumption bundle (the quantities of commodities purchased by the household).

The consumer is faced with utility maximization problem. The utility function can be written as:

$$U = u(x).$$

Consider a two-service case $q_1$ and $q_2$. The utility function can then be defined as,

$$U = u(q_1, q_2)$$

Where, $q_1$ and $q_2$ are the quantities consumed of the two services.

The consumer maximises $U = u(q_1, q_2)$, subject to the income constraint.

Thus Maximize $U = u(q_1, q_2)$

$$2$$

Subject to $\sum p_i q_i < Y$

$i=1$

Where $P_i$ is the price of service $i$ ($i=1,2$)

The income constraint of the consumer requires that the amount spent on bicycle and "matatu" transport services should not exceed the total amount the consumer has to spend.

Forming the Langrangian Function, and solving first order conditions (FOC) gives the demand functions
\[ q_1 = q_1(P_1, P_2, Y). \]
\[ q_2 = q_2(P_1, P_2, Y). \]

Where \( q_1 \) is the quantity of bicycle services demanded and \( q_2 \) is the quantity of matatu transport services demanded and,

\( P_1 \) is the fare paid for bicycle services

\( P_2 \) is the fare paid for matatu transport services

3.2 MODEL SPECIFICATION:

The study postulates a relationship between the travel demand for bicycle passenger service and its determinants.

From Economic theory, demand for a service is mainly determined by its own price, prices of other alternative transport services (substitutes or complements) and income. Other factor(s) fall under tastes and preferences.

The literature already reviewed indicates that travel demand for a transport service is determined by its attributes and personal and socio-economic characteristics of the consumer. These are price of the service, travel time, income, age, sex, occupation of the traveller, availability of the mode, vehicle ownership etc.

The general specification for travel demand for bicycle passenger service is of the form:

\[ Q_x = f(P_x, P_m, Y, KM, Ag, Sx, Oc, Bo) \]

where

\( Q_x = \) quantity of bicycle transport services demanded.
\( P_x = \) price of bicycle transport service.

\( P_m = \) price of alternative transport service(s).

\( Y = \) income of the household head.

\( KM = \) distance travelled in km

\( Ag = \) age of the household head.

\( Sx = \) sex of the household head.

\( Oc = \) occupation of the household head.

\( Bo = \) bicycle ownership.

There are various functional forms of demand which are consistent with optimization. The three most commonly used ones are:

(i) Linear,

(ii) Logarithmic, and

(iii) Semi-logarithmic demand functions.

The study adopted the Logarithmic demand function because the researcher was particularly interested in measures of price and income elasticities which are directly obtained from the logarithmic function. The coefficients in the log-linear function define elasticities.

The Model was thus specified as:

\[
Q_x = A P_x^{a_1} P_m^{a_2} Y^{a_3} \, KM^{a_4} \, Ag^{a_5} \, e^{a_6 S_x} \, e^{a_7 Oc} \, e^{a_8 Bo} \, e^\epsilon
\]

In the linearized form, the model became:

\[
\ln Q_x = \ln A + a_1 \ln P_x + a_2 \ln P_m + a_3 \ln Y + a_4 \ln KM + a_5 \ln Ag + a_6 S_x + a_7 Oc + a_8 Bo + \epsilon
\]

where, \( A = \) constant and \( a_i (i=1,...,8) \) are parameters to be estimated
3.3 DEFINITION AND MEASUREMENT OF VARIABLES

**Quantity of bicycle services consumed (Q)**

This was the number of trips made by the consumer (household head) using the bicycle transport services over one month. A trip is a journey separated by points of origin and destination, along a route and by a certain mode of transport.

**Price of bicycle services (P)**

This was the fare paid for the last trip made, measured in shillings.

**Price of matatu transport services (P_m)**

This was the fare paid for "matatu" transport services for the same distance covered, in shillings. The term "matatu" refers to Public Service Vehicle with a carrying capacity of twenty five passengers.

**Income of the household head (Y)**

This was obtained from total monthly expenditures of the household, measured in shillings.

**Distance Travelled (KM)**

This was the distance travelled to cover the last trip made, in kilometers.
Sex of the household head (Sx)

This involved the use of a dummy variable which took the value, 1 if male
0 otherwise

Age of the household head (Ag)

Age was measured in number of years from the date of birth.

Occupation of the household head (Oc)

This was defined by the source of income of the household head (whether employed or otherwise). A dummy variable was used taking the value 1 if employed (formal or informal) and 0 otherwise.

Bicycle ownership (Bo)

This measured ownership of a bicycle, a dummy variable was also used taking the value 1 if a household owned a bicycle and 0 otherwise.

In summary this chapter has been concerned with modelling. The author has briefly justified the choice of the model adopted. The next chapter will be concerned with the methodology used in data collection and analysis, and the empirical results.
CHAPTER 4
METHODOLOGY AND EMPIRICAL RESULTS.

4.0 Introduction

This chapter describes the methodology used to collect the data used for this study and the empirical results obtained. These include sources of data, method of sample selection, interview procedures, data limitations, data analysis and, the correlation and regression outputs.

4.1 Methodology

4.1.0 Introduction

This section describes the nature of the data used for analysis, the methodology used to collect it and the statistical computer package used for the analysis. The section further presents a summary of the data used for the study.

4.1.1 Data Sources.

In order to analyse the determinants of demand for passenger bicycle transport services, data on the number of trips and the explanatory variables was obtained from primary sources. A questionnaire was designed and administered to the household head.
4.1.2 Sample Selection

The study utilized both probability and non probability sampling techniques. In particular, purposive, random and cluster sampling procedures were employed to choose the sample. Busia district was chosen as per the reasons already given. Bicycle transport (passenger carrying) services are extensively used in Nambale, Matayos and Butula Divisions. Butula Division was again purposively selected. Butula has four locations (Marachi East, Marachi West, Marachi Central and Marachi North), and Marachi Central was purposively selected. The location has three sub-locations (Bukhalalire, Kingandole and Esikoma). Esikoma sub-location and three villages from the sub-location were randomly selected.

Due to unavailability of lists of households in these villages, the researcher resorted to cluster sampling. A cluster sample of twenty households in each village was selected and the required information was collected from the household head.

It is appreciated that biasedness is an inherent problem in purposive sampling, elements within a cluster are similar and that the cross-section of the population represented in the cluster sample is less compared to sampling by elements. However, these were resorted to because of limited finances and time and the absence of the sampling frame.

4.1.3 Interview Procedure.

Interviews were carried out in one village before moving to another. They were carried out on the household basis and every household head that constituted the sample was interviewed. A structured questionnaire was administered.
The subject matter of this study, bicycle transport services (locally known as 'boda boda') aroused much interest from the respondents. As a result, they (respondents) were cooperative. They cited instances where these services really met and still meet their travel demand. They attributed the demand for these services to their availability, reliability, convenience, flexibility and affordability. The respondents blamed the poor state of the roads for the inadequate supply of motorized transport services.

4.1.4 Data Limitations

Data on income was difficult to obtain from the respondents as this is treated with a lot of suspicion. As a result data on total expenditure was used as a proxy. Data on forty six household heads was finally used in the analysis because some fourteen respondents did not have complete information.

4.1.5 Data Analysis

Regression analysis was employed in this study where the number of trips made using bicycle transport services was the dependent variable. This analysis was used because of its lower computational costs in the initial estimation stages to explore alternative measures of a variable or numerous alternative specifications of the model. Correlation analysis was used to show the relationship between the dependent and explanatory variables. The statistical computer package used for the analysis was STATA.
Table 4.1 Summary of the data used for estimation.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>MEAN</th>
<th>STD.DEV</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_x$</td>
<td>4.37</td>
<td>2.51</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>$P_x$</td>
<td>30.50</td>
<td>11.56</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>$P_m$</td>
<td>43.30</td>
<td>15.68</td>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>$Y$</td>
<td>2139.80</td>
<td>1257.73</td>
<td>1030</td>
<td>7900</td>
</tr>
<tr>
<td>$K_M$</td>
<td>12.90</td>
<td>5.52</td>
<td>3</td>
<td>25</td>
</tr>
<tr>
<td>Ag</td>
<td>38.0</td>
<td>11.62</td>
<td>20</td>
<td>77</td>
</tr>
</tbody>
</table>

The table above shows that there is variability in the data used for this study. It also shows that on average;

(a) the number of trips made by the interviewed consumers per month is four (4),
(b) "matatu" fares are higher than bicycle fares,
(c) the distance travelled using bicycle transport services is 12.9km and,
(d) the consumers were aged 38 years.
4.2 Empirical Results

4.2.0 Introduction

This section presents correlation and regression results. Correlation coefficients are presented in a correlation matrix (Table 4.2), and the regression results are presented in Tables 4.3, 4.4, 4.5 and 4.6. Table 4.6 shows the estimation outputs of the model specified in chapter three. The empirical results are presented in terms of the parameter estimates; measures of statistical reliability of the parameter estimates (t-statistics) and the model (F-statistics) and the measure of the goodness of fit ($R^2$). The estimates of the parameters provide information about the effect of the variables on the total number of trips made by household head using bicycle transport services in one month.

4.2.1 Correlation and Regression Results

Before the regression analysis was done, a correlation matrix was generated (Table 4.2 below).
### Table 4.2

**CORRELATION MATRIX**

<table>
<thead>
<tr>
<th></th>
<th>Qx</th>
<th>Px</th>
<th>Pm</th>
<th>Y</th>
<th>KM</th>
<th>Ag</th>
<th>Sx</th>
<th>Oc</th>
<th>Bo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qx</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Px</td>
<td>-0.6147</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pm</td>
<td>-0.5807</td>
<td>0.9159</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>0.6077</td>
<td>-0.1460</td>
<td>-0.0930</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KM</td>
<td>-0.5658</td>
<td>0.9319</td>
<td>0.9668</td>
<td>-0.0988</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ag</td>
<td>-0.0327</td>
<td>-0.2019</td>
<td>-0.2019</td>
<td>-0.1658</td>
<td>-0.1195</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sx</td>
<td>0.0716</td>
<td>0.2158</td>
<td>0.2808</td>
<td>0.2593</td>
<td>0.2805</td>
<td>-0.0143</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oc</td>
<td>0.3499</td>
<td>-0.0995</td>
<td>-0.0986</td>
<td>0.4376</td>
<td>-0.0651</td>
<td>-0.1033</td>
<td>0.3089</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Bo</td>
<td>-0.2776</td>
<td>0.1407</td>
<td>0.2154</td>
<td>0.0191</td>
<td>0.1044</td>
<td>0.0568</td>
<td>0.1319</td>
<td>0.0701</td>
<td>1.000</td>
</tr>
</tbody>
</table>
Regression analysis entailed univariate and multiple regressions. The depended variable was first regressed on each independent variable and later on all the independent variables.

When the dependent variable was regressed on each independent variable, the signs of the regression coefficients were consistent with the signs of the correlation coefficients and six variables were significant. The results are presented in Table 4.3.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-value</th>
<th>F-value</th>
<th>r-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_x$</td>
<td>-0.1338</td>
<td>-5.170</td>
<td>26.73</td>
<td>0.3779</td>
</tr>
<tr>
<td>$P_m$</td>
<td>-0.098</td>
<td>-4.731</td>
<td>22.38</td>
<td>0.3372</td>
</tr>
<tr>
<td>$Y$</td>
<td>0.0012</td>
<td>5.072</td>
<td>25.76</td>
<td>0.3693</td>
</tr>
<tr>
<td>$K_M$</td>
<td>-0.258</td>
<td>-4.551</td>
<td>20.71</td>
<td>0.3201</td>
</tr>
<tr>
<td>$A_g$</td>
<td>-0.007</td>
<td>-0.217</td>
<td>0.05</td>
<td>0.0011</td>
</tr>
<tr>
<td>$S_x$</td>
<td>0.3356</td>
<td>0.476</td>
<td>0.23</td>
<td>0.0051</td>
</tr>
<tr>
<td>$O_c$</td>
<td>1.697</td>
<td>2.477</td>
<td>6.14</td>
<td>0.1224</td>
</tr>
<tr>
<td>$B_o$</td>
<td>-1.3825</td>
<td>-1.917</td>
<td>3.67</td>
<td>0.0771</td>
</tr>
</tbody>
</table>

Table 4.3a  UNIVARIATE REGRESSION RESULTS FOR LINEAR MODEL
### 4.3b UNIVARIATE REGRESSION RESULTS FOR LOG-LINEAR MODEL

<table>
<thead>
<tr>
<th>logQ&lt;sub&gt;x&lt;/sub&gt;</th>
<th>coefficient</th>
<th>t-value</th>
<th>F-value</th>
<th>r-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>logP&lt;sub&gt;x&lt;/sub&gt;</td>
<td>-1.021</td>
<td>-6.013</td>
<td>36.15</td>
<td>0.4510</td>
</tr>
<tr>
<td>logP&lt;sub&gt;m&lt;/sub&gt;</td>
<td>-0.922</td>
<td>-5.165</td>
<td>26.67</td>
<td>0.3774</td>
</tr>
<tr>
<td>logY</td>
<td>0.7653</td>
<td>5.019</td>
<td>25.19</td>
<td>0.3641</td>
</tr>
<tr>
<td>logKM</td>
<td>-0.712</td>
<td>-4.806</td>
<td>23.10</td>
<td>0.3442</td>
</tr>
<tr>
<td>logAg</td>
<td>0.0621</td>
<td>0.219</td>
<td>0.05</td>
<td>0.0011</td>
</tr>
<tr>
<td>Sx</td>
<td>0.0732</td>
<td>0.468</td>
<td>0.22</td>
<td>0.0050</td>
</tr>
<tr>
<td>Oc</td>
<td>0.2998</td>
<td>1.923</td>
<td>3.70</td>
<td>0.0775</td>
</tr>
<tr>
<td>Bo</td>
<td>-0.30228</td>
<td>-1.885</td>
<td>3.55</td>
<td>0.0747</td>
</tr>
</tbody>
</table>

From the table above, the variables which were significant at 5% were \( P_x, P_m, Y, \) and KM. Oc and Bo were significant at 10%. The others were insignificant at the two levels. When the depend variable was regressed on the six significant variables, significant variables became fewer since some of the variables that were significant in the univariate regression became insignificant and signs of some coefficients changed. These results are contained in Table 4.4 below. \( P_m, \) KM and Oc became insignificant and, the coefficients of KM and Oc changed signs.
Table 4.4 MULTIPLE REGRESSION RESULTS OF SELECTED VARIABLES, FOR LOG-LINEAR MODEL

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>log $Q_x$</td>
<td>-0.947</td>
<td>-3.244</td>
</tr>
<tr>
<td>log $P_x$</td>
<td>-0.498</td>
<td>-1.133</td>
</tr>
<tr>
<td>log $P_m$</td>
<td>-0.018</td>
<td>-0.191</td>
</tr>
<tr>
<td>log $Y$</td>
<td>0.696</td>
<td>6.194</td>
</tr>
<tr>
<td>log $KM$</td>
<td>0.463</td>
<td>1.278</td>
</tr>
<tr>
<td>$O_c$</td>
<td>-0.189</td>
<td>-2.141</td>
</tr>
<tr>
<td>$B_o$</td>
<td>0.052</td>
<td>0.043</td>
</tr>
</tbody>
</table>

When the model was expanded to include variables that were insignificant in the univariate regressions, signs of some parameter estimates were not consistent with the signs of the correlation coefficients.
Multiple Regression Results.

Table 4.5: REGRESSION RESULTS FOR THE LINEAR MODEL

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F(8, 37) )</td>
<td>11.77</td>
<td></td>
</tr>
<tr>
<td>Prob &gt; F</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>R-square</td>
<td>0.7179</td>
<td></td>
</tr>
<tr>
<td>Adj R-square</td>
<td>0.6569</td>
<td></td>
</tr>
<tr>
<td>( P_x )</td>
<td>-0.104</td>
<td>-1.856</td>
</tr>
<tr>
<td>( P_m )</td>
<td>-0.064</td>
<td>-0.985</td>
</tr>
<tr>
<td>( Y )</td>
<td>0.001</td>
<td>4.661</td>
</tr>
<tr>
<td>( KM )</td>
<td>0.144</td>
<td>0.715</td>
</tr>
<tr>
<td>( Ag )</td>
<td>-0.017</td>
<td>-0.750</td>
</tr>
<tr>
<td>( S_x )</td>
<td>0.422</td>
<td>0.894</td>
</tr>
<tr>
<td>( Oc )</td>
<td>0.276</td>
<td>0.551</td>
</tr>
<tr>
<td>( Bo )</td>
<td>-0.982</td>
<td>-2.112</td>
</tr>
<tr>
<td>constant</td>
<td>7.220</td>
<td>4.416</td>
</tr>
</tbody>
</table>
Table 4.6: REGRESSION RESULTS FOR THE LOG-LINEAR MODEL

<table>
<thead>
<tr>
<th>Term</th>
<th>Coefficient</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>logP_x</td>
<td>-0.999</td>
<td>-3.390</td>
</tr>
<tr>
<td>logP_m</td>
<td>-0.739</td>
<td>-1.577</td>
</tr>
<tr>
<td>logY</td>
<td>0.662</td>
<td>5.925</td>
</tr>
<tr>
<td>logKM</td>
<td>0.626</td>
<td>1.583</td>
</tr>
<tr>
<td>logAg</td>
<td>-0.148</td>
<td>-0.900</td>
</tr>
<tr>
<td>Sx</td>
<td>0.148</td>
<td>1.681</td>
</tr>
<tr>
<td>Oc</td>
<td>-0.066</td>
<td>-0.680</td>
</tr>
<tr>
<td>Bo</td>
<td>-0.179</td>
<td>-2.038</td>
</tr>
<tr>
<td>constant</td>
<td>1.477</td>
<td>0.900</td>
</tr>
</tbody>
</table>

Tables 4.5 and 4.6 above present multiple regression results when all variables were considered. The results indicate that $R^2$ was relatively high and significant as shown by the F-statistics, but, there were few significant t-ratios. This was due to multicollinearity problem.
Multicollinearity is the existence of "perfect" or exact linear relationship among some or all explanatory variables of a regression model (Gujarati, 1989). Its consequences are insignificant t-ratios, a high $R^2$, a significant F-statistics but few significant t-ratios, which are evident from the estimation results above.

The degree of multicollinearity was tested for and was found to be high. The method used for the test is one suggested by Kmenta (1986). This entails regressing each independent variable on the other independent variables and examining the $R^2$. When an $R^2$ that approaches one (1) is obtained then a high degree of multicollinearity exists. Indeed, when the distance variable was regressed on the other independent variables an $R^2$ of 0.9468 was obtained.

Therefore, with such a high degree of multicollinearity, parameter estimates are expected to be less precise. Hence, care should be taken when interpreting them.

Results Discussed

The estimated coefficients for demand for bicycle transport services using both linear and log-linear functions are presented in the tables 4.5 and 4.6 above. The data used for the regression analysis are presented in appendix 2. On the basis of the coefficient of multiple regression $R^2$, t-statistics and F-statistic, the regression results indicate that at 95% level of confidence, the log-linear function gave a better description of the relationship between the variables than the linear model. The parameter estimates in the log-linear function measure elasticities. Therefore, the interpretation of the results was based on the log-linear function.

The regression output for the log-linear function (Table 4.6) shows that only three
variables significantly affected demand for bicycle transport services. At 95% confidence level, the significant F-statistic showed that the explanatory power of the model was good. More specifically, the results indicated that;

The price of bicycle transport services was negatively related to the demand for the services and was a significant variable (determinant). This means that an increase in the fare would lead to a decrease in the number of trips made. Own price elasticity of demand is negative and less than unity. The elasticity was found to be -0.999. This means that a one percent increase in the fare would lead to a 0.999 per cent decrease in the total number of trips made using the service. This elasticity is significantly different from zero, which implies that bicycle fare is an important determinant of demand for bicycle transport services.

The price of "matatu" transport services was found to be an insignificant determinant even though it was found to be inversely related to the demand for bicycle transport services. The t-value of -1.577 means that the cross-price elasticity of demand is not significantly different from zero. This implies that bicycle and matatu transport services are unrelated. One possible explanation for the insignificance of the parameter estimate is the multicollinearity problem, for example "matatu" and bicycle fares were very closely correlated (r=0.92).

Income of the household head was a significant determinant which was also positively related to the demand for bicycle transport service. The elasticity coefficient of 0.662 indicates that a one per cent increase in incomes would increase the number of trips made by 0.662 per cent. This suggests that those engaged in some income generating activities like
business, make more trips than otherwise. The elasticity coefficient of less than unity implies that low income consumers make fewer trips using the bicycle transport services than their high income counterparts. A possible reason for this is that the low income residents resort to walking or they only make very necessary trips.

Distance travelled was found to be an insignificant determinant of demand for bicycle services. A possible explanation for this insignificance is the existence of multicollinearity problem, for example, distance was found to be highly correlated with bicycle and "matatu" fares ($r=0.93$ and $r=0.97$ respectively).

Age of an individual was an insignificant determinant and appeared to be inversely related to the demand. However, the data does not support the popular view that older people do not travel.

Sex of the traveller was an insignificant factor. This means that the difference between the number of trips made by men and women is not significant. The implication is that men do not necessarily travel more often (or make more trips) than women. This can be explained by the fact that both men and women had almost similar reasons for travelling. Most trips made were business, work and social.

Occupation which defined employment (formal or informal) was insignificant at 5 per cent level. This shows that there is no significant difference between the unemployed and the employed when it comes to demand for bicycle services. This implies that these services are also used for some other trips apart from the business or work trips, for instance social (that is, visiting, attending social functions e.t.c.) trips.

Bicycle ownership was a significant determinant of demand for bicycle transport (pa-
ssenger-carrying) services. The parameter coefficient is however negative. The significant parameter estimate implies that there is a significant difference between demand for bicycle services by those who own at least one bicycle and those who do not. The reason is that individuals without bicycles heavily depend on these services to meet their travel demand. This is consistent with the fact that bicycle transport (passenger-carrying) services meet a travel demand that is otherwise not met.

The constant term was insignificant and negatively related to the demand. This implies that the influence of the other variables not included in the model is insignificant.

In summary, this chapter has basically been concerned with the data (data sources, sample selection, interview procedure e.t.c.) used for the analysis and the presentation of empirical results. The price of bicycle transport services, income of the household head and bicycle ownership have been found to be significant determinants of demand for bicycle transport services. The following chapter concludes this study with summary, conclusions, policy recommendations, and suggestions for further research.
CHAPTER 5
SUMMARY AND CONCLUSIONS

5.0 Introduction

This chapter is divided into two sections. The first section gives a summary of the objectives of the study, the type of data used to achieve these objectives, the methodology used to collect and analyse the data, and the results. The second section concludes the study; highlighting problems (both data and statistical) encountered, policy recommendations based on the research findings and areas for further research.

5.1 SUMMARY

This study was based on the demand for bicycle transport (passenger-carrying) services in Busia District. The objective of the study was to estimate the demand function and measure the responsiveness of demand to changes in price and income. The results of the study were expected to be useful to policy makers in the planning of rural transport services.

The main type of data used was obtained from primary sources. A structured questionnaire was administered and interviews carried out at the household level. The data collected from the interviews highlighted certain aspects of the demand for bicycle transport services. The data showed that on average, the number of trips made per month is four. It also showed "matatu" fares are higher than bicycle fares. This is an indication that bicycle services are relatively more affordable. Another aspect that was highlighted was that these
services are used for distance ranging between 3km and 25km.

A continuous choice model was estimated to measure the impact of each determinant on the total number of trips made using bicycle transport services. The purpose of this was to find out which of socio-economic variables affect this travel demand.

The results showed that own price, income and bicycle ownership are the only significant variables. Price of matatu transport services, distance, age, sex and occupation were insignificant. However, the model developed explained 79.13 per cent of the total variations in the dependent variable.

The results of the correlation analysis showed strong correlations between the price of bicycle and matatu transport services; the distance travelled and the bicycle and "matatu" fares.

5.2 Conclusion

Certain limitations were pointed out in the process of data collection and analysis. Data on household income was difficult to obtain, as such, total household expenditures were used as a proxy. From the statistical analysis (both regression and correlation) multicollinearity was an evident econometric problem.
5.2.1 Policy Recommendations

On the basis of the study results, the following policy implications (recommendations) arise.

Own Price and income coefficient are significant and have the correct signs. The significant bicycle ownership variable has some policy implications as far as the supply of transport facilities in the rural areas is concerned.

The inelastic demand function for bicycle transport services is consistent with the fact that these services do not have close substitutes. Therefore, as a measure towards facilitating easier communication by bicycles, rural access roads should be improved.

If the demand for bicycle transport services is to be enhanced thus expanding the use of these services, incomes should be increased and the fare reduced. From the results, those with low incomes make fewer trips using these services. Similarly the higher the fare, the fewer the number of trips made. Hence, the pricing of these services should take into account the low income households. Fare on one hand can be reduced if the supply of these services is increased (for instance by increasing the supply of bicycles). This can be made possible by reducing the tariff rate on bicycles and bicycle spare-parts. This is to make them affordable to the rural population. Incomes on the other hand can be increased by initiating productive rural-based projects.

On the average, "matatu" fares are higher than bicycle fares. Hence, there is need to reduce them. This can be done by improving the roads to motorable standards and putting up petrol stations at Butula and Nambale service centres. This, in the long-run is expected to increase the supply of "matatu" in the area.
The insignificant effect of the price of matatu transport services is an indication of unreliability of these services. The inverse relationship between the variable and the number of trips made using bicycle transport services shows that the two are complementary. Therefore bicycle transport services can effectively supplement motorized transport services in the rural areas where in fact much travelling takes place on earth tracks and footpaths.

On average the distance travelled was 12.9km. The shortest distance covered was 3km while 25km was the longest and demand for bicycle services declined as distance approached 25km. It is tiring and uncomfortable to use bicycle transport services for long journeys and hence the services can conveniently be used for short distances.

Bicycle ownership was a significant variable meaning that the difference between the demand for bicycle services by consumers who own bicycles and those that do not was significant. This difference is however negative. This means that travellers without their own bicycles resort to passenger-carrying services. It is worthy noting that bicycles have speed advantage over walking. In using these services, time that would otherwise be used on walking is saved and used on other economic activities.

The government should encourage the bicycle operators (suppliers of the services) to form co-operatives, so that they (the operators) can be taught traffic rules as well as get any assistance available (be it financial or otherwise). Knowledge of traffic rules is particularly important as far as the passengers' safety assurance is concerned.

Therefore, the integration of bicycle transport services within the rural transport system is essential and viable. Policy measures should thus be taken to ensure the spread of the use of bicycles as one of the low cost measures to satisfy rural mobility needs. This is
mainly because provision of bicycle transport services by way of increasing bicycles does not require high investments by way of providing motorable roads nor high cost of mobile assets.

As a remark therefore, bicycle transport service is a rural transport aspect that is efficient and effective. Its economic performance can be seen both in terms of direct monetary gains that cyclists are able to make and indirect saving by way of time saving.

5.2.2: Further Research Area.

Multicollinearity is a sample and not a population problem. However the results are still unbiased and among the estimation methods, the Ordinary Least Square method still gives the best results. A possible cause of this problem could be that the sample size was small. Further research is therefore necessary (required) to consider more variables and observations, and if possible pool cross-sectional and time series data. This is to allow for an accurate and precise prediction.

It would be interesting to study demand for bicycle transport services in other areas of the country to find out if similar results would be obtained.

It is also important to determine the factors affecting the supply of bicycle transport services in Busia and other districts. Such a study would be extended to probably show the contribution of this business to employment creation in these areas.

Last but not least, there is a need to investigate the suitability of bicycle transport (passenger-carrying) service as a mode of transport in the urban areas of Kenya.
REFERENCES


APPENDIX 1: SURVEY QUESTIONNAIRE

SECTION A: IDENTIFICATION

Research site (Village) name:

Household head (serial number): ___

Name: __________________________ Sex: ___ Age: ___

Date: __________

SECTION B:

MODAL CHARACTERISTICS

1.0 How many trips did you make over the last one month, using bicycle transport services? __________

1.1 When was your last trip? __________

1.2 How long did it take? _______ hours

1.3 How far did you travel? __________ KM

Origin of the trip _______ Destination _______

1.4 What was the purpose of the trip?

Going to: a) the market  b) the hospital

c) visit (relative or friend)

d) work

Other (specify) __________

1.5 How much did you pay for this trip? ______
1.6 Was there any other mode of transport available and accessible to you for this trip?

YES  NO

1.6.1 If YES, which mode? ________________

1.6.2 How much would you have paid if you had used that mode for the trip? _____

ECONOMIC PARTICULARS OF THE HOUSEHOLD HEAD

2.0 Occupation

2.01 Are you employed? YES NO

A: If YES, what is your occupation? ________________

How much do you earn per month? ____________

Do you operate from home? YES NO

B: If NO, are you self-employed? YES NO

B1: If YES, identify the form of the employment.

Business____

Farming____

Other(specify)_____________________

B1.1: For the above named form of self-employment identify its nature.

(E.g What is the nature of your business?) ____________________

B1.2: How much do you earn (E.g in terms of profits made or receipts from the sale of farm produce) ________

B2: If NO, do you have any asset(s) YES NO
B2.1: If YES, which asset(s)?

Land____ (how many acres/hectares?_______)

Other(specify)________________

B2.1.1: Do you rent out your asset(s)? YES____NO____

B2.1.2: If YES, how much rent do you receive per month?_______

B2.2: If NO, do you receive any money from relative(s)? If YES, how much?_______

2.1: Expenditures

What is your monthly expenditure on the following:

Food____________

Education________

Clothing________

Health__________

Transport________

Other(specify)__________________________

________________________

2.2: Bicycle Ownership

Do you own any bicycle? YES____NO____
SECTION C: GENERAL

2.3  For how long have you been using bicycle transport services?
    Specify the duration __________

2.4  Are you satisfied with the services and the fare charges?  YES___NO___

2.4.1 If NO, what particular aspects don’t you like? Specify

2.5  What do you suggest should be done to improve the
    services? __________________________________________

2.6: What is your opinion of "matatu" transportation in this
    area?

__________________________________________

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