COST MODELLING FOR ROAD ACCIDENTS IN NIGERIA
CASE STUDY OF KADUNA STATE

BY

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DECLARATION

I hereby declare that this thesis has been composed by myself and that it is a record of my own research. It has not been accepted in any previous application for a higher degree.

All quotations and their sources of information are specifically acknowledged by means of references.

BENSON Gabriel Bankole

1996

CERTIFICATION

This thesis entitled "COST MODELLING FOR ROAD ACCIDENTS IN NIGERIA" by BENSON, Gabriel Bankole meets the regulations governing the award of the degree of Master of Science (HIGHWAY AND TRANSPORTATION ENGINEERING) of Ahmadu Bello University and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to my loving wife, Irenonse; my children, Olusegun, Oluwaseun and Olufunke.

They are wonderful gifts from God.

ABSTRACT

This work addresses the question of the method of accounting for loses due to all the injury levels for all persons involved in road accidents and the costs of specific accident types. By assuming that fatalities in road accidents lead to a permanent loss in the economy that is not replaced and by accounting for all lost outputs and damages from accidents, accidents' costs have been estimated for various severity levels.

On the average, each fatal accident has been found to cost N 453,187.69 while a serious accident costs N 279,258.41 on the average and each minor accident costs N 99,999.39 on the average. The data used for the analyses were the 1989 to 1993 statistics for Kaduna State.

COST MODELLING FOR ROAD ACCIDENTS IN NIGERIA
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CHAPTER ONE : INTRODUCTION

1.1 Preamble

Road traffic accidents may at first seem to be a relatively unimportant problem to a developing countries, such as Nigeria, when compared with the more obviously acute problems of malnutrition, education and the poorly developed infrastructures. However, an analysis of causes of death in a number of countries in the developing world, including Nigeria, by Transport and Road Research Laboratory (Report Numbers 396 and 676), Akoto and Wiredu (1986), has shown that deaths caused by motor vehicle accidents ranked third behind those caused by diseases and natural deaths. World Health Organisation (WHO) sources indicate that Nigeria leads eleven other countries in the World in terms of accident involvement and severity. The tremendous toll of motor-vehicle accidents on Nigerian roads, not only causes much suffering, pains and misery but leads to a waste of scarce human and material resources. Many papers have been written in the past, notably within the period 1972 to 1979, and several data given of road accidents in Nigeria. For example, 'Road Traffic Accident in Nigeria', a Nigerian Army publication (1977) on road safety, it is claimed that, on the average, 31 persons died on road accidents every 12 minutes in 1976.

Actually, the loss, in real terms, may be greater than apparent since those involved are not representative of the population as a whole. Many of the fatalities involved are vehicle users who come from the small minority of skilled people such as Doctors, Teachers, Engineers, Accountants and other professionals whose loss to the country is particularly detrimental.

The cost of road traffic accidents in Nigeria is obviously a worthy subject for detailed research and hence, this study.

1.2 Research Justification

The high number of accidents that occur on Nigerian roads is common knowledge. For example, total cases reported in all the states of Nigeria in the five year period (1989-1993) was 144,180 (Nigerian Police Force, 1994). Every accident entails an overall loss to the community far beyond what the country can afford.

Hence, a country like Nigeria should give thoughts to improving the road accident situation while she is in a relatively early stage of development since it is easier to incorporate safety features into roads during construction than afterwards.

Furthermore, changes in attitude and policy on road safety, made at an early stage in development, are likely to have a profound and continuing influence on accident occurrence and involvement by different groups. It is obvious, from an economic standpoint, that highway improvements that result in decreased accident rates indirectly bring about monetary savings to the road Users and the public in general which can be used to justify such investments.

Paradoxically, research carried out by the Nigerian Building and Road Research Institute (1989) showed that, in areas where number of accidents was not really increasing, the fatality rate increased probably because of the increased speed of travel caused by the improved roads.

The subject of this study is cost modelling of road accidents in Nigeria.

The study is on the same lines as those carried out by previous researchers in some European countries, especially, Britain. The work is however, a pioneering effort within the context of Nigeria and it differs, in some respect, from the earlier works in the treatment of the loss of output. It uses different sources of information, but it adopts formulae suggested by various British Researchers, where appropriate.

The study becomes necessary because it has been observed that accidents are on the increase on our roads despite huge investments to improve road geometries.

It has become necessary to carry out this work in order to quantify the loss to a family, the community and the country at large, in terms of fatality rate, damages to properties and human lives due to the occurrence of road accidents. The findings will also facilitate the development of adequate safety measure(s) to be taken in given situations as well as facilitate the estimation of returns from accident abatement measures.

1.3 Objectives

The primary objective of this study is to formulate a model that can be used for estimating the total cost of motor vehicle accidents at all levels of severity. In achieving this, the following secondary objectives have been defined:

a. To quantify, in monetary terms, road accidents in Nigeria.

b. To identify and quantify the loss(es) to a family, the community and to the nation as a whole, on account of road accidents in terms of deaths, damages to properties and incapacitation.

c. To deduce parametric values related to accidents as inputs for economic evaluation of highways and traffic improvements.

d. To provide basic input data needed in formulating frameworks for evaluating the cost-effectiveness of proposed countermeasures.

e. To provide a rational basis for assessment of financial claims to the family of accident casualties.

f. To undertake a valuation of the economic consequences of the road traffic accidents that occurred in Nigeria in the five years (1989-1993).

A knowledge of the costs of accidents is highly essential to facilitate the design of cost effective countermeasure to be employed in given situations. Unfortunately, it might be very difficult to quantify the loss in any accident because it is impossible to place a value upon human life. Hence, some minimum conditions must be met before accidents can be costed. These include:

1. The types of accidents and the extent of damages to properties and human lives involved in each accident type must be known.
2. The productivity rate per year for different categories of victims as well as the discount/inflation rate prevailing within the study period should be known.
3. The medical records of each casualty involved in accidents should be available and facilitate the assessment of medical costs to victims as well as lost output on account of disability.
4. The administrative cost (insurance) of accidents should be deduced from available records.

This work adopts a standard method of accounting for all the injury levels for all persons involved in reported accidents to deduce the costs of specific accident types.

CHAPTER TWO : LITERATURE REVIEW

2.1 Introduction

Road accidents, beside causing a large amount of personal suffering and bereavement which cannot be valued directly, also cause considerable direct losses on which a monetary value can be placed. An estimate of the total monetary cost of accidents helps to put the problem of road accidents in proper perspective. An average cost of accidents is required for use in the economic assessment of road improvement schemes; this however, should include an allowance for suffering and bereavement. It might be very difficult to quantify the loss in any accident because it is impossible to place a value upon a human life. However, at least an implicit value has to be put on life under many different circumstances.

2.2 Classification of Accidents

An approach to accidents costing starts by classifying accidents by severity. Accidents are either personal - injury or damage accidents. All accidents are supposed to be reported to the police but, in reality, whether personal injury accidents are reported to the police, depend on the degree of severity. Some are not even reported at all if the injuries are very minor. Personal injury accidents are classified as either fatal, serious or slight. R.F.F.Dawson (RLL Report LR79), defined the above classes of accident as follows:

"A fatal accident is an accident in which a person is killed as a result of the accident, provided death occurs within 30 days of the accident. A serious accident is an accident in which there are no deaths but a person is seriously injured. A serious injury is one for which the person involved is detained in hospital as an "in - patient", or any of the following injuries sustained whether or not he is detained in hospital:- fractures, concussion, internal injuries, crushings, severe cuts and lacerations, severe general shock requiring medical treatment.

A slight or minor accident is an accident in which there are neither fatality nor serious injury but a person is slightly injured. A slight injury is an injury of a minor character such as sprain or bruise. Persons who complain of shock but sustain no other injury should not be included unless they receive or appear to need medical treatment. Persons

who appear to be only slightly injured but nevertheless are admitted to hospital as "in-patients" either immediately or later should be recorded as seriously injured".

Lawrence Arokodare (1978) classified road accidents by severity, in terms of proportion of fatal accident cases to the total personal injury accidents in a group of accidents, the number of death(s) recorded per fatal accident case and also the proportion of death(s) to the total casualties, which he expressed in three perspectives as follows:

1. "An accident is said to be fairly severe if the proportion of fatal accident cases to the total personal injury accidents lies between 5% and 10%; severe if the proportion is greater than 10% but less than or equal to 15% and very severe if the proportion is more than 15%.
2. An accident is fairly severe if death(s) per fatal accident case value is less than 1.25, severe if it is more than 1.25 but not greater than 1.5 and very severe if greater than 1.5.
3. An accident is fairly severe if the proportion of death(s) to the total casualties lies between 5% and 10%, severe if greater than 10% but not greater than 15% and very severe if the proportion is greater than 15%".

The Abbreviated Injury Scale (AIS) is an internationally recognised clinical classification in which the severity of injury for each casualty is classified with respect to the part of the body. Injuries are coded as follows:

AIS 0		-	No Injury
AIS 1	Minor	-	Minor cuts, bruises or abrasions. Undisplaced fractures of fingers and toes.
AIS 2	Moderate	-	Moderate cuts (more than 50mm in length on the body and more than 25mm in length on the face), mild concussion. Undisplaced fractures of the long bones of the arms.
AIS 3	Severe (not life threatening)	-	Severe cuts (greater than 100 mm in length on the face or penetrating to deeper soft tissue, e.g, muscle). Displaced fractures of the arms. Fractures of the long bones of the leg.

AIS 4	Serious (Life threatening but survival possible)	-	Ruptured spleen. Multiple rib fractures with a unilateral flail chest.
AIS 5	Critical (survival uncertain)	-	Bilateral flail chest. Extensive lacerations of liver.
AIS 6	Maximum (injuries currently untreatable)	-	Decapitation. Massive intra-cerebral haemorrhage leading to death within 60 minutes. Transection or rupture of the aorta with immediate exsanguination.

Death, which can result from a range of severities of injury, and from complications (such as pulmonary embolism) arising from relatively minor injuries, does not have a separate category within this injury classification. The term fatal is thus not used but would correspond to AIS 6 or to any lower AIS category which resulted in death - within 30 days of the accident.

Classification by length of stay in the hospital as a result of injuries have been found to correspond to AIS system but in cases where length of stay is used, many countries do not have the same definition. For example, in Czechoslovakia, a 'slight' injury requires up to 42 days hospitalization and a 'severe' injury requires more than 42 days. Austria requires more than 21 days for a 'severe' injury. Germany requires 1 day. As a result of these differences in definitions among countries all over the world, the World Health Organisation (WHO) suggested that a fatal road traffic accident is one where an injured person dies within 30 days of the accident. It also proposes a 3-category classification involving: Not detained, detained for less than 4 nights and detained for 4 or more nights to indicate the degree of severity of injury.

D.C.Andreassend (1985) opined that in working out the cost of accidents, there needs to be clarification between "accidents" and "casualties". To distinguish between the two, "casualty class" was used in his paper to refer to a person, while "severity level" was used to refer to an accident. Accidents, as opposed to persons, are classified by the most severe casualty class sustained by one of the persons involved.

He researched that the casualty classes, used in Victoria, Australia since 1969, are as follows:

1 = fatal

2 = "admission" to hospital

3 = injured, required medical treatment

4 = injured, did not require medical treatment

5 = not injured.

He explained that these classes provide a finer breakup than do the coarser divisions of fatal, injury, and no injury.

For "official" statistics, severity levels 4 and 5 accidents are designated as "property damage only", levels 2 and 3 are designated as "personal injury", and level 1 is designated as "fatal" accidents. He however stressed that, generally, for "reporting" an accident, all states in Australia require by law, any accident involving injury (levels 4 and below), be reported to the police, adding that some states also require the reporting of accidents which resulted in property damage (no injuries) above a specified monetary value.

He explained that, the severity levels are those known at the time the report form is filed, and only in the case of a death within 30 days of the accident is any change made to the recorded severity level. He then discussed the problems with these "as-recorded" severity levels as follows:

1. Level 1 suffers from inconsistencies such as deaths not being counted if the person dies from "natural causes" or heart attack following the accident. An example of a natural cause is when a person suffocates or drowns in his own vomit with no other death-causing injury present.
2. The later diagnosis of injury of the not injured person, and the division between levels 3 and 4 being not as sharp as that between levels 2 and 3.

He said that "Medical treatment" is supposed to be treatment by a registered medical practitioner, and while hospital "admission" is a formal procedure a person might be admitted "for observation" and found subsequently to be uninjured. He opined that a system of specific injuries or days of stay in hospital would no doubt be more useful but is not yet available for the mass data record system.

He observed that generally, 97% of road deaths occur within 30 days (WHO) of the accident but it should be recognized that this time limit is for "census" purposes and not

for economic purposes. The time limit is not applied in accident compensation cases, nor are the natural-cause deaths debarred from claiming compensation.

Police classification, in Nigeria, for minor accident cases, falls under damage accident; serious injury is one in which a person is detained in the hospital for more than one day as a result of injury sustained. Minor or slight injury is one of a minor nature (bruise) in which a person is detained in the hospital for one day or not detained at all.

In this work, accidents have been classified on the basis of severity of injuries. The work has relied on the data obtained from the Nigerian Police Force, Ahmadu Bello University Teaching Hospitals, ABUTH (i.e. Zaria, Kaduna and Malumfashi) and the Federal Roads Safety Corps, Kaduna State. Details on the data used for the study are given later in the text. The field data spanned 1989 to 1993 and its geographical coverage is limited to Kaduna State.

With the adopted classification, a fatal road traffic accident is one in which at least, one person died within 30 days of the accident. A serious accident is one in which a person is seriously injured but no death is recorded. A minor accident is one in which there are no deaths or serious injuries and the injury sustained is minor in nature. Damage only accident is one that involves no casualty but damages of properties such as vehicles, farms, building, goods and other valuables. An accident may involve one or combination of two or more of the above-mentioned degrees but the classification is based on the greatest severity.

R.F.F.Dawson's definition of accident classes has been adopted with little modifications as per the available data. WHO's definition of fatal accident has also been adopted for simplicity of analysis. The classification of accidents adopted in this work differs from that of WHO in that, accidents have been classified by the severity of injuries sustained by the Casualties, whereas, WHO has classified accidents by the numbers of days detained in the hospitals; records of which are not sufficiently available for this work, due to lack of proper follow-up.

2.3 Conceptual basis for Accident Costing

A British Researcher, R.F.F. DAWSON (1967), opined that accident costs may arise from injury to persons, damage to property or incidental expenses and that such costs can be divided into two categories, namely:

i. Those that are due to a diversion of current resources, and

ii. Those that are due to a loss of future output.

He observed that injury to persons may lead to costs in both categories, but property damage and incidental expenses lead only to a diversion of current resources. An estimation of the measurable costs (an allowance for some unpaid services that are excluded from the national income accounts) of accidents indicates the effect that road accidents have on the national income. This amount, however, is only the minimum that the community would be prepared to pay to avoid these accidents. The community places a value on the lives of its members over and above the expected value of their net contribution to the national income: This is evident from the large sums that some communities pay, via the National Health Service to save or prolong the lives of their aged and unproductive members. If the value of the cost of accidents is to be used in carrying out economic assessments of road improvements and thereby have an effect on policy, then the cost should reflect the value that the community places on the saving of life and reducing suffering.

O'Flaherty (1974) in his analysis of accident costs, argued that "In practice, the figure which is normally used to assess the cost of accidents per personal-injury accident; that is, the total cost of all personal-injury and damage only accidents divided by the total number of personal-injury accidents. The main reason for using an average in this form is that records of damage - only accidents are often very inadequate and, except over a wide area, there will be in any given year only a few accidents of any degree of severity (certainly of fatal and serious ones) and any changes in these numbers will probably not be significant. If, however, the number of casualties per accident is much different from the average, then the cost which should be used in the accident calculations is the cost per casualty".

He further found that there are also deplorable social consequences of highway accidents, including the pain and suffering of the victims and the losses to parents, children, relatives and friends. Hence, it has been suggested that a multiplier of 1.4 should apply to the

computed costs to accommodate these hidden costs as well as insurance company overheads. This is because many, if not all, overhead items vary or would vary after a short time, with the claims paid. On the other hand, there are omissions from the cited costs such as the losses in productivity when enterprises are deprived of effective, talented people permanently or for a time.

Other views expressed by the researcher are that the costs of highway accidents that should appropriately be considered in economy studies include the property damage, medical expenses, wage loss, and those portions of insurance company overhead such as claim adjustment that are directly related to the accident. Other items should include (assuming full employment) the projected net future losses in earnings of persons killed or injured in highway accidents and the costs associated with disruptions of or delays to economic activities because the services of key or specialized personnel are lost or vital goods are destroyed or damaged or their delivery delayed.

At present, in developed countries like Britain, the method used in estimating cost of accidents is by determining the costs of those accidents in terms of benefits which would have accrued if the accidents had been prevented, i.e, the accidents which should be costed are those that do not occur but which without the introduction of the road improvements would have occurred. In any case, these costs are those which may be attributed to known accidents and do not take into account the cost of accidents which are not reported. They do, however, take notional account of the pain and suffering 'cost' imposed on other members of the community as a result of road accidents.

2.4 Value of the loss of output

Road accidents may lead to a loss of output in the current year as well as in the future years. The loss of a person's future output may be complete as in the case of death or a few serious injuries, or for a limited period possibly followed by a period of reduced output, a period which might be the remainder of his or her working life. Depending on the circumstances, this loss may be incurred by the casualty himself, or by his family or by the taxpayers. Present costs are usually inflated to give the costs in future years. There is no unique inflation rate which can be considered the "correct one". The rate should be based on the average inflation rate in the country.

The number of fatalities concerned and the extent of the loss of output (i.e. total or

partial) can be worked out by making certain simplifying assumptions once the loss in man years can be estimated. In the case of injuries, the total numbers reported are known but there are no direct statistics regarding the extent of the disablement either as regards its effects on output or the length of time for which it will last.

R.F.F.Dawson in (RRL Report LR79) opined that, most output is paid for but some services are provided free. The principal unpaid services are those of housewives. For some comparative purposes, the required value of output would be that which enters into the calculation of the National Income; in such cases, no value would be placed on the loss of unpaid services. He opined that there might be underestimation of the loss of paid output as some unpaid services might be undertaken by those who were previously in paid services. He argued that, for most purposes, the interest is in the effect of accidents on the nation and it is really immaterial whether or not the items being considered enter into the published estimates of the National Income. He suggested that, it would be quite possible to have a system where husbands paid their wives a wage. If such a system were instituted then the National Income would appear to increase considerably; this however would be a purely book keeping increase and the real wealth of the nation would be unaffected. He explained that, the services rendered by housewives are an important part of the real income of the country and the loss of these services is a loss to the country. He advised that, a value should therefore be placed on housewives' services that are lost as a result of road accidents.

Having decided to include a value for the loss of housewives' services, a number of questions then arise:

i. What is the average annual value of such services?

ii. Should the same value be used for all housewives irrespective of whether they go out to work or not?

iii. Should wives, for the point of view of this exercise, cease to be considered housewives at any particular age?

The answers to these questions would be largely arbitrary. Hence, the Researcher suggested the following:

i. To value the output of housewives who do not go out to work, regardless of latent earning power, at the average wage rate of employed women. This might be an underestimation since most housewives engage in businesses that bring more

income than salaries.

ii. For housewives who go out to work, to value their output as housewives at half the average wage rate of employed women. (The reasons for valuing their services is that some will pay others to undertake part of their household duties and thus will have less than average household responsibilities).

iii. To consider married women as housewives as long as their husbands are working. In practice, to avoid complicated calculations, involving the retirement ages of men and the difference in ages between husbands and wives, which would not be justified by the arbitrariness of some of the assumptions, it has been assumed that all wives are aged sixty when their husbands retire.

2.4.1 Loss of output due to death

When a worker is prevented from working as a result of an injury, then in a time of full employment the community loses his production for the period of his incapacitation. In the case of death, the position is more complicated. While the community loses his future output, it also saves his future consumption. The loss to the community is thus the difference between what would have been his future production and consumption, after both have been inflated. The resulting figure is usually referred to as the net loss of production.

It is sometimes argued that if a cross section of the population, as regards age and sex, were killed, the net loss would be zero. Some go even further and argue that the country is overpopulated, is suffering from a balance of payments deficit and therefore the loss of a cross section of the population would lead to net gain. In a very primitive community this might be so, as the loss of a complete family would not impose an economic loss on the community. If the community were living in an area that was overpopulated, because it was being over-hunted or over cultivated, then the community would gain from the death of a family. The economy of this country, however, is a complex one. The effect on the economy of a reduction in the population will depend on a number of factors:

i. The amount of unemployment or shortage of labour,

ii. The division between saving and consumption,

iii. Economies of scale in production,

iv. The extent of the division of labour and the available amount of capital per head.

It can be assumed, in relative term, that this country is over populated. There is a shortage of housing and an abundance of labour. If some of the population is killed then the stock of capital per head will increase, at any rate in the short run, but it does not necessarily follow that there is an economic gain. For example, if a cross section of the population of Nigeria were killed, the number of buses per head would increase but as there would be fewer bus drivers and the standard of service to the remaining bus passengers would probably be lower. More roads per head would be a gain in some ways but it could be offset, to some extent, by an increase in the fixed costs of maintenance per head.

In the case of child casualties, the estimate of the cost of their death to the community could be based on the amount of money that had already been spent on them instead of the discounted value of their future net output. Some young children who are killed in accidents may be replaced by their parents. In these cases the only direct monetary loss to the community might be considered to be the amount that has been spent on them. It is also possible that some of the child casualties will not be replaced, in which case society will lose their future output. For the lost future outputs, consideration would need to be made of the cost of upkeep and training which the child casualties would have required before acquiring appropriate skills. This shows the complexity involved in using lost output as a basis for costing child casualties. In this work, no estimates have, thus, been made of the proportion of child casualties who would be replaced. A disadvantage of basing the calculation of the cost of child fatalities on the amount invested in them is that the estimate of the total cost of fatalities so realized is inconsistent with what is proposed for adults. Taking the loss of output as the basis in all cases and ignoring replacements tends to overestimate the total cost. The overestimate is likely to be small as replacement will mainly apply to the very young for whom the discounted net loss of output is small or even negative.

Moreover, when a person is killed in a road accident it is difficult to assess what the net effects on the population and the national income will be. In many cases there will be a considerable readjustment. In order to replace fatalities, children

might be born who otherwise would not have been; widows might go to work who otherwise would have remained at home; a worker being killed might result in a large number of people changing their jobs; future children will not be born because their parents have been killed, *and so on and so forth.*

2.4.2 Loss of output due to serious injuries

In order to calculate the value of the loss of output which results from serious injuries, which may be anything from minor fractures to those causing incapacity for life, it is necessary to know the average length of time the victim is kept away from work. For long term incapacitation, it is also necessary to know the amount by which the ability to work is reduced and the length of time for which this disability continues.

2.4.3 Loss of output due to slight injuries

Slight injuries that are of a minor character such as sprains and bruises, will lead to loss of output by causing some people to be absent from work for short periods. There is no evidence of how long such absences will be. In many cases there will be no absence and in the great majority of cases when there is an absence it will be under four days and therefore may not be felt seriously.

CHAPTER THREE : METHODOLOGY AND DATA COLLECTION

3.1 Introduction

This study was designed to give an overview of road traffic accident causation and costs in Nigeria. However, uneasy availability of data constrained the study execution and only Kaduna State has been considered. In collecting needed data, the following steps were taken:

a. Roads Traffic Accidents Data, within Kaduna State, for five years (1989 to 1993) have been obtained and used in this work. The reason for taking Kaduna state data as a model for Nigeria is because more information about the casualties' personal data such as age, profession, sex, etc., are obtainable which are not available for all the states in Nigeria. It is worthy of noting that, the total number of accident cases in Kaduna State (4,806) for the period of five years is almost the same with the annual average in the same five years (4,650) for the whole country.

b. The accident data so obtained have been classified into the following groups so as to be able to estimate the number of persons killed and or injured and property damage, for use in quantifying, in monetary terms, road accidents:

   i. Fatal

   ii. Serious injury

   iii. Minor injury

   iv. Damage only

c. Costs of accidents, in terms of age, profession, sex, etc., are then worked out by estimating the following:

   - The net costs due to the loss of output caused by death and injury (with due allowance in the case of persons killed for what they might otherwise have consumed).
   - Medical Expenses
   - Damage to property, and
   - The administration expenses of motor insurance.

d. Overall cost per accident are then worked out which have been taken as a model for accident cost in Nigeria.

e. In calculating the effective loss of output of those who are killed or injured in road accidents, ideal situations for productivity level have been assumed. Also, the future consumption of the victims have been deducted from their future output, since they are not able to enjoy the consumption. Average cost of repair of damaged vehicles were obtained with an average cost of spare parts which compared well with the average cost per damaged vehicles obtained from the insurance companies. A multiplier of 1.5 is applied to the costs to accommodate insurance company overhead since overhead items vary within a short time, with the claims paid.

3.2 Data Collection

3.2.1 Sources of Data

Several sources of data were used. These are:

i. Police Case Files
ii. Federal Road Safety Corps Data
iii. Hospital Records
iv. Insurance Data
v. Other Primary sources.

i. Police Case Files - Data were extracted from the accident case files of the Operations and Training Department, State Headquarters, Nigerian Police Force, Kaduna. These data are summarized in Tables 3.1, 3.2 and 3.3. Data in Table 3.1 indicates the number of accident cases for different classes (Fatal, Serious and Minor), and the number of Casualties (persons killed and persons injured), on a year by year basis, whereas, data in Table 3.2 contains the type and number of vehicles involved in accident on yearly basis while data in Table 3.3 gives the number of vehicles involved in accident by severity level.

Annual and Daily averages for the personal injury cases have been worked out and indicated in Table 3.1. This gives, at a glance, a sort of overview of traffic accidents on roads within Kaduna State.

Moreover, the calculated averages shows the severity of personal injury accidents and it reflects very high value of Fatality Index which a nation like Nigeria cannot

afford.

From Table 3.2, Private car Owners seem to be more prone to Road traffic accident than other Road Users. This may not be necessarily true since the figure in the table might simply be reflecting on the composition, in terms of vehicle ownership of vehicles plying the roads. It might even be that vehicle accidents involving other vehicle types have been suppressed due to non-reporting. Table 3.3 indicated a higher value of vehicles involved in fatal cases than minor cases which is an indication of recklessness of drivers on our roads.

Generally, data obtained from the Police do not contain accurate assessments of injuries sustained. It is not stated in the data whether the injury is major or minor. The limitations, in terms of details, were corrected by augmenting the available records with data obtained from the hospitals.

TABLE 3.1: ACCIDENT DATA FOR KADUNA STATE 1989 TO 1993

	YEAR	NUMBER OF ACCIDENT CASES				CASUALTIES			AVERAGES		
		FATAL INJURY	SERIOUS INJURY	MINOR INJURY	PERSONAL INJURY (TOTAL)	NO. OF DEATHS	NO. OF THOSE INJURED	TOTAL	FATAL TOTAL %	DEATH PER FATAL ACCIDENTS	DEATH CASUALTIES %
KADUNA STATE	1989	468	448	567	1483	638	2667	3305	31.6	1.36	19.3
	1990	402	410	382	1194	580	3004	3584	33.7	1.44	16.2
	1991	211	247	228	686	279	1140	1419	30.8	1.32	19.7
	1992	272	244	283	799	459	1184	1643	34.0	1.69	27.9
	1993	215	209	220	644	308	877	1185	33.4	1.43	26.0
TOTAL		1568	1558	1680	4806	2264	8872	11136	32.6	1.44	20.3
ANNUAL AVERAGE		314	312	336	961	453	1774	2227	32.7	1.44	20.3
DAILY AVERAGE		0.86	0.85	0.92	2.63	1.24	4.86	6.10	32.7	1.44	20.3
TOTAL PERSONAL INJURY		4806				11136			-		
DAMAGE ONLY		* 48060									

Source: The Nigerian Police, Force State Headquarters, Kaduna.

** Estimated at ten damage accidents per personal injury accident.*

TABLE 3.2: BREAKDOWN OF VEHICLES INVOLVED IN ACCIDENT BY VEHICLE TYPE.

TYPE OF VEHICLE	YEAR					TOTAL NO. OF EACH TYPE.	PERCENT AGE OF EACH (%)
	1989	1990	1991	1992	1993		
TAXI CABS	130	182	177	120	118	727	16
PRIVATE CARS	209	283	324	356	238	1410	31
MINI BUSES	113	145	175	240	195	868	19
LORRIES	184	159	119	150	109	721	16
MOTOR CYCLES	104	139	131	102	81	557	12
BICYCLES	89	48	31	53	32	253	6
TOTAL NO. OF VEHICLES	829	956	957	1021	773	4536	100

TOTAL NUMBER OF VEHICLES INVOLVED = 3726

TOTAL NUMBER OF MOTOR CYCLES INVOLVED = 557

TOTAL NUMBER OF BICYCLES INVOLVED = 253

Source: State Headquarters, Nigerian Police Force, Kaduna State.

TABLE 3.3: NUMBER OF VEHICLES INVOLVED IN ACCIDENT BY SEVERITY LEVEL FROM 1989 TO 1993 *

YEAR	NUMBER OF VEHICLES INVOLVED IN ACCIDENT			
	FATAL	SERIOUS	MINOR	TOTAL NO. OF VEHICLES INVOLVED IN PERSONAL INJURY.
1989	2178	3634	1862	7674
1990	1871	3326	1255	6452
1991	982	2004	749	3735
1992	1266	1979	930	4175
1993	1001	1695	723	3419
TOTAL	7298	12638	5519	25455

Source: Nigerian Police, Force Headquarters, Kaduna.

* *Extrapolated from Tables 3.1 ,3.2 and 3.7*

ii. **Hospital Records** - Data were obtained from the Medical Records Department of Ahmadu Bello University Teaching Hospitals in Kaduna State. These data have been collated and are summarized in Tables 3.4, 3.5 and 3.6. The Tables also contain further categorization of occurrences according to severity, age and profession of victims. From Table 3.4, it can be seen that highest fatality is recorded in the 15 - 44 years age group which clearly shows how badly the nation's economy is affected as this age-group, under normal situations, contains the most resourceful and productive segments of the nation's workforce. This age group seems too wide which is likely to give very low average age as can be seen in Table 3.6. Most data in Nigeria involving age group are usually presented in this form. The reason might be that this age group 15 - 44 is the prime of life where people are very productive.

During this study, it was noted that the most fatalities were recorded from commercial vehicles. Table 3.5 shows that high fatalities are recorded in the following categories:

- Farming
- Children
- Trading
- Housewife
- Driving
- Student

Investigations revealed that these victims are either hit in the process of crossing a highway or died in commuting. This might be due to lack of proper education in driving ethics and/or impatience on victim's part.

Average age of each fatality in each group has been worked out and shown in Table 3.6. This shall be used in working out the cost of total casualties in the analysis.

Police Data vis-a-vis Hospital Data - The number of fatalities recorded in the data obtained from the hospital is less than the number recorded in the Police data. Interviews revealed that the number recorded in the hospital data were those that died while on admission. Those that died on the spot were taken to the mortuary straightaway and no record of them are kept in the Medical Records Department. Also, at the mortuary, no personal data such as age and profession of those killed in accidents are recorded as there

may be no means of identifying the victims. The Police data contained those that died on the spot and those that died on admission. Hence, Police data have been augmented with the Hospital data for use in the analysis of loss of output due to death in this work. In analyzing number of injuries, the total number obtained from the police data is also greater than that obtained from the hospital data despite the fact that there were cases which the police were not informed about which were brought to the hospital for urgent medical attention. There were cases that were not reported at all, neither to the police nor brought to the hospital. There are also possibilities that casualties were taken to hospitals, other than the Teaching Hospitals. Interviews were conducted in these private hospitals in order to obtain data for road accident victims for the period 1989-1993. Most cases reported were recorded as accident cases other than road accidents. It is suspected that some actual road accident cases were recorded as other accident cases for fear of legal implications when road accident victims are brought for treatment without police report. On account of this fear, private hospitals do not normally admit accident victims. As a result, road accident casualties are reported as accidents other than road traffic accident in order to be admitted into the private hospitals.

However, there are limitations in the data obtained from both police and hospital as earlier mentioned above, but since the main source for all the data is from the State Police Force, Headquarters, Kaduna, data from the latter have been made use of in this work where similar data from other sources differ from it.

TABLE 3.4: SUMMARY STATISTICS ON CASES OF ROAD TRAFFIC ACCIDENT FROM 1989 TO 1993

PERIOD	TOTAL CASUALTIES	NO. OF DEATHS WITHIN 30 DAYS	SERIOUS INJURIES	MINOR INJURIES	AGE GROUPS OF THOSE WHO DIED					
					UNDER 1 YR.	1 - 4 YRS.	5 - 14 YRS.	15 - 44 YRS.	45 - 64 YRS.	ABOVE 65 YRS.
1989	3113	480	2057	576	-	26	68	235	101	50
1990	3413	435	2327	651	8	17	98	140	131	41
1991	1286	209	842	235	-	6	12	119	48	24
1992	1501	345	903	253	-	9	19	233	65	19
1993	1091	232	671	188	-	-	16	136	56	24
TOTAL	10404	1701	6800	1903	8	58	213	863	401	158

Source: Ahmadu Bello University Teaching Hospitals, (Kaduna, Zaria and Malumfashi).

TABLE 3.5: FATALITIES BY PROFESSION FOR PERIOD 1989 TO 1993

Profession of those that died within 30 days.	*PERIOD*					
	1989	*1990*	*1991*	*1992*	*1993*	*Total*
Farming	*92*	*58*	*101*	*56*	*56*	*363*
Trading	*42*	*41*	*24*	*47*	*40*	*194*
Driving	*50*	*33*	*12*	*9*	*16*	*120*
Housewife	*59*	*25*	*6*	*56*	*16*	*162*
Student	*34*	*33*	-	*28*	*8*	*103*
Police	*17*	*8*	-	-	-	*25*
Tradesmanship	-	*17*	*24*	-	-	*41*
Children	*76*	*82*	*18*	*38*	*32*	*246*
Military Personnel	*8*	-	-	*9*	*8*	*25*
Architecture	-	-	-	-	-	-
Engineering	-	-	-	*9*	-	*9*
Clerical	*8*	-	-	*9*	-	*17*
Security	*8*	*8*	-	-	-	*16*
Administrator/Manager	*8*	-	-	-	-	*8*
Accountant/Auditor	-	*17*	-	*9*	-	*26*
Teaching	*11*	*21*	*13*	*5*	*2*	*52*
Tailoring	*2*	*15*	*2*	-	-	*19*
Medical Practice	-	*5*	-	*8*	*1*	*14*
Nursing	*2*	-	*1*	-	-	*3*
Labourer	*8*	-	-	*26*	*2*	*36*
Unspecified	*55*	*72*	*8*	*36*	*51*	*222*
TOTAL	*480*	*435*	*209*	*345*	*232*	*1701*

Source: Medical Records Dept. Ahmadu Bello University Teaching Hospital, Kaduna State.

*TABLE 3.6: FATALITIES BY PROFESSION AND AVERAGE AGE BY GROUP**

Profession of those that died within 30 Days	*Age of those that died*						
	Under 1 Year	*1-4*	*5-14*	*15-44*	*45-64*	*65+*	*Total*
Farming	-	-	-	*169 (30.5)*	*169 (52)*	*25 (72.5)*	*363*
Trading	-	-	-	*145 (30.6)*	*39 (45)*	*10 (70)*	*194*
Driving	-	-	-	*96 (31.9)*	*8 (45)*	*16 (80)*	*120*
Housewife	-	-	-	*110 (32.9)*	*47 (53.4)*	*5 (68)*	*162*
Student	-	-	*60 (9.4)*	*43 (21.8)*	-	-	*103*
Police	-	-	-	*21 (32.6)*	*4 (48)*	-	*25*
Tradesmanship	-	-	-	*33 (32.5)*	*8 (49)*	-	*41*
Children	*38 (.08)*	*76 (2.9)*	*132 (5.9)*	-	-	-	*246*
Military	-	-	-	*25 (35)*	-	-	*25*
Engineering	-	-	-	*9 (35)*	-	-	*9*
Clerical	-	-	-	*17 (29.5)*	-	-	*17*
Security	-	-	-	*16 (38)*	-	-	*16*
Administrator/Manager	-	-	-	-	*8 (45)*	-	*8*
Accountant/Auditor	-	-	-	*20 (32.7)*	*6 (45)*	-	*26*
Teaching	-	-	-	*52 (35.5)*	-	-	*52*
Tailoring	-	-	-	*19 (35)*	-	-	*19*
Medical Practice	-	-	-	*14 (35.5)*	-	-	*14*
Nursing	-	-	-	-	*3 (45)*	-	*3*
Labourer	-	-	-	*36 (26.7)*	-	-	*36*
Unspecified	-	-	-	*191 (31.4)*	*31 (48.7)*	-	*222*

** The values in brackets are the average age of each fatality in the indicated group.*

TABLE 3.7: INVOLVEMENT RATES COMPUTED FOR SEVERITY LEVELS (Aggregated Data) *

ACCIDENT SEVERITY LEVEL	NUMBER OF ACCIDENT CASES	INVOLVEMENT RATES BY SEVERITY LEVEL WITHIN EACH GROUP			TOTAL
		FATAL	SERIOUS	MINOR	
FATAL	1568	1701 (1.08)	2414 (1.54)	176 (0.11)	4291 (2.74)
SERIOUS	1558	-	4386 (2.82)	1023 (0.66)	5409 (3.47)
MINOR	1680	-	-	704 (0.42)	704 (0.42)
TOTAL	4806	1701 (0.35)	6800 (1.41)	1903 (0.40)	10404 (2.16)

* *The values in brackets are the Involvement Rates (i.e. average number of persons per accident occurrence) in each casualty class for an accident of that severity level.*

iii. **Federal Roads Safety Corps (FRSC) Data - Data were obtained from FRSC RS3 CAT.I, Kaduna Sector Command and what was obtained is summarized as shown in Table 3.8. Due to the late establishment of the Organisation, sometime in 1989, and the fact that it took additional time for the Kaduna Sector Command to get organized, data available covered only from 1991 to 1993 as at the time these data were collected. Moreover, data available are mainly for trailers, tankers and trucks. These data have not been useful in this work because of lack of information on smaller cars which is particularly of interest in this study. The data have however been included for the benefit of future researchers who may be carrying out similar studies in this aspect.**

TABLE 3.8 : ACCIDENT CATEGORIZATION WITHIN VEHICLE TYPE (LARGE VEHICLES ONLY).

YEAR	VEHICLE TYPE	NATURE OF ACCIDENT	NO. OF PERSONS INVOLVED	NO. OF CASUALTIES BY SEVERITY		
				FATALITY	SERIOUS INJURY	MINOR INJURY
1991	TRAILER	FATAL	35	19	14	2
		SERIOUS	10	-	6	4
		MINOR	15	-	-	-
	TANKER	FATAL	22	6	16	-
		SERIOUS	6	-	3	-
		MINOR	15	-	-	-
	TRUCK	FATAL	-	-	-	-
		SERIOUS	9	-	7	-
		MINOR	-	-	-	-
1992	TRAILER	FATAL	23	9	16	-
		SERIOUS	30	-	3	1
		MINOR	24	-	-	2
	TANKER	FATAL	4	4	-	-
		SERIOUS	5	-	2	-
		MINOR	-	-	-	-
	TRUCK	FATAL	29	6	23	-
		SERIOUS	9	-	9	-
		MINOR	6	-	-	2
1993	TRAILER	FATAL	6	3	1	2
		SERIOUS	12	-	4	3
		MINOR	14	-	-	1
	TANKER	FATAL	-	-	-	-
		SERIOUS	8	-	3	2
		MINOR	-	-	-	-
	TRUCK	FATAL	3	2	1	-
		SERIOUS	35	-	9	20
		MINOR	17	-	-	9
OVERALL TOTALS			337	49	71	48

Source: Federal Roads Safety Corps; Kaduna State.

iv **Insurance Data** - There are extensive statistics relating to road accidents that involved personal injury but there is only very limited information regarding pure damage accidents. In order to assess the cost of all road accidents, it is necessary to estimate the cost characteristics as well as the number of damage accidents. Unfortunately, returns got from Insurance Companies consulted could not be used to obtain a direct estimate of the cost details in damage accidents vehicles involved in personal injury accidents because most vehicles were found not to be comprehensively insured and those with third party insurance do not normally report at all regardless of the level of awareness.

However, the total claims for property damage as reported for all of the road traffic accident cases within five years (1989 - 1993) were collected from both National Insurance Corporation of Nigeria (NICON) and Leadway Assurance Company, Kaduna. An average cost per damage accident was then calculated from the data so obtained which was then adopted as the average cost per damage accident for subsequent work in this analysis.

In estimating the number of damage accidents, cross reference has been made with values obtainable in different European countries in studies reported in the Road Research Laboratory RRL Report LR79. In one of such studies, Professor Jones used a sample of all accident data recorded for 1942 - 3 and found that there were 2.3 damage accidents for each personal injury accident. The result was also used by Reynolds in his analysis of cost of road accidents. Rex estimated that the ratio was 5 to 1 while the result reported by fifty-two police chiefs in England and Scotland, for the years 1960 and 1961, found the average number of damage accidents per personal injury accident to be 1.6 and 2.3 respectively. The reported values are similar to those used by Jones but they are almost certainly underestimated as there are a large number of damage accidents of which the police are not informed. It is worthy of noting that less than a fifth of the damage accidents reported to the Police have been reported to the Insurance companies, indicating that there are probably over eight (5 times 1.6) damage accidents per injury accident. However, from data collected (Tables 3.1 and 3.9), damage accidents per injury accident gives an average value of 2.1. It is assumed that about

one-fifth of the damage accidents reported to the Police has been reported to the Insurance Companies. Hence, ten damage accidents per injury accident has been estimated to truly reflect the Nigerian situation. The assumed ratio reasonably reflects the country's level of development and attitude to driving of the citizens. However, a sensitivity analysis is also undertaken to ascertain the effects of this assumption on cost parameters. The results of the sensitivity analysis would also be used to establish some form of confidence intervals on the cost parameters.

TABLE 3.9: RETURNS RECEIVED FROM INSURANCE COMPANIES OF PROPERTY DAMAGE AND CLAIMS SETTLED TO DATE DUE TO ROAD TRAFFIC ACCIDENTS FROM 1989 TO 1993

ITEMS	NUMBER OF CASES					AMOUNT OF CLAIMS (Naira)					TOTAL NO. OF CASES	TOTAL AMOUNT OF CLAIMS (Naira)
	1989	1990	1991	1992	1993	1989	1990	1991	1992	1993	1989 TO 1993	
VEHICLES	25	351	449	1723	1932	115243.05	4452607.04	15188052.74	20510103.39	43043410.20	4480	83309416.42
BUILDINGS	2	257	193	1097	600	7800.00	3535309.48	5616123.79	9306519.38	12905891.34	2149	31371643.99
FARMS	-	-	-	-	-	-	-	-	-	-	-	-
OTHERS	-	17	573	788	2101	-	4158969.78	4702631.40	11392584.14	19251712.25	3479	39505897.57
TOTAL	27	625	1215	3608	4633	123043.05	12146886.30	25506807.93	41209206.91	75201013.79	10108	154186958.00

Sources: National Insurance Corporation of Nigeria (NICON) and Leadway Assurance Company Limited, Kaduna State.

v. Other Primary Sources - For comparison purposes, questionnaires were prepared (see Appendix I) containing professions, ages, average monthly incomes, number of children and their ages, amount of money spent on each child to-date (only for children under 15 years and/or not up to working age) and average amount given to spouse as monthly domestic allowance. Average income for a housewife and the average amount spent on a child were estimated from the data so obtained. Statistical Reductions of the returns got are given as Table 3.10 below. Some of the responses given in the questionnaires regarding the amount spent on a child to-date seem to be exaggerated while some are apparently underestimated. A balance was struck between the two extremes by finding an average which was applied for subsequent analysis in the work.

However, amount given to spouse as monthly domestic allowance as reflected on the questionnaires could not be employed as it does not reflect the true situation in the country at present. Most questionnaires have the spaces for spouse allowance blank. It had been intended that if good and reliable figure was obtained, it would have been used to work out the cost of death of a housewife. An average wage of a working woman by the Federal Government Scale Salary has been used in this regard.

TABLE 3.10: RANDOM SAMPLING OF NATIONAL INCOME DATA

CANDIDATE	*PROFESSION*	*AVE. MONTHLY INCOME*	*AVE.AMOUNT SPENT ON EACH CHILD TODATE*	*AVE. AMOUNT OF MONEY GIVEN TO SPOUSE*
1	*Engineer*	*2,800.00*	*10,080.00*	*2,000.00*
2	*Technician*	*3,900.00*	*30,500.00*	*1,000.00*
3	*Engineer*	*4,000.00*	*33,750.00*	*2,500.00*
4	*Engineer*	*5,000.00*	*14,600.00*	*2,200.00*
5	*Driver*	*1,080.00*	*22,500.00*	*750.00*
6	*Technician*	*2,500.00*	*36,250.00*	*1,800.00*
7	*Engineer*	*5,466.67*	*30,000.00*	-
8	*Administrator*	*2,785.00*	*1,520.00*	*1,500.00*
9	*Civil Servant*	*1,334.00*	*6,655.00*	-
10	*"*	*1,409.35*	*4,432.50*	*700.00*
11	*"*	*1,000.00*	*2,800.00*	*500.00*
12	*"*	*1,500.00*	*5,469.33*	*800.00*
13	*Computer Operator*	*1,500.00*	*27,600.00*	*700.00*
14	*Insurance Executive*	*1,386.25*	*15,000.00*	*1,500.00*
15	*"*	*2,500.00*	*16,650.00*	*2,500.00*
16	*Civil Servant*	*2,000.00*	*70,000.00*	*400.00*
17	*"*	*2,600.00*	*18,666.67*	*15,000.00*
18	*"*	*3,000.00*	*11,333.33*	*1,000.00*
19	*"*	*3,000.00*	*36,666.67*	*200.00*
20	*Clerk*	*2,450.00*	*39,666.67*	*1,900.00*
21	*Technician*	*1,315.00*	*2,307.50*	*1,800.00*
22	*Clerk*	*1,200.00*	*9,285.71*	*9,000.00*
23	*Technician*	*1,500.00*	*8,236.25*	*15,800.00*
24	*Civil Servant*	*4,000.00*	*520*	*1,500.00*
25	*"*	*3,000.00*	*47,666.67*	*2,000.00*
26	*Insurance Executive*	*3,000.00*	*62,000.00*	*1,500.00*
27	*Civil Servant*	*4,500.00*	*38,400.00*	-
28	*Engineer*	*4,200.00*	*72,000.00*	*1,500.00*
29	*Civil Servant*	*1,486.00*	*28,000.00*	*750.00*
30	*Insurance Executive*	*3,000.00*	*20,600.00*	*1,500.00*
TOTAL		*78,412.27*	*723,156.30*	*72,300.00*
AVERAGE		*2,613.74*	*24,105.21*	*2,410.00*

Source: National Income Data Questionnaires.

CHAPTER FOUR : DATA ANALYSIS AND DISCUSSIONS

4.1 Introduction

In arriving at cost(s) for accidents of various severity levels, using unit costs per person - casualty class, a knowledge of all the casualties of various classes within a specific severity level is required. If this vital information is not available, the accident costs may be underestimated. This work has tried to illustrate how data should be structured to facilitate the computations of unit accident costs at different severity levels. Different accident types have different severity classifications and differing numbers of vehicles and other severities involved. The following formula has been used for calculating the average cost of any accident type:

$$AC_i = C_{1i} X_1 + C_{2i} X_2 + C_{3i} X_3 + C_{4i} X_4 \quad \text{------} \quad (1)$$

Where,

AC_i = **Average Accident Cost per casualty for a particular level of severity (i) classification,**

where i can be any of the followings:

- **1 - (Fatal accident)**
- **2 - (Serious accident)**
- **3 - (Minor accident)**
- **4 - (Damage only);**

variables $X_1 \ldots X_4$ = **Involvement rate in each casualty class for an accident of that severity level for accidents classified into severity;**

constants $C_{1i} \ldots C_{4i}$ = **Unit average cost of a casualty and/or property damage for the corresponding particular severity level.**

The following assumptions have been made for easy computations and derivation of unit costs:

- **That a road fatality leads to the permanent loss of a member of the community and that no other adjustment takes place.**
- **Persons that sustain severe intracranial injury of other and unspecified nature have been classified to be life incapacitated while those of internal injury to unspecified organ and cerebral contusion have been classified to be incapacitated for a**

maximum of six months. The values obtained in consequence of these assumptions may only be approximate as there are no available information regarding the detail medical history and follow-up of these cases. However, from analysis of data obtained from the hospitals, about 10% of those that sustained serious injury as defined above are incapacitated for life. About 40% of them were incapacitated for six months, while 50% were incapacitated for four weeks.

- Persons suffering from permanent effects of road accident injuries will receive a permanent disability pension. Pensions and gratuities have been worked out according to ages of casualties.
- On account of the insignificant nature of some of the slight casualties, it has been assumed that an average of four working days is lost as a result of slight injuries to those who go to work. By this assumption, the average loss of output is four days per casualty. Hence, the total loss output is equal to the number of slight casualties who are workers multiplied by 4 which when divided by 260 (no. of working days in a year, excluding Saturdays and Sundays) gives the number of man years lost. The above listed assumptions have been thoroughly researched to be reasonable and are medically justified.

4.2 Basis for Computation of Average Costs Per Accident Occurrence

Total costs have been worked out by computing the coefficients included in equation (1) from the field data used for this study. Since detailed data were not got for all the accident cases, those on which detailed data are available constitute the samples from which general inferences were deduced.

The numbers of accident cases for the three severity levels, as summarized in Table 3.1, are:

Fatal	-	1568	accident cases
Serious	-	1558	"
Minor	-	1680	"
Total	-	4806	"

The numbers of persons in Casualty Class, as summarized in Table 3.4, are:

Fatal	-	1701	casualties
Serious	-	6800	"
Minor	-	1903	"
Total	-	10404	"

The numbers of vehicles involved in each accident type, as summarized in Table 3.3, are:

Fatal	-	7298	vehicles
Serious	-	12638	"
Minor	-	5519	"
Total	-	25455	"

By relating the vehicles' involvement to the number of accident cases in the various severity levels, we have that the number of vehicles per accident type is as follows:

Fatal	-	4.65	vehicles per accident
Serious	-	8.11	"
Minor	-	3.29	"
Combined (all cases)-		5.30	"

Similarly, by relating the casualties to the actual number of accidents in the different severity levels, we have the ratios of casualties to accident cases as follows:

Fatal	-	1.08	casualties per accident
Serious	-	4.36	"
Minor	-	1.13	"
Combined (all cases)-		2.16	"

These ratios are the values that have been mistaken by some researchers as those to multiply by unit casualty class costs to achieve the cost of each severity level accident. That is, they have been viewed as "casualties per accident". To achieve the correct framework for applying costs, the data must be restructured into the form shown in Table 3.7. Table 3.7 was obtained from the raw data given in Tables 3.1 and 3.4. Table 3.1 contains the total number of accident cases by severity levels, whereas, Table 3.4 contains the total

casualties by severity levels. Table 3.7 contains the rate of involvement for each severity level. Thus, for 4,806 reported accidents there were a total of 10,404 persons involved, giving an average of 2.16 persons per accident.

TABLE 4.1: ESTIMATED COSTS FOR THE TREATMENT OF VICTIMS OF R.T.A. BASED ON THE SEVERITY OF THE INJURY

ITEM NO	COST SUBHEADS FOR MAJOR ROAD TRAFFIC ACCIDENT (R.T.A)	ITEM COST	
		NAIRA	KOBO
1	G.O.P.D. VISIT	10	00
2	ACCIDENT & EMERGENCY UNIT	30	00
3	ADMISSION DEPOSIT:-		
(a)	Accommodation	70	00
(b)	Feeding	210	00
(c)	Investigation and Medical consumable (Drugs).	620	00
	TOTAL for (3)	940	00
4	EX - RAY	120	00
5	MAJOR OPERATION	1000	00
	GRAND TOTAL	3060	00

ITEM NO	COST SUBHEADS FOR MINOR ROAD TRAFFIC ACCIDENT (R.T.A.)	ITEM COST	
		NAIRA	KOBO
1	G.O.P.D. VISIT	10	00
2	ACCIDENT & EMERGENCY UNIT	30	00
3	EX - RAY	120	00
4	MINOR OPERATION	450	00
5	SUTURING OF LACERATION.	50	00
6	ORTHOPAEDIC SERVICES:-		
(a)	Ex - Ray	100	00
(b)	Consultation Fees	50	00
(c)	P.O.P. Application	300	00
(d)	Bed Services	75	00
	Total for (6)	1185	00
7	DRUGS & MEDICAL CONSUMABLE (Where applicable)	620	00
	GRAND TOTAL	1805	00

Source: Ahmadu Bello University Teaching Hospital, Kaduna State.

The column totals on Table 3.7 can be seen to give the figures previously computed. The row totals give the total number of persons involved in accidents at each severity level and, from this, the average number of persons involved per accident for each severity level is as follows:

Fatal	-	2.74	persons per accident
Serious	-	3.47	"
Minor	-	0.42	"
Combined (all case)-		2.16	"

This appears to indicate that both fatal and serious accidents involve high number of persons per accident whilst minor injury accidents involve relatively fewer persons. It is tempting to divide the total number of persons involved by the number of vehicles and derive :

Fatal	-	0.23	persons per vehicle involved in accident
Serious	-	0.54	"
Minor	-	0.34	"
Combined (all cases)-		0.41	"

Such computations would give misleading results since the persons involved in accidents are not only vehicle occupants. The numbers of persons involved in accident include pedestrians and pedal cyclists who are hit, in addition to the vehicle occupants.

4.3 Accident Costs - The involvement rates deduced in Table 3.7 are very useful for computing the cost of each accident occurrence. For example, the average cost of a fatal accident occurrence is made up of:

1.08 x the unit average cost of a death + 1.54 x the unit average cost per person involvement where serious injury is sustained + 0.11 x the average cost per person involvement where minor injury is sustained + 4.65 x the unit average cost of repairing vehicle damaged in accidents.

A similar basis can be deduced for computing average costs per accident occurrence for other accident severity levels.

4.3.1 Costs due to death - The different aspects of the costs due to death were discussed earlier. In order to estimate the net value of output loss, calculations have been based

on a number of averages (i.e. average wage, average consumption, average duration of working life, etc.) and the present values of consumption and production have been inflated to give future values. In normal situations, separate analyses should be undertaken for accidents in rural and urban areas. In this work, no separate estimates have been made for accidents in these different areas because of the limitations in the available data set.

The ages and professions of some of those killed in road accidents were obtained through the hospital records but there was no reliable information about their income. Hence, calculations have been based on the assumption that incomes of employed persons killed, of whatever age, are equal to the average earnings of workers with similar socio-economic characteristics in the Federal Ministry Establishments. The same average is used for both men and women. Annual consumption per person, for both men and women, is taken as the total consumer's expenditure on goods and services divided by the total population. Production and consumption will normally vary with age but the available data does not contain the detailed categorization needed for the computations. Hence, no attempt was made to reflect the age bias in the calculations.

However, general analysis showed that the average total cases of road traffic accidents per year from 1989 to 1993 in all the states of Nigeria is 4650, whereas in Kaduna State alone, a total of 4806 cases were recorded in the five year period.

The following are the sample calculations for each accident type using the following data:

Total Inflation from 1989 to 1993	-	184.2% (Annual average Consumer price Index: Fed. Office of Statistics).
Expected working life (assumed)	-	60 years
Consumption / Month / Household of average of 6 people	-	₦ 5,000.00

Loss of output due to death is:

No of workers killed (No. of fatalities in the group x percentage working) x the expectation of working life x the average annual earnings.

Saving in consumption due to death is:

Number of fatalities x the average expectation of working life x the average annual consumption.

Total loss of Output due to death, using the above expression and data

in Tables 3.4, 3.5 & 3.6.	**=**	**₦600,366,210.40**
Total savings of consumption	**=**	**₦448,468,650.00**
Net loss of output due to death	**=**	**₦151,897,560.40**
Inflated Net Loss of Output	**=**	**₦431,692,866.70**

Thus, Unit average cost of death is:

$$\frac{\text{Inflated Net Loss of Output + Medical + Property Damage}}{\text{Total Death}}$$

With the above, expression, using Table 4.2, Unit average cost of each causalty level is given as follows:

Unit average cost of a death	**-**	**₦277,939.58**
Unit average cost of a serious injury	**-**	**₦14,582.00**
Unit average cost of a minor injury	**-**	**₦22,290.08**
Unit average cost of damage only	**-**	**₦27,549.41**

From the above figures, the cost of a serious accident can be seen to be much less than the cost of a minor accident. The reason is that, the number of casualties recorded under serious accident is very high and when the average unit cost per casualty is calculated using this high figure, the result so obtained is relatively very low. See detail calculation in Appendix II.

TABLE 4.2: AVERAGE MEASURABLE COSTS PER ACCIDENT TYPE

CLASS OF ACCIDENT	COSTS (₦)				
	Loss of Output	*Medical Treatment*	*Damage to Property*	*Administrative Costs*	*Total*
FATAL	*431,692,866.70*	*5,205,060.00*	*23,918,198.48*	*11,959,099.24*	*472,775,224.40*
SERIOUS	*42,698,141.54*	*20,808,000.00*	*23,767,658.95*	*11,883,829.48*	*99,157,629.97*
MINOR	*543,145.48*	*3,434,915.00*	*25,626,641.22*	*12,813,320.61*	*42,418,022.31*
DAMAGE ONLY	-	-	*83,309,416.42*	*41,654,708.21*	*124,964,124.60*

CHAPTER FIVE : CONCLUSION

The calculations in this paper are based on the rather extreme assumption that a road fatality leads to the removal of a member of the community and that no adjustment takes place. An opposite but even more extreme assumption would be that a death resulting from a road accident had no long term effect but that the community quickly adjusted to a position where the national income per head was the same as before the accident. Such a complete adjustment is unlikely, particularly as road fatalities do not strike a cross section of the population as regards age and sex. The truth will be somewhere between these two extremes but it is not possible to make any reasonable estimate of which adjustments will take place. The maximum figure has therefore been used in the present calculations.

In the calculations, it is pertinent to point out that no account has been taken of any **sentimental value that a person may place on his own life or other members of the society may place on such lives. Losses due to death have been measured in terms of economic losses to those remaining alive: his relatives and the community in general. In other words the cost are based on the measurable costs to the population after the accident. The estimated costs derived from the 1989 to 1993 statistics for Kaduna State are that:**

- **average cost per fatal accident is ₦ 453,187.69**
- **average cost per serious accident is ₦ 279,258.41**
- **average cost per minor accident is ₦ 99,999.39**

These costs of accident for each severity level (Fatal, Serious and Minor) so obtained can be taken as models for estimating road accident costs in Nigeria. These costs vary *in order of magnitude of losses suffered from each level, fatal accident having the* highest cost while minor accident cost the least. It should be realised that the current cultural setting in Nigeria is that there is no amount of money placed on human life that can suffice. However, the figures obtained can be very useful in the assessment of accident abatement measures, especially if further studies that would establish causal

relationships between specific factors and accident occurrence are undertaken.

A major advantage of this study is that a basis has been established from which further refined and broader studies can be undertaken which can be used to give more reliable estimates of accident costs. Those factors that constrained total objective attainment in this study need to be addressed if future studies are to achieve improved results. Among the factors are availability of data with the needed details. This makes it highly essential for the country to adopt standard and properly detailed accident reporting format that all relevant agencies need to implement. Also, a way of ensuring that all accidents are reported and properly documented needs to be found.

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APPENDICES

QUESTIONNAIRE FOR NATIONAL INCOME DATA

1. SEX:_____ 2. PROFESSION:_____
3. AGE:_____ 4. MARRIED:_____ (YES/NO)
5. AVERAGE MONTHLY INCOME: N_____
6. NO. OF CHILDREN AND THEIR AGES:____
   (i) _____
   (ii) _____
   (iii) _____
   (iv) _____
   (v) _____
7. AMOUNT OF MONEY SPENT ON EACH CHILD TODATE
   (Only for Children under 15 years and / or not up to working age).
   (i) _____
   (ii) _____
   (iii) _____
   (1v) _____
   (v) _____
8. AVERAGE AMOUNT OF MONEY GIVEN TO SPOUSE AS MONTHLY DOMESTIC ALLOWANCE:_____
   (Please, specify if spouse is working or not).

COMPUTATION OF LOSS OF OUTPUT.

Loss of output due to death (RRL Report LR79) is:

No of workers killed (No. of fatalities in the group x percentage working) x the expectation of working life x the average annual earnings.

Similarly, Saving in consumption due to death is:

Number of fatalities x the average expectation of working life x the average annual consumption.

Loss of Output due to death (e.g. Farming)

From Table 3.6,

169 x 1.0 (assumed all are working) x 29.5 x 18,552 = ₦ 119,335,740.00

Total for all professionals worked out as above gives = ₦ 600,366,210.40

Similarly,

Saving in consumption due to death

₦5,000.00 / month / Household of average of six (6) people is assumed.

₦5,000 / 6 = ₦ 833.33 / head / month.

Therefore,

Consumption / head / month = ₦ 833.33 x 12 = ₦ 10,000.00

Savings = 1701 x 10,000 x 26.365 (average expectation of working life),

= ₦ 448,468,650.00

Net loss of Output due to death = ₦ 600,366,210.40 -₦ 448,468,650.00

= ₦ 151,897,560.40

Total Inflation from 1989 to 1993 = 184.2% (Annual Average Consumer Price Index: Fed.Office of Statistics).

Thus, Inflated Net Loss of Output = ₦ 151,366,210.40 x 2.842

= ₦ 431,692,866.70

Average Unit Cost of Death

$$\frac{\text{Inflated Net Loss of Output + Medical + Property Damage + Admin. Cost}}{\text{Total Death}}$$

From the above, Unit average cost of a death, is (Table 4.2)

$$\frac{431,692,866.70 + 5,205,060.00 + 23,918,198.48 + 11,959,099.24}{1701}$$

= ₦ 277,939.58

For average unit cost of a serious injury, using the above formula we have that:

$$\frac{42,698,141.54 + 20,808,000.00 + 23,767,658.95 + 11,883,829.48}{6800}$$

= ₦ 14,582.00

For average unit cost of a minor injury, using the above formula we have that:

$$\frac{543,145.48 + 3,434,915.00 + 25,626,641.22 + 12,813,320.61}{1903}$$

= ₦ 22,290.08

For average unit cost of a damage accident, using the above formula we have that:

$$\frac{83,309,416.42 + 41,654,708.21}{4536}$$

= ₦ 27,549.41

Also, cost per any accident type can be obtained using the expression in section 4.1:

$$AC_i = C_{1i} X_1 + C_{2i} X_2 + C_{3i} X_3 + C_{4i} X_4 \quad \text{------} \quad (1)$$

Where,

AC_i = Accident cost for a particular level of severity (i),

where i can be any of the followings:

- Fatal accident
- Serious accident
- Minor accident
- Damage only;

variables $X_1 \ldots X_4$ = Involvement rate in each casualty class for an accident of that severity level; and

constants $C_{1i} \ldots C_{4i}$ = Unit average cost of a casualty and/or property damage for a particular severity level.

From Tables 3.7 and above calculated unit cost, Cost of a fatal accident is:

1.08 x the unit average cost of a death + 1.54 x the unit average cost per person involvement where serious injury is sustained + 0.11 x the average cost per person involvement where minor injury is sustained + 4.65 x the unit average cost of repairing vehicle damaged in accidents.

= 1.08 x 277,939.58 + 1.54 x 14,582.00 + 0.11 x 22,290.08 + 4.65 x 27,549.41

= ₦ 453,187.69

Serious accident

= 2.82 x 14,582 + 0.66 x 22,290.08 + 8.11 x 27,549.41

= ₦ 279,258.41

Minor accident

= .42 x 22,290.08 + 3.29 x 27,549.41

= ₦ 99,999.39