PROBLEMS IN ESTIMATING THE COSTS AND BENEFITS OF A ROAD PROJECT

by

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

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This Thesis has been submitted for examination with my approval as University Supervisor

JOHN R. KING

C O N T E N T S

P R E F A C E

Like yesterday's lovers
Today's textbook writers
Act in haste
And repent in leisure

(E.J. Mishan)

This observation applies equally well to students writing academic degree theses - with the difference that textbook writers do get an opportunity at certain intervals to revise their books and to make good whatever they might have cause to repent for. Students never get a chance to write the second, third, etc. editions of their theses. Yet, perhaps, they act in even greater haste than textbook writers for the pressures against them are many indeed. The time constraint was an important consideration in the writing of this thesis.

In it I have attempted - in an amateurish fashion - to focus attention on what seems (to me) to be a fundamental problem area in Cost-Benefit Analysis: namely, the measurement of the costs and benefits of a public sector project. The basic premise in the paper is that the theoretical apporches to the estimation of a project's costs/benefits which have been advanced to date have probably occasioned project analysts in the field more problems than they have helped to solve.

The approach is a very simple one. In Chapters II, III, and IV is set out the conceptual framework for cost/benefit measurement. The case study in Chapter V is (or at least it is intended to be) illustrative of the proposition in the hypothesis. The final chapter is a concluding recapitulation of the substance of the preceding chapters.

A C K N O W L E D G E M E N T S

I wish to express gratitude to my Supervisor, Mr. John R. King, who guided me in the preparatory work with some very useful comments. Unfortunately, he had to leave for Lonsdale College, Lancaster (England) before the final version of the thesis was ready.

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3. the District Agricultural Officer - Nakuru
4. the Area Settlement and Co-operative Officers - Nakuru and T. Falls
5. the Planning Officer (Ministry of Tourism)

as well as officials in the Central Statistical Bureau (Ministry of Finance and Economic Planning), the Coffee Board of Kenya and the Tea Board - all in Nairobi.

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PART ONE

CHAPTER I

1.1 INTRODUCTORY

Reading some of the literature available on Social Cost-Benefit Analysis (or CBA in short) one gets the impression that this branch of Applied Welfare Economics has attained a very high level of sophistication in its development. This is true at least of the theoretical literature. Some rather complicated treatises have been written on virtually every aspect of CBA - ranging from the identification of costs and benefits of projects, measuring (i.e. pricing) them, investment criteria, the treatment of risk and uncertainty, spillover effects, etc. To illustrate:

1. Mishan[1] has proposed an elaborate scheme for the evaluation of the direct and indirect costs and benefits associated with a project based on what he terms the "willingness-to-pay".

2. Little and Mirrlees[2] have also come up with an even more complex alternative approach to the evaluation of the cost and benefit items of an investment project.

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[1]E. J. Mishan "Cost-Benefit Analysis ...."

[2]Little and Mirrlees "Manual of Industrial Project Analysis ...."

Of all the problems in CBA that of measuring costs and benefits - both direct and indirect - is the most fundamental. Yet, apparently it is one area in which not much progress has been made - not much at least in relation to the advances that have been made in the other areas of Cost-Benefit Analysis. For instance, the application of Operations Research techniques, e.g. Probability Theory, Game and Decision Theory, etc., has made it possible to grapple with the problems of risk and uncertainty with a reasonable degree of effectiveness and confidence. Regression and correlation techniques are now established tools in forecasting. Refined investment criteria (or decision rules) such as the now popular Internal Rate of Return (IRR) or the Net Present Value (NPV) are now commonplace, having developed over time from measures such as the simple rate of return (still widely used in simple financial analyses) and the pay-back period. The problem of inconsistencies which used to arise in ranking investments on the basis of the three decision rules in common use nowadays - namely the IRR, the NPV and the Benefit-Cost (B/C) Ratio - have virtually been overcome by the "Normalization Procedure", which Mishan[3] has elaborated very well in his book.

Yet all these refinements are in vain if the raw data used in cost-benefit calculations are only crude approximations. Such data are derived by two basic processes:

(1) identifying and enumerating the cost-benefit items.

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[3] E. J. Mishan, Op. Cit, Chapters 34-37

(2) measuring these items in money terms.

There is nothing particularly difficult in identifying the costs or benefits of a public sector project. But two factors should be borne in mind in doing so:

(a) for CBA purposes all costs and benefits should be social as distinct from private costs and benefits - i.e. they should relate to the whole economy rather than to private individuals or organizations.

(b) costs and benefits fall into two broad categories:

(i) direct (efficiency) costs and benefits consisting of intended social outlays and anticipated outputs and

(ii) secondary or indirect costs and benefits - i.e. the unintended adverse and favourable effects of a project.

The efficiency effects - the flow of intended inputs and anticipated outputs - are relatively easier to identify than the indirect ones. The direct inputs for, say the construction of a new road or the improvement of an existing one are the real resources that society must forgo to have the new or better road. The corresponding benefits will be the gains that are expected to accrue to road users in particular and to society at large. Such gains will include items as varied in nature as savings in vehicle operating costs, journey-time, lower risk of accident or greater comfort and reliability. Indirect project costs and benefits also take various forms. The point about them at this stage is that, unlike the direct effects of a project, they are the unintended ramifications of

a project and are not as easy to identify. It would appear from the literature there is no general consensus among CBA experts as to how the secondary effects of a project should be treated. Some analysts advocate they should be excluded from the costs and benefits of a project altogether. Others feel this is rather an extreme position and suggest that as far as is possible, under certain circumstances, secondary project effects should be taken into account in the evaluation of a public sector project. Mishan, for example, suggests that increases in site (property) values should be counted as benefits if it can be shown that they are not mere transfers of value from properties located elsewhere in the economy to properties situated near or along a road or some other investment. As a further illustration, the Foreign and Commonwealth Office (FCO) and the Overseas Development Administration (ODA) in their "Guide to Project Appraisal in Developing Countries" propose that "backward linkage" effects of a project be included either as costs or benefits, as the case may be. However, they caution against incorporating "multiplier" effects.

Apart from these scattered and brief cautionary remarks most of the CBA literature tends to shun the treatment of indirect project effects. The majority of those who prefer that secondary effects be kept out of the picture altogether do so on the grounds that they are too difficult to trace and evaluate. Moreover, even those who advocate a more positive approach also call for care on the part of the project analyst in his treatment of secondary costs and benefits of a project. At its

current stage of development it would appear that CBA is still ill-equipped to tackle secondary project effects properly; and in the developing countries where the additional problems of lack or inadequacy of statistical information and shortages of properly trained project appraisers abound, it is probably best only to take note of the possibility or actual existence of these effects without attempting to trace and evaluate them.

The second fundamental step in the appraisal of a project is how to measure the worth to society of the inputs and outputs of the project. Since both inputs and outputs contain items of different types there is need to convert them to a common measure so that a single summary index for the net worth of the project to society can be derived.

Problems associated with the measurement or evaluation of project inputs and outputs are even more troublesome than those of identification. Firstly, the worth of project inputs and outputs in cost-benefit calculations is social or economic - not private - worth. The measure of the private worth of a project's inputs and outputs would be the market prices at which they sell. On the other hand, market prices are usually poor indicators of economic value and must be adjusted to reflect the social valuation of goods and services produced in an economy. Only if an economy is so competitive that market prices are determined largely by the interplay of "market forces" of supply and demand can such prices be regarded as a fair measure of social value. A major measurement problem then is

one of how to adjust market prices to reflect what is considered to be the social worth of the goods and services that are the inputs and outputs of an investment project.

The problem stated in the foregoing paragraph is one of adjusting already available market prices. A slightly different but related problem is to establish a price where none exists. Two aspects of this should be distinguished:

(a) the problem of determining the price of a product that has not been in existence before. To do this it may be helpful to know something about the pricing policy of the producer of the new product. Possible bases for pricing decisions are Marginal Cost (MC) and Average Cost (AC). However, the use of these two pricing criteria subsumes:

either (i) that the economy is sufficiently competitive to ensure a close correspondence between MC or AC and the market price;

or (ii) that the producer has sufficient influence over his market to enable him to set his price in line with his MC or AC.

In the latter case we are once again confronted with the problem of having to adjust the market price to arrive at the social value of the product in question. In a highly competitive economic setting the market price, whether it be equivalent to MC or AC, would be considered as an acceptable approximation of the social value of a good or service.

(b) determining a price for a non-marketable or non-marketed product - e.g. a "public good", a spillover effect, an intangible item such as improvements in the scenery of a locality. Since in the so-called "market economies" a major factor in the determination of value is the interaction of supply and demand, the valuation of goods and services for which no markets exist must necessarily be arbitrary.

It is one of the basic axioms in Economics that all economic production is geared towards the satisfaction of consumers' needs - the consumer is supreme: his needs provide the motivation for production activity. This axiom applies equally to production activity in both the private and public sectors of the economy. Hence in CBA the net social worth of an investment is the net benefit that accrues from it to the consumers of its output(s). Profits from the sale of a project's output which accrue to the private investor (including profit making government enterprises) are obviously not a social benefit. Most public sector investments are not undertaken to yield business profits as their outputs are not produced for the market. They do, however, yield benefits to society. The social worth of both private and public sector projects is measured in terms of Consumers' Surplus (CS) - i.e. the difference between consumers' maximum willingness-to-pay and what they actually pay directly or indirectly in terms of forgone tangible benefits or opportunities.

Basically CS is an economic concept that is virtually impossible to measure accurately. In economic theory it refers to the surplus utility a consumer enjoys from consuming a good

or service but for which he does not pay, although he would be prepared to pay if he were required to do so. In CBA net benefit is considered in terms of this amount of money (or some other valuable asset) that the consumer would be prepared to pay rather than go without the good or service in question. Although this overcomes the difficulty of having to convert CS into its money equivalent, it raises a new difficulty. To obtain the monetary CS associated with the consumption of a given good or service one requires to have a demand curve for the good or service. But, as any honest economist will admit one of the most difficult tasks in economics is to establish a demand curve for a good with anything like "reasonable accuracy". By definition a demand curve represents consumers' purchase plans. To determine a demand curve is to establish these plans in quantitative terms. This is an exercise that is replete with all manner of difficulties, not the least of which is uncertainty about the behaviour of consumers. Commenting on consumer behaviour at large William Stanton[4] makes the following rather humorous remark which succinctly underlines the causal influences behind this uncertainty:

> "If he (the consumer) is king, he maintains a strange palace court in which the subjects (sellers) have to spend huge sums to try to find out what the vacillating, disorganized fickle king desires and to proclaim loudly that they, over all courtiers, have just what he wants".

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[4] William J. Stanton, "Fundamentals of Marketing" (1971) page 175.

The various techniques that economists and statisticians have developed so far for the purpose of determining and predicting what the "disorganized, fickle king desires" at best yield only rough approximations. Among them are consumer surveys, test markets, market trend analyses which rely heavily on the regression technique, etc. These techniques can be applied only to establish the demand for goods that have a market. For non-marketed products it would not even be appropriate to talk of them as having demand curves since, strictly, demand curves represent price-quantity relationships. Public goods, for example, have no price as such. Yet in CBA it is this type of product for which one needs to calculate CS to arrive at their social worth. The social value of marketed or marketable goods and services is easier to determine because all that is required is to adjust their market prices so that they reflect their economic values. For public goods one must establish a premise for pricing them. The trouble is that one may have no way of telling whether the premise is correct or not. Consequently, there is no clue as to the correctness of the price one attaches to a public good.

1.2 PURPOSE AND SCOPE OF THE PAPER

This paper attempts to focus attention on the basic problems involved in appraising road transport projects in particular and public sector projects in general. The public sector is a very large portion of the economy in many of the developing countries in Africa and Asia. In some of them it comprises virtually the entire economy, save for minor

activities. In the so-called "mixed economies" it may be as large and as important as the private sector. Notwithstanding the relative size of the public sector in any one country, the fact is that its existence and importance must be reckoned with even in the industrialized, largely market economies of Western Europe and North America.

It is this fact which gives CBA its present eminence in government planning agencies in many countries and in academic circles. As an aid to rational investment decisions in the public sector, CBA is invaluable. In fact its very "raison d'être" is to aid the project analyst to deploy a country's scarce resources in a manner that yields maximum net benefit to society. In other words, CBA should be a practical planning tool. But indications seem to be that while it has made considerable advances on the theoretical front, it is still lacking in a number of aspects in the realm of practice. But in view of the great need for the application of its principles and techniques, it is imperative that, while CBA should certainly retain its respectability as an academic discipline, it should be a practical tool for project planning.

This paper will limit itself to a detailed examination of the two basic steps in estimating the costs and benefits of a project which were mentioned earlier - i.e. the identification and evaluation of the inputs and outputs of a road project. The actual transportation of people and goods belongs more to the private sector - at least this is the case in Kenya. The paper

will also touch on other areas in CBA such as discounting, investment criteria, uncertainty, etc. But their inclusion is for the sake of completeness and no effort will be made to deal with them in detail.

The reason for the preoccupation with the two steps in the estimation process is that they form the foundation on which work in other areas is built. The ingenuity of the discounting techniques is meaningless if the streams of costs and benefits discounted have not been properly determined. Errors in either identifying the nature and magnitude of the physical inputs and outputs or in estimating their money values would render any subsequent analysis of little value, no matter how sophisticated the analysis may be.

1.3 STATEMENT OF HYPOTHESIS

This paper is not the professional treatise of an expert in cost-benefit analysis: rather it represents the reaction of a novice in the "business" of project appraisal in the public sector to the kind of problems that the expert has to grapple with in his work. It focuses specifically on the conceptual and practical difficulties that arise in the process of identifying and evaluating project inputs and outputs. Some of the issues raised in it may be problems for which solutions already exist but which the writer is unaware of; others may be problems of his own making possibly because of his own inexperience in handling them. But whatever the case may be, it appears that, despite the very commendable contribution theorists have made

to the growth and development of CBA as a discipline worthy of academic study, questions of its practical use have not received as much attention as they should - a failing which has created a discrepancy between the theoretical and practical aspects of the subject. And in this gap seems to lie the root cause of the difficulties that plague the project planner's work in the field.

It is therefore suggested here that the existence of this discrepancy between the levels of development in the theory and practice of CBA gives rise to the undesirable consequence that some of the CBA concepts, so eleborately expounded by theorists cannot easily be translated into usable form. Consequently, efforts aimed at narrowing the theory-practice gap would be far more rewarding than further theoretical advances. A basic premise taken in this paper is that CBA is primarily a practical decision tool in the hands of the economic planner. This is the main reason why it is desirable that the gap mentioned above be eliminated or at least reduced. The cause of the discrepancy seems rooted in both the concepts and estimation procedures proposed by the theorists. Some of the problems that the planner encounters in practice arise from the difficulty in measuring some of the concepts he has to use. But a good number of his troubles seem to spring from the complexity of the procedures and models that have been advanced by writers for purposes of identifying and evaluating project cost-benefit items. The narrowing of the said gap then must proceed on two fronts:

(i) redefining unclear or too abstract concepts (or possibly formulating new ones where necessary) in a manner that makes them easily understood and measurable.

(ii) simplifying or reformulating estimation procedures and models to make it possible for those intended to use them to handle them with ease and confidence.

Generally less difficulty arises in identifying the (direct) cost and benefit items of a project. The indirect effects, however, are sometimes obscure. But this is a problem in tracing - not identifying - the effects. The greatest diffficulties are in trying to measure the value of project effects - whether these are direct or indirect. And this is the reason why a number of alternative approaches have been proposed by the various "schools of thought" in CBA. The two prominent such approaches which will be considered in this paper are:

1. the Willingness-to-pay method - championed by the majority of thinkers and writers on CBA including, among others Mishan, Prest, Turvey, Millward etc. Under this approach the costs and benefits of a project are measured in terms of what people are prepared to pay for them - i.e. measured by the prices they would pay for them.

2. Under the World (Border) Prices approach, first propounded by Ian M. Little and James Mirrlees, project inputs and outputs would be valued at import-export prices.

Both of these evaluation proposals raise both conceptual and procedural difficulties. Detailed discussion of these is deferred to later chapters. Suffice to remark here in general

that some serious misgivings have been expressed about each of these two approaches and on CBA as a whole. One of the main problems in the willingness-to-pay approach is that the domestic market prices which are taken as the measure of people's willingness-to-pay do not always reflect the social value of goods and services. They have to be adjusted to do this - the adjusted prices being termed "shadow prices". It is in attempting to determine shadow prices that the planner finds the greatest valuation problem. To date there seems to be no set formula for converting market prices into shadow prices. Loose statements to the effect that the shadow prices of inputs should be the money values of the inputs' opportunity costs do not appear to be very helpful. The question still remains as to exactly how the opportunity values of the inputs are to be determined. The social values of outputs are usually derived by adjusting market prices for distortions in them due to indirect taxes and subsidies of various sorts. But then market prices may fail to reflect social worth properly for reasons other than fiscal effects, for example monopolistic influences. No specific direction is available as to how monopolistic distortions may be eliminated from market prices to arrive at a social measure of goods and services. Economic theory has it that market prices would be ideal measures of social value in a perfectly competitive economic setting. The real world economies are far from being perfectly competitive so that in practice there is no such standard of judgement against which market prices may be gauged.

In terms of validity willingness-to-pay is a highly commendable concept. One short-coming of the approach is the apparent lack of some definite procedural mechanics of deriving shadow values, given that the market measures of willingness-to-pay - namely the commodity and factor prices - are not necessarily appropriate measures of people's valuation.

In the Little-Mirrlees model world prices are regarded as the direct measures of social worth. The prices of goods and services on the international market are, therefore, shadow prices and require no further adjustments. The arguments for and against this approach have been the subject of some controversy in the literature and will be discussed in the next chapter. At this juncture it will only be noted that the Little-Mirrlees approach as a whole is both controversial regarding its validity and objectionable on account of its complexity. Price Gittinger has the following remarks to make about it:

> "Since the appearance of the Little and Mirrlees' second volume in 1969, their valuation proposals have aroused a continuing exchange among planners in developing countries and among professional development economists. Comments about the system have centered around its complexity and whether in fact it leads to better investment decisions. There is little doubt that their system of determining accounting prices is difficult both to understand and to apply. Even highly trained economists admit ambiguities in the system as Little and Mirrlees expound it and question its practical application."[5]

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[5]J. P. Gittinger, "Economic Analysis of Agricultural Projects" (1972), p.45.

When he wrote Gittinger was a division chief in the World Bank's Economic Development Institute responsible for its training program in agricultural project evaluation - a position which afforded him closer acquaintance with the practical problems in project analysis than the academic theorists can ever have. Gittinger, along with many other writers, is not only complaining that the Little-Mirrlees model is too complicated for most project appraisers (partly because of the very high degree of mathematical facility it calls for); he is also questioning the validity of it as may be deduced from the words:

> ".... Comments have centered around ..... whether in fact it leads to better investment decisions".

This criticism may imply one or both of two deficiencies in the model - namely:

(1) that the computational mechanics of the model is faulty. This would be a problem in the mathematics of it which need not concern us here.

(2) that the logic of the assumptions and other premises underlying it are invalid. If this is so then the above criticism is very much the concern of this paper - and it is an important one.

The view that the Little-Mirrlees system is too complicated is further borne out by the fact that the Foreign and Commonwealth Office (FCO) in conjunction with the Overseas Development Administration (ODA) have found it necessary to write a more simplified version of the original manual.

The FCO/ODA adaptation of the Little-Mirrlees model is one instance of the reduction in the theory-practice discrepancy which is being advocated here. When the gap between what is theoretically plausible and what is practically useful is so wide as in the case of Little-Mirrlees system it only serves to frustrate the very people who are expected to translate theory into practice. This has at least two harmful consequences:

(i) the project appraisals done with the aid of only partially understood concepts and techniques must necessarily be distorted, except if chance and coincidence operate in favour of the appraisers. And, moreover, this is assuming that the appraisers have the patience and courage to withstand the psychological discomfort of knowing that they are working with models that they do not fully comprehend.

(ii) the development of CBA to maturity would be stultified if it cannot find encouragement and nourishment from the experience of practical application. Developing countries, which, it is said, stand to benefit most from the application of CBA have no need for fine ideas or models which cannot be applied easily to solve their myriads of development problems. The saying: "knowledge for its own sake" is very relevant to such things as art and the like and in countries where basic needs are not much of a bother. Technology - and CBA is part of it - is essentially utilitarian: it must even be more so in the backward regions of the world.

But the problems in the application of CBA such as have been mentioned above must be seen in the context of the nature of the subject. One of the fundamental causes of difficulty in CBA is that it is a <u>social science</u> - and this, among other things, implies that the degree of rigor and precision of the

mathematician and the physical scientist are difficult, if not impossible, to attain in the analysis and solution of CBA problems. Those who complain about the lack of these qualities and the range of assumptions in cost-benefit studies display a failure to realize this fundamental point. The lack of mathematical rigor and precision in the social sciences is deeply rooted in their psycho-social nature. Underlying the data and method of analysis, interpretation and predictions of the social scientist is human behaviour which is as difficult to comprehend fully and to manipulate as it is infinitely varied. There are not as many constant "laws" in the realm of psycho-social behaviour as there are in the physical world - a point which largely absolves the social scientist from the indictment of imprecision and lack of rigor. But this must not be taken as an excuse for the social scientist to be unnecessarily careless in the formulation of his concepts or analytical procedures. It simply means that a certain amount of imprecision must be tolerated in the social sciences. In some areas the cost-benefit analyst, for example, may not even be able to quantify some of the variables he manipulates. Asked how far he thought CBA could be applied in appraising educational projects such as the MBA degree program recently introduced at the University of Nairobi a C.I.D.A. official retorted:

> "I have given up ever trying to apply CBA to education, health or any other social service ....".

This may be unwarranted despair on the part of the official but it does illustrate that there are legitimate limitations to be

reckoned with in the social sciences. Fortunately cost-benefit analysts and general economists have never pretended that it is an easy matter to appraise "social service" projects. The problems which bedevil any quantitative appraisal of the net worth of such projects are well known and fully acknowledged.

1.4 METHODOLOGY

The method adopted in this paper to illustrate the gap between theory and practice in CBA consists simply of a comparison of the theoretical and practical aspects of project appraisal. To this end a statement of the theoretical aspect will first be presented, followed by a case study of a proposed road project in Kenya's Rift Valley Province. The reason for juxtaposing these two is to highlight the extent to which current practice falls short of the theory. To be sure some of the short-comings in the application of the principles will be due to short-comings in the empirical data of the case study. Where this is so it will be pointed out. But this type of difficulty is not the principal concern of this paper, although obviously empirical problems are important. The short-comings in the piece of research done for the case study will undoubtedly have some bearing on the conclusions to be drawn from the case study regarding the theory-practice discrepancy. The main interest of the paper, however, centers on those problems which would still arise even with the most well planned and conducted data gathering and analysis. Difficulties which arise out of the writer's faults in the collection and processing of the field

data will be indicated wherever possible and they should be regarded as being peripheral to the theme of this thesis. Discrepancies between a principle and its application may arise possibly because of the misconception of it on the part of the person who makes use of it. This would be a grievous fault and it is hoped that the possibility of occurrence of such a mistake in this paper is remote.

In the following chapters are set out details of the theoretical framework which in a way forms the back-bone of the thesis. This description is preceded by some introductory remarks on the peculiar characteristics of appraisal problems in the transport sector, followed by a detailed consideration of the enumeration and evaluation of inputs and outputs of a road project. The theoretical framework sets out the analytical procedures to be followed in the case study.

The case study will be presented in three sections dealing with a general description of the case study of the road project and its area of influence, the data gathering process and the presentation and analysis of the field data. The role of the case study must be seen as being purely instrumental in justifying (or disproving) the hypothesis posed earlier.

It will probably be difficult to find inadequacies in the empirical data which are not in one sense or another associated with the way the concepts of cost and benefit are defined. It is this association which prompted the hypothesis that the major evaluation problems are rooted in the theoretical aspect of Cost-Benefit Analysis.

P A R T T W O

THE THEORETICAL FRAMEWORK

CHAPTER II

TRANSPORT SECTOR PROJECTS

2.1 GENERAL

In East Africa most of the transport sector of the economy is under some form or other of government ownership or control. Railway, lake steamer; harbor facilities; internal and international air services are all operated by East African Community corporations - namely the East African Railways Corporation (EARC), the East African Harbors Corporation (EAHC), and the East African Airways Corporation (EAAC). These corporations are jointly and wholly owned by the three partner governments of Kenya, Tanzania and Uganda. Some lake and internal charter flights are operated by small private firms but these are an insignificant proportion of the total volume of inland and sea and internal air transport services in East Africa. Railway services are the exclusive monopoly of the EARC.

Road transport is the only one in which the private sector may have a significant share. However, even this is probably true only in Kenya, and possibly, Uganda. In her nationalization moves, socialist Tanzania brought all major

companies operating within her territory under public or government ownership. With the exception of small local services, road transport is virtually wholly a public sector service in Tanzania. In Kenya and Uganda the Governments limit their role in the field of road transport to the construction and maintenance of roads. Operating road transport services is left open to the private sector. Only in one instance is the Kenya Government known to have extended its interest to actually operating road transport services: through KENATCO the Government participates in heavy road haulage and taxi hire service. The only one of the local authorities in the country having a hand in road transport is the City Council of Nairobi with a minority share interest in the Kenya Bus Services company - a public service company operating in Nairobi and Mombasa.

Currently plans are underway to build an oil pipeline from the oil refinery at Mombasa to Nairobi and possibly to be extended to Kampala (Uganda) in future. Indications are that this project might be undertaken jointly by the Governments of the two countries, perhaps in conjunction with some minority interest private shareholder(s) in the proposed pipeline company. If the project does materialize, East Africa will have added to its transport system a dimension that has so far only been limited to bringing water to urban areas from local dams.

Given the highland nature of the East African topography and the small size of the region's rivers, it is unlikely that rivers or canals will ever become an important part of the

transport system in this part of the world.

2.2 TYPES OF TRANSPORT PROJECTS

The foregoing description gives some indication of the type of projects that could be undertaken by the government or some agency acting on its behalf - i.e. projects which call for Cost-Benefit appraisal. Such projects would include:

Road Transport

(i) Construction of a new major or minor road.

(ii) Improving or reconstructing an existing trunk or feeder road.

(iii) Construction of a set of special purpose roads: tea roads, sugar roads, tourist roads, etc.

Railway Transport:

(i) Building a new railway line or extending an existing one: for some time now the EARC has been persistently urged to extend the Kisumu-Butere line to link up with the main Nairobi-Kampala at Bungoma to serve the agriculturally vital Western Province. Another possibility which has also been mentioned is the extension of the Nakuru-Kisumu line to Kisii and possibly to Homa Bay on Lake Victoria to help opening up the claimed potential copper deposits in South Nyanza and to serve the coffee-rich Kisii highlands.

(ii) Purchasing new locomotives: thus as part of its modernization program the EARC recently purchased some ninety diesel-electric engines to replace its now outmoded diesel engines.

(iii) Increasing "rolling-stock"; the EARC has recently come under pressure to increase its carrying capacity, particularly at harvest time when farmers' storage capacity is exhausted.

(iv) Increasing or modernizing passenger coaches or building some other facility.

Air and Sea Transport

(i) Construction of an airport or harbor

(ii) Purchasing a fleet of aircraft or ships: there are plans afoot to replace the present fl EAAC's fleet of VC10 jets with DC9 aircraft.

(iii) Opening new internal or international flight services.

Each one of the community corporations which would undertake the above projects operates on a commercial basis: it is expected to make profits like any other commercial enterprise. For this reason a profitability analysis of the projects would be a first and necessary step. But to the extent that the projects would be financed by public funds, cost-benefit appraisals of the projects would not be out of place. Although the projects would primarily be commercial undertakings, they must also be seen as economic enterprises the social profitability of which must be established. Ideally then any of the above projects would have to satisfy both commercial and social profitability requirements to qualify for undertaking. In many cases a commercially profitable investment may also be

economically viable. But there may well be projects which may be commercially sound but economically undesirable. These are the projects that pose the greatest evaluation problems. Whether they are undertaken or not will depend largely on what policy guidelines the government may have laid down affecting investment decisions. But in the absence of this, given that the Community corporations are firstly commercial enterprises and only secondly "socioeconomic" institutions, private profitability considerations may take precedence over social considerations.

As experience in Kenya and Uganda has shown the private sector in any one of the East African countries would be quite capable of providing efficient and adequate road passenger and freight transportation if public authorities provide the necessary infrastructure. The Tanzanian nationalization of bus and road transport companies appears to have been prompted by political-ideological rather than economic considerations of efficiency or effectiveness. On the face of it the small scale nature of the road transport business would seem to favour private operations. Public ownership and operation would be more suited for such large-scale undertakings as rail or air services. These require substantially heavier initial investment outlays than most private firms in East Africa would be ready to undertake.

2.3 IDENTIFYING PROJECT COSTS AND BENEFITS

To calculate the net commercial or social profitability of an investment project two sets of basic data are required: quantities of the physical inputs and outputs and prices at which these are to be valued. For meaningful comparison of the various types of input items on the one hand and output items on the other it is necessary that they be converted to some common measure - the usual and obvious one being money. There are then, two distinct but related basic steps in the appraisal of a project:

1. identifying (or enumerating) and quantifying the physical inputs to be used up by a project and the physical outputs it is expected to produce.

2. determining the monetary prices at which to value the inputs and outputs.

Both of these steps are by no means easy but generally it is easier to identify and quantify a project's inputs than its outputs. Every project uses up real (economic) resources in the form of time, effort and materials and these are not too difficult to identify or to quantify. The outputs of some projects, though economic in nature, are intangible and not easily recognizable as benefits, e.g. the comfort road users enjoy driving on a smooth surfaced road; others may be both intangible and non-economic - e.g. the prestige (real or imagined) to a country from having a monumental building, stadium or some other imposing structure or the aesthetic value of a public park, etc. When the benefits expected from a project are largely or wholly non-economic in nature so that an economic valuation of them is not possible, economists do caution investment decision makers

to bear in mind that the resources that such a project absorbs are a real cost to the economy.

Secondly, there is the element of uncertainty to reckon with in quantifying project inputs and outputs: one can never be certain about the exact amount of resources a proposed project will use up or the precise magnitude of output(s) it will produce. This problem is of particular significance in relation to operating cost and benefit items the flow of which stretches further into the future. The degree of uncertainty increases the further into the future one projects so that forecasts of the magnitudes of cost/benefit items that will be realized in the relatively more distant future are less reliable than forecasts about the near future.

2.31 ENUMERATING PROJECT COSTS

The economic costs associated with a road project fall into three broad categories:

(a) Construction costs

(b) Maintenance costs

(c) Incidental adverse effects or externalities resulting from the construction and utilization of the road affecting the road users themselves and/or the inhabitants of the area it traverses.

(a) Construction Costs

These are generally the largest cost item for a road project. They can be sub-divided into:

(i) Cost of capital goods - construction equipment like bull-dozers, scrappers, rollers, motor-graders, tippers, etc.

(ii) Cost of construction materials - stone aggregate and chippings, cement, bitumen, etc.

(iii) Cost of fuel and lubricants

(iv) Land acquisition costs

(v) Cost of labor - skilled and unskilled.

(b) Maintenance Costs

These are the recurrent costs of keeping a road in usable condition. With the exception of such things as land, maintenance costs will consist much of the same items as construction costs. How often these costs are incurred -- hence their magnitude - will, among other things, depend on the standard of construction adopted. This also determines when they start to be incurred after construction.

Note: Contingency Allowances

Estimates of construction and maintenance costs are liable to some margin of error. There are two sources of error for which allowance should be made. First there may be errors in estimating the quantities of physical inputs. Provision should be made for the possibility of increases in the quantities of the inputs required for construction and maintenance. The second source of error is in pricing the inputs: provision should be made in the cost estimates for possible increases in the prices of such items as materials, fuel and labour. If, however, prices are expected to change in such a way that the input relative prices remain unchanged or if the road project costs (and benefits) are valued in real terms this second provision should not be made. If input relative prices remain

unchanged total construction and maintenance costs will be unaffected by changes in the prices of individual input items because the price movements will neutralize one another. If the costs are measured at constant prices, moreover, current or future prices are rendered irrelevant in the valuation of project inputs.

(c) Adverse Spillover Effects

If a project gives rise to incidental effects which affect society adversely they should, as far as is possible, be evaluated and added to the intended money costs or alternatively subtracted from the benefits of the project. Common adverse spillover effects associated with road projects may be:

(i) pollution of the environment - largely in the form of smoke and noise from passing vehicles

(ii) traffic congestion: if the construction or reconstruction of a road generates more traffic volume than it was designed to carry, those who travel on it (in their own vehicles) will incur extra journey costs in terms of increased fuel consumption, delays and annoyance. Although incidental, these effects are real social costs.

2.32 ENUMERATING PROJECT BENEFITS

Categories of Traffic:

The benefits of a road accrue directly to those who use it and, perhaps, only indirectly to the rest of society. The direct beneficiaries may be those who actually travel on the road or those who transport goods on it. The transportation of people and the conveyance of goods on a road constitute the traffic for the road. In order to identify the direct benefits from a road economists find it convenient to classify the

the traffic on it into the following categories:

(a) Normal Traffic

Consists of those who would use an existing road regardless of whether it is improved or not. In the majority of cases road projects involve the upgrading of an already existing road or the construction of a new road to replace an existing one. It is rare that a road is built into an area where there has not been some route, even if it is only a footpath. In this essay the term "road project" is taken to mean either of the above two undertakings.

Normal traffic then is the traffic that would continue to use an existing road whether it is improved (upgraded or replaced by a new one) or not.

(b) Generated Traffic

This is entirely new traffic which would not come into existence if an existing road is not improved. It may consist of one or both of the following:

(i) extra journeys undertaken by the present users of the existing road solely as a result of the road having been improved. This should, however, be carefully distinguished from the extra journeys that would be undertaken as a result of growth in normal traffic;

(ii) extra journeys made by new road users who would otherwise not have utilized the existing road if it were not improved.

Generated traffic reflects the increase in economic

activity stimulated by the construction or improvement of a road in the area of its influence. On the other hand, an increase in normal traffic, although it does also reflect increased economic activity, cannot be attributed to the road improvement because, by definition, such normal traffic growth would have occurred with or without the improvement.

(c) Diverted Traffic

Consists of those who, in the absence of the planned improvement of an existing road, would travel by other roads or use some other different mode(s) of transport. They are attracted to use the new road in the hope of deriving some benefit by so doing.

Benefit items:

In East Africa the services of road facilities are in the category of "public goods" - goods the amount of which consumed by any one individual is also the amount consumed by all its users. There is thus no way of determining how much of such a good each person consumes so that there is no way of deciding what price to charge for it. Consequently, a public good has no market in the commercial sense. This special characteristic of public goods largely explains why they are usually provided by public authorities even in strongly market-oriented economies. The market mechanism depends crucially on the existence of a price for any good that is or can be marketed. But for a good to have a price it must be possible to determine how much of it a person or group of persons consume at any given time.

Ultimately the benefit the consumers of a good or service derive from consuming it is the satisfaction or utility they enjoy. But utility is an abstract concept which is difficult to measure and apply in empirical studies. The concept, mentioned earlier, which project analysts employ in practice is that of willingness-to-pay which is not only easier to measure but also has the further property of being an indicator of the strength of the desire of consumers for a good or service. Traditional economic theory defines utility as a state of being content. The sources of utility may be physical, social or even spiritual but the notion refers to a purely psychic property. The trouble with it is that it is also used in senses other than the psychological one in which economists use it. For example, many students being introduced to economics for the first time find it difficult to avoid conceiving of utility as some biological satiation especially when it is so closely associated with almost equally ambiguous terms like the "consumer", "goods", etc.

Moreover, for analytical purposes the term utility is inferior to the willingness-to-pay concept in that the association between the latter term and its empirical measure - money prices - is evident even to the non-economist. On the other hand, one of the greatest difficulties in elementary economics is for beginners to visualize the connection between the price a person pays for an item and the utility he anticipates to derive from it. And herein lies the root cause of the confusion that bedevils the "cardinal" approach in the study of consumer

behaviour that the price a consumer pays for a good is the money measure of the "marginal significance" of the good to him. The willingness-to-pay concept, because of its direct and explicit association with prices, is more easily acceptable as a measure, by proxy, of the benefit for which the consumer is prepared to part with in terms of money or some other valuable item in exchange. Whether that benefit is termed utility or given some other appelation is of little consequence and saves us from having to make the rather awkward assumption, so common in elementary economic text-books, that utility can be measured in some fictitious units (such as "utils" and what have you) as writers are often forced to do in an effort to explain the connection between utility and price. Using the willingness-to-pay notion, all that is necessary to remember is that willingness-to-pay is a measure of the desire that underlies the decision by a person to pay a specified price for an item. It is not necessary to know the nature of that desire. All that one requires to know is its strength since it is this that determines the price paid. A distinct advantage of the willingness-to-pay is that it is easier to understand, define and determine a measure for it.

The benefits that road users derive from a new or improved road are mostly in the nature of savings - that is, avoided sacrifices which road users would have incurred if the road in question were not constructed. Admittedly those who travel (or transport goods) on the new road would derive some utility from the fact that they incur less cost than they would on the

old road but for purposes of Cost-Benefit analysis it is not the utility that is of immediate concern. Of direct interest to the project analyst is the total willingness-to-pay of the prospective road users for the benefit of having a better road - this total willingness-to-pay being measured as the sum total of the costs (sacrifices) they would incur to utilize it. The purpose of improving an existing road (or any transport facility is to lessen this sacrifice. The benefit to the road user then is the difference in the amount of cost users incur in utilizing a road in its present state and the cost they would incur if it were improved. Thus the benefit is a saving.

The cost road users incur by travelling or transporting goods on a road measures the price they are prepared to pay for the use of that road. If it were possible to express this price on a unit basis (as "so much per unit of road service") a relationship between the different levels of this price and the different "amounts of road service" in the nature of a demand curve could be derived and the determination of the net benefit to the road users would be in the form of the conventional analysis of consumer behaviour. In effect this is what cost-benefit analysts attempt to do. Just as a decrease in the price of a marketed product confers a benefit to consumers in the form of a saving in the price they have to pay; the reduction in some or all of the total price of utilizing a road is a boon to the users of the road. However, it should be borne in mind that not every benefit item associated with a road project need be a saving. An outline of the various benefit items is given

in the following paragraphs: it will be noted that, although the majority of them are "savings", some are not.

The principal benefits are:

(a) Vehicle Operating Cost Savings

Vehicle operating cost (VOC)(or user-cost) savings consist of the difference between the costs of running a vehicle on a poor quality road and the costs of operating it on a new or improved road. User-cost savings may also be "alternative cost" savings - i.e. the savings in the costs of travelling or transporting goods by road and the costs of doing so by some other mode of transportation. For instance the alternative cost saving benefit of the proposed pipeline linking Mombasa and Nairobi would be the difference between the costs of transporting petrol by road in tankers and the operating costs of pipeline transmission.

Specific operating cost items in which savings might be realized would be:

(i) fuel and lubricants

(ii) vehicle tyres

(iii) vehicle (or pipeline) maintenance

(b) Time Savings

There are two main time savings items - namely:

(i) savings in working time

(ii) savings in leisure time

This is a benefit common to all transport projects which make the movement of people and goods easier and faster.

(c) Savings in (road) Maintenance Costs

An important benefit associated with building a better quality road or some other transport facility to replace a similar or different existing one is the possible reduction in the costs of maintaining the facility to be replaced. If for instance the proposed Mombasa-Nairobi pipeline does materialize it will save the Kenya Government considerable sums of money currently being spent on keeping the Mombasa road in good working order. The pipeline would remove a substantial fraction of the heavy petrol tanker traffic which possibly accounts for a good amount of damage to the road.

(d) Reduced Risk of Accidents

In principle, building a wide, smooth surfaced road should not only reduce journey time to road users but, by reducing traffic congestion and eliminating concealed corners and narrow bridges it should also reduce the risk of accidents. There are two main types of road accidents which may be avoided by the improvement of a road:

(i) damage to property - vehicles, crops, fences, livestock, etc.

(ii) injury to, or loss of, human life.

But whether building better roads does reduce accident risks is not an altogether indisputable fact. Experience on Kenya's paved roads has been one of soaring - not declining - accident rates. Relatively straight, wide, smooth surface roads seem to encourage overspeeding and inattentiveness on the part of

drivers which in turn can only enhance the risk of accident. By no means are these the only causal factors underlying the rising number of injuries, death tolls and property damage arising from road accidents. But they seem to be important contributors. The claimed possible reduction in potential accidents then is very much contingent upon the assumption that a good road is in itself an insurance against a rise in the rate of accidents, which is not true.

(e) Economic Development

This benefit consists of the increase in the output of such economic activities as agriculture, manufacturing, mining, tourism, etc. But it is not an easy benefit to identify. As Hans Adler[6], a prominent transport economist with the World Bank, has pointed out for a road project to be credited with an increase in economic activity some three conditions must be satisfied- viz:

(i) That the construction or improvement of the road is the "sine qua non" for such an increase - i.e. that the development would not have occurred without the road improvement.

(ii) That the resources used in the road construction would otherwise have remained underemployed or would have remained idle.

(iii) That the economic activity or activities stimulated by the road project do not replace other equally or more socially beneficial activities that would otherwise have been undertaken.

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[6]Hans Adler, pp. 29-32

Given these requirements there are some three circumstances under which a road project may be associated with an increase in economic development:

1. The road may be an integral part of an agricultural, industrial or tourist project. Investment in the road is, in this case, part and parcel of the investment in the principal project and it would be both impracticable and improper to attempt to show the development effects of the road separately

2. Whether a road is the only bottle-neck to increased economic production - all other requirements, for example, productive facilities readily accessible markets, etc. already exist - the benefits attributable to the road project would be the net increase in the output of the various activities.

3. Where a road is built into an area with considerable development potential the realization of which requires other investments besides the road no particular difficulty arises since, evidently, the road by itself would not generate any development activity.

Thus only if we are faced with the situation described in (2) above need we worry about tracing the development effects of a road project.

(f) Comfort and Reliability

Like the "economic development" benefit, these two are "non-savings" benefits; they are intangible but real. Reliability in this context refers to the greater likelihood of one successfully completing a journey or getting goods to intended destinations in time on account of a road being in good condition (and there being enough vehicles on it for road users who do not

own vehicles).

Both benefits are difficult to measure on account of their being difficult to quantify. It may suffice merely to recognize their possible existence.

2.4 MEASURING PROJECT COSTS AND BENEFITS

Two possible approaches to the valuation of the inputs and outputs of projects were given earlier on as the Willingness-to-pay and the World (Border) Prices methods. Problems of measuring project costs and benefits will always arise irrespective of which one of these two approaches is adopted. To emphasize this fact a brief statement of the latter approach will be given. In general, it is easier to apply than the Willingness-to-pay approach but then transport projects pose special problems which render world prices inappropriate measures of the costs and benefits.

2.41 VALUATION AT WORLD PRICES

The main reason which prompted Little and Mirrlees to adopt international instead of domestic prices for the measurement of the costs and benefits of projects in developing countries are the distortions in market prices in these countries. The system was proposed primarily for industrial projects but the authors suggest it may be used to value the inputs and outputs of any other types of projects.

For any one country "world prices" are those it would

pay for its imports and those it would receive for its exports. Following is a description of the procedure for determining "Border Prices". A basic step in the procedure is to classify project inputs and outputs into "Traded and Non-Traded" goods (and services). Traded items are those which are or could be traded on the world market. Non-traded items are those that do not normally enter world trade and consequently have no world price.

1. Valuing Costs

(a) Traded Items:

These include categories of input items such as construction equipment, materials, fuel and skilled labour. These may be direct imports or they may be import substitutes. They should be valued at their c.i.f. import prices (Pm) or at their Marginal Import Cost (MIC) depending on whether the market(s) in which they are traded are reasonably competitive or not.

Although strictly speaking skilled labour is not normally traded, for most developing countries it is an import item and should be valued at its direct foreign exchange (FE) cost. Even if it is procured locally it most probably has a FE content (through the educational and training processes) and should be valued at the FE equivalent of its domestic cost.

(b) Non-Traded Items:

A large number of inputs for road projects in developing countries are traded goods and services. But certain others like domestic transport, unskilled labour and some materials (like stone) are not. Little and Mirrlees suggest the FE values of these items can be obtained by converting their domestic currency values to FE values by means of predetermined conversion factors - computed by a governmental central planning agency.

Unskilled labour, probably the largest non-traded input especially for projects employing labour-intensive construction methods, also poses the most troublesome valuation problems. Firstly it is necessary to determine its opportunity cost in domestic currency and then to establish the appropriate conversion factor for transforming this value to FE.

In the Little-Mirrlees model the SOC of unskilled labour is to a very large degree influenced by the attitude of the government (as embodied in its economic policy) towards saving and consumption in general. If current consumption is thought to be more important relative to savings, the social cost of the unskilled labour employed on a project is considered to be, in principle, the output forgone in the next best alternative use for the labour. In practice this cost would simply be the output that the labour would have produced in the sector from which it is drawn to work on

the road project. If a higher premium is placed on savings - and hence on future consumption - than on current consumption, the level of the shadow wage rate will depend on whether the consumption per capita of those employed on the project out of their wages is higher or lower than what they were consuming before. If it is equal to or less than their previous level of consumption per head the shadow wage will be equivalent to the value of the output lost elsewhere by transferring the workers to the road project. But if it is higher the social cost of the unskilled labour will exceed the value of output forgone elsewhere by the difference between the previous and current per capita consumption levels.

2. Valuing Benefits

(a) Traded Output Items:

If the output(s) of a project are or can be exported they should be valued at their f.o.b. export prices if the export market is highly competitive. In that case the export price (Px) for each export item would tend to be fairly constant and independent of the quantity (Qx) of it exported. If the export market is not very competitive the item should be valued at its Marginal Export Revenue (MER) since in this case Px falls as Qx increases and vice versa. The net addition to total export revenue would be MER, not Px.

If the project's output replaces an import, its benefit would be the FE saved by not having to import. Such an import substitute would be valued at the c.i.f. price, Pm, of the displaced import in case the import market is competitive. If it is not, then the import substitute should be valued at the MIC of the replaced import since under non-perfectly competitve circumstances Pm would tend to understate the true cost of the item to the importing country.

In either of these two cases there will be domestic costs of transport, insurance, and distribution for an imported good and costs of transport and insurance for an export. These may be termed respectively as:

(i) port-to-user costs, and

(ii) producer-to-port costs.

For an import substitute the port-to-user costs become a cost saving when the imported good is replaced. This cost saving should be converted to its FE equivalent and added to the FE saving by not importing. For an exported item the producer-to-port costs would be converted from its FE earnings.

(b) Non-Traded Goods:

If the output of a project is non-traded its value at domestic prices should be transformed into FE by means of a suitable conversion factor for the particular item(s) or for the industry producing it. Non-traded items include services like domestic freight, construction

or electricity. There is no world market for these.

The central point in the Little-Mirrlees approach is import/export prices are a better measure of social value than domestic prices in developing countries, assuming that these countries adopt the "proper" economic and commercial policies. There are two basic premises for this contention:

(i) Firstly, whatever distortions there may be in world trade - and hence in import/export prices - are not peculiar to any one individual country. They affect all countries participating in international trade and are, therefore, irrelevant to valuation problems from the point of view of any given country.

(ii) Secondly, fast economic growth and development which developing countries are so desparately in need of depend to a significant degree upon the availability of foreign exchange. Because of its relative scarcity FE is thought to be a more sensitive measure of the social worth of goods and services in developing countries.

Little and Mirrlees advance the following three reasons, among others, for discrediting domestic market prices as good measures of social value:

(1) Most developing countries - for example in Latin America - are afflicted with chronic inflation which possibly is symptomatic of imbalances between aggregate demand and supply.

(2) These countries suffer from perenial high levels of unemployment - especially of unskilled labour. This, coupled with government intervention in the labour market (e.g. minimum wage legislation) and other labour market imperfections, result in market wage rates that bear little or no relation to the economic value of the various labour categories.

(3) Most developing countries' currencies are over-valued - i.e. the exchange rates for the currencies are kept artificially at levels much higher than they really need be. Under a regime of freely determined rates the exchange rates would be so low that most developing countries would be beset with even greater balance of payments problems than they are at present. This over-valuation is sustained through various measures (exchange control, tariffs, quotas, etc.) devised to protect domestic agriculture, industry and other sectors.

On the face of it, it would appear as if the implication is that Little and Mirrlees recommend world prices because they are deemed to be distortion-free. But some supporters of the approach argue that the real justification is that whatever distortions there may be in import-export prices are a common factor to all countries which buy and sell on the world market. World prices may, therefore, be taken as a norm or price standard. On the other hand, domestic price distortions are peculiar to those countries in which they occur and represent a departure from the world price standard. What the proponents of this view-point do not make clear is whether it is to be understood that the distortions in world prices are considered irrelevant to valuation problems in any one country because they affect all countries to the same degree. Clearly, if this is not the case then indeed the price distortions may not be irrelevant to some individual countries.

More often some writers have given the impression that prices in developing countries are considered "distorted"

vis-a-vis prices in developed countries. It is argued that:

(i) the developed economies are competitive to a degree that makes the market the major determinant of resource prices. The infuence of non-market forces is a relatively minor factor.

(ii) these economies have attained very high levels of employment - in some cases approaching full employment - so that resource market prices are fairly good measures of resource opportunity values.

(iii) investment projects undertaken in developed economies have only marginal influence on the economies in terms of their effects on prices and outputs. Some kinds of projects in developing economies are so large that they have a greater than marginal effect on the economy. Such projects as multi-purpose dams, large-scale industrial, agricultural or mining projects have been cited as undertakings which might upset existing relative factor or commodity prices because of the sheer magnitude of the resources they absorb and the outputs they produce.

However, whether market prices measure social worth better in industrial countries than they do in developing countries, and for whatever reasons this may or may not be true, seems to be an irrelevant argument. There is clearly a difference between market prices in developed countries being good measures of social value in those countries and the same prices serving as international norms. In the first place, the prices that rule in each developed country are not necessarily the prices at which the country buys from or sells on the world market. They must, therefore, be regarded simply as being peculiar to the country in which they prevail. Secondly, it is by no means true that market prices in developed countries

are so free of distortions as some writers have attempted to show. In this respect the difference between developed and developing economies is the type and degree of distorting influences that exist in each of the two types of economy - not that the one is free of such influences whereas the other is replete with them.

Moreover, the prices ruling on the world market are different from those that prevail on the domestic markets in the advanced as well as in the developing countries. The economic and political forces that determine international prices are not identical to those that operate at home in either developed or developing countries, although, undoubtedly, the domestic production and market forces have a bearing on world market prices. It would, therefore, be misleading for some people to suggest that domestic prices in developing countries are a poorer measure of social worth than domestic prices in developed economies on the grounds that the latter economies fulfill certain conditions which the former do not. The comparison is not between market prices in developed and developing countries but between market prices in any one country vis-a-vis those ruling on the world market. It is an irrelevant matter, therefore, whether developed economies are more competitive, enjoy higher levels of employment, suffer less from inflation, are better in this or that respect than developing economies as far as the pricing of project inputs/outputs at world prices is concerned.

It was hinted above that unless it can be shown that world price distortions affect all countries participants in world trade in the same way and to the same degree - and to be sure they do not - they may not altogether be irrelevant considerations in project evaluation as Little and Mirrlees and their supporters would have us believe. If this condition is not met, the distortions cease to be a common feature to all the participants. In other words, world prices cease to be an international price norm.

But even if world prices were acceptable on this score, they still might not be good enough for the evaluation of road project outputs. No difficulty would arise in using them to evaluate the inputs. Most construction input items - equipment, a large number of materials, technical and supervisory personnel - are imported and can easily be valued in terms of import-export prices. Of the benfit items, VOC savings and maintenance cost savings can also easily be measured in FE. But it would be difficult to measure the value of time savings, favourable spillover effects and comfort in FE. There is firstly the problem of establishing appropriate values for these items at domestic prices and, secondly, of converting the values to their FE equivalent measures. The same difficulty would be encountered in evaluating unskilled labour. This is a general problem pertaining to all non-traded items.

Some writers have suggested that time savings may not be an important benefit in developing countries because time

in these countries is not a scarce resource as is evidenced by the generally high levels of unemployment. One simple way out of the problem of evaluating time savings, they suggest, would be simply to ignore them. The validity of this argument is questionable. It may be true that for some categories of people time is not a scarce resource - and it would be desirable to identify such groups. Moreover, even if it were a general truth that people in developing countries have plenty of time at their disposal, it would still be necessary to find a way of measuring the value of time savings for projects in developed countries where time is a scarce resource. Like all other non-traded items, time savings raise the two valuation problems mentioned in the previous paragraph.

Some of those benefits which may seem amenable to FE valuation may in fact not be so. Induced economic production, for example, is a generic term embracing goods and services which can as well as those which cannot appropriately be valued in FE. The value of agricultural, industrial or minimg outputs for instance can quite easily be measured in FE since most of the outputs are or can be traded on the world market. But the FE value of increases in, say, domestic transportation, distribution services, etc. cannot so easily be determined since these are non-traded items.

Finally, there are those benefits like comfort the value of which cannot just be measured. The best one can do is simply to recognize them.

Evidently, it would be most illogical and inconsistent to measure some costs and benefits of a project at world prices and others at domestic prices. Similarly it would not do to measure the costs and benefits of some projects in FE and to measure the costs and benefits of other projects at domestic prices.

The foregoing problems relate to the validity of the Little-Mirrlees method. There are also procedural and statistical difficulties such as:

1. compiling Pm and Px or computing MIC and MER for valuing the inputs and outputs of a project.

2. determining the social opportunity costs of input items such as accounting prices for materials or shadow wage rates for labour. An important aspect of this problem is the determination of proper conversion factors for non-traded items. Little and Mirrlees suggest such factors should be prepared by some central planning agency. But it is not often that planning agencies in developing countries undertake to calculate conversion factors and the project evaluator may have to compute his own factors. Such a calculation is complicated by the fact that it requires both measurable and unquantifiable variables such as government policy regarding investment and consumption.

Thus despite the relative ease with which the Little-Mirrlees approach can be applied to the appraisal of projects whose inputs and outputs are traded items, it will not do so for road projects. The method proposed in this paper for the appraisal of road projects is the willingness-to-pay approach.

2.42 THE WILLINGNESS-TO-PAY APPROACH

As stated previously this method measures the value of project inputs and outputs at what their users are prepared to pay for them in domestic currency. A common feature to both approaches is the recognition that, in general, social costs and benefits differ from private costs and revenue. Social costs are social opportunity costs (SOCs). Social benefits will in addition to sales revenue appropriately adjusted for indirect taxes, subsidies and other market imperfections, also include other items that would hardly count as benefits to a businessman. The basic difference between the methods of evaluation is on the other hand not what should or should not constitute a social cost or benefit but how to measure project costs and benefits. The physical inputs and outputs will be the same irrespective of the valuation method one adopts.

CHAPTER III

MEASURING PROJECT COSTS

The economist conceives of resource costs essentially in terms of resource opportunity values or, as they are more commonly known, Opportunity Costs. The opportunity cost of a factor of production is, in simple terms, the forgone earnings or benefits in the factor's next best alternative use. Defining the cost of an economic resource in terms of its maximum earnings forgone carries the implication that, to a rational resource owner the forgone alternative earnings must also be the minimum he will accept as a payment for the use of the services of the resource he possesses in its present use or employment. In the ideal hypothetical perfectly competitive world of economic theory a productive factor would earn the equivalent of its opportunity cost in any of its possible alternative uses; for if it were paid less in any one such use, given the assumptions of perfect knowledge, high resource mobility, etc. it would move out of that use. Conversely, if it were paid more than its opportunity cost (or "supply price") more of it would be attracted into that occupation and the increase in its supply would depress its price. Thus under perfect competition any divergences from the factor's opportunity cost would not be sustained for much longer than the economic short run when factor mobility tends to be low and knowledge of alternative economic opportunities limited. Consequently, factor market prices would generally not exceed the supply prices of the

factors of production. Similarly incomes to resource owners would tend to equal the supply prices of their resources.

The real world economies are anything but perfectly competitive and as a consequence resources may be paid more or less than their opportunity values. If the market price for a factor of production exceeds its supply price the excess accrues to the factor owner in the form of a "pure" or "economic rent". This is an "unearned surplus" and should be subtracted from the market price of the factor. The presence of this rent element in the price of a resource is one reason why economists object to valuing economic resources at their market prices. A second reason is the distortion caused in factor prices by the imposition of indirect taxes or subsidies on the use of factors of production. A tax imposed on the use of an input raises its market price and so makes the input more costly than it <u>really</u> is. On the other hand, subsidizing an input results in an understatement of its economic cost to the user. To arrive at the social value of a resource the use of which is subsidized or taxed, the subsidy should be added to, or the indirect tax subtracted from, its market price. The resulting price figure may not necessarily be an accurate estimate of the social worth of the resource but for most practical purposes it will probably be good enough. There are two possible reasons why the above adjustments may not yield the social value of an economic resource:

1. Taxes and subsidies may not be the only causes of distortions in factor market prices. If there are monopolistic

influences operating, adjusting a factor's price for the effects of a subsidy or an indirect tax alone will not ensure that the adjusted price reflects social value.

2. The subsidy or tax on the resource may not have been properly determined. It is, for example, possible to overtax or undertax the use of a factor. The same can be said of subsidization. Undertaxation implies the tax rate is not high enough to discourgae producers from using it: thus even with the tax, the factor price would still be low enough for producers to make "excess profits" by employing it. Too high a tax rate would raise the price of a factor to a level where producers would find it uneconomic to hire the factor. In either of these two cases merely removing the tax from its market price will not produce the shadow price for the factor. Similarly when a resource is oversubsidized or undersubsidized merely adding the amount of the subsidy to its market price will not do. Adding subsidies to or subtracting indirect taxes from the market prices of economic resources will produce their correct social values or shadow prices only if the subsidy or tax rates are optimum, other things being equal.

In general, road project costs are easier to identify and to measure than the benefits largely because the physical inputs are tangible marketed or marketable items. There are intangibles also - for example, noise from passing vehicles possible increases in risk of accidents, etc. - but these are often in the minority and quantitatively (where they can be measured) relatively insignificant. The cost items identified earlier could be categorized into some two broad groups -

namely: construction and maintenance costs on one hand and spillover effects on the other. The same measurement procedure will apply to both construction and maintenace costs since very much the same types of physical inputs underlie both of these direct costs for a road project. But the evaluation procedure for adverse spillover or external effects must necessarily be different given that spillover effects differ in nature from the direct input items.

There are two approaches to the determination of the opportunity values of the input items for a project. One would be to estimate the total sums of capital and maintenance costs and then to compute the benefits that society would give up by not spending these sums in the next best alternative investment opportunity available. One objection against this procedure is that it is too aggregative and moreover it assumes the opportunity cost of the various inputs for a project which could be purchased with the money consists of only the benefits that could be derived from this one use. In practice this is not likely to be the case. The opportunity cost of the services of capital equipment used on road construction might be the benefits that would have been enjoyed by society if the equipment were used in, say, clearing building sites in urban areas. That of land taken up by the road might be the value of agricultural output that could have been produced on that land. The opportunity cost of the unskilled labour employed on the road project might be high or low depending on whether there is a high or low level of employment in the country. Thus,

simply to estimate the opportunity cost of the total sum of funds spent on building and maintaining the road would not yield a good enough approximation of the economic value of the resources used up. Such an aggregative method is liable to understate the economic value of some inputs and overstate that of others.

A better approach would be to compute the economic cost of each input separately. This, undoubtedly, is more difficult partly because it augments the number of alternative uses for the inputs to be considered in order to arrive at the total economic cost for a project. But it is more likely to give a more valid and accurate estimate of the opportunity cost of the resources.

3.1 CONSTRUCTION COSTS

3.11 VALUING THE SERVICES OF CAPITAL EQUIPMENT

The valuation of the services of capital equipment is made more difficult by the fact that the equipment used on a project was not purchased specifically for that project. If it were, the cost of the equipment would be part of the initial investment in the project and the economic value of its services would be the purchase price of the equipment, appropriately adjusted for fiscal and other market price distortions. The equipment used in the construction or reconstruction of a given road will have been bought to be used on other projects as well and it would be improper to charge the whole of its cost to the benefits of a single project in computing the project's NPV, B/C ratio or IRR. The problem then is to determine what proportion of the economic cost of the machinery

and tools used on the road construction to attribute to the particular road, assuming that the economic cost has been correctly assessed. The correct determination of this cost would entail first of all identifying the next best alternative use for the equipment and then calculating the benefits that would accrue to society if the equipment were employed in that use.

To a large extent the funds that the government invests in public sector projects are raised from the private sector through taxation, government borrowing or through some combination of these two methods of financing. Western writers on CBA are very fond of the assumption that the SOC of funds invested in the public sector is the return forgone on investment in the private sector. It is further asserted that private sector rate of return (y) is generally higher than the rate of return (r) on investment in the public sector. On the basis of this then it is calculated the cost to society of investing £1 in some public sector project is the discounted NPV of the private sector return:

$$PVr\ (£1) = 1(y.r^{-1})$$

The value PV(£1) then is society's willingness-to-pay for the anticipated benefits from the public sector project. If a total of £K were drawn from the private sector through taxation for investment in a public sector project it can be safely assumed that part of this amount would be taken out of private savings (potential private investment) and part would come out of private consumption. To estimate how much of £K would be drawn from either of these two sources one would require to

know either the marginal propensity to save (MPS) or the marginal propensity to consume (MPC). If the marginal propensity to save is given as MPS = s and the marginal propensity to consume is c then:

$$c = 1 - s.$$

The SOC of each £1 taken out of private savings would then be given as:

$$SOC(£1) = s(y.r^{-1})$$

and for each £1 drawn from private consumption

$$SOC(£1) = 1-s$$

For a total of £K then:

$$SOC(£K) = sK(y.r^{-1}) + cK$$

If we let $s(y.r^{-1}) + c = a$, then

$$SOC(£K) = aK$$

On the other hand if one assumes the whole of £K will be raised by increasing public debt there is little reason to suppose that a significant portion of it would be taken out of potential consumption so that for practical purposes:

$$a = y.r^{-1}, \text{ and}$$

$$SOC(£K) = K(y.r^{-1})$$

Thus, if government raises the amount £K by taxation there are two sets of benefits sacrificed - namely:

1. the stream of future consumption benefits that would have been produced by investment(s) in the private sector, given as

$$sK(y.r^{-1})$$

2. consumption benefits that would have been enjoyed currently (by private consumers) equivalent to

$$cK$$

Note:

a. In practice the values of the MPS and MPC or information required for their computation may not be readily available. The project analyst will, in that case, have to use the average propensities to save and to consume, APS and APC respectively.

   Furthermore, although in principle it would be ideal to use MPS and MPC of the particular income groups whose savings and consumption would be affected, in practice such specific data will probably not be available and the analyst may have to do with the overall national APS and APC.

b. The proportion of K estimated as cK is not discounted for the reason that funds taken out of consumption would otherwise have been spent on goods and services in the current period or in the near future.

This procedure of deriving the SOC of resources invested in a public sector project is basically sound. What need not hold true, especially in the developing countries is the assumption that the opportunity cost of funds invested in the public sector is the private sector yield on such an investment. Whereas the assumption that $y > r$ may be largely true of Western economies one wonders if it applies with equal force to developing countries for a number of reasons:

1. Generally developing countries suffer from an almost chronic paucity of such critical factors as entrepreneurial talent technical skills and certain capital goods so that

productivity rates in their private sectors are much lower than in advanced countries.

2. In those developing countries in which the private sector is under the control of foreign entrepreneurs by virtue of their ownership of capital and other resources, the private sector yield may indeed be higher than the return on investment in the public sector. But the repatriation of profits and other receipts may well depress that part of the return that is retained in the country (in the form of dividends paid to local shareholders - if any - and tax payments) to a level lower than the return on investment in the public sector. In that case the country from which the profits are repatriated suffers a net loss by channelling investment funds into the private sector - and to that extent, it makes little sense to talk of the private return as the SOC of funds invested in the public sector.

3. Furthermore, it would be both inappropriate and misleading simply to compare directly the returns on investment in the public and private sectors since the the net benefits which constitute the public sector return contain elements that would be inadmissible in computing the private sector yield. Unless, therefore, the latter is adjusted to reflect financial as well as non-financial benefits or alternatively the former is adjusted to reflect only financial benefits any comparisons of the two rates of return will not be valid.

4. In a good many developing countries the private sector is usually much smaller and weaker than the public sector. There is a marked tendency for governments in these countries - especially in Africa and Asia - to extend their participation in, and control over, the economy.

It would instead seem more meaningful to compare rates of return on different investments within the public sector.

For instance, y might be the rate of return from government owned industrial, mining, agricultural or tourist projects; r could be the rate of return on investment, say, in social services or some similar sector the benefits from which are largely for consumption purposes. The point is that the social cost of funds invested in a public sector project is the discounted net present value (NPV) of the stream of future benefits that would have accrued from the next best alternative use for the funds - and in a developing country that "next best alternative use" does not necessarily always lie in the private sector as European or American writers would have us believe.

Having determined the SOC of capital equipment by a procedure such as the one described above it then remains to determine how to compute the proportion of this cost to be attributed to the use of the equipment on a particular construction project. In a way such a proportion would represent a form of <u>depreciation</u> in the equipment. Depreciation can be defined in a number of ways, depending on whose point of view one takes - it could be that of the accountant or businessman, engineer, economist or layman. Only the first three of these need be considered here:

a. Accounting (business) depreciation refers to the periodical writing off of the original cost of an asset. It is merely a book entry and has little or nothing to do with either reductions in the physical productive capacity of the asset or a decline in its "economic" (market) value. Such

depreciation is of use neither to the engineer nor to the economist.

b. the engineer's depreciation refers more to the physical wear and tear in an asset due to use. This is what Myron Ross[7] terms as "user cost". This term has now gained currency in economics and may eventually help the economist to overcome the age-long problems that have dogged him in his attempts to evolve an acceptable economic definition of depreciation.

But engineering depreciation has relevance to economics only to the extent that the physical wear and tear of an asset, by diminishing the physical life of an asset, may also affect its economic life - that is, the wear and tear may reduce the asset's productivity and hence its economic value.

c. The concept of user cost is the closest approximation of what the economist might conceive as depreciation. Ross defines user cost as the change in the "expected value" (EV) of an asset due to use during some period of time. User cost measures the forgone benefit that would have accrued from future use of an asset when it is used in the present or current period. The current use of an asset, by reducing its productive capacity also reduces its future earning power. The future benefits thus lost are the price that the owner of the asset has to pay to enjoy the benefits accruing from its present us. For example, if:

V_0 = the value of the asset at some future period when it is not used.

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[7]Myron Ross, "Depreciation and User Cost", (1960).

V_1 = value in future when it is used

User cost is given as: $V_0 - V_1$

If repairs are done to the asset during the period the asset is in use they may be designated as:

R_0 = repairs that would be done even if the asset was not utilized;

R_1 = repairs done when it is used. User cost when repairs vary with the rate of usage of the asset, would be

$$(V_0 - R_0) - (V_1 - R_1)$$

Repairs are a method of forestalling capital consumption - and hence postponing capital replacements. Only when repairs are independent of usage can they be ignored in defining user cost.

The above value of user cost can then be discounted at some suitable discount rate r to give its PV

$$\frac{V_0 - R_0 - V_1 + R_1}{(1 + r)^n}$$

The economist would define depreciation in similar terms as Ross defines user cost. It is the decline in the value of an asset resulting from its use on a project - this value being the "revenue productivity" of the asset. Reduced future earnings are a measure of the opportunity cost of an asset to its owner resulting from its present utilization. If he has already made estimates of the asset's expected earnings over its economic life the calculation of "economic" depreciation is made a lot easier. Defined in this manner, depreciation is the difference between the discounted present values of the net benefits from using an economic asset as measured at two consecutive points in time.

The one important difference between user cost and economic depreciation as defined here is that user cost is a component of depreciation. In principle depreciation consists of two elements: the variable and fixed components. The variable element is a function of the extent to which a piece of equipment is utilized, which in fact is what Ross calls user cost. The major physical factor which underlies this variable component of depreciation is wear and tear. A certain amount of the fixed component of depreciation may also result from wear and tear but probably the larger proportion of it is a function of obsolescence.

Obsolescence is independent of the degree of use, so that the cost resulting from it is independent of the level of output.

Although business and economic depreciation generally have little in common they share one characteristic: both are expressed in value terms. But whereas business depreciation is simply a historical book entry, economic depreciation as defined here may be an actual or an expected reduction in the value of an asset. Moreover, economic depreciation probably has a stronger association with the physical-technological processes of wear and tear and obsolescence than business depreciation. The arbitrary determination of the latter in many business firms makes what relationship there might be between it and these technological factors remote.

Also economic and engineering depreciation differ: the latter being a purely physical process. A piece of

equipment could be physically sound and yet be economically worthless and vice versa.

Evidently this approach to the valuation of the services of capital equipment is very difficult and time consuming. Project analysts, if they decide to use it, may find the capital budgeting technique of great help although it may not necessarily solve all their problems. Thus even if the technique can help them to derive reasonably acceptable estimates of economic depreciation, the value obtained will be a private (financial) cost and there still remains the problem of converting it into a social datum unless the market for equipment is so competitive that the price of capital goods is a reasonable measure of their economic worth.

A second way - perhaps the easier but less accurate one - of determining the economic value of construction equipment used on a road or some other construction project is to determine what society would give up now by not using the equipment in some other way. The emphasis here is on alternative use at present rather than on "present" versus "future" uses as in the previous paragraph. The principal difficulty in this second approach is to identify the next best alternative use for the equipment. Once this is done the rest is mainly statistical - computational work. If the equipment is imported - which is invariably the case in developing countries - the opportunity cost of the equipment must be appropriately shadow-priced to derive its FE equivalent value. Worth noting here is the fact that what is to be shadow-priced is not the purchase price of the

equipment but the value of what society would sacrifice by using the equipment to build a road.

But if the market for construction services is fairly competitive (say through a tender system) it may be assumed that the price a successful contractor quotes (in his contract rates) does reflect the opportunity cost - as defined in the second sense above - of his machinery and other equipment. This price can then be shadow priced into FE as well as being adjusted for indirect taxes or subsidies. This in fact is the evaluation procedure followed by the MOW.

3.12 THE COST OF MATERIALS AND FUEL

There are two categories of construction materials which need be considered here: materials which are imported and those which are procured locally. A third possible category are items like petrol which have both an import and a domestic value-added content. This third category may raise rather complicated valuation problems. Fortunately, such items are not many and even if they were, the domestic value-added content in them is not significant. It will consist largely of the value of domestic labour and other minor services. Domestic processing, for example, oil refining, which is capital-intensive and requires highly specialized technical labour services is clearly a FE cost. The value-added element in the cost of domestic transportation may be much smaller than the import (FE) content. For practical purposes the domestic element in the value of imported items which are also processed in the importing country may be safely ignored and the items treated

like items which are imported and utilized without any further processing.

The FE cost of such items may be shadow priced in any one of three ways depending on the manner in which the FE to finance their purchase is procured. The most obvious way in which a country may raise FE is to export some (or more) of its domestic output. The second one, which many countries including the East African ones have taken recourse to in these troubled times of economic crises is to reduce the quantity and/or range of its imports. Invariably in this case the first items to disappear from the import list are the so-called "luxury" items. Thirdly, a country may boost its exchange reserves through loans, aid and gifts.

If imported materials are purchased with FE earned from exports their shadow price is the domestic value - net of indirect taxes or gross of subsidies - of the exports which the domestic economy forgoes. If the FE is obtained by displacing some imports (and for a developing country these would mostly be consumer items) the shadow price of the construction materials and other items would be the domestic value, appropriately adjusted for subsidies and indirect taxes, of the imports displaced to procure the FE. Again the domestic value of the displaced imports is clearly a benefit forgone by the domestic economy. The ratios of the domestic prices of the exports and displaced imports to their respective FE prices are the conversion factors for the two sets of FE earning items.

It is likely that most countries employ both of these methods of raising FE simultaneously. The capacity of developing countries to expand their exports is generally limited, perhaps mainly because of the high price elasticity and low income elasticity of demand as well as trade restrictions in the consuming countries. The generally low productive efficiencies are also a contributory factor to this inability to export more. On the other hand, most of their imports are essential capital goods and the degree to which import displacement can be carried out is now very small. This, taken together with the fact that exports cannot so easily be expanded and, furthermore, that the prices in the consuming industrialized countries have in recent years shown a marked tendency to decline further and further, means that these two methods of procuring FE used either separately or in combination cannot be relied upon to yield adequate amounts of FE. Readjustments in the rules governing international trade as well as improvements in productivity rates will be necessary if developing countries are to increase their exports - which is the only long term solution to their FE shortage difficulties.

Kenya relies heavily on outside aid for its road development program. The main principal donors so far have been the World Bank and now increasingly the African Development Bank (ADB). Some writers have argued that when a project is financed from a foreign loan the loan funds spent on purchasing inputs for the project may or may not have an opportunity cost to the country receiving the loan, depending on whether the loan is "tied" to the particular project or not. If it is, the funds

have no alternative use in the recipient country and hence, by definition, no opportunity cost. The goods and services which the loan money is used to purchase should in that case be costed at the interest charges on the loan. If on the other hand, the recipient government is free to switch the loan to other uses in the economy, the opportunity cost of the loan funds would be the discounted PV of the net benefits that would accrue to society from the next best alternative use for the loan money.

This latter part of the argument is straightforward enough. But the validity of the former is rather dubious. The fact that a loan is "tied" to a specific project does not mean the loan is free - i.e. it is costless in social terms to the country receiving it. If it has (or seems to have) no opportunity cost in terms of forgone benefits at the time it is given, it must surely have some opportunity cost later when its repayments and interest earned on it become due. There can be no doubt that interest paid is an opportunity cost to whoever pays it - the price that the recipient country has to pay to procure the loan. The social cost associated with the loan repayment(s) may be less obvious to conceive of. This cost is in the fact that repayments have to be made in FE which, being a scarce resource in the developing countries, must be shadow priced. This means that the goods and services purchased with the loan money must be costed in terms of both the interest and principal repayments. Pricing them at the interest charges alone would seriously understate their social value. The safer stand to take in this matter would be to treat both interest charges and principal

repayments as costs to society irrespective of whether the loan is tied or not.

The social value of locally procured materials such as stone, stone aggregate, chippings, cement (in Kenya), water, etc. should be based on their value in alternative uses - i.e. the prices they would fetch in other uses such as building residential or business accommodation, etc. In practice an item like water would not be worth bothering about in this country unless the road traverses arid country where water is difficult to obtain (as was the case with the Nairobi-Addis Ababa road running through the semi-desert northern Kenya) . The cost of the water would be the value of the time and effort spent in fetching it. If it is drawn from a pond to the extent that the pond dries up and as a consequence some livestock or wild game perish of thirst, this would be an adverse spillover effect of the road project which should be evaluated and added to the other costs of the road.

3.13 THE COST OF LABOUR

The cost of labour may be split into two categories for purposes of project evaluation;

(i) the cost of skilled labour

(ii) the cost of unskilled labour.

Skilled Labour

The cost of skilled labour would comprise largely of the salaries of civil engineers, mechanics, surveyors, etc. Most of the skilled personnel on the road project would likely be

expatriates especially if the contractor is an overseas firm. Foreign firms prefer to have their own engineers on the project, who repatriate the greater percentage of their earnings to their home countries and possibly spend the remainder here on imported goods. Their salaries are thus a FE cost and should be shadow-priced in the same way as other imported items. But it may be difficult to identify the particular exports which earned, or the imports which were displaced to make possible the procurement of the FE paid for the skilled labour services. Furthermore, there seems to be little advantage in attempting to determine the cost of skilled labour separately from that of other direct import items. In practice it would save a lot of involved calculations to estimate a single shadow price for the FE bill for these items and then to calculate the economic cost of each item as a fraction of the total shadow price. The economic value of skilled labour like that of bitumen or fuel would then be a percentage of the total shadow cost of input items imported directly for the construction or maintenance of a road. As stated earlier this is the procedure followed by the MOW for the valuation of imported road projects inputs. It may be imprecise but it is more workable.

Unskilled Labour

Unskilled and semi-skilled labour raise a different evaluation problem. Given the very high rates of unemployment and underemployment, coupled with imperfections in the labour market such as we have in the developing countries today, actual

market wage rates are a poor indication of the economic value of these two types of labour.

Some authorities on CBA suggest that unemployed labour should be valued at zero or at some price very close to zero since by definition idle labour has zero opportunity cost. Its use on a given task costs society nothing.

Mishan on the other hand argues that the value of unskilled labour is the minimum amount of money that the unskilled workers would be willing to accept to take up a job on a project - that is, the minimum sum of money necessary to induce them to give up their idleness. For, although they might be idle, it is by no means always true or obvious either that they are indifferent to their being idle or that they dislike being so. If they were indifferent then indeed the social value of their labour would be zero or very close to zero. If they dislike their idleness they would in fact be prepared to pay a certain maximum sum of money - designated as a negative amount ($-V_i$) - to be employed on a given (road) project. In this case, not only would society not lose anything by having the unskilled workers take jobs on the road construction works but it would also gain by the amount $-V_i$ for each one of them thus employed. So if the market wage rate were, say, AW the shadow wage rate (SW) would be:

$$SW = AW - V_i$$

But if it is that in fact they derive some satisfaction

from their being unemployed each of them would have to be offered a certain minimum sum of money V_i on average as a compensation for their loss of satisfaction entailed in taking up a job. If the market wage rate, AW, were less than V_i then

$$SW = AW + (V_i - AW) = V_i$$

But if AW is higher than V_i the worker will readily take up a job without requiring any extra payment.

This method of deriving the shadow wage rate for unskilled labour is obviously very difficult to work with in practice. But it is conceptually much sounder than arbitrarily valuing such labour at zero just because it appears to be idle.

In practice an accurate estimate of V_i or $-V_i$ would be impossible to obtain. But hopefully, construction firms may have some idea of the minimum wage rate they have to pay to induce a sufficient supply of unskilled workers. In Kenya it is likely to be much less than the statutory minimum wage which may be assumed to be equal to AW. The difference between this market wage and the minimum wage necessary to induce adequate labour supply - the Supply Price (SW) - is an economic rent which the worker would in fact be prepared to pay to have the opportunity of being employed on a road project works. The social cost of unskilled labour, expressed as a rate is, therefore, SW.

By definition this rate, SW, is the willingness-to-pay, looked at from the point of view of the worker. It measures

for him the value of what he has to give up in exchange for the expected job benefits (which incidentally need not be monetary ones only). But since SW is defined as the minimum payment a worker will accept, it is obvious the employer either agrees to pay it or does without the worker's services. In a perfectly competitive labour market SW would in the long run be both the minimum sum a worker will accept to be paid as well as the maximum the employer would be willing to pay.

3.14 THE COST OF LAND

The willingness-to-pay method can easily be applied to the prising of land. Although the Kenya Government, through the Ministry of Lands and Settlement has worked out its own estimates of prices for various categories of land - arable land, ranching land, etc. - in the country and although it may sometimes impose price ceilings on the land market, land transactions in most parts of the country are fairly competitive and free of governmental restrictions. Transactions even in the former "scheduled areas" are on a "willing buyer-willing seller" basis which justifies the use of the willingness-to-pay approach to the shadow pricing of land. In principle the prices at which land is transacted reflect (or should reflect) the subjective estimates by the buyer and seller of the value of the present and future net benefits (monetary and otherwise) of the land. The case is very much similar to that of shadow-pricing unskilled labour. The social cost of land is the minimum sum of money a land owner would be willing to accept in exchange for it.

The cost of acquiring land for a road project is usually not a significant proportion of the total initial investment and very elaborate attempts to establish accurately the social opportunity cost may not be justified.

3.2 MAINTENANCE COSTS

These are the recurrent costs of a road project incurred to keep the road in working order. The physical inputs used up in road maintenance are similar to those used in construction so that the measurement problems and procedures will be identical to those mentioned above. But total maintenance costs for a road may be much less than its construction costs partly because the inputs used will not be required in as large quantities and some items like land will not be required at all.

3.3 EVALUATING ADVERSE SPILLOVER EFFECTS

In addition to the direct costs considered above there are also indirect costs associated with a road project in the form of adverse external or spillover effects. There are two principal categories of these - namely:

1. environmental pollution in terms of noise and smoke from passing vehicles.
2. traffic congestion resulting in increased vehicle operating costs, especially fuel consumption; delays leading to increased journey time, etc.

But these are not likely to be serious adverse effects in this country mainly because the volume of traffic on roads in these areas is likely to remain small for quite some time to

come. Moreover population in most Kenyan rural areas is still too scattered and too light to be seriously affected by noise or smoke from vehicles. It may even be argued that contrary to being a social nuisance the improvement of a road in rural Kenya and East Africa at large confers benefits upon the inhabitants which far outweigh the noise or smoke from vehicles so that most rural dwellers would in fact rather be close to than be far from it.

So for as long as traffic volume on a road is low these effects would be too minor to count as social costs. When traffic congestion rises to a level where its effects become a social bother the road can be considered to have outlived its economic usefulness: it is then due either for further improvement or replacement. Part of the benefit expected from a road project is the avoidance of these effects so a road which makes their existence possible no longer yields as much benefit to society as it ought to. Thus, in the absence of traffic congestion the above spillover effects need not concern the project appraiser.

In some countries the risk of road accidents would be regarded as a spillover effect. There are numerous causes of road accidents but in Kenya it would seem, paradoxically, one of them is the improvement of roads itself! Experience has shown the rate of road accidents and their degree of severity tend to rise with the increase in the rate of road improvement. As yet no concerted research effort has been made in this

country to demonstrate empirically the precise relationship between accident rates and road improvements but there does seem to be some correlation between them.

The soaring rate of accidents on the country's roads is at present the cause of much concern on the part of the Government and the general public. On this account it may be assumed that one of the explicit aims of any road improvement would be to reduce the incidence of road accidents and on the basis of this assumption the possible reduction in the risk of road accidents would be one of the intended direct favourable effects of the road improvement. But, if, as experience would tend to show, accidents tend to rise when roads are improved, the increased risk of accidents would be a cost to society and its value should be added to that of other cost items.

One theoretically feasible procedure for evaluating increased risk of accident will be presented at some length in a later chapter in connection with the evaluation of reductions in such risk. The actual occurrence or an increase in the risk of road accidents is a social cost whereas their avoidance or a reduction in the chances of their occurrence is a benefit. But both would be evaluated in precisely identical fashion. All that is necessary is to recognize the value of the former as a negative magnitude to be subtracted from the benefits (or to be added to the costs) and that of the latter as a positive sum to be added to the value of the other benefit items.

CHAPTER IV

MEASURING PROJECT BENEFITS

The benefits from a road investment project may include some or all of the following items:

1. Vehicle operating cost savings
2. Savings in journey-time
3. Savings in road maintenance costs
4. Economic development
5. Reduction in risk of accidents
6. Comfort and reliability

Any one or a group of these benefits may feature more prominently than others for different road projects. In developed countries economic development would probably be a relatively small item. In developing countries roads have important developmental effects. Being part of the transport infrastructure, which is still one of the areas posing severe bottlenecks to economic development in these countries, road projects, if well planned in the light of the economic (and other) requirements of the country or countries it traverses cannot fail to confer some development blessings upon these countries.

But this does not mean that for every road project development (in terms of net induced output) will always be the largest or the most important benefit. In view of the conditions

that were spelt out earlier which should first be fulfilled if a road is to be credited with the economic development benefit, it may not always be possible to identify and/or measure the development effects of a road investment. For most road projects savings in VOCs and journey time are usually the principal benefits and there are many instances of road developments which have been undertaken with these in mind as the chief justification for the investment in the roads built. Occasionally road construction or improvement has been undertaken to reduce accidents on existing roads or some other modes of transport but for most road projects this is a minor benefit.

Maintenance cost savings or comfort to road users very much depend on the quality of the "new" and "old" roads. If a road project consists of upgrading a murram or earth-surface road to bitumen standard, savings in the costs of maintaining the earth/murram road may be substantial. Although on the whole the annual costs of maintaining a gravel road may be smaller than those of maintaining a tarmac one, they are incurred more frequently. They also tend to rise sharply as the volume of traffic increases so that the total maintenance cost bill may be several times larger than the corresponding cost bill for maintaining a tarmac road. Clearly the size of the comfort-cum-reliability benefit would be large enough to be taken note of in this case. If the project is upgrading an earth road to murram standard there will be little or no difference in maintenance costs or comfort to its users.

These are, however, minor in relation to the other benefits and rarely in themselves constitute a sufficient justification for undertaking a road project.

The measurement of the benefits society derives from a road is beleaguered by even more tantalizing conceptual and statistical difficulties than that of costs. The main source of coneptual problems is, as was stated earlier, the fact that there is no market - and hence no market price - for the services of a road facility. The services are a public good. The price that society is willing to pay to have the road is to be conceived of in terms of the real resources road users and the rest of society are prepared to sacrifice in order to utilize the road. If a decision is taken to construct or improve a road it is to be understood that it is felt that the price paid for the use of the road or some existing mode of transport is too high and that the construction or improvement of the road will lower this price. As the list of benefits given above will show most of the benefits from a road are in the form of "savings" - i.e. the difference between the social sacrifice if the road is built and the sacrifice if it were not built. The specific items in this sacrifice or price society incurs are VOCs for vehicle owners, journey-time for travellers, costs of maintaining the road to be improved and, possibly risk of accidents. The "non-savings" benefit items like economic development and comfort to motorists do not seem to fit quite nicely into this conception of the price society pays for the use of a road. The savings benefits really are negative magnitudes - i.e. reductions in

some positive but unfavourable elements. These latter benefits are increases in some favourable direct effects of a road. But if it is considered that in the absence of a proposed road construction or improvement these favourable effects would not occur then indeed their non-occurrence would be an unfavourable effect of not undertaking the road construction or improvement and hence a cost to society. Building the road could be considered to reduce such unfavourable effects - i.e. to save society from them. In this sense economic development and other non-savings benefits may be categorized as savings.

The foregoing remarks suggest an idea that has become fundamental in the procedure for evaluating the benefits of a road project. The idea is that the benefit to society is the difference in the price it pays if a road is built or improved and the price it would pay if the construction or improvement were not undertaken. This is the with-without approach to project evaluation. The presumption is that with the new road society incurs a smaller sacrifice than without it. The difference in this social sacrifice in the two circumstances is the gross social benefit to be set against the capital costs of the project to determine the project's net social worth. The with-without approach is the one the World Bank recommends and uses in its project evaluation.

An alternative approach which is not very popular with project evaluators and is in fact disrecommended by the World Bank experts and writers elsewhere is the "before-after" method.

Under this approach project benefits would be the difference between the sacrifice society incurs "before" the project is undertaken and the sacrifice which it would incur "after" the project is completed. The diagram below illustrates the difference claimed by writers between the two approaches.

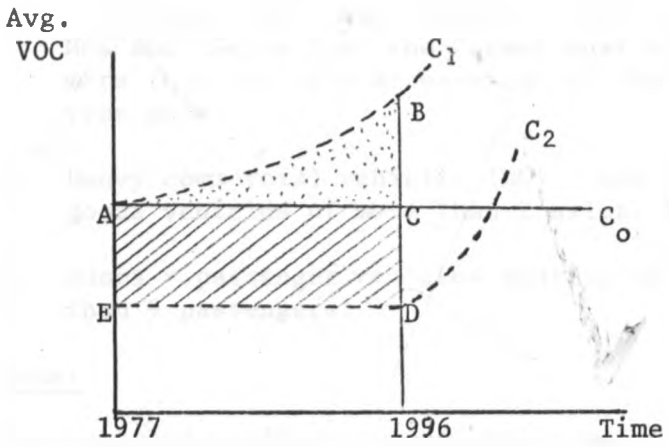

FIGURE IV.1

Avg. VOC = Average VOC per vehicle per kilometer

AC_1, EC_2 = Trend in VOC "with" and "without" the proposed road respectively

AC, ED = The "before" and "after" VOC for the 20 year (1977-96) life of the road.

Since VOCs differ with the size and model of vehicle it would be necessary to classify vehicles according to some convenient criterion such as the size of vehicles expected to use the road and compute average VOC for each such vehicle type. The Ministry of Works in Kenya classifies vehicles into:

1. Passenger cars (C) - vehicles seating not more than 9 persons including driver - e.g. estate cars, taxis, etc.

2. Light commercial vehicles. The MOW terms these "Light Goods" (LG) vehicles: they include commercial vans, mini-buses, Land-Rover/Jeep category of vehicles with unladen weight of less than 1,524 kg. or alternatively with a pay load of up to 762 kg.

3. Medium commercial vehicles - also termed "Medium Goods" (MG) by the MOW are all 2-axled vehicles of 1,524 unladen weight or a pay-load of more than 762 kg. Apart from weight one other difference between MGs and LGs is that the former must have more than one tyre at each end of the rear axle.

4. Heavy commercial vehicles (HG) - are all goods vehicles of more than 2 axles.

5. Buses - passenger vehicles seating more than 9 passengers.

Note:

Tractors and trailers, construction machinery and the like are excluded from the above classification and in fact are unclassified. However, although they may not be regular users of roads their owners do benefit whenever they run them on a (good) road. Bicycles, motor-cycles, etc. are also unclassified.

Obviously more refined classifications are possible and would be preferable. Apart from the fact that the MOW nomenclature may cause confusion there is little reason why say buses and "medium goods" vehicles should be classified separately. In terms of average VOC rates there is little difference between them. Perhaps a better grouping might be as follows:

"Passenger" Vehicles

(i) Private and "Public Service Vehicle" (PSV) (C)

(ii) Vans (mini-buses) (V)

(iii) Medium Buses (MB)

(iv) Heavy Buses (HB)

"Commercial" Vehicles

(i) Light Commercials (LC)

(ii) Medium Commercials (MC)

(iii) Heavy Commercials (HC)

In determining VOC savings only cars would require separate calculations. The others can conveniently be paired into three groups - Vans and LCs, MBs and MCs, HBs and HCs - and VOC savings calculated for each. Time savings would be worked out only for people travelling in passenger vehicles. This classification has the twin advantage that it does not require different calculations of VOC rates for the two vehicle groupings while at the same time it draws a clear distinction between "passenger" and "goods" vehicles, which is an important consideration in the calculation and evaluation of time savings. One possible short-coming of this classification is that it may raise more involved data-gathering problems than the cruder MOW classification. It calls for more detailed data on VOCs, journey-times, earnings rates of travellers, etc., which is by no means always readily available. Given the existing shortage of transport economists in the country, it would be asking a little too much to expect the Ministry to provide the detailed amount of information that would be required if this classification were adopted.

But vehicle classification is not the primary concern of this section. For purposes of this paper the MOW classification is good enough. Moreover, the VOC rates to be used in the case study were worked out on the basis of this classification. To adopt a different classification would necessitate computing fresh rates - which is quite a different task altogether from the aim of this paper.

Following the with-without approach the size of the VOC savings benefit for any vehicle type would be represented by the area

$$ABCDE = ACDE + ABC$$

in Figure IV.1 above. The before-after approach on the other hand, would yield a benefit represented by ACDE for every type of vehicle. But an important short-coming of this latter approach is the implicit assumption that the "before" average VOC rate for any vehicle type would have remained constant throughout the 20 years. This has the effect of understating the size of the VOC savings benefit to road users. On the other hand, although the with-without approach correctly recognizes the possibility that VOCs would rise over time if the road was not improved, it is very difficult to project the rate of the increase especially if in the past the costs have not shown a definite trend or if, as is likely to be the case in general, not enough information is available to enable the determination of the pattern of cost behaviour on the road.

4.1 THE VOC SAVINGS BENEFIT

The cost savings benefit accrues primarily to motorists

and other vehicle operators - owners of private and passenger cars, commercials and traders transporting goods by road. The reductions in VOC resulting from the improvement of a road may or may not benefit PSV passengers or traders who depend on other people for the transportation of their merchandise. If they do benefit from such reductions, it will be in the form of lower fares and transport charges on the freight of goods respectively. But such a benefit would be a mere redistribution of the cost savings benefit initially accruing to the owners of the transport vehicles and should not be counted as a separate benefit.

Reliable data on the various VOC items would be very difficult to obtain in East Africa. Some of the possible sources of information on them would be the MOW, the East African Automobile Association and, may be, the larger dealers in automobiles. In Britain the Ministry of Transport through its Road Research Laboratory[8] has, over the years, accumulated considerable amounts of data on road users' vehicle operating costs and carried out fairly sophisticated analyses of the data. Jan de Weille[9] has, under the auspices of the World Bank, worked out quantitative estimates of road user costs and cost savings for a range of vehicle categories -"European car" "Average Car", "American Car", light trucks and vans and heavy-duty trucks under three types of road conditions namely - earth surface roads, gravel or murram roads and paved roads in America.

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[8]R. F. F. Dawson, "Vehicle Operating Costs" Transport and Research Laboratory, Dept. of the Environment, TRRL Report- LR 439 (1970)

[9]Jan de Weille, "Quantification of Road User Savings" (1966).

Although the data are derived for American road conditions they could be adapted for use in other countries. Jan de Weille suggests the figures for his "average car" type of vehicle can, with slight modifications, be applicable to developing countries. The vehicles on Kenyan roads are predominantly of European or Japanese origin. But in terms of VOCs there may be little difference between them so that de Weille's cost data could easily be modified for use in Kenya. However, rather than classify the vehicles as "European" or "Japanese" the MOW classification described earlier will be adopted in this paper.

Road users' operating costs are a part of the price society has to pay for the use of a road facility - a measure of part of their total willingness-to-pay (WTP) for the services of a road. And much in the same way as a fall in the price of a marketed product is a gain to the consumers of the product, a reduction in road users' operating costs is a benefit to road users in particular and society in general.

For a marketed product the part of the total benefit that buyers derive from consuming it can be gauged by the total amount of money they are prepared to spend on it - i.e. the total revenue its producer(s) would receive. If the total revenue (TR_x) received from the sale of a product X just equals the total willingness-to-pay, WTP, of the buyers of the product it cannot be said the buyers derive a net benefit from consuming X. The total benefit represented by

WTP which they obtain from it is just off-set by the total price TRx which they have to pay for it. Granted the producers of X may benefit in terms of the profits they make from their sales. But in CBA a benefit is that which accrues to the final users of a project's output. Producers' profits as such are not a social gain.

The net benefit to consumers of final products in CBA is what has been termed previously as Consumers' Surplus, measured as the difference between the price consumers are prepared to pay for a product and the price they actually pay. On the assumption that consumers are rational economic beings who aim to derive maximum gain out of their expenditures it may be taken as a rule that $CS \geq 0$. A consumer for whom $CS < 0$ is irrational in that he would be paying for the product he consumes a price which exceeds his WTP for the product and thereby reducing or actually minimizing his gain from it. Thus, for a rational consumer:

$$CS = WTP - TR \geq 0.$$

Consumers' surplus arises out of the joint operation of two principles of Economic (Price) Theory:

a. Because a consumer's (subjective) valuation of a good diminishes with each additional unit(s) of the good he purchases and consumes his willingness-to-pay for each extra unit or batch of units bought also diminishes accordingly. In Price Theory this is the Classical Notion of Diminishing Marginal Utility.

b. But instead of paying different prices for each unit bought in accordance with his subjective valuation of it the consumer in fact pays the same price for all the units he buys - this price being equal to the value to him of the marginal unit. A consumer values a product at its marginal significance to him.

These two principles imply that for all the units of a good that he buys, except the marginal one, a consumer pays less than what he would be prepared to pay and so enjoys an unpaid-for (surplus) value on each unit equal to the difference between the maximum price he would be willing to pay for it and the price he actually pays. This difference is his CS on each unit. The total sum of such differences measures his total CS from the good or service he buys.

If a consumer's willingness-to-pay is assumed to diminish as the above tenet holds his individual demand curve for a good X - i.e. the relationship between the different amounts of X that he buys at different prices levels - must be negatively sloped. Horizontal summation of such curves for all consumers of X yield a similarly negatively sloped market demand curve such as AD in the diagram below:

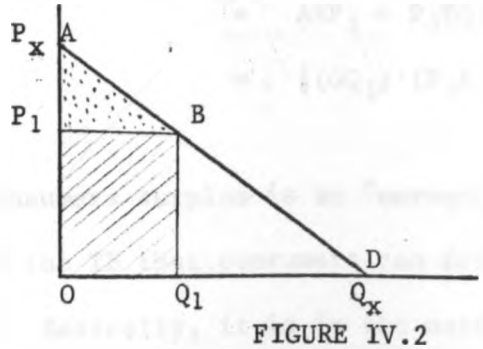

FIGURE IV.2

The shaded area measures the total consumers' expenditure on X:

$$TRx = P_1BQ_1O = P_1Q_1$$

But since for each of the OQ_1 units - except the marginal (Q_1th) unit $(WTP)_j > P_1$

where $(WTP)_j$ = willingness-to-pay for any unit j

it follows that:

$$\sum_{j=1}^{Q_1} (WTP)_j > P_1Q_1.$$

The total benefit (TB) - i.e. the sum total of all the consumers' willingness-to-pay is measured as:

$$TB = \sum_{j=1}^{Q_1} (WTP)_j = ABQ_1O$$

Of this total, P_1Q_1 is realized as revenue to the producer(s) of X. The remainder which is the benefit to consumers is CS, measured as

$$\begin{aligned} \sum_{j=1}^{Q_1} (CS)_j &= \sum_{j=1}^{Q_1} (WTP)_j - P_1Q_1 \\ &= ABQ_1O - P_1Q_1 \\ &= ABP_1 + P_1BQ_1O - P_1BQ_1O \\ &= \tfrac{1}{2}(OQ_1)\ (P_1A) \end{aligned}$$

Consumers surplus is an "unrequited" benefit: the portion of the TB that consumers can forgo without being made worse off. Basically, it is in the nature of a saving - and

for that reason, a fundamental notion in CBA.

Applying this analytical framework to the measurement of the VOC savings benefit a sort of "demand curve" can be drawn to show the relationship between the price (average VOC) that road users have to pay for the services of a road and the degree of their utilization of the road,in terms of the number of journeys made. If the road is improved or a better one is built to replace it the resulting reduction in VOCs will be a benefit to all the three types of traffic that were described earlier - namely Normal, Generated and Diverted traffic. But the extent to which each of these traffic categories benefits from the cost reduction will be different.

4.11 VOC SAVINGS FOR NOARMAL AND GENERATED TRAFFIC

The cost savings benefit to Normal traffic on a road is the "with-without" difference in VOCs on that road and another or other roads - where "other roads" may include the same road but in a condition different from its present one. Normal traffic benefits by the full amount of this difference. The cost savings benefit to Generated traffic is slightly more difficult to determine because not the full amount of the reduction accrues to it.

In terms of the model described above the measurement of the VOC savings benefit may be depicted as follows:

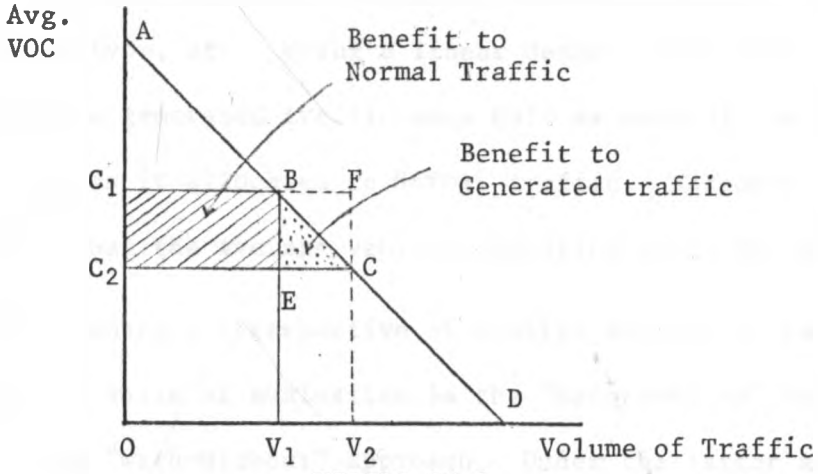

FIGURE IV.3

The incremental benefit to both types of traffic is

$$\Delta(TB) = C_1BCC_2$$

$$= C_1BEC_2 + BCE$$

$$= (OC_1 - OC_2)(OV_1) + \tfrac{1}{2}(EB)(EC)$$

$$= (C_1C_2)(OV_1) + \tfrac{1}{2}(C_1C_2)(V_1V_2)$$

These two portions of $\Delta(TB)$ are the benefits that accrue to Normal and Generated traffic respectively following the reduction in VOC from OC_1 to OC_2 . This formulation assigns only half of the cost savings to Generated traffic whereas Normal traffic gains by the full amount of the cost reduction.

The above expression of the incremental benefit is based on the assumption that AD is linear. But a linear demand curve is only a special variant of the general curve-linear demand curve. In practice, it would be extremely difficult to construct the actual road users' demand curve for the services of a road largely because of the inadequacy of information

on the various aspects of the present and future traffic on the road such as traffic volume, current and future VOC by vehicle type, etc. Using a linear demand curve must inevitably assign to generated traffic only half as much of the VOC savings as it allocates to Normal traffic. Moreover, to the extent that the average vehicle operating costs OC_1 and OC_2 remain constant irrespective of traffic volume, it is implied that the basis of evaluation is the "before-after" rather than the "with-without" approach. Under the latter approach OC_1 would tend to rise as traffic volume rises from OV_1 to OV_2 so that the VOC savings would be greater than C_1BCC_2. Similarly, the benefit to Generated traffic would be larger than BCE.

For Normal traffic OV_1 total road users willingness-to-pay for the use of the existing road is in terms of Figure IV.3 given as:

$$\sum_{i=1}^{V_1} (WTP)_i = ABV_1O$$

$$= C_1BV_1O + ABC_1$$

$$= (OC_1)(OV_1) + \tfrac{1}{2}(AC_1)(OV_1)$$

The portion ABC_1 is CS to existing traffic OV_1. The cost reduction results into an increase in this CS amounting to:

$$C_1BCC_2 = C_1BEC_2 + BCE$$

$$=(C_1C_2)(OV_1) + \tfrac{1}{2}(C_1C_2)(V_1V_2)$$

This increase in CS measures the net benefit resulting

from VOC reduction. The first portion of it, $(C_1C_2)(OV_1)$, obviously accrues to Normal traffic; the second accrues to generated traffic. It is to be noted that the original CS, given as:

$$ABC_1 = \tfrac{1}{2}(AC_1)(OV_1)$$

is not any more part of the net benefit.

4.12 VOC SAVINGS FOR DIVERTED TRAFFIC

The foregoing measurement procedure also applies to the determination of the cost savings to Diverted traffic, except that the net benefit is now defined as the "with-without" difference between VOCs on a given road and the avoidable operating costs on other roads and/or other modes of transport from which traffic is expected to be diverted. Fixed operating costs like insurance, road licences, interest charges, etc. are not relevant since they would still be incurred in the same amounts whether traffic is diverted or not. Avoidable costs will include vehicle depreciation in terms of wear and tear. In practice there may be little difference cost savings for diverted and normal traffic in Kenya, given the similarity of road conditions in most parts of the country.

4.2 THE TIME SAVINGS BENEFIT

Time is a real resource and in an economy with a high level of employment it is just as scarce as any other economic resource. In such an economy any investment which saves time confers an economic benefit to those directly and indirectly connected with it. A road investment which reduces journey time

does confer a time-savings benefit upon road users - who include both those who travel in their own vehicles, PSV passengers and traders transporting goods.

Some writers on project appraisal suggest that time savings for crews in passenger and goods vehicles (drivers, bus conductors, "ton-boys", etc.) are allowed for in the calculations of VOC savings. The services of these people are regarded as part of the costs of providing a transport service. The value of their time savings would be included in reduced operating costs to vehicle owners. To count them again as time savings would be double-counting. In this respect then the time savings of those who drive their own vehicles would be considered to accrue to them as the owners - not as drivers - of the vehicles.

But given the way VOCs were defined in Chapter II, the wages of vehicle crews were not included as part of VOCs - and it would not have been feasible to recompute VOC rates to incorporate crew wages for purposes of this paper . Since, however, vehicle crews do enjoy a benefit when journey time is reduced, time savings were estimated in the case study for passenger as well as non-passenger-carrying vehicles like MGs and HGs. As was stated earlier the MOW definition of LGs does not distinguish between passenger and non-passenger LG vehicles. So even if time savings were to be evaluated for passenger-carrying vehicles only (including private cars) it would not have been possible to do so in the case study, hence in this

paper time savings will be estimated for all types of vehicles mentioned irrespective of whether they are passenger or goods vehicles.

The time savings benefit can be broken into three sub-categories for the purpose of evaluation:

(i) savings in road users' working time

(ii) savings in road users' leisure time

(iii) savings in the time taken to transport goods.

4.21 VALUE OF WORKING AND LEISURE TIME SAVINGS

Savings in working time are valued at the earnings rate(s) of those who enjoy the benefit. Since there will probably be as many such rates as there are road users, it is essential to identify some broad income groups into which the road users fall and to compute some average rate for each group. To facilitate calculation, the types of vehicles in which road users travel can be used as a basis for classifying road users into income groups. This is also the system used by the MOW: earnings rates are calculated for road users according to the type of vehicles they travel in.

The evaluation of leisure time savings is a difficult exercise even in the developed countries. The values people attach to their free time vary so widely among individuals in any one country as well as among countries. But the difficulty is more formidable in the developing countries where levels of

unemployment and underemployment are generally high. As noted earlier, some writers have expressed doubt as to whether it is proper at all to evaluate leisure or non-working time savings since time in these countries is not thought to be a scarce resource.

To what extent this assertion may be valid is questionable and some economists have expressed open disagreement with it. Firstly, little is known of the leisure activities of the people in these countries - especially in the rural areas where most of them stay. But ignorance of what they do in their leisure time is not sufficient justification for supposing that their leisure time has no value. Secondly, as Mishan correctly argues, even if they do not spend their free time in some "economically" rewarding occupation one further requirement would be necessary if their leisure time is to be valued at zero - and that is, that they are involuntarily unemployed. If the unemployment is imposed upon them against their wishes then indeed their free time has no alternative use(s) since by definition the only alternative available to them in that case would be to remain idle. But if the unemployed derive some satisfaction from being idle, their leisure time savings should be valued at the minimum sum of money it would be necessary to pay to induce them to give up their idleness. Some compensation would be necessary to persuade them to take up a job. Being unemployed in itself is thus not a sufficient reason to value leisure time savings at zero. The necessary and

sufficient conditon for doing so is that those whose leisure time is to be so valued be either indifferent to or positively dislike being unemployed.

In principle then leisure time savings need not always have zero value. In practice it is just impossible to establish the correct amount that would just compensate a group of prospective employees. Prest and Turvey[10] suggest that if leisure time savings must be evaluated, their value may be taken at some arbitrary estimate of anything between a quarter and two-thirds of the value of working time savings. Otherwise it is better that leisure time savings be simply recognized as a benefit and left at that. But this is on account of the difficulties of obtaining proper and adequate data for their evaluation - not because of any conceptual objections.

4.22 VALUE OF TIME SAVINGS IN TRANSPORTING GOODS

In the words of Hans Adler:

> "Time saved on the shipment of freight may well be more valuable in the less developed countries than in those already advanced. Freight tied up during transit is in fact capital and is, therefore, of particular importance where capital is in short supply. This saving can be measured by the price of capital - i.e. the rate of "interest".[11]

More specifically the rate to be used should be the rate

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[10]Prest and Turvey, "Cost-Benefit Analysis - A Survey"

[11]H. Adler, Op. Cit, p.35.

of interest payable on the funds tied up in the goods transported. For purposes of project evaluation it will probably be necessary to adjust this rate because of capital market imperfections. The resulting shadow rate of interest would be the social value of the time taken to transport the goods. In addition fast transportation reduces spoilage, increases the chances of reliable delivery of goods and enables consigners to avoid piling up excessive inventory stocks.

There appears to be no reason why time savings on the transportation of personal belongings should be valued as a distinct item. It seems reasonable to argue that the value of time savings in the transportation of personal effects and other non-business goods is included in the value of the reductions in journey time for their owners.

4.3. MAINTENANCE COST SAVINGS

One reason for constructing a new and better road in place of an existing one may be to lower the costs of maintaining the existing road. Even if it is not one of the intended effects of undertaking the road construction or reconstruction, it may - and it usually does - turn out to be one of the favourable direct effects of the road project. If the maintenance costs for the new road are expected to be higher than the costs of maintaining the existing road the maintenance cost savings will be negative - a loss to society which must be offset by the value of other benefit items.

The procedure for measuring construction costs described earlier applies with equal force to maintenance costs. Consequently, the determination of maintenance costs savings is a simple matter of calculating the difference between the costs of maintaining the existing road and the expected maintenance costs for the new one intended to replace it.

4.4 ECONOMIC DEVELOPMENT

If the conditions which were set out earlier as prerequisities for regarding the development effects of a project as one of its benefits are met the problem of measuring them is the usual one of

(i) forecasting correctly the expected net increase in the output(s) of the sectors or industries which will be influenced by the project

(ii) determining the appropriate social values for the extra outputs.

As Adler[12] points out

> "It is not sufficient to estimate outputs merely in macro-economic terms, since transport investments (such as roads, railway lines and ports) are fixed at definite locations and cannot be moved to to other areas. It is, therefore, necessary to estimate not merely future production and consumption as a whole but also its specific location".

In other words in order to forecast future production (for both home consumption and export) it is necessary that the particular industries in which net increases in output are likely to occur be identified and the appropriate input-output coefficients for

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[12] H. Adler, Op. Cit, p. 17

the industries worked out.

The issue of establishing the proper prices at which to value the increase in output is a matter of determining the willingness-to-pay for the outputs by the prospective beneficiaries. If these output items are marketable they may be valued at their market prices (or equivalents of these) appropriately adjusted for indirect taxes and subsidies. Outputs for export would be valued at the FE shadow prices.

If the requisite conditions are not met - and in many cases they will not be - it is sufficient merely to acknowledge the possibility that a project might have some effect on the development of the economy without much further ado.

4.5 REDUCED RISK OF ACCIDENTS

Road accidents in Kenya have become a social menace. Any road improvement must have as one of its aims the reduction in the incidence of road accidents, which makes such a reduction one of the direct or intended effects of the road improvement. On the other hand, if despite the intention to reduce accidents, the road improvement does in fact result in an increase in the rate of accidents (on the improved road), the increase would be an incidental effect for the simple reason that the increase in accidents cannot be an intended effect of improving a road.

The costs that road accidents inflict upon society may be categorized into two:

(i) property damages and losses

(ii) injury to, and loss of, human life.

4.51 PROPERTY DAMAGES AND LOSSES

Property damages and losses may further be sub-divided into:

(a) those involving non-durable consumers and capital goods such as passengers' personal effects, merchandise, farmers' crops (along the road, etc).

(b) those involving durable property items such as vehicles, bridges, livestock, etc.

Non-durable items may be valued at their replacement cost - that is, at their market prices suitably adjusted to reflect the social values of the items.

Ideally durable items, since they yield services to their owners over an extended period of time, should be valued at the discounted NPV of the services they would produce over their life spans. But whereas such values can relatively easily be estimated for durable capital goods it would be difficult to obtain adequate and reliable data on durable consumer goods to do this. Normally, travellers do not keep records of the values of their belongings so that if they are damaged or lost in an accident there is practically no way of establishing their values. Perhaps a more practical and easier way out of the difficulty is to value the more significant non-business durable goods like private cars, furniture etc, at their social replacement costs as is done for non-durable items.

4.52 INJURIES AND LOSS OF LIFE

Accidents involving injury to or loss of human life are very difficult to deal with both in principle and practice.

1. Evaluating Injuries:

The benefit to society from a reduction in the chances of occurrence of non-fatal road accidents may be considred to consist mainly of:

(i) Savings in the annual costs of treating those injured - incurred by themselves, their relatives or the state;

(ii) Savings in production that would have been lost annually during the time the injured would be confined in hospital or at home, measured as the sum total of what they would have earned during such confinement;

(iii) Savings in the personal discomfort, pain and disability to the injured themselves and grief to their relatives and friends.

Clearly it would be impossible to determine a price or prices for the savings in the last item. It is enough only to take note of it.

A theoretically plausible but empirically troublesome approach to evaluating the savings in potential injuries, which could also make it possible to measure the value of the emotional cost of accidents to society, is that proposed by Mishan in his general principle of the "Potential Pareto Improvement" to be discussed below.

The main difficulty in evaluating the first two savings above would be the statistical one of obtaining correct and adequate data on the number and type of road accidents, the occupations of the accident victims, their average earnings, etc. If this information is available the value of the various items of ouput that would be lost on account of the accidents and the resources that would be spent on treating the injured can be valued at their respective shadow prices. The inputs for medical services in this country have a very large FE content so that the value of the resources used in treating injuries may be conceived of in terms of the shadow value of the FE savings that would be realized if the injuries were avoided. In terms of the scheme proposed earlier on for shadow pricing FE, the value of the savings would be the domestic value (net of any domestic subsidies or gross of indirect taxes) of the imports that would have been made possible for this amount of FE saved.

2. Evaluating Loss of Life:

A number of approaches to measuring the economic value of human life have been put forward by theorists but none of them has proved wholly satisfactory. They fail either because they are not conceptually sound - hence their validity is questionable - or simply because they are just impossible to work with in empirical studies. Some of the methods that have been proposed, collectively referred to as the "Income Approaches", include:

(a) Contribution to Net National Product (NNP)

This approach considers the economic value of a person's life to be the sum total of the discounted present values of his current and future earnings.

(b) Personal Expenditure

The value of a person's life under this approach would be the discounted present value of the sum of money he would spend on himself.

(c) Contribution to Others

The value of one's life under this approach would be measured by the sum of the differences between his periodic earnings and the corresponding periodic expenditures on himself, discounted to the present.

So far only the first one of these approaches has been used in CBA studies to any appreciable extent. It does not, however, seem to be any more valid a measure of the economic value of human life than the other two. As Schelling and Devons[13] point out, a person's contribution to NNP is more a measure of his livelihood than a measure of the value of his life.

One other attempt which has been suggested in the literature but which does not appear to have ever been applied in any study is the so-called "Insurance Principle" which would value human life at the value of the policy a person takes out on his life. Mishan correctly dismisses it on the grounds that the value of an insurance policy reflects the

[13] In Mishan, Op. Cit.; p. 156.

holder's concern for the welfare of his dependants in the event of his "untimely" death or alternatively his concern for his own welfare in old age. Neither of these concerns appears to have anything to do with the value of his life. In fact, in either case the value of the insurance would seem to be a measure of the livelihood of the insured himself or that of his dependants.

The so-called "social" approach would value human life in terms of the value of "life-saving" (or for that matter, "life-destroying") investments which society, through its political process, undertakes. It is worth emphasizing at once that it is important that such investments be explicitly intended to save (or destroy) human life. If the investments affect human life only incidentally, they do not reflect the value society attaches to people's lives. But even when a public investment is specifically intended to save life it may well not be a proper measure of the lives of those it affects for other reasons. Firstly, public investment decisions are taken only by a handful of people in authority, supposedly acting on behalf of the rest of society by virtue of the mandate - if any - conferred upon them by the electorate. But there is no guarantee that what they consider to be good (or bad) for society will necessarily be so even in the so-called "democratic free societies". Secondly, even if by some stroke of chance their values do reflect the attitudes and interests of those on whose behalf they act, their judgements are anything but objective. There is no way they can ascertain just how

far the investments they may decide to undertake measure the worth of the lives they intend to affect one way or another.

Mishan's approach seems to be the first attempt at the theoretical level that has come closest to tackling the problems of measuring the value of life effectively. But he does not set out to establish a procedure for evaluating human life. He rightly recognizes the futility of trying to do this. What Mishan sets out to do is to measure people's willingness-to-pay for reductions or total avoidance of the risk of injury or death. This willingness-to-pay is measured by the maximum sum of money a person would be prepared to pay to have the risk reduced to its minimum level. Such a sum Mishan terms a Compensating Variation (CV).

For an injury the CV would be the maximum sum of money a road user would pay to avoid injury, or , if he has already sustained it, to have it made good. It would include the values of the savings in:

(i) the output that would otherwise be lost if the person were in fact injured;

(ii) the costs that he, his relatives or society at large would incur to have him treated;

(iii) the pain, personal discomfort to himself, and possibly, the grief that his relatives would suffer in case the injury does occur.

The rationale in this proposition may be stated as follows:

Part of the CV is a measure of the savings in the economic production of the potential victim of road accident injuries: he would like to avoid such injuries in order to be able to continue to earn his livelihood. Drawing on the economic principle that a person's earnings in a period of time are a measure of the value of his output one may conclude that one of the results of a person's efforts to avoid injuries is to save society some potential loss in economic production. Some portion of the remainder of the CV would be represented by the costs of treatment. The size of this portion as a percentage of the total CV would probably depend on whether the potential injury victim would have to "foot" the total bill of treatment costs or whether it would be shouldered in total by society in the form of "free" medical care. It would seem plausible to assume that this proportion would be larger if the individual has to pay for medical services than if they are offered at government expense. Since the entire CV is a cost, any part of it assumes greater significance to an individual if he has to bear it personally than if others meet it for him. Where free medical services are available the greater portion, or even the whole of the remainder, of the CV would reflect the individual's dislike of the pains and discomfort resulting from injury. To what extent this may also reflect his aversion to seeing his relatives and friends grieved on account of his being injured is a controversial matter. But such an aversion may be considered to be a component of this residual part of the CV.

One merit with this way of looking at the social value of savings in road accident injuries is that it provides this value as a single total sum at once and thereby obviates the need to evaluate the three savings items separately. Secondly, it incorporates the value of the savings in the emotional cost of such accidents which the "income approach" cannot do.

Similarly the value of a reduction in the risk of fatal accidents would be the maximum sum of money that road users would be willing to pay to be rid of the risk of such accidents or to have it minimized. In practice, accidents can never be eliminated completely so that the users of a new, better road always bear a certain amount of risk of sustaining either fatal or some less serious injuries. If this risk is expressed as probability - however this may be derived - it is appropriate to weight the value of the accident injuries to and loss of human life avoided by improving a road by the probabilities of their occurrence on the old road. The following very simplified hypothetical example illustrates the point:

1. Let X be the number of people who sustain non-fatal accidents, Y be the number of people who die, on some existing road annually. A new road, built to replace it, is expected to reduce non-fatal injuries by n and the fatalities by m.

2. Let the probabilities of occurrence for these numbers of injuries and fatalities respectively on the old road be defined as:

   $P(H) = nX^{-1}$ and $P(D) = mY^{-1}$

   The risk of injury is assumed, for simplicity, to be the same for all

the n potential injury victims and so is that of death for all the m potential victims of road accident fatalities.

3. The CV for any of the n road users is given as CV $= V_i$ and that for any of the m road users as CV $= V_j$. Both V_i and V_j are assumed to be different for different individuals in in either category.

The total CVs for each year can then be given for those who would be injured as:

$$P(H) \cdot \sum_{i=1}^{n} V_i = nX^{-1} \cdot \sum_{i=1}^{n} V_i$$

and for those road users who would be killed as:

$$P(D) \cdot \sum_{j=1}^{m} V_j = mY^{-1} \cdot \sum_{j=1}^{m} V_i$$

Discounting these Expected Values (EVs) at a selected rate of discount r for the life of the new road (T) and adding the two discounted values yields the following total EV:

$$PV_r(EV) = \sum \left[nX^{-1} \cdot \sum_{i=1}^{n} V_i + mY^{-1} \cdot \sum_{j=1}^{m} V_j \right] (1 + r)^{-T}$$

If, as is likely to be the case, only rough average estimates for V_i and V_j can be obtained, the total value of accidents avoided by building the new road can be stated simply as:

$$PVr(EV) = \sum (nX^{-1} \cdot nV_1 + mY^{-1} \cdot mV_2)(1 + r)^{-T}$$

where V_1 is the same for all the n and V_2 is constant

for all m road users.

But there is one substantial snag with this approach: the statistical data it calls for may simply not be available. It would require considerable research effort to establish the CVs even as average magnitudes. Statisticians could conceivably work out some estimates of the chances of occurrence for the various kinds of road accidents from information gathered and compiled by the Kenya Police in their reports. To date, however, no one seems to have undertaken this exercise.

The values of the savings in potential road accidents are weighted by probability indices because what is being evaluated is the reduction in the chances or risk of occurrence for the accidents.

4.6 EVALUATING EXTERNAL EFFECTS

Also known as externalities or spillover effects, these are the incidental costs and benefits to the rest of the economy which result from the execution of an investment project. Being incidental, spillovers are indirect or secondary in relation to the direct or "efficiency" effects of a project; being unintended they are not easy to identify or to evaluate.

Externalities vary in nature for any one project as well as for different types of projects. For a road project, for example, the principal external effects would be:

1) "growth" effects

2) income redistribution

3) environmental effects.

As noted earlier some writers suggest that secondary effects should be excluded from the costs and benefits of a project altogether. The majority, however, feel that as far as is feasible indirect effects should be taken account of in the evaluation of a public sector project. They, nevertheless caution the project analyst to exercise care and discretion in doing this. The first difficulty in evaluating the indirect effects of a project is in identifying them. The second is to quantify them and to determine their social values.

4.61 GROWTH EFFECTS

What are termed here as "growth" effects would consist of:

a) Linkage effects

b) Multiplier effects

1. Linkage Effects:

These may further be subdivided into "forward" and "backward" linkage effects. As indirect project effects, forward linkages would be the effects an investment project has on industries producing ouputs similar to the output of the project itself. For a road project forward linkage effects would be increases or reductions in the services of other transport facilities such as rail, air, canal/river transport. In so far as these are alternatives to road transport, the effects on them of building a new road or improving an existing

one may be adverse. But there may be cases where these facilities are complementary to road transport in which case the effects of the road project on them would be favourable. When the road is a substitute for any or some of the other transport facilities the forward linkage effects on those facilities will be a reduction in the production (and sale?) of their services - hence a decrease in the incomes from them. This lost income is a cost associated with the road project. But the fixed investment in the facilities which is, as a consequence, rendered idle need not be counted as a social cost since by definition it is a "sunk" cost with no alternative use(s) - hence no opportunity value. If, on the other hand, the other transport facilities are complementary to the road, the building of the road may occasion increases in their activities and increased incomes to those who own the facilities. Such an increase in earnings would be a favourable side effect of the road project.

The indirect backward linkage effects of a project would be the increases or decreases in the activities of those industries which use the same inputs as the project. If say a road construction project causes a shortage in the supply of some material, category of labour or a type of machinery so that other users of these inputs have to pay higher prices for them, these higher prices are a cost to the economy. Ultimately, the producers in these other industries will have to raise the prices of their products which in turn reduces the CS of those who consume these products. For a road project

adverse backward linkage effects may take several other forms: soil erosion on adjacent farms caused by trenches dug to drain rainwater away from the road; crop spoilage from dust or mud thrown about by the vehicles, etc.

On the other hand, if the construction of a road stimulates demand for some inputs so that the industries supplying them can operate at their full capacity the economy gains to the extent that idle productive capacity in these industries is utilized to increase output and thereby, hopefully, production costs and prices are reduced.

There are also what may be termed as "direct" forward and backward linkage effects. The former would be the increase or decrease in the activities of industries using the outputs of a project. The latter would be the effects of the project on industries supplying it with inputs. Either of these effects may be positive or negative (i.e. benefits or costs). However, since they are "direct" effects they would be included in the calculations of the efficiency effects of the project. For instance if increasing returns prevail in the industries producing the inputs required for a project the project's costs will probably not rise as fast as if there were diminishing returns in those industries. If on the other hand, diminishing returns prevail the project's input requirements might impose an extra strain on the productive capacity of the industries so that the prices of their outputs would have to rise. If there are increasing returns in the industries the project's requirements will stimulate increases in their operations and

thereby confer upon the industries the blessings of economies of large scale production which, among other things, means lower unit production costs. Hopefully, this may also be passed on to the project in the form of lower prices for its inputs; or if the prices do not fall they will at least not rise.

The same goes for direct forward linkages. If the capacity of a given investment project producing or intended to produce intermediate goods for firms in other industries is limited relative to their actual or potential demand, expansion in these industries will be retarded especially if the intermediate goods are critical inputs for the industries. This would obviously be an adverse direct growth effect in the sense that the project, being a bottleneck, occasions society losses in potential output in the other industries. But this and other such direct growth effects would be taken care of in evaluating the "economic development" benefit and no more need be said about them here.

(2) Multiplier Effects

These are short run increases in incomes generated when surplus producing capacity in an economy or certain sectors of it is activated by rounds of spending resulting from investments in a project. The FCO/ODA in their summary adaptation of the Little-Mirrlees Manual caution against including multiplier effects in a project's costs and benefits unless there are unemployed or underemployed resources which cannot be utilized because of inadequate demand for the final

products such resources help to produce. If this condition holds the benefit to society from the project is the present value of the net income flows that would not otherwise have been earned if the investment were not undertaken. In practice it would be extremely difficult to trace or forecast such income flows.

4.62 INCOME REDISTRIBUTION

One of the most important side effects of a project may be the redistribution of income in a region or country either on a geographical or occupational basis or both. Some investment projects are undertaken by government with the express purpose of changing the pattern of income distribution in some desired direction in which case income redistribution becomes one of the direct effects of the project. An investment may affect income distribution in one or both of the following forms:

(i) by increasing employment opportunities

(ii) by raising the site values of adjacent properties.

Social equity is a goal that many countries today view as not only desirable but also necessary. One economic argument in support of this idea is that gross inequitable income distribution in a country tends to militate against balanced economic development and may slow the rate of growth. But there are also more persuasive non-economic arguments. Equity is but a means to achieve a number of goals of which the

economic is only one and by no means the most important. This multiplicity of ends makes it difficult to evaluate the distributional effects of an investment project. Moreover, the majority of economists seem to be of the opinion that questions of income redistribution should be kept out of investment project analysis. Equity, they contend,would be better effected by means other than investment projects, one of the reasons for this objection being that equity and economic efficiency considerations (with which the project analyst would be most concerned) often run at cross purposes. If the economic aim of maximizing the net social benefit from an investment project is to be achieved, economists argue, then a certain amount of inequity must be accepted. While no one need dispute this observation it is also valid to advance the converse of it as a counter argument - which in fact would amount to questioning whether efficiency need be the sole or even the principal criterion in appraising a project in a developing country. Such an overconcern with questions of economic efficiency as is apparent in text-books and journals at the virtual exclusion of other equally important but non-economic considerations smacks of sheer academic folly. Developing countries today are faced with problems for which solutions must be sought in spheres of life extending beyond the realm of economic analysis.

Of the above two aspects of the distributional effects only the second one need be evaluated. The value of the first one - increased employment opportunities - can be taken to be the net increase in the output of other firms or industries

connected with the project. This may be treated in the same way as direct forward linkages by including it in the value of the development benefit. It stands to reason that if the value of the economic development benefit is the value of the net increases in the output of industries other than the project itself then indeed part of that output must have been produced by labour which would otherwise have remained idle. It would, therefore, be a clear case of double-counting to include both increased employment and "economic growth" in the benefits of a project.

According to Mishan the second aspect - appreciation in property values - should be included only if it can be shown that such increases in property values are not mere transfers - that is, property values lost elsewhere in the economy. If this condition is satisfied the value of this benefit would be the net appreciation in PV terms. On the whole, it would be better in practice to omit appreciation in property values mainly because it is not possible to isolate the net portion of it from the transfer element in it. It is too involved and the gain from the calculations would not justify the effort required.

4.63 ENVIRONMENTAL EFFECTS

In principle the two environmental effects mentioned above can easily be measured in terms of the willingness-to-pay of those affected. There is little to be said in favour of a road project in terms of positive environmental effects.

It may be possible there are people who consider a road passing through their area as having some aesthetic value. Some others may see it as something that gives them prestige. Careful consideration of this prestige will show that it is derived from or based on one or more of the more tangible benefit items.

To the extent that there are probably more adverse than favourable environmental effects associated with a road project, it is likely in many cases the construction of a road imposes a net environmental cost upon society. From the point of view of cost-benefit measurement it is the net value of both the positive and negative effects that need be included in the costs or benefits of a road.

The value of each environmental spillover of a project may be conceived of in terms of the maximum sum of money its beneficiaries would be prepared to pay rather than go without it or the minimum sum of money those who are adversely affected would be willing to accept to put up with its ill effects. This may also be seen as the maximum sum of money they would be prepared to pay to avoid such effects. The adverse effects of a project would be the loss of a benefit or benefits enjoyed prior to the initiation of the project. In real terms this loss might be forgone clean air or a quiet environment.

If a road confers environmental benefits on some n people but affects m others adversely it may be assumed each of n would be prepared to pay a maximum sum of V_i to procure or retain the benefits; each of the m individuals might be willing

to accept a minimum sum V_j to suffer an adverse project effect. For the n beneficiaries the total willingness-to-pay for the spillover can be given as:

$$CV_n = \sum_{i=1}^{n} V_i \qquad \text{where } i = 1, 2 \ldots n$$

Similarly the total compensation for the m losers can be expressed as:

$$CV_m = \sum_{j=1}^{m} V_j$$

The net environmental spillover benefit (or cost) then is simply the difference between these two sums discounted to the present.

If this difference is negative society would suffer a real loss in terms of forgone environmental benefits; if positive there is a net gain to society: those who benefit can more than compensate the losers. The difference may then be discounted and added to the PV of the other benefit items. If, however, it turns out that, "ceteris paribus",

$$\sum_{i=1}^{n} V_i - \sum_{j=1}^{m} V_j = 0$$

then a Pareto Optimal situation does exist and any changes in the magnitues or quality of the spillover would result into one of the groups being made worse off than the other.

PART THREE

CHAPTER V

AN ILLUSTRATIVE CASE STUDY

5.0 INTRODUCTION

Road transport in Kenya has expanded very rapidly in the last ten years or so. This growth has been both quantitative and qualitative in nature: not only have many roads been built in the country, but there has also been substantial upgrading of many formerly seasonal roads to all-weather standard. There are currently some 43,000 kilometers of classified roads consisting of the following categories:[14]

Class of Road	Bitumen	Gravel	Earth	TOTAL
Trunk Roads:	(Km.)	(Km.)	(Km.)	(Km.)
International (A) National (B)	3,040	2,002	437	5,479
Primary roads (C)	1,070	3,114	3,114	7,748
Secondary " (D)	211	2,462	7,273	9,946
Minor " (E)	107	1,675	18,327	20,109
T O T A L	4,428	9,253	29,601	43,282

TABLE 5.1

[14] "Third ADB Project Loan Application", MOW (Oct. 1973) p.6

There is in addition to this over 8,850 kilometers of unclassified roads. There is every indication that the growth in road transport will continue as the economy expands and generates greater demand for transport services.

Unfortunately, this growth has apparently been at the expense of the railways. As elsewhere the world over, roads in East Africa have changed from being mere supplements to become ruinous rivals to the railways. Some of the advantages which roads enjoy over railways include greater flexibility (e.g. door-to-door delivery of goods and people, shorter journey times, suitability in handling small-scale activities, etc.). In Kenya, the competitive edge in favour of roads has been boosted further by the improvement in the quality of roads, the non-enforcement of restrictive road licencing which formerly gave the railways a virtual monopoly over the transportation of bulky goods and long-distance haulage. It has also been suggested in some quarters that the rigid pricing policy of the EARC has had a bearing on the poor performance of the railways in recent years. Because of the very heavy initial costs in the construction of railway lines it seems likely the current rate of development and growth in road transportation will continue for some time in the foreseeable future. There may well be a corresponding slow-down or even stagnation in the growth of railway transport. Furthermore, the small scale nature of the economic activities in most parts of this country seems to warrant more investments in road construction than in railways.

A number of Government ministries are concerned with various aspects of road transport in the country. The Ministry of Power and Communication through its Road Transport Branch, is responsible for matters related to the utilization of roads such as licencing of vehicles and drivers. The construction and maintenance of roads and bridges as well as the administration of these activities are the responsibility of the MOW. The financing of the road construction and maintenance program is taken care of by the Ministry of Finance and Planning which is also the agent responsible for overall economic planning in the country.

Road development proposals are initiated by the various operating ministries. The proposals are forwarded to the MOW which screens them, compiles and works out rough estimates for each proposal and in turn forwards them to the Ministry of Finance and Economic Planning for overall preliminary cost-benefit evaluation of the proposals as a package. The proposals which get approved by the Treasury are then sent back to the MOW for more detailed engineering and economic appraisal.

The particular ministries which in the past have been responsible for a large number of the proposals include the Ministry of Agriculture (largely tea and sugar roads), the Ministry of Lands and Settlement (roads in settlement schemes), the Ministry of Tourism (tourist roads), the Ministry of Defence (strategic roads) and the Ministry of Finance and Planning (international and national trunk roads which are a

kind of "general-purpose" roads). Most of the road proposals put forward by the other ministries are either primary or secondary roads but a good number of them may be segments of the trunk roads.

5.1 THE PROJECT

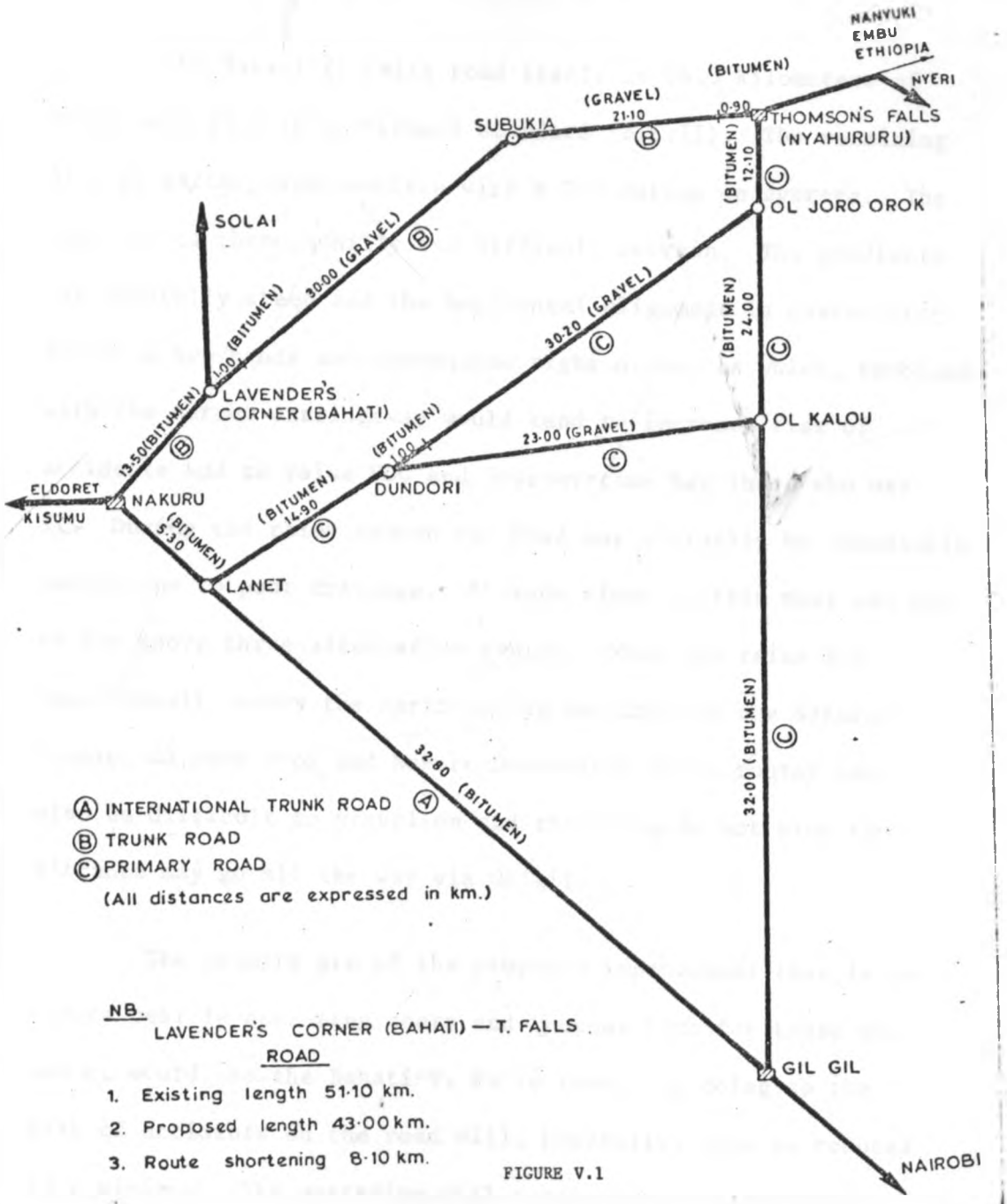
The road project in this case study involves upgrading the present murram road linking Nakuru and Thomson's Falls (presently known as Nyahururu) township to bitumen standard. The road is a segment of the B5 road connecting the two provincial headquarters of Nakuru (Rift Valley) and Nyeri (Central Province). The entire B5 road is some 195 kilometers long and provides a convenient link between the two townships for those who do not wish to travel all the way to Nairobi. It also connects two important international trunk roads - viz: the so-called the Great North Road (A 104) linking Central and East Africa and the newly constructed Nairobi-Addis Ababa (A2) road. The segment of the B5 road which is the subject of this case study starts at Bahati (formerly known as Lavender's Corner) some 13.5 kilometers north of Nakuru town and just to the east of the famous Menengai Crater and runs for some 51 kilometers through the agriculturally rich Subukia area to Thomson's Falls.

At present Nakuru and Thomson's Falls are linked by a number of other roads (see Figure V.I) namely:

1) Nakuru-T. Falls via Gilgil - all tarmac

2) Nakuru-T. Falls via Dundori and Ol Joro Orok - a total of 63.4 kilometers, of which 30.2

DIAGRAMATIC PRESENTATION OF THE EXISTING ROAD LINKS BETWEEN NAKURU AND T'FALLS



NB.

LAVENDER'S CORNER (BAHATI) — T. FALLS ROAD

1. Existing length 51·10 km.
2. Proposed length 43·00 km.
3. Route shortening 8·10 km.

FIGURE V.1

kilometers is of low gravel (G.2) standard.

3. Nakuru-T. Falls via Dundori and Ol Kalou, 79.2 kilometers long of which 23.0 kilometers is gravel grade (G.2).

The Bahati-T. Falls road itself is 66.5 kilometers of which only 15.4 is to bitumen standard (Bit.II). The remaining 51.1 is earth/gravel surface with a G.2 rating on average. The road passes through hilly and difficult terrain. The gradients are generally steep and the horizontal alignment is characterized by sharp bends and inadequate sight distances which, combined with the narrow carriageway would tend to increase risk of accidents and to raise VOC and journey-time for those who use it. During the rainy season the road may virtually be impassable mainly due to poor drainage. At such times traffic must use one of the above three alternative routes. When the rains are exceptionally heavy the earth/murram sections of the Nakuru-Dundori-Ol Joro Orok and Nakuru-Dundori-Ol Kalou routes may also be difficult to travel on and those who do not mind the distance may go all the way via Gilgil.

The primary aim of the proposed improvement then is to reduce vehicle operating costs and journey time for those who use or would use the Bahati-T. Falls road. In doing so the risk of accidents on the road will, hopefully, also be reduced to a minimum. The upgrading will consist of reconstructing the road to Bit. I standard with a carriageway of 7.0 meters and a design speed of 80 kmp. The works will involve recentering, reshaping and paving. A completely new alignment will be

followed where necessary in order to improve sight distances and to reduce gradients. The length of the existing route will be reduced from the present 51.1 kilometers to 43.0 kilometers.

5.11 AREA OF INFLUENCE

The greater part of the road lies in Nakuru district. The impact of the proposed improvement will probably be greater in the Bahati, Subukia and Dundori areas and the south-western parts of Laikipia district. All these are very important agricultural areas producing wheat, maize, barley, coffee, tea, horticultural products, pyrethrum, milk, wool, etc. The fruit and vegetable canning factory at Kabazi also stands to benefit if the road is paved. The improvement would be a boon to the tourist industry as it would provide a much needed link between Nakuru and T. Falls. From the traffic Origin-Destination (OD) survey done on all the four roads linking Nakuru and T. Falls and discussions with the local tour operators and hotel managers, there is a strong indication that virtually all the tourist traffic that presently travels between Nakuru and T. Falls via Gilgil would prefer the Bahati-Subukia route if it were improved. For one thing, it would be shorter; and moreover, the route itself with the valleys and escarpments is a tourist attraction.

The main population centers are the two townships (Nakuru and T. Falls). This being mainly a large scale farming area the population in the outlying rural areas tends to

concentrate around the rural market centers, most of which are situated along the four roads. Population density is lighter in the farms. The following table indicates the approximate sizes and densities of population in the districts in which the area of influence for the Bahati-T.Falls road lies as well as the projections of future population growth trends for both the districts and the principal townships:

POPULATION PROJECTIONS AND LAND AREAS FOR THE DISTRICTS SERVED

District	Land Area (sq. km.)	Total Population			Population Density
		1969	1976	1986	
Nakuru	7,024	291,000	372,000	531,000	53
Nyandarua	3,528	177,000	227,000	403,000	64
Laikipia	9,718	66,000	73,000	82,000	8

TABLE 5.2 (a)

POPULATION PROJECTIONS FOR THE MAIN TOWNS

TOWN	P O P U L A T I O N		
	1969	1976	1986
Nakuru	47,000	70,600	126,400
T. Falls	7,600	13,000	29,600

TABLE 5.2 (b)

5.12 ECONOMIC ACTIVITY

The most important activity in the area is farming. Light industries engaged mainly in processing farm produce are concentrated in Nakuru town. Nakuru and T. Falls are also tourist centers as they lie on the western fringes of the main "tourist zone" in the country.

(1) A G R I C U L T U R E

The area of study lies in one of those parts of the country which were formerly referred to as "scheduled areas". Although it is still predominantly a large-scale farming area, considerable changes have taken place in the ownership of land. Some of the farms have been purchased from European settlers and broken down into small scale settlement holdings. Other farms have been bought by co-operative societies, private companies and individuals who still operate them as large-scale units.

The main crops grown in the area are coffee, tea, pyrethrum, wheat, maize, a variety of vegetables and pulses and potatoes. Livestock is predominantly cattle but there are also some sheep and pigs.

a) Large-Scale Farms:

Crop Production

The table overleaf gives in summary form some indication of the crop areas, average annual crop production and its value for the years 1972 and 1973.

Crop	Crop Area (in hectares)		Annual Production (in tonnes)		Value (K£'000')	
	1972	1973	1972	1973	1972	1973
Coffee	2,320	2,413	2,900	3,016	1,400.00	1,456.00
Tea	200	220	37	41	12.95	14.25
Pyreth-rum	280	308	72	79	14.30	15.73
Wheat	3,600	3,816	5,200	5,512	204.70	216.98
Maize	3,600	(NA)	11,340	(NA)	220.50	233.73
Horti-culture	200	(NA)	600	(NA)	15.50	17.05
Barley	600	612	900	918	28.12	27.56

TABLE 5.3

NOTE: NA = Not Available

The area under tea is expected to increase from the present 220 hectares to some 1,200 hectares over the next five years. At present the green leaf has to be taken to Kericho for processing. Since this must be done within 12 hours of picking the need for quick transport requires no stressing. But this particular need should come to an end when a processing factory now under construction near Subukia comes into operation towards the end of this year or early next year. The area under wheat is expected to increase following the recent increase in the price of wheat from Sh. 53 to Sh. 70 per bag. According to the District Agricultural Officer at Nakuru the amount of maize given in the table constitutes only some 30% of the total production of the crop which is marketed

through the Maize and Produce Board. The rest is consumed locally. Barley is not a very significant crop in the area. But grassleys are, on account of the large population of cattle in the area. It was not, however, possible to obtain data on this crop. Horticultural crops (such as tomatoes, onions, cabbages, beans, peas, potatoes) are grown widely in the area. In fact, this is the chief source of supply of these items for Nakuru and Nairobi. Some of the produce is also sent to Mombasa. Encouraged by good export prospects the Ministry of Agriculture intends to encourage farmers to double the output of horticultural produce. But it is likely that the local market which is also expanding rapidly will absorb most of the production.

Livestock

Cattle, a large percentage of which are dairy cows and heifers, are the principal livestock item. The population of sheep and pigs has been decreasing at an annual rate of some 11% according to the 1972 livestock census by the Ministry of Agriculture. According to the same census the annual slaughter rates for cattle, pigs and sheep are 30%, 80% and 40% respectively. The table below shows figures on the population of livestock and the production and value of livestock products for the large scale farms for the year 1972:

(Please turn over for the table)

	Population (head)	Production	Value (K£)
Dairy Cattle	14,739	6,632,100 milk (Litres)	232,120
Beef Cattle	7,483	2,245 Head	89,800
Pigs	1,470	1,160 "	18,000
Sheep	1,363	500 "	1,500

TABLE 5.4

b) Settlement Schemes

Four settlement schemes fall within the area of influence of the Bahati-T.Falls road - namely: Nyahururu, Marmanet, Ol Arabel and Lariak. The first one is in Nyandarua district, just to the south of T. Falls township; the other three are in Laikipia district.

Thomson Falls serves as a collecting center for the agricultural produce of the schemes. The range of crops grown in the schemes is the same as that of the large scale farms except that there is no coffee and tea. Pyrethrum, wheat and maize are sent to Nakuru for processing. About 25% of the potato crop and vegetables is sent to Nakuru; the bulk of it goes to feed the Nairobi market. As of 1973 the nature and extent of agricultural activity in the schemes was as shown in the table overleaf.

CROP AREAS AND POPULATION IN THE SCHEMES

	SCHEME				
	NYAHURURU	MARMANET	OL ARABEL	LARIAK	TOTAL
Total Area (Ha)	4,852.8	4,855.2	6,452.8	6,452.8	21,813.6
Total population	256	374	256	143	1,029
Crop Areas (Ha.)					
Wheat	213	-	-	-	213
Maize	214	876	1,375	523	2,988
Pyrethrum	124	42	-	-	166
Potatoes	13	-	133	-	146
Beans	21	13	223	42	299
Total Crop Area	585	931	1,731	565	

TABLE 5.5.

Although there is a Kenya Co-operative Creameries factory at Nakuru - and it is also nearer to T. Falls - most of the milk produced in the schemes is sent to Naivasha for processing because it is easier to transport it there. Most of the wool goes to feed the blanket factory at Nakuru.

About 20% of the available land in the schemes is devoted to cash crops; the remainder is left either for live-stock or subsistence farming. According to the resident settlement officials crop areas could easily be expanded if

need be. The following two tables summarize the crop and livestock production data for each of the settlement schemes for 1973.

Crop	SCHEME			TOTAL FOR ALL SCHEMES	
	Nyahururu	Marmanet	Ol Arabel & Lariak	Quantity	Value (K£'000')
Wheat (tonnes)	249.21	-	-	249.21	6.23
Maize "	254.70	1,890.00	4,099.50	6,244.20	123.18
Pyrethrum "	30.65	3.76	-	34.40	6.88
Potatoes "	117.00	-	1,197.00	1,314.00	14.60
Beans "	22.77	14.04	285.66	322.47	14.32
Livestock					
Dairy Cattle (Hd)	2090 (900)	2861 (1387)	1389 (954)	6,340	
Beef " "	780	933	1208	2,921	
Sheep & Goats	2241 (1169)	1718 (928)	380 (247)	4,339	
Poultry (birds)	3214	3390	4565	11,169	
Milk (litres)	494.18	782.98	60.01	1,337,164	
Wool (tonnes)	2.99	-	-	2.99	

TABLE 5.6

Note;

(i) Figures in brackets in the above table refer to livestock under one year.

(ii) Only a very small proportion of the livestock and livestock-based products is marketed and it would have been misleading to place sales values beside production figures in the table.

These figures (sales values) are given in the table below:

	SCHEME			TOTAL FOR ALL SCHEMES	
	Nyahururu	Marmanet	Ol Arabel & Lariak	Quantity	Value (K£'000')
Milk	4,976	(NA)	(NA)	4,976	1,472
Beef Cattle	-	246	25	271	813
Sheep & Goats	81	81	15	177	531
Poultry	3,214	3,290	4,568	11,072	2,180
Wool	2.99	-	-	2.99	1,195

TABLE 5.7

c) Non-Settlement Co-operative Farms

These are primarily large-scale farms but in which individual members of the co-operatives are alloted plots for growing subsistence crops. The total production from the farms and their values for the year 1973 are shown below:

(a) CROPS:	QUANTITY (Tonnes)	VALUE K£'000'
Wheat	727.40	14.47
Maize	570.87	10.74
Pyrethrum	2.39	1.51
Barley	308.34	9.37

TABLE 5.8 (a)

(b) L I V E S T O C K		V A L U E (K£ '000')
Cattle (head)	307	5.95
Milk (litres)	310.97	18.76
Butter-fat (Tonnes)	3.92	1.59

TABLE 5.8 (b)

(2) T O U R I S M

The proposed road improvement will help to bring closer the national parks and other tourist attractions in the Rift Valley and those to the east of it especially those around Mt. Kenya in Central and Eastern Provinces, thus completing a "tourist road loop" connecting Nairobi, Nakuru, T. Falls, Nyeri and Meru. The main tourist attractions at Nakuru are the Lake Nakuru National Park with its flamingo concentration, the huge Menengai Crater and the prehistoric sites at Gilgil (on the way to Nakuru) and Hyrax Hill. The high falls, some game in the Marmanet Forest and a generally mild weather attract tourists en route to and from the Mt. Kenya and Nakuru areas to T.Falls. The Midland and Stag's Head hotels at Nakuru offer reasonably high standard accommodation. The T.Falls Lodge is the only "tourist class" hotel at T. Falls. In the "peak season" these hotels enjoy very high rates of bed occupancy. The pattern of seasonal utilization of the accommodation facilities is as indicated in the table that follows.

SEASONAL BED OCCUPANCY RATES AT NAKURU AND T. FALLS

	Bed Capacity	Occupancy Rates	
		Peak	Off-Season
Midland	80	1300	1100
Stag's Head	89	1500--2000	600-800
T.Falls Lodge	62	1200--1900	-

TABLE 5.9

Discussions with the managements of these hotels revealed that occupancy rates might even be higher if the B5 road were improved throughout all its length as this would provide an all-year-round circular flow of tourists. As of now, the Nyeri-T.Falls section of the road is only of gravel standard and may be impassable in the rainy season. A rough indication of what impact the planned road improvement might have on tourism in the area is the fairly high percentage increase (of more than 50%) in the number of tourists who have been visiting the T. Falls Lodge since the Nakuru-Gilgil-T. Falls was paved.

But in the light of the fact that the hotels are booked almost to capacity during the peak season an increase in the flow of tourists would impose some strain on the hotel facilities during this season so that further investments in accommodation would be necessary. Despite the relatively lower occupancy rates in the "off-season" it would not be proper to consider this seasonal under-utilization an indication of over-investment in

hotel accommodation in the two townships. This could be the case only if in the peak seasons the hotels usually had excess capacity. Further evidence that there is room for more investment in tourist accommodation facilities in the area is the proposed Baharin Lodge (100 beds) to be built by the Kenya Tourist Development Corporation in the Lake Nakuru National Park.

But only improving the Bahati-T. Falls segment of the B5 road will probably not in itself generate substantial increase in the flow of tourists to the area the new road will be serving. Such an increase would come about if the entire B5 road were upgraded. Improving the Bahati-T. Falls road will certainly have some effect on tourism in the area but such an effect is likely to be only a marginal one.

(3) INDUSTRY

Nakuru town has a number of light industries the important ones of which include flour, timber and steel mills, soap, paint, fertilizer and textile (blanket) factories, a battery manufacturing plant and milk and pyrethrum processing factories. Generally it is expected that the proposed road upgrading will have some bearing upon these industries in varying ways and to differing degrees. The industries engaged in processing farm produce such as milk and pyrethrum will probably be the greatest beneficiaries. Earlier it was stated that most of the milk produced in the area around T. Falls (which extends to the eastern escarpment of the Subukia Valley) is collected

into a depot and T. Falls and then shipped to Naivasha - some 97.1 kilometers away - for processing. The road improvement will most likely divert the milk output from this area to the Nakuru plant. But then the Naivasha milk factory has a much larger capacity than that at Nakuru so that the milk produced in the area between T. Falls and Subukia would still have to be sent to Naivasha. There might be delays in processing it resulting into spoilage and losses to producers. Furthermore, there is no clear indication from the field information that transporting milk on the existing road has been much of a problem; except perhaps when there are unusually very heavy rains. Pyrethrum, which is less easily perishable than milk, has always reached the processing plant at Nakuru in a wholesome state; and the tea-factory now being constructed near Subukia will greatly reduce the significance of the new road to tea growers in the area. Those who stand to benefit most from the improved road are the vegetable producers - or more accurately, those who transport the produce from farms to Nakuru. But as is indicated below there is little to suggest that the present state of the road has been a bottleneck to increased production of vegetables or that it has occasioned farmers prohibitive losses.

The only industrial activity of any importance outside Nakuru town is the fruit and vegetable canning factory at Kabazi, situated some 25 kilometers from Nakuru along the

present road. The factory draws its raw materials from as far afield as Kinangop, Naivasha, Limuru, Meru and Mombasa. A small fraction of the raw materials supply comes from the surrounding area. The present factory can handle as much as 200 tons of tomatoes and other vegetable material per day during the peak operating period. The annual production capacity of the plant is some 250,000 cartons of canned products which are marketed by Brooke Bond Leibig (Kenya) Limited.

The existing road is the only route by which the raw materials (and other inputs) can be brought to the factory and the finished products transported from it. According to the factory manager occasionally the road may be impassable, particularly for heavy vehicles. This may cause delays in the delivery of raw materials which in turn results in losses in working time and delays in the shipment of finished items to the market. If the raw materials are spoilt en route to the factory on account of the vehicles being stuck in the mud or due to some other mishap, the suppliers or the factory owners - depending on who of the two is responsible for the goods while in transit - incur losses. The benefit to the raw material suppliers and factory owners of improving the road would then be the avoidance of the losses that would otherwise result from lost working time, delayed delivery of finished goods, or damaged materials.

But the probability of these losses occuring during any one year does not seem to be significant. The number of days during the rainy season the road would be impassable may

not be so large: compared to the number of days the factory is in operation they are only a tiny fraction. Moreover, the fact that extensions had been made to the factory even before plans to pave the road were initiated is ample evidence that the present state of the road is not a constraint on the operations of the factory. Undoubtedly, the proposed road improvement would benefit the factory and its suppliers of inputs. But the gain would probably not be so large as to deserve the time and effort required to estimate it.

In conclusion, there seems to be little reason to suppose that the new road by itself will have any substantial impact on the farming activities in the area of its influence. The area is fairly well developed agriculturally, the present road has so far been reasonably adequate: the roads have not been a serious bottleneck to expansion in agricultural output. In fact, to effect further output increases it is likely that other investments, apart from those in transport, would be necessary. Similarly, the effect of the road improvement upon the other two economic activities, namely - tourism and industry - will probably not be much. Consequently, no effort has been made in this paper to estimate what would be the net effects on the outputs of these activities of paving the Bahati-T. Falls road. Moreover, to be able to do this, it would have been necessary to secure more detailed information about the functional relationships between the inputs and outputs for the different production activities. In the light of time and financial constraints no more than the total

production data presented in the tables in the foregoing pages could be collected.

5.2 DATA GATHERING

The data used in the evaluation of the project in this case study was collected with the aid of the staff of the Planning Section of the Roads Department of the Ministry of Works and under the direction of the Superintending Engineer in the section. Two broad sets of statistics were collected: one on traffic and the other on economic activity in the area of study. A summary of the latter has already been given above. Briefly, the method of collecting information on the different main land uses - agriculture, industry and tourism - consisted principally of interviews with a selected sample of farmers in both the large scale and settlement farms, a fruit and vegetable canning factory manager at Kabazi, hotel managers at Nakuru and T. Falls, agricultural, settlement and co-operative officials at Nakuru and T. Falls. Additional information was obtained from the Provincial Planning Officer, the Provincial Director of Agriculture, the District Agricultural Officer at Nakuru; the Central Bureau of Statistics (Ministry of Finance and Economic Planning), Ministry of Tourism, the Coffee and Tea Boards at Nairobi.

The major part of the research effort, however, was devoted to the collection of traffic information since this forms the principal input for the economic evaluation of the

proposed project. The following paragraphs present a description of the methodology that was employed in the gathering and processing of the traffic data.

5.21 TRAFFIC DATA

Traffic counts on Kenya roads started in 1952 on an "ad hoc" basis. But since 1965 there has been a regular program of repetitive counts undertaken by the Planning Section.

There are four types of traffic counts which have been undertaken over the years:

a) The 60-Point Census:

Between 1965 and 1969 manual traffic counts were done four times a year at 60 randomly selected points covering all the main roads in the country. Since 1970, however, only one count is taken at each of these points every year in June/July. Each count lasts 5 days (Monday-Friday); for 12 hours for four days and round the clock on any one of the five days.

b) The 50-Point Count:

Automatic counts at 50 randomly selected points have been undertaken since 1966. Counting is continuous (starting at 7 a.m. each day) throughout the year. For ease of supervision and maintenance of equipment the points are located in the vicinity of MOW camps and police posts.

c) Other Manual Counts:

These have been done since 1952 as occasion demands. They are taken at selected points and run for 12 hours per day for 5 days and one night. The counts are done to provide supplementary information.

d) Special Counts:

These are more detailed and aim to provide a wider range of data than can be obtained through the other counts. Special counts consist of:

i) Origin-Destination (O-D) Surveys

ii) Vehicle Speed Studies

iii) Speed-Flow relationships investigations.

iv) Junction (and ferry) counts:

Unlike the other counts, special counts are undertaken for a road only when the road is earmarked for reconstruction and more detailed plans and economic analysis are required.

For the four roads in this study, manual, automatic and special counts were done to provide a basis for estimating the level of utilization of the Bahati-T. Falls road at present and in future after it is bitumenized. The methodology thus has three distinct phases:

1. gathering the raw traffic and other data,

2. determining the average level of utilization of the roads at present,

3. forecasting the level of utilization of the Bahati-T. Falls road when it is improved.

Present utilization of the road will be measured by the volume of Normal traffic. Future utilization, on the other hand, will consist of Normal, Generated and Diverted traffic.

In addition to the manual and automatic counts, O-D surveys, vehicle-speed surveys and junction counts were carried

out on all the four roads connecting Nakuru and T. Falls. The four links will be referred to simply as the Bahati-Subukia, Dundori-Ol Joro Orok, Dundori-Ol Kalou and Gilgil-Ol Joro Orok routes in the remainder of this paper. The surveys were carried out chiefly by means of roadside interviews with motorists at pre-selected points at Bahati, Ol Joro Orok, Subukia and T. Falls. The survey results are shown in Figure V.2.

Two adjustments were done to the raw sample data to derive the average daily traffic volume for the year on the routes. The first adjustment was to convert the 12-hour sample average values to their 24-hour normal traffic equivalents. For this purpose conversion factors were worked out by the MOW for each vehicle type. The factors are given in the table overleaf.

The second adjustment was to correct the adjusted sample values for seasonal variations in the annual flow of traffic for which a seasonal "Correction Factor" was established. On the basis of the automatic counter data an overal seasonal correction factor of 1.06 was worked out and applied to traffic flows on all the routes. The seasonal variations in the annual traffic flow for the past three years as recorded by the automatic counter at T. Falls, depicted in Figure V.3, are typical of the variations on roads in the area of study.

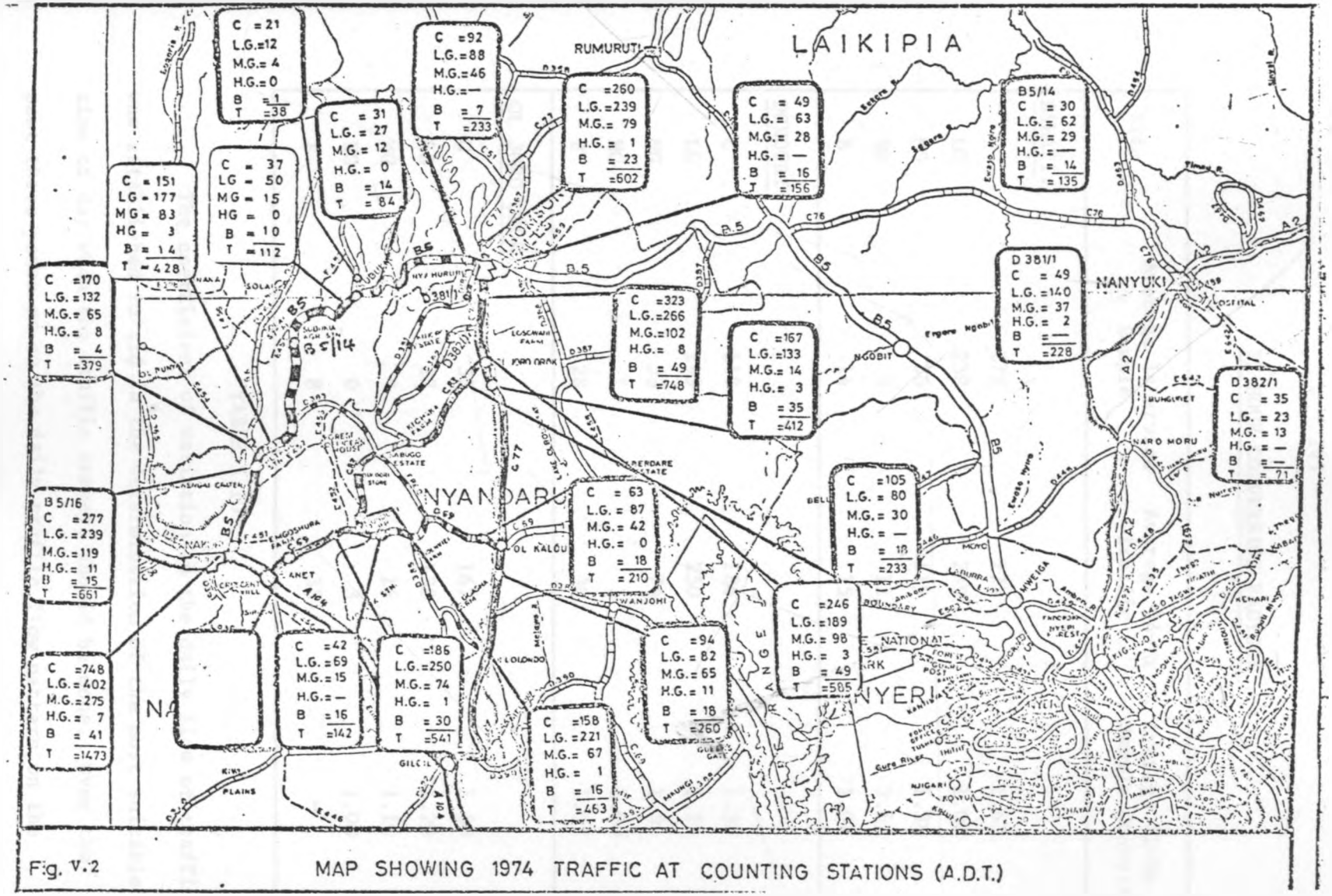


Fig. V.2 MAP SHOWING 1974 TRAFFIC AT COUNTING STATIONS (A.D.T.)

12-HOUR CONVERSION FACTORS

Site	Average Interview Sample	Average 24-Hr. Traffic	Average 12-Hr. Sample Converter
BAHATI:			
C	172	277	1.61
LG	238	239	1.00
MG	86	119	1.38
HG	3	11	3.67
B	14	15	1.07
DUNDORI:			
C	119	186	1.56
LG	199	250	1.25
MG	53	74	1.39
HG	1	1	1.00
B	28	30	1.07
OL JORO OROK:			
C	37	167	1.20
LG	22	133	1.20
MG	9	14	1.10
HG	0	3	1.00
B	8	35	-

TABLE 5.10

The coefficient of variation in the daily flow of traffic was established to aid in the determination of the most suitable time of day when the traffic surveys should be done. Over the past three years or so the daily traffic flow pattern on the roads as indicated by this coefficient tends to be more stable between the hours of 7 a.m. and 7 p.m. - a typical characteristic

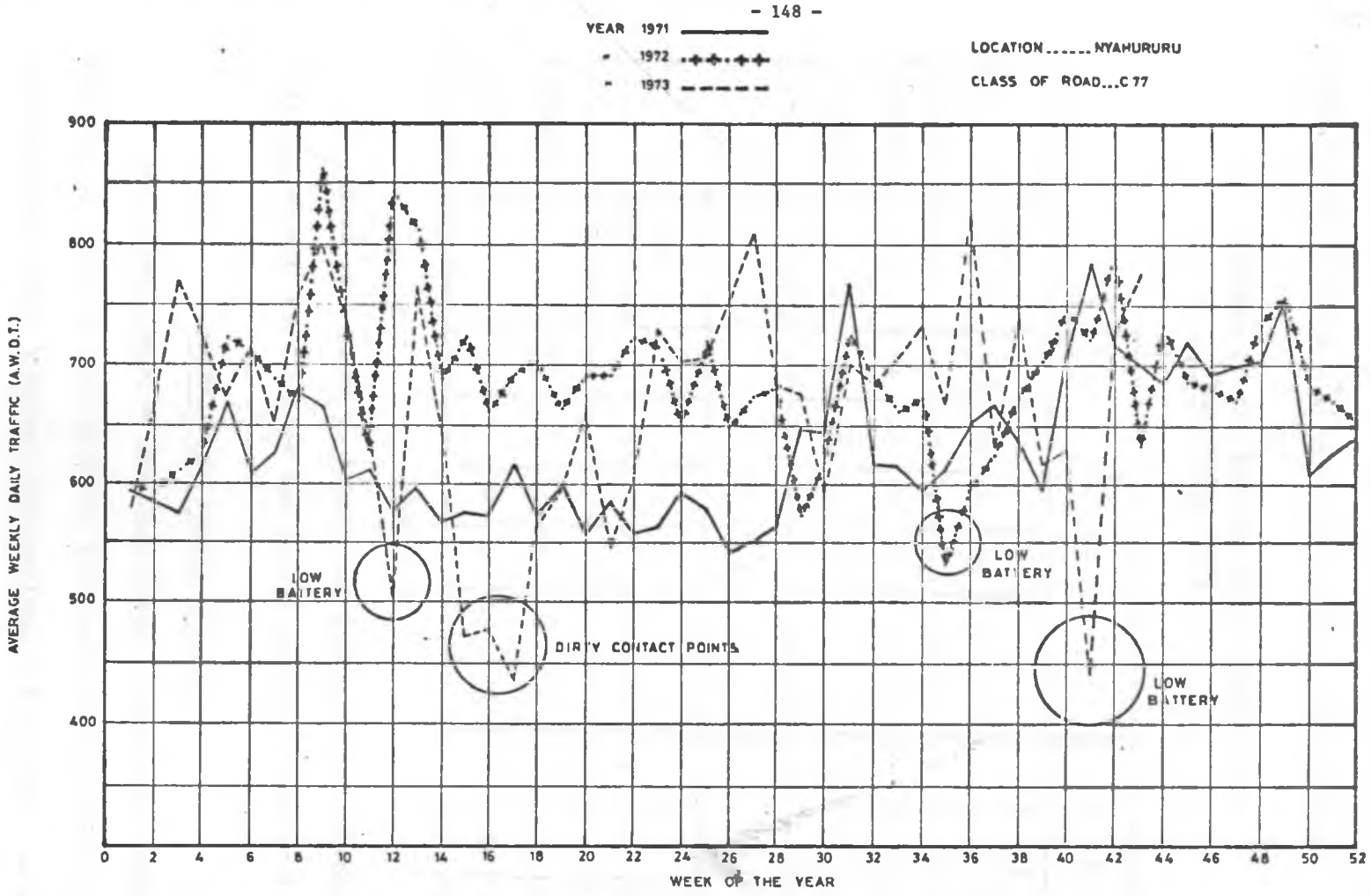


Fig. V.3

ANNUAL TRAFFIC PATTERN AT SITE 45 (NYAHURURU)

of the traffic flow in the rural areas in this country. The sample data in Table 5.11 amply illustrate this feature.

SUMMARY OF THE AVERAGE DAILY TRAFFIC FOR THE SURVEY WEEK

		A . M .						P . M .					
Site	Hour Starting	7	8	9	10	11	12	1	2	3	4	5	6
Bahati		8	42	57	52	58	42	55	40	45	50	37	46
Dundori		8	28	42	42	41	44	40	33	35	36	30	37
		P . M .						A . M .					
	Hour Starting	7	8	9	10	11	12	1	2	3	4	5	6
Bahati		39	33	17	14	7	4	2	4	5	1	-	2
Dundori		41	31	17	6	10	3	3	3	2	0	0	1

TABLE 5. 11

Indeed the counts at Bahati and Dundori sites revealed that 85% of the traffic flow was in the period 7 a.m. to 7 p.m.

5.22 TRAFFIC AND TRAVEL SURVEYS

The surveys done on the four roads in this study were designed to yield a wide range of information on the trips made on the roads: their origins, destinations and purposes, as well as information on the land uses that generate the trips. The selection and control of the survey samples were important phases of the survey exercise on account of the fact that

information from the analyses of the survey data was to form the basis of estimating total traffic and other values. Fortunately, the continuous automatic and manual counts provided fairly reliable but unclassified estimates of the normal ADT (24-Hour) flows on the routes against which the results of the sample surveys could be compared to establish their reliability and relative accuracy.

Areal sub-divisions were made to facilitate the identification and correlation of information on trips made with economic activities. Side roads or tracks connecting the principal junctions, mountain ranges and river courses formed the boundaries for the subdivisions or traffic zones. The zonal map is in Figure V.4. The main traffic generators such as the small shopping centers of Bahati, Dundori, Ol Kalou and Ol Joro Orok were identified and treated as the centroids of the various relevant zones.

Adequate numbers of interviewers were deployed at the interview sites and over 90% of all the motorists passing at the sites during the survey week were interviewed. Traffic police from the nearby police posts helped during all hours of interviewing to supervise and control traffic. For each trip the vehicle type and occupancy, origin, destination and purpose of the trip were recorded. In addition the goods carried were recorded for commercial vehicles.

Manual counts and other traffic surveys were done at the centroids for five days - Monday to Friday between 7 a.m.

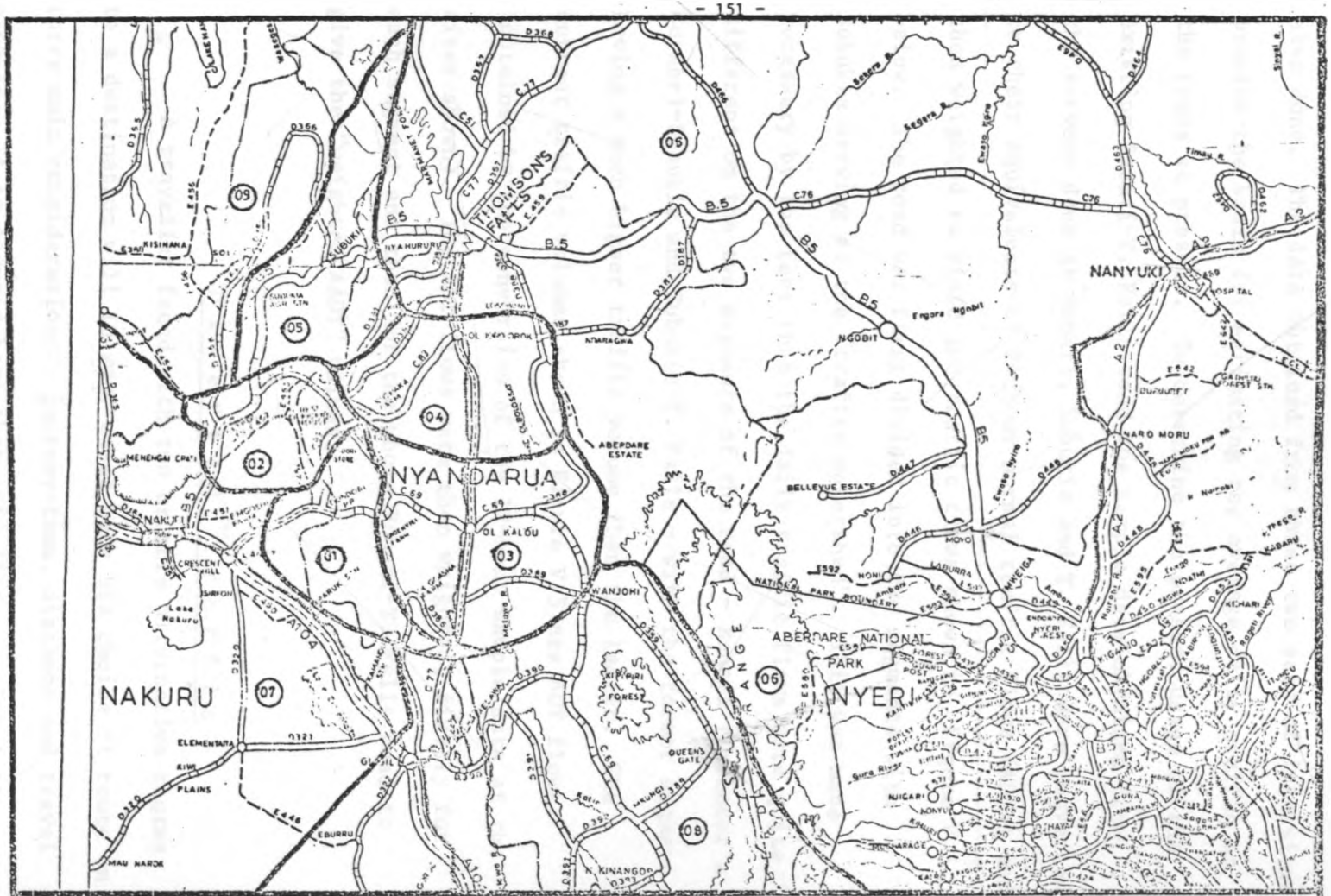


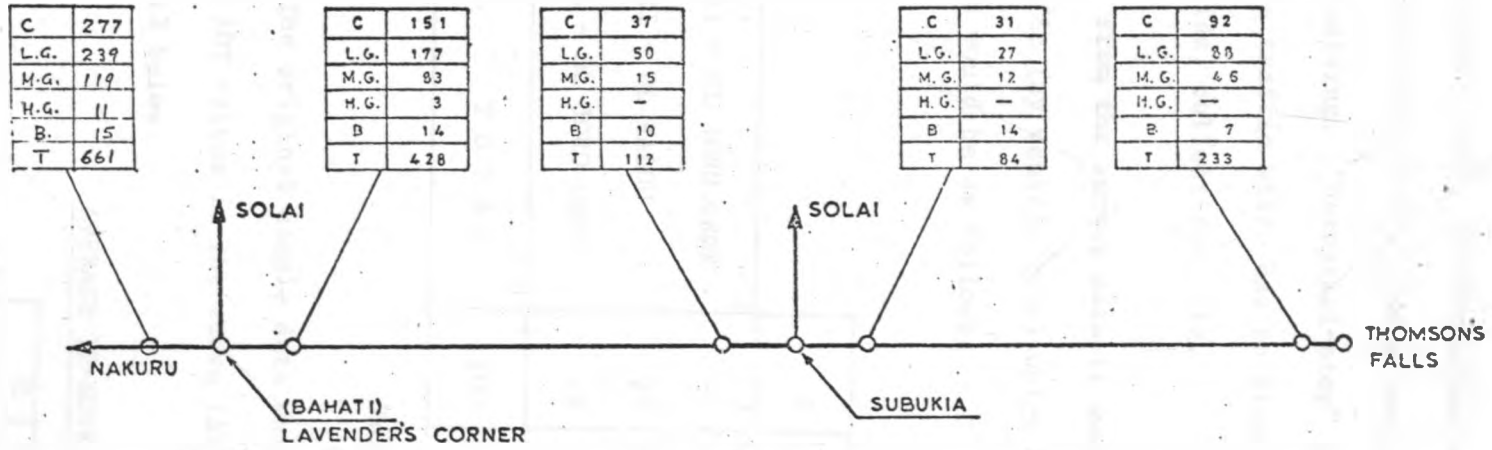
Fig. V.4 MAP SHOWING TRAFFIC ZONES

and 7 p.m. each day. In addition two night interviews were also done. The data obtained from these two sets of interviews provide the basis for estimating the average daily traffic on the roads at present. To determine the present usage of the existing Bahati-T. Falls road the sample data obtained from the surveys done at Bahati, Subukia and T. Falls were converted to their equivalents of 24-hour normal traffic flows (ADTs) and then weighted to yield the traffic flows shown in Figure V.5 below. The road was first divided into two segments with Subukia serving as the "traffic watershed". This was made necessary by the fact that the daily traffic flows were quite different on the two segments of the road - Bahati (Lavender's Corner)-Subukia and Subukia-T. Falls - with the former segment having a much higher traffic volume than the latter. The current traffic volumes shown in Figure V.5 are ADT flows (obtained by the conversion of the 12-hour sample data at the sites shown). The ADT flows were then weighted, firstly for each segment and then for the whole Bahati-T. Falls road to give the "weighted AADT" values.

Diverted Traffic

A traveller faced with two or more alternative routes to a destination will in many cases base his choice of route on three main considerations: journey-time, distance and travel expense. It is assumed here that only distance will influence travellers' choice of route between Nakuru and T. Falls when the Bahati-T. Falls road is paved so that all "non-essential-

CURRENT (1974) TRAFFIC VOLUMES (A.A.D.T.) ON EXISTING LAVENDERS CORNER – T FALLS ROAD



LAVENDER'S CORNER – SUBUKIA SEGMENT
WEIGHTED A.A.D.T.

YEAR	C.	L.G.	M.G.	H.G.	B.	T.
1974	94	113	49	2	12	270

SUBUKIA – T FALLS SEGMENT
WEIGHTED A.A.D.T.

YEAR	C.	L.G.	M.G.	H.G.	B.	T.
1974	63	58	29	–	11	161

LAVENDERS CORNER – T. FALLS (THE ENTIRE ROAD)
WEIGHTED A.A.D.T.

YEAR	C.	L.G.	M.G.	H.G.	B	T.
1974	81	92	41	1	12	227

FIGURE V.5

stop" traffic on the other three routes will be diverted to the improved road. Non-essential-stop traffic would be traffic stopping for purposes such as resting, refreshments and refuelling. "Essential-stop" traffic on the other hand, would be traffic which has to stop for purposes such as deliveries, collections, etc.

From the survey data it was estimated that the amount of traffic (by vehicle type) which would be diverted to the new road would be as follows:

	C	L.G.	M.G.	H.G.	B	TOTAL
DUNDORI - OL JORO OROK	55	45	21	0	8	127
DUNDORI - OL KALOU	28	11	1	0	0	40
GILGIL - OL JORO OROK	19	9	6	0	0	34
T O T A L	100	65	28	0	8	201

TABLE 5.12

The original sample data which were adjusted to give the diverted ADT values in the above table are summarized in Table 5.13 below.

AVERAGE 12-HOUR SAMPLE DATA

	C	L.G.	M.G.	H.G.	B	TOTAL
DUNDORI - OL JORO OROK	32	34	14	0	7	87
DUNDORI - OL KALOU	17	8	1	-	-	26
GILGIL - OL JORO OROK	15	7	5	0	0	27
T O T A L	64	49	20	0	7	140

TABLE 5.13

These 12-hour sample values were firstly converted to 24-hour normal traffic (ADT) flows and then corrected for seasonal variations from their respective norms (automatic counter daily traffic averages).

5.23 JOURNEY-TIME SURVEYS

To a large extent the cost of a journey depends on the average speed at which it is made. Speed in turn determines the length of time the journey takes.

Journey-time surveys were done on all the four routes between Nakuru and T. Falls. Journey-time cards were issued to motorists at the interview sites and at T. Falls. Cards issued at T. Falls were collected at the sites and those issued at the sites were collected at T. Falls. Following is a summary of the average speeds determined for the different vehicle types. On the various route segments:

AVERAGE SPEEDS IN KM./HR.

ROUTE SEGMENT	VEHICLE CATEGORY				
	C	LG	MG	HG	B
NAKURU - BAHATI	80	70	65	60	65
NAKURU - GILGIL	90	70	65	60	65
LANET - NDUNDURI	80	65	60	55	60
BAHATI - T.FALLS	60	55	50	40	45
DUNDORI-OL JORO OROK	70	60	55	50	55
DUNDORI - OL KALOU	65	60	55	50	55

TABLE 5. 14

5.24 TRAFFIC FORECASTS

In Hans Adler's[15] words,

> "estimating future traffic is still an imprecise - but essential - art".

Road and most other transport investments last long so that the decision to undertake them must necessarily be based on long term forecasts. A necessary consequence of this is that a greater degree of uncertainty is brought to bear upon the results of the economic evaluation of projects in this area.

Traffic forecasting falls into three main stages - namely:

1) estimating the volume and location of future agricultural, industrial, mining and other economic output and consumption.

2) translating output and population information into traffic data - by volume, origin and destination.

3) determining what proportions of the total expected traffic volume will be carried by the different modes of transport available.

Since future traffic depends on developments in economic activity its estimate can be no more accurate than the forecasts of economic growth and development.

The next step would be to establish the relationship between these traffic generating activities and growth in traffic volume. To this end sophisticated mathematical models

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[15] H. Adler, Op. Cit, p. 16

have been formulated. But, as Adler points out the traffic generators "are frequently complex and construction of the models difficult and time-consuming." Secondly, there is the statistical problem of insufficient and/or unreliable data.

The MOW Planning Section use the more conventional technique of "Trend Analysis" to forecast future traffic . Traffic forecasts are based on past traffic growth trends as shown by traffic counts and O-D and other surveys. The growth rates derived from analysis of past traffic behaviour patterns are, with modifications, used to project future trends.

The growth rates that were applied to estimate future traffic on the Bahati-T. Falls road were derived from the post-bitumenization data collected on three roads over a period of some four years. In view of the brevity of this period and in the light of the economic events that have taken place both at home and abroad in recent times, the rates may not be very reliable indicators of future traffic developments. But for purposes of this case study they will do. The roads used in deriving the rates were:

1. Gilgil - T. Falls (C 77)
2. Athi River - Namanga (A 104)
3. Ahero - 'Isabenia (B 4)

The last two roads are not indicated in the map in Figure V.2. The second one is a section of the so-called Great North Road connecting Arusha and Nairobi - Namanga being a border post. Similarly, the third road is just a

segment of the road linking the two Lake Victoria ports of Kisumu and Mwanza. Isabenia is another border post on the Kenya-Tanzania boundary. Additional information was also obtained from vehicle registration records and the 1970-73 60-Point Census. The growth rates which were derived are tabulated below:

		C	L.G.	M. G.	H. G.	B
1st 5 years	%	12	12	10	13	10
2nd " "	Growth	10	10	9	11	9
For the rest of Project life	Rates	9	9	8	9	8

TABLE 5.15

Basically these rates were applicable to all the three traffic categories: Normal, Generated and Diverted traffic. However, to take cognizance of the fact that generated traffic tends to grow rapidly in the first few years after the paving of a road and then to revert to the normal growth pattern, it was assumed that generated traffic would be some 10% of the normal traffic in the first year, 15% in the second year and 20% in the third year after butumenization. After this generated traffic would grow at the normal growth rates shown above. Clearly if this assumption is valid, it will not be until the second 5-year period after bitumenization that generated traffic will fully revert to the normal traffic growth pattern.

The rates tabulated above are very much on the conservative side. Recalculations after this study was done indicated traffic growth rates in particular regions in the country could be much higher. The rates, however, are comparable to the overall national traffic growth rates based on vehicle registration but slightly lower, on average, than the overall national rates based on the 60-Point (1970-73) Census. The table below illustrates this.

		C	L.G	M.G.	H. G.	B
Vehicle registration	% Growth Rates	10.2	10.2	10.3	10.3	11.5
60-Point Census		13.6	21.3	14.3	40.7	15.2

TABLE 5.16

5.3 ECONOMIC ANALYSIS

The economic valuation of a project consists essentially of comparing its costs with the benefits in order to determine its net worth to society. The costs for a road project consist of the initial capital outlays and the recurrent expenditures incurred to keep it in proper running condition. The more significant benefits are in the nature of savings: savings in road users' costs, journey time, maintenance costs and reductions in accident risks. The actual computation of the costs and benefits associated with a road project is the main concern of this chapter. The computational procedure adopted here is similar to that followed by the MOW. There are, however, some differences in the treatment or definitions of some specific items.

5.31 COMPUTING PROJECT COSTS

The physical (engineering) basis of determining construction and maintenance costs is the Bills of Quantities document prepared by the MOW or, as is generally the case, by a consultant for the MOW. The document sets out the details of the works to be carried out and the construction or maintenance cost rates applicable to each of the works items.

The following is a summary of Bills of Quantities showing the estimates of the cost items for the proposed Bahati-T. Falls road.

Item	Description	Amount (KSHS.)
i)	Preliminary and general expenses	841,320.00
ii)	Site clearing	968,600.00
iii)	Earth Works for formation of road pavement (7.0 m.)	16,634.041.00
iv)	Gabion walls	771,000.00
v)	Culverts and drainage works	2,858,132.20
vi)	Maintenance of existing road and diversions	750,000.00
vii)	Water-bound road base	3,658,617.50
viii)	Sub-base and shoulders	4,724,432.00
ix)	Bituminous surfacing	2,441,794.70
x)	Concrete framework and reinforcements	500,000.00
xi)	Road furniture	899,480.00
		35,047,418.00
xii)	Schedule of Dayworks @ 2½%	876,185.50
	S U B - T O T A L	35,923,603.50
xiii)	Contingencies @ 7½% of sub-total	2,694,270.30
	TENDER SUM (based on MOW 1970 rates)	38,617,873.80
xiv)	Reduce to 92% for lowest tender	35,528,443.80
xv)	Escalate @8% p.a. for 4¾ years to assumed m.p.c., Dec. 1975	51,207,146.00

or £2,560,357; an average of £59,500 per km.

NOTES:

1. The MOW use this engineering cost estimate as a norm for assessing tender bids for a project. When offers have been received from contractors the average of the lowest three tenders is used as a rough standard against which the engineering estimate itself is also checked. Normally, the difference between this average and the consultant's (or the Ministry's) estimate is a minor one. Also the lowest tender bid is usually some 92% of this average

while the highest rarely exceeds the average by more than 8%. Other things being equal, the successful bidder would be the one who bids lowest. This "ceteris paribus" assumption seems a reasonable one to make since at the time the engineering cost estimates are made "other things" about potential bidders, including who these might be, are not known - especially when the estimates are made so long in advance (3 years in the case of the road project in question here).

2. Contingencies, allowed at 7½%, provide for unforeseen increases in works quantities. Some of the factors which necessitate this provision include:

   (i) exceptionally heavy rains

   (ii) presence of rock or some other hard material,

   (iii) changes in road alignment

   (iv) changes in type of pavement material.

   The proportion of the contingency provision to total cost varies according to the physical conditions which in turn are the principal determinants of the engineering design and - hence - the cost estimates.

3. Escalation "is a sum of money(expected to be spent) as an additional works cost to account for the mid-point of any contract (m.p.c.) being at date later than the fixed base used in preparing engineering estimates."[16] Escalation caters for trends in unit (cost) rates and changes in the purchasing power of money. The works cost rates are contained in a document entitled Analysis of Contract Rates based on rates furnished by contractors. The rates are subjected to close scrutiny by the MOW staff or their consultants before they are accepted as reasonable.

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[16]MOW "Road Loan Application: Highways V", September 1972, pp.33-34.

The amount of escalation depends partly on the point in time when the works are expected to be executed. The actual amount of escalation can be read off the MOW "Escalation Graph" which compares actual road construction costs with contract rates tendered. Escalation rates vary from as low levels as 1.5% to 12% per annum depending on the size of the contract which generally ranges from £100,000 to substantially much larger amounts (of £3 million or more).

4. Works supervision is usually done by consultants (e.g. Alexander Gibb & Partners, E.A. Consultants, John Burrow & Partners, etc.). The Ministry prefers that a consultant supervise the project he designs,which is in accordance with the Standard Design and Supervision Agreement to which the MOW and the Kenya Association of Consulting Engineers (1970) are party.

   Supervision costs are calculated as a percentage of the total works costs and vary inversely with the size of a contract. On high cost contracts it may be as low as 6%; on low cost contracts it may be anything from 12% to 25%.

5. Contracts are awarded through a competitive tender system in accordance with either the "Guidelines Relating to Procurement Under IBRD and ADB Credits" or alternatively in accordance with the more universally accepted "Conditions of Contract (International) for Works of Civil Engineering Construction" prepared by "Internationale des Inginieurs - Conseils and Federation Internationale des Entrepreneurs European de Batimet et de Travaux Publics" with the approval of Asian and Western Pacific Contractors Association.[17]

   While the size of a contract is an important consideration in awarding a job to a contractor, it is by no means the case that the lowest bidder always wins. Other considerations which

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[17] MOW, "Highways V", September 1972, p. 37.

> may even be more important in awarding a contract include the contractor's experience, the capacity in terms of the amount and quality of his equipment, technical personnel, financial resources, etc.

Once a contractor has been awarded a contract he may not alter his contract rates. The rates will have been determined on the basis of market prices and, given the competitiveness of the tender system and the international market in which most of the road construction inputs are bought it can be assumed that the market prices for the inputs are good enough approximations of the inputs' opportunity cost values. It then remains to adjust the market prices to obtain the social opportunity cost values of the inputs. But rather than attempt to compute the SOC of each input item separately the MOW have found it more practicable to firstly estimate the total financial cost of a project and then to adjust this cost to get its economic equivalent measure.

Three adjustments are done to convert financial to economic costs. Taken together the three adjustments constitute the shadow-pricing of the inputs. Three categories of inputs items are shadow-priced:

(a) FOREIGN EXCHANGE

A very large proportion of construction (and maintenance) costs are in FE. The foreign exchange component (FEC) in these costs can easily be derived from the MOW's Analysis of Contract Rates (1971) document as well as from information provided by

private contractors. The basic assumption in the derivation of the FEC is that the official exchange rate understates the true value of FE (or conversely, overstates that of the domestic currency) to the economy. The following table summarizes the estimated foreign and domestic currency or "internal exchange" components in the total construction costs for the proposed Bahati-T. Falls road.

I T E M	Item as a % of Total Cost	FEC %	IEC %	As a % of Total Cost FEC	As a % of Total Cost IEC
1. Capital equipment	18	95	5	17.10	0.90
2. Materials:					
(a) bitumen	6	85	15	5.10	0.90
(b) cement	9	85	15	7.65	1.35
(c) stone	9	40	60	3.60	5.40
3. Fuel and Oil	6	85	15	5.10	0.90
4. (a) Design and construction overheads	27	60	40	16.20	10.80
(b) Engineering supervision	10	50	50	5.00	5.00
5. Unskilled labour	10	10	90	1.00	9.00
6. Miscellaneous	5	85	15	4.25	0.75
				65	35

TABLE 5.17

NOTES:

(i) Capital equipment consists of a host of items such as bulldozers, scrappers, rollers, tippers,

shovels, etc. Detailed break-downs of costs on the basis of these specific items have been worked out by the MOW and the FEC in the cost of each could easily be determined if need be.

(ii) Design and construction overhead costs consist of the cost of MOW design work or that of consultants.

(iii) The FEC in the engineering supervision item is decreasing steadily with the advance of Africanization.

(iv) The small FEC in the cost of unskilled labour reflects the estimated proportion of the wage bill which unskilled workers spend on imported goods.

Through similar procedure the FEC in maintenance costs for the proposed road was estimated to be about 30% of total financial maintenance cost bill. The shadow-pricing of FE is effected by adding an extra 15% to the 65% and 30% FECs in the construction and maintenance costs respectively. The "FE conversion factor" is, therefore, 1.15.

(b) TRANSFER PAYMENTS

The second adjustment to the financial costs relates to such transfers as indirect taxes and subsidies of various types on certain cost items. The adjustment is to subtract the sum of indirect taxes from, and add subsidies to, the financial costs. Capital goods including equipment and certain intermediate goods are imported tax-free into Kenya. Through its investment allowances policy the Government does subsidize capital equipment and materials imported by private firms. Government agencies, until recently, were exempt from local

excise taxes and import duties which amounted to subsidizing them. There was however, no indication that the government directly subsidizes such intermediate goods as bitumen. The indirect subsidies on capital equipment through allowances/ deductions of various sorts would have been too difficult and time consuming to determine. Consequently, the only "transfer payment" adjustment done to the financial costs of the proposed road project was the deduction of indirect taxes on materials. Until recently, the MOW was using an indirect tax rate of 10%. Since the imposition of the 10% sales tax the rate has probably changed (risen) although in principle the sales tax was supposed to replace the previous consumption tax of approximately the same magnitude.

(c) UNSKILLED LABOUR

It is generally agreed that the market wage rate in this country, as elsewhere in the developing world, overstates the economic value of unskilled labour. The Central Bureau of Statistics (in the Ministry of Finance and Economic Planning) estimates that the SOC of this category of labour is some 50% of the market wage rate. The financial wage costs were therefore reduced by a half to arrive at the SOC of unskilled labour. As indicated in Table 5.18, unskilled labour costs constitute only about 10% of total construction costs; but they rise to a significant 30% in maintenance costs, reflecting the relatively more labour-intensive nature of road

maintenance work.

MAINTENANCE COSTS

The calculation of maintenance costs for gravel roads - routine maintenance and regravelling - is based on the average daily traffic (or vehicle per day, v.p.d.). Gravel roads are graded by the Ministry as G4, G3, G2, G1 and G0 (in descending order) according to their surface quality, width and other characteristics. The average maintenance cost rates for gravel roads at different volumes of traffic are given below.[18]

V.P. D.	Routine Maintenance cost/km.	Regravelling
Over 300	£200	£600
200-300	180	600
100-200	140	500
50-100	120	500
0-50	80	500

Regravelling and routine maintenance cost rates vary in different parts of the country and the MOW have worked out rates on a provincial basis. Since the factors which determine the magnitude of the cost rates are not confined within provincial boundaries, this hardly appears an appropriate basis. The above rates are for the Rift Valley Province but they could very well apply to most areas in Western Kenya.

The regravelling cycle depends almost entirely on the

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[18] MOW, "Maintenance, Resealing and Regravelling Costs ...."(1974)

volume of traffic as shown below:

V.P.D.	C Y C L E
0 - 50	Every 5 years
50 - 100	" 4 "
100 - 200	" 3 "
Over 200	" 2 "

For tarmac roads the annual maintenance cost rates are given as follows:

	Cost Rate For:	
Grade	Routine Maintenance	Resealing
Bit. II	£140	£650
Bit. I	140	700

Resealing is carried out every 5 years irrespective of traffic volume. The rates shown for resealing are for a single coat, assuming the resealing is done by the MOW itself. If it is contracted out to a private firm the rates may be higher by between 20% and 25%. If the rate of deterioration in a road is faster than was expected, "extra-ordinary maintenance", for which the MOW always makes a provision, must be done.

The actual calculation of the total maintenance costs per year for the present and proposed Bahati-T. Falls roads was done as follows:

1. Existing Road:

a) Annual routine maintenance:

Period	v.p.d.	v.p.d.	Cost
1974-1976		227-283	51.1 x £80 = £9,198
1977-1996		300+	51.1 x £200 =£10,220

b) Regravelling (due in 1977):

Traffic in period 1977-1996 is over 200 v.p.d.

Therefore cost = 51.1 x 600 = £30,660 p.a.

2. Proposed Road:

a) Routine maintenance costs

= 43 x £140 = £6,020 p.a.

b) Resealing - every 6th year after bitumenization:

= 43 x £700 = £30,100 p.a.

The annual totals of these costs are shown in the Cost Analysis Sheet (Table 5.18) for the entire 20 year estimated life of the proposed road.

NOTE:

The contractor will hand over the new road to the MOW at the start of 1977 - about one year after completion of construction. So any maintenance costs incurred by the contractor before 1977 do not enter the MOW's maintenance costs.

TABLE 5.18

FINANCIAL AND ECONOMIC COST ANALYSIS : (IN £ '000')

YEAR	MAINTENANCE COSTS ON EXISTING ROAD					CONSTRUCTION COSTS ON PROPOSED ROAD					MAINTENANCE COSTS ON PROPOSED ROAD				
	TOTAL ESTIMATED COST	MINUS: TAXES (10% OF A)	PLUS: SHADOW PRICE FOR FOR. EXCH (15% ON 30% OF A)	MINUS: UNSKILLED WAGE BILL SHADOW PRICE (50% ON 30% OF A)	EQUALS: ECONOMIC COST	TOTAL ESTIMATED COST	MINUS: TAXES (10% OF F)	PLUS: SHADOW PRICE FOR FOR. EXCH (15% ON 65% OF F)	MINUS: UNSKILLED WAGE BILL SHADOW PRICE (50% ON 10% OF F	EQUALS: ECONOMIC COST	TOTAL ESTIMATED COST	MINUS: TAXES (10% OF K)	PLUS: SHADOW PRICE FOR FOR. EXCH (15% ON 30% OF K)	MINUS: UNSKILLED WAGE BILL SHADOW PRICE (50% ON 30% OF K	EQUALS: ECONOMIC COST
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1974	9.20	8.28	8.69	1.38	7.31	-	-	-	-	-	-	-	-	-	-
1975	9.20	8.28	8.69	1.38	7.31	1000.00	900.00	997.50	947.50	947.50	-	-	-	-	-
1976	9.20	8.28	8.69	1.38	7.31	1304.36	1173.92	1301.10	1235.88	1235.88	-	-	-	-	-
1977	30.66	27.59	28.97	4.60	24.37	256.00	230.40	255.36	242.56	242.56	-	-	-	-	4.79
1978	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1979	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1980	30.66	27.59	28.97	4.60	24.37	-	-	-	-	-	6.02	5.4	5.69	0.90	4.79
1981	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.45	5.69	0.90	4.79
1982	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	30.10	27.09	28.44	4.52	23.92
1983	30.66	27.59	28.97	4.60	24.37	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1984	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1985	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1986	30.66	27.59	28.97	4.60	24.37	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1987	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1988	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	30.10	27.09	28.44	4.52	23.92
1989	30.66	27.59	28.97	4.60	24.37	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1990	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1991	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1992	30.66	27.59	28.97	4.60	24.37	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1993	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1994	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	30.10	27.09	28.44	4.52	23.92
1995	30.66	27.59	28.97	4.60	24.37	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79
1996	10.22	9.20	9.66	1.53	8.13	-	-	-	-	-	6.02	5.42	5.69	0.90	4.79

5.32 COMPUTING PROJECT BENEFITS

For conceptual and/or statistical reasons stated in the foregoing theoretical statement on the measurement of the benefits of a road project it was possible to estimate the values of only three benefit items, namely:

(a) VOC Savings

(b) Time Savings

(c) Maintenance Cost Savings

It was felt whatever development effects the proposed road might have in the area it traverses would be marginal. Largely because of lack of statistics on accidents on the existing road and also because of the possibility that the incidence of accidents on the road is as low as it could be on any such road it is considered that the proposed road will confer little benefit by way of reductions in risk of accidents. If anything it may in fact raise the incidence of accidents. External effects would have been too involved to trace and evaluate. Spillovers such as linkage and multiplier effects would,like the potential development effects, probably be negligible. It is possible there might be some income redistribution in the form of increases in the values of properties situated along the proposed route but it would virtually be impossible to determine what proportion of it is a net increase in site values and what proportion is a mere transfer. It has been stated above there would be little benefit by way of favourable spillover effects from a road

project. On the other hand even the possible unfavourable spillover effects, mainly in the form of environmental pollution would have negligible impact in rural Kenya.

The method adopted for forecasting future traffic on the Bahati-T. Falls road and other routes in the area of its influence consisted simply of escalating the ADT volumes for the year 1974 on each of the roads by the growth rates shown in Table 5.16 above. Clearly this is not an altogether satisfactory method of forecasting traffic but then in the nature of things, "estimating future traffic is still an imprecise .... art" as Adler observes. A more satisfactory method of establishing future traffic on the four routes would have required far more detailed information on the economic and other factors which have a bearing upon growth in traffic volumes than the time constraint would allow. Moreover, the forecasting techniques themselves would probably be more complicated than the writer could handle with ease. Since the field investigation for this case study was carried out the MOW have introduced some refinements in their forecasting techniques although the method remains essentially that of Trend Analysis.

Except, as already stated, for Generated traffic growth in the first three years, the growth in the volume of traffic on all the four roads was determined simply by compounding the 1974 ADTs at the growth factors in Table 5.16. The forecasts of Normal and Generated traffic volumes for the existing

Bahati-T. Falls road are shown below in Table 5.20. For the calculation of VOC and Time Savings benefits only traffic volumes for the period 1977-1996 are relevant. The figures for the years 1974-1976 are shown only for completeness. The forecasts for Diverted traffic are given in Table 5.24.

(a) VOC SAVINGS

The VOC rates used were derived from notes by the MOW Chief Engineer (Roads) on "Vehicle Operating Costs for Gravel (and bitumen) Roads in Kenya 1970" up-dated to 1974. Below is a table showing average VOC rates by vehicle type on various grades of roads:

VOC RATES/KM. FOR 1974 IN KENYA

Grade of Road	Average Speeds Km/Hr.	VOC RATES (IN KSHS) BY VEHICLE TYPE				
		C	LG	MG	HG	B
G0	40	0.79	0.82	1.76	3.16	1.90
G1	50	0.71	0.75	1.59	2.89	1.73
G2	45	0.64	0.68	1.43	2.61	1.51
G3	55	0.56	0.61	1.26	2.34	1.40
G4	65	0.49	0.52	1.10	2.07	1.24
Bit.II	80	0.45	0.47	1.00	1.93	1.13
Bit.I	100	0.39	0.42	0.90	1.78	1.02

TABLE 5.19

The 1970 rates were averaged by the MOW out of more detailed data provided by Alexander Gibb & Partners, the E. A. Transport Study, the World Bank and the MOW itself. The rates in Table 5.19 were arrived at by escalating the 1970 rates by 8% - which is the estimated average rate of inflation in the country until late last year. Factors which were considered to be important determinants of the magnitudes of the road users' cost rates included:

i) riding quality of roads: gravel quality, horizontal alignment,

ii) gradients

iii) rainfall, drainage

iv) sight distances

For purposes of this paper only the rates for G2 and Bit. I are relevant: all the existing four roads are gravel grade two (G2) roads; the proposed road will be a grade one (Bit. I) road. The calculations of VOC savings per vehicle trip are given in Table 5.21 and in Table 5.22 are set out the total VOC savings by type of vehicle for Normal and Generated traffic.

The expected Diverted traffic volumes for each year of the 20 year life of the proposed road are given in Table 5.24. It was earlier stated that on gravel roads VOC rates would tend to rise as traffic volume increases. For volumes of traffic below 1000 v.p.d. the rates would be the normal ones given in Table 5.17. For volumes of over 1000 v.p.d. but below 17000 the rates would be 8% higher than the normal rates, and for

over 1700 v.p.d. the VOC rates would be 12% higher than the normal. For simplicity in computations it was estimated the increase in VOC rates would rise in steps rather than continuously.

On the three gravel roads from which traffic is expected to be diverted VOC savings were calculated for both Diverted and Undiverted traffic (the traffic that would continue to use the roads after some has been diverted). The benefit to Diverted traffic would be the difference between the VOC rates at given traffic volumes on the present roads (or road segments) and the rates on the new Bit. I road. The benefits to Undiverted traffic would be the difference between the rates that road users would have incurred on these roads if no traffic were diverted at all and what they would incur when some traffic is diverted to the new road. The computations of VOC savings for Diverted and Undiverted traffic would then be as shown below for the Dundori-Ol Joro Orok route:

Let V_T = v.p.d. for any vehicle type

V_D = Diverted traffic volume

V' = Undiverted traffic

C_0 = VOC rate for any vehicle type for V < 100 on gravel road segments

C_b = VOC rate on existing tarmac road segments

C_n = VOC rate on the proposed Bit. I road

Then VOC savings for:

Diverted Traffic

when

$V_T < 1000$; $33.2\ C_b V_D + 30.2 C_0 V_D - 15.4\ C_b V_D - 43.0 C_n V_D$.

$V_T > 1000 < 1700$; $33.2 C_b V_D + 30.2(1.08 C_0 V_D) - 15.4\ C_b V_D - 43.0 C_n V_D$

$V_T > 1700$: $33.2\ C_b V_D + 30.2(1.12\ C_0 V_D) - 15.4\ C_b V_D - 43.0\ C_n V_D$

Undiverted Traffic

(a) when $V_T > 1000 < 1700$

without proposed road

$$VOC = 30.2(1.08\ C_0 V')$$

with proposed road

$$VOC = 30.2\ C_0 V'$$

Savings benefit due to some traffic diversion

$$= 30.2(1.08 C_0 V' - 30.2\ C_0 V')$$

$$= 30.2(0.08\ C_0 V')$$

(b) when $V_T > 1700$

without

$$VOC = 30.2(1.12\ C_0 V')$$

with

$$VOC = 30.2(1.08\ C_0 V')$$

VOC savings $= 30.2(1.12\ C_0 V') - 30.2\ (1.08\ C_0 V')$

$= 30.2(0.04\ C_0 V')$

Note

1. For Undiverted traffic volumes of less than 1000 v.p.d. there would be no savings in road users' operating costs since the cost rates on all the existing roads would be the normal ones (C_0).

2. Similar calculations would yield the VOC savings for Diverted and Undiverted traffic on the Dundori-Ol Kalou route. There would be no VOC savings benefit for Undiverted traffic on the Gilgil-Ol Joro Orok route because it is tarmac throughout its whole length and it has been assumed VOC rates on tarmac roads remain unchanged irrespective of traffic volume.

The resultant VOC savings per vehicle per annum on each of the three routes - namely: Dundori-Ol Joro Orok, Dundori-Ol Kalou and Gilgil-Ol Joro Orok are presented in Tables 5.25, 5.26, and 5.27 respectively. The corresponding total annual VOC savings for each vehicle type are set out in Tables 5.28 and 5.29. Undiverted traffic on each route would simply be the difference between total traffic volume on each route (See Table 5.23) and the traffic volume expected to be diverted from it (shown in Table 5.24). Undiverted traffic volumes for Dundori-Ol Joro Orok and Dundori- Ol Kalou routes after the new road is opened are given in Table 5.30. No similar traffic figures are given for the Nakuru-Gilgil-Ol Joro Orok route. Such traffic would not enjoy any VOC savings benefit. Nor was there any reason to show the total traffic volume on that route since it would not be required for the determination of Undiverted traffic.

FORECAST TRAFFIC ON PROPOSED ROAD

TABLE 5.20

AADT

YEAR	NORMAL						GENERATED						TOTAL					
	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL
1974	81	92	41	1	12	227												
1975	91	103	45	1	13	253												
1976	102	115	50	1	15	283												
1977	114	129	55	1	16	315	11	13	6	0	2	32	265	233	98	1	29	626
1978	127	145	60	2	18	352	19	22	9	1	3	54	303	269	110	3	33	718
1979	143	162	66	2	19	392	29	32	13	1	4	79	347	308	125	3	36	819
1980	160	182	73	2	21	438	32	36	14	1	4	87	390	347	137	3	39	916
1981	179	203	80	2	23	487	36	40	16	1	5	98	436	386	151	3	44	1020
1982	197	224	87	3	25	536	40	44	17	1	5	107	480	426	164	4	47	1121
1983	217	246	95	3	28	589	44	49	19	2	6	120	529	468	179	5	53	1234
1984	238	271	103	3	30	645	48	53	20	2	6	129	580	514	194	5	56	1349
1985	262	298	113	4	33	710	53	59	22	2	7	143	639	568	213	6	62	1488
1986	288	328	123	4	36	779	59	65	24	2	7	157	704	624	231	6	67	1632
1987	314	357	133	4	39	847	64	70	26	2	8	170	767	680	249	6	73	1775
1988	343	389	143	5	42	922	70	77	28	3	9	187	835	741	268	8	79	1931
1989	373	424	155	5	45	1002	76	84	30	3	9	202	910	807	291	8	84	2100
1990	407	462	167	6	49	1091	83	91	33	3	10	220	992	879	314	9	92	2286
1991	444	504	181	6	53	1188	90	99	36	3	11	239	1081	959	340	9	99	2488
1992	484	549	195	7	57	1292	98	108	38	4	12	260	1178	1046	367	11	107	2709
1993	527	599	211	7	62	1406	107	118	41	4	13	283	1285	1141	396	11	116	2949
1994	575	653	228	8	67	1531	117	129	45	4	14	309	1402	1243	429	12	125	3211
1995	626	711	246	9	72	1664	127	140	48	5	15	335	1527	1354	462	14	135	3492
1996	683	775	265	9	78	1810	139	153	52	5	16	365	1665	1476	498	14	146	3799

NORMAL TRAFFIC: ANNUAL V.O.C. SAVINGS/VEHICLE

TABLE 5.21

TRAFFIC VOLUME	LENGTH		VEHICLE CATEGORY	VEHICLE OPERATING COSTS				SAVINGS	
				PRESENT		PROPOSED		Savings per veh. journey	Savings/Veh/year
	Present	Proposed		V. O. C Rate G2 (SH/KM)	V.O.C. on G2 (SHS)	V.O.C. Rate Bit. I SH/KM)	V.O.C. on Bit. I (SHS)	(SHS)	(K£)
Below 1000 v.p.d.	51.1 km. G2	43.0 km. Bit. I	C	0.64	32.70	0.39	16.77	15.93	290.72
			LG	0.68	34.75	0.42	18.06	16.69	304.59
			MG	1.43	73.07	0.90	38.70	34.37	627.25
			HG	2.61	133.37	1.78	76.54	56.83	1037.15
			B	1.51	77.16	1.02	43.86	33.30	607.73
1000 - 1700 v.p.d.	G2	Bit. I	C	0.69	35.26	0.39	16.77	18.49	337.44
			LG	0.73	37.30	0.42	18.06	19.24	351.13
			MG	1.54	78.69	0.90	38.70	39.99	729.82
			HG	2.82	144.10	1.78	76.54	67.56	1232.97
			B	1.63	83.29	1.02	43.86	39.43	719.60
ABOVE 1700	G2	Bit. I	C	0.72	36.79	0.39	16.77	20.02	365.37
			LG	0.76	38.84	0.42	18.06	20.78	379.24
			MG	1.60	81.76	0.90	38.70	43.06	785.85
			HG	2.92	149.21	1.78	76.54	72.67	1326.23
			B	1.69	86.36	1.02	43.86	42.50	775.63

NOTE: Total Traffic on G2: <1000 v.p.d. - normal rate of V.O.V. (C_0)

1000-1700 v.p.d. - normal rate on V.O.C.x 1.08 = 1.08 C_0

>1700 v.p.d. - normal rate of V.O.C.x 1.12 = 1.12 C_0

B E N E F I T S

NORMAL AND GENERATED TRAFFIC: TOTAL V.O.C. SAVINGS

TABLE 5.22 IN Kℓ'000'

YEAR	NORMAL TRAFFIC						GENERATED TRAFFIC						
	C	LG	MG	HG	B		C	LG	MG	HG	B		TOTAL
1974													
1975													
1976													
1977	33.14	39.29	34.50	1.04	9.72		1.60	1.98	1.88	-	0.61		123.76
1978	36.92	44.17	37.64	2.07	10.94		2.76	3.35	2.82	0.52	0.91		142.10
1979	41.57	49.39	41.40	2.07	11.55		4.22	4.87	4.08	0.52	1.22		160.84
1980	46.52	55.44	45.79	2.07	12.76		4.65	5.48	4.39	0.52	1.22		178.84
1981	52.04	61.83	50.18	2.07	13.98		5.23	6.09	5.02	0.52	1.52		198.48
1982	57.27	68.23	54.57	3.11	15.19		5.81	6.70	5.33	0.52	1.52		218.25
1983	63.09	74.93	59.59	3.11	17.02		6.41	7.46	5.96	1.04	1.82		240.42
1984	69.19	82.54	63.98	3.11	18.23		6.98	8.07	6.27	1.04	1.82		261.21
1985	76.17	90.77	70.88	4.15	20.06		7.70	8.99	6.90	1.04	2.13		288.79
1986	83.73	99.91	77.15	4.15	21.88		8.58	9.90	7.53	1.04	2.13		316.00
1987	91.29	108.74	83.42	4.15	23.70		9.30	10.66	8.15	1.04	2.43		342.88
1988	99.72	118.49	89.70	5.19	25.52		10.81	11.73	8.75	1.56	2.73		373.60
1989	125.87	148.88	113.13	6.16	32.38		12.82	14.75	10.95	1.85	3.24		470.02
1990	137.34	162.22	121.88	7.40	35.26		14.00	15.98	12.04	1.85	3.60		511.57
1991	149.81	176.97	132.10	7.40	38.14		15.18	17.38	13.14	1.85	3.96		555.94
1992	163.32	192.77	142.31	8.63	41.02		16.53	18.96	13.87	2.47	4.32		604.20
1993	177.83	210.33	153.99	8.63	44.62		18.09	20.72	14.96	2.47	4.68		656.28
1994	194.03	229.29	166.40	9.86	48.21		19.74	22.65	16.42	2.47	5.04		714.11
1995	211.24	249.65	179.54	11.10	51.8		21.41	24.58	17.52	3.08	5.40		775.35
1996	249.55	293.91	208.25	11.94	60.50		25.39	29.01	20.43	3.32	6.21		908.51

TABLE 5.23 TOTAL TRAFFIC VOLUME BEFORE DIVERTING AADT

YEAR	DUNDORI-OL JORO OROK SEGMENT						DUNDORI-OL KALOU SEGMENT											
	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL
1974	167	234	71	1	17	490	45	73	16	-	17	151						
1975	187	262	78	1	19	547	50	82	18	-	19	169						
1976	209	294	86	1	21	611	56	92	19	-	21	188						
1977	235	329	95	1	23	683	63	103	21	-	23	210						
1978	263	368	104	2	25	762	71	115	23	-	25	234						
1979	294	412	114	2	27	849	79	129	26	-	27	261						
1980	330	462	126	2	30	950	89	144	28	-	30	291						
1981	369	517	138	2	33	1059	99	161	31	-	33	324						
1982	406	569	151	3	36	1165	109	178	34	-	36	357						
1983	447	626	164	3	39	1279	120	195	37	-	39	391						
1984	491	689	179	3	43	1405	132	215	40	-	43	430						
1985	541	757	195	4	47	1544	147	236	44	-	47	474						
1986	595	833	213	4	51	1696	160	260	48	-	51	519						
1987	648	908	230	4	55	1845	174	283	52	-	55	564						
1988	706	990	248	5	59	2008	190	309	56	-	59	614						
1989	770	1079	268	5	64	2186	207	337	60	-	64	668						
1990	839	1176	290	6	69	2380	226	367	65	-	69	727						
1991	915	1282	313	6	75	2591	246	400	70	-	75	791						
1992	997	1397	338	7	81	2820	269	436	76	-	81	862						
1993	1087	1523	365	7	87	3069	293	475	82	-	87	937						
1994	1185	1660	394	8	94	3341	319	518	89	-	94	1020						
1995	1291	1809	425	9	102	3636	348	564	96	-	102	1110						
1996	1408	1972	460	9	110	3959	379	615	104	-	110	1208						

EXPECTED DIVERTED TRAFFIC

TABLE 5.24

AADT

YEAR	DUNDORI- OL JORO OROK						DUNDORI - OL KALOU						G I L G I L					
	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL
1974	53	45	21	-	8	127	28	11	1	-	-	40	19	9	6	-	-	34
1975	59	50	23	-	9	141	31	12	1	-	-	44	21	10	7	-	-	38
1976	66	56	25	-	10	157	35	14	1	-	-	50	24	11	7	-	-	42
1977	74	63	28	-	11	176	39	15	1	-	-	55	27	13	8	-	-	48
1978	83	71	31	-	12	197	44	17	1	-	-	62	30	14	9	-	-	53
1979	93	79	34	-	13	219	49	19	2	-	-	70	33	16	10	-	-	59
1980	105	89	37	-	14	245	55	22	2	-	-	79	38	18	11	-	-	67
1981	117	99	41	-	16	273	62	24	2	-	-	88	42	20	12	-	-	74
1982	129	109	45	-	17	300	68	27	2	-	-	97	46	22	13	-	-	81
1983	142	120	49	-	19	330	75	29	2	-	-	106	51	24	14	-	-	89
1984	156	132	53	-	20	361	82	32	3	-	-	117	56	26	15	-	-	97
1985	172	146	58	-	22	398	91	36	3	-	-	130	61	29	17	-	-	107
1986	189	160	63	-	24	436	100	39	3	-	-	142	68	32	18	-	-	118
1987	206	175	68	-	26	475	109	43	3	-	-	155	74	35	19	-	-	128
1988	224	190	73	-	28	515	118	47	3	-	-	168	80	38	21	-	-	139
1989	244	207	79	-	30	560	129	51	4	-	-	184	88	41	23	-	-	152
1990	266	226	86	-	33	611	141	55	4	-	-	200	95	45	24	-	-	164
1991	290	247	93	-	35	665	153	60	4	-	-	217	104	49	26	-	-	179
1992	316	269	100	-	38	723	167	66	5	-	-	238	113	54	29	-	-	196
1993	345	293	108	-	41	787	182	72	5	-	-	259	124	59	31	-	-	214
1994	376	319	117	-	44	856	199	78	6	-	-	283	135	64	33	-	-	232
1995	410	348	126	-	48	932	217	85	6	-	-	308	147	70	36	-	-	253
1996	447	379	136	-	52	1014	236	93	6	-	-	335	160	76	39	-	-	275

DIVERTED TRAFFIC: DUNDORI - OL JORO OROK

ANNUAL V. O. C. SAVINGS/VEHICLE

TABLE 5.25

Traffic Volume	LENGTH		VEHICLE CATEGORY	VEHICLE OPERATING COSTS										SAVINGS	
				PRESENT					PROPOSED					Savings per Veh. journey	Savings/ Veh/year
	Present	Proposed		V.O.C. Rate Bit. II (Sh/Km)	V.O.C. Rate G2 (Sh/Km)	V.O.C. on Bit. II (Shs)	V.O.C. on G2 (Shs)	TOTAL V.O.C. Bit.II + G2 (Shs)	V.O.C. Rate Bit.II (Sh/Km	V.O.C. Rate Bit.I (Sh/Km	V.O.C. on Bit.II (Shs)	V.O.C. on Bit.I (Shs)	TOTAL V.O.C. Bit. II + Bit. I (Shs)	(Shs)	(£)
Below 1000 v.p.d.	33.2Km Bit II + 30.2Km G2	15.4Km Bit II + 43.0Km Bit I	C	0.45	0.64	14.94	19.33	34.27	0.45	0.39	6.93	16.77	23.70	10.57	192.90
			LG	0.47	0.68	15.60	20.54	36.14	0.47	0.42	7.24	18.06	25.30	10.84	197.83
			MG	1.00	1.43	33.20	43.19	76.39	1.00	0.90	15.40	38.70	54.10	22.29	406.79
			HG	1.93	2.61	64.08	78.82	142.90	1.93	1.78	29.72	76.54	106.26	36.64	668.68
			B	1.13	1.51	37.52	45.60	83.12	1.13	1.02	17.40	43.86	61.26	21.86	398.95
1000-1700 v.p.d	Bit II + G2	Bit II + Bit I	C	0.45	0.69	14.94	20.84	35.78	0.45	0.39	6.93	16.77	23.70	12.08	220.46
			LG	0.47	0.73	15.60	22.05	37.65	0.47	0.42	7.24	18.06	25.30	12.35	225.39
			MG	1.00	1.54	33.20	46.51	79.71	1.00	0.90	15.40	38.70	54.10	25.61	467.38
			HG	1.93	2.82	64.08	85.16	149.24	1.93	1.78	29.72	76.54	106.26	42.98	784.39
			B	1.13	1.63	37.52	49.23	86.75	1.13	1.02	17.40	43.86	61.26	25.49	465.19
Above 1700 v.p.d.	Bit II + G2	Bit II + G2	C	0.45	0.72	14.94	21.74	36.68	0.45	0.39	6.93	16.77	23.70	12.98	236.89
			LG	0.47	0.76	15.60	22.95	38.55	0.47	0.42	7.24	18.06	25.30	13.25	241.81
			MG	1.00	1.60	33.20	48.32	81.52	1.00	0.90	15.40	38.70	54.10	27.42	500.42
			HG	1.93	2.92	64.08	88.18	152.26	1.93	1.78	29.72	76.54	106.26	46.00	839.50
			B	1.13	1.69	37.52	51.04	88.56	1.13	1.02	17.40	43.86	61.26	27.30	498.23

1977 - 1980 1981 - 1986 1987 - 1996

DIVERTED TRAFFIC: DUNDORI-OL KALOU - ANNUAL V.O.C. SAVINGS/VEHICLE

TABLE 5.26

TRAFFIC VOLUME	LENGTH		VEHICLE CATEGORY	VEHICLE OPERATING COSTS						SAVINGS		Period when Rates are Applicable
				PRESENT					PROPOSED			
	PRESENT	PROPOSED		V.O.C. RATE Bit.II (SH/KM)	V.O.C. RATE G2 (SH/KM)	V.O.C. on Bit. II (SHS)	V.O.C. on G2 (SHS)	TOTAL V.O.C. Bit. II + G2(SHS)	TOTAL V.O.C. on Bit II + Bit. I (SHS)	Savings per Vehicle journey (SHS)	Savings/ Vehicle/ year (£)	
Below 1000 v.p.d.	56.2 km Bit. II + 23.0 km G2	15.4 km Bit. II + 43.0 km Bit. I	C	0.45	0.64	25.29	14.72	40.01	23.70	16.31	297.66	1977 to 1993
			LG	0.47	0.68	26.41	15.64	42.05	25.30	16.75	305.69	
			MG	1.00	1.43	56.20	32.89	89.09	54.10	34.99	638.57	
			HG	1.93	2.61	108.47	60.03	168.50	106.26	62.24	1135.88	
			B	1.13	1.51	63.51	34.73	98.24	61.26	36.98	674.89	
1000-1700 v.p.d.	Bit. II + G2	Bit. II + Bit. I	C	0.45	0.69	25.29	15.87	41.16	23.70	17.46	318.65	1994 to 1996
			LG	0.47	0.73	26.41	16.79	43.20	25.30	17.90	326.68	
			MG	1.00	1.54	56.20	35.42	91.62	54.10	37.52	684.74	
			HG	1.93	2.82	108.47	64.86	173.33	106.26	67.07	1224.03	
			B	1.13	1.63	63.51	37.49	101.00	61.26	39.74	725.26	

DIVERTED TRAFFIC: GILGIL: ANNUAL V.O.C. SAVINGS/VEHICLE

TABLE 5.27

LENGTH		/EHICLE	VEHICLE OPERATING COSTS PER VEHICLE JOURNEY							Savings per Vehicle Journey	Savings per Vehicle per annum
			PRESENT		PROPOSED						
PRESENT	PROPOSED	CATE-GORY	V.O.C. Rate Bit. II (SH/KM)	V.O.C.on Bit. II (106 Km) (SH/KM)	V.O.C. Rate Bit. II (SH/KM)	V.O.C. Rate Bit. I (SHS)	V.O.C. on Bit. II (15.4 Km) (SHS)	V.O.C. on Bit. I (43.0 Km) (SHS)	TOTAL V.O.C. on Bit II + Bit I (SHS)	(SHS)	(£)
106.1 Km Bit. II	15.4 Km Bit. II + 43.0 Km Bit. I	C	0.45	47.75	0.45	0.39	6.93	16.77	23.70	24.05	438.91
		LG	0.47	49.87	0.47	0.42	7.24	18.06	25.30	24.57	448.40
		MG	1.00	106.10	1.00	0.90	15.40	38.70	54.10	52.00	949.00
		HG	1.93	204.77	1.93	1.78	29.72	76.54	106.26	98.51	1797.81
		B	1.13	119.89	1.13	1.02	17.40	43.86	61.26	58.63	1070.00

B E N E F I T S

DIVERTED TRAFFIC: DUNDORI-OL JORO OROK & DUNDORI-OL KALOU

TABLE 5.2 8 TOTAL V. O. C. SAVINGS K£'000'

YEAR	DIVERTED TRAFFIC DUNDORI - OL JORO OROK						DIVERTED TRAFFIC DUNDORI - OL KALOU						
	C	LG	MG	HG	B		C	LG	MG	HG	B		TOTAL
1974													
1975													
1976													
1977	14.27	12.46	11.39	-	4.39		11.61	4.59	0.64	-	-		59.35
1978	16.01	14.05	12.61	-	4.79		13.10	5.20	0.64	-	-		66.40
1979	17.94	15.63	13.83	-	5.19		14.59	5.81	1.28	-	-		74.27
1980	20.25	17.61	15.05	-	5.59		16.37	6.73	1.28	-	-		82.43
1981	25.79	22.31	19.16	-	7.44		18.45	7.34	1.28	-	-		101.77
1982	28.44	24.57	21.03	-	7.91		20.24	8.25	1.28	-	-		111.72
1983	31.31	27.05	22.90	-	8.84		22.32	8.87	1.28	-	-		122.57
1984	34.39	29.75	24.77	-	9.30		24.41	9.78	1.92	-	-		134.32
1985	37.92	32.91	27.11	-	10.23		27.09	11.00	1.92	-	-		148.18
1986	41.67	36.06	29.44	-	11.16		29.77	11.92	1.92	-	-		161.94
1987	48.80	42.32	34.03	-	12.95		32.44	13.14	1.92	-	-		185.60
1988	53.06	45.94	36.59	-	13.95		35.12	14.37	1.92	-	-		200.89
1989	57.80	50.05	39.51	-	14.95		38.40	15.59	2.55	-	-		218.87
1990	63.01	54.65	43.04	-	16.44		41.97	16.81	2.55	-	-		238.47
1991	68.73	59.73	46.54	-	17.44		45.54	18.34	2.55	-	-		258.84
1992	74.86	65.05	50.04	-	18.93		49.71	20.18	3.19	-	-		281.96
1993	81.73	70.85	54.05	-	20.43		54.17	22.01	3.19	-	-		306.43
1994	89.07	77.14	58.55	-	21.92		63.41	25.48	4.11	-	-		339.68
1995	97.12	84.15	63.05	-	23.92		69.15	27.77	4.11	-	-		369.27
1996	105.89	91.65	68.06	-	25.91		75.20	30.38	4.11	-	-		401.20

BENEFITS

DIVERTED TRAFFIC: GILGIL - TOTAL V.O.C. SAVINGS

TABLE 5.29 K£ '000'

YEAR	DIVERTED TRAFFIC GILGIL												
	C	LG	MG	HG	B	TOTAL	C	LG	MG	HG	B		TOTAL
1974													
1975													
1976													
1977	11.85	5.83	7.59	-	-	25.27							
1978	13.17	6.28	8.54	-	-	27.99							
1979	14.48	7.17	9.49	-	-	31.14							
1980	16.68	8.07	10.44	-	-	35.19							
1981	18.43	8.97	11.39	-	-	38.79							
1982	20.19	9.86	12.34	-	-	42.39							
1983	22.38	10.76	13.29	-	-	46.43							
1984	24.58	11.66	14.24	-	-	50.48							
1985	26.77	13.00	16.13	-	-	55.90							
1986	29.85	14.35	17.08	-	-	61.28							
1987	32.48	15.69	18.03	-	-	66.20							
1988	35.11	17.04	19.93	-	-	72.08							
1989	38.62	18.38	21.83	-	-	78.83							
1990	41.70	20.18	22.78	-	-	84.66							
1991	45.65	21.97	24.67	-	-	92.29							
1992	49.60	24.21	27.52	-	-	101.33							
1993	54.42	26.46	29.42	-	-	110.30							
1994	59.25	28.70	31.32	-	-	119.27							
1995	64.52	31.39	34.16	-	-	130.07							
1996	70.23	34.08	37.01	-	-	141.32							

TABLE 5.30

- UNDIVERTED TRAFFIC

AADT

YEAR	DUNDORI-OL JORO OROK						DUNDORI-OL KALOU											
	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL	CARS	LIGHT GOODS	MEDIUM GOODS	HEAVY GOODS	BUSES	TOTAL
1974																		
1975																		
1976																		
1977																		
1978																		
1979																		
1980																		
1981	252	418	97	2	17	786												
1982	277	460	106	3	19	865												
1983	305	506	115	3	20	949												
1984																		
1985																		
1986																		
1987	442	733	162	4	29	1370												
1988	482	800	175	5	31	1493												
1989	526	872	189	5	34	1626												
1990																		
1991																		
1992																		
1993																		
1994							120	440	83	-	94	737						
1995							131	479	90	-	102	802						
1996							143	522	98	-	110	873						

UNDIVERTED TRAFFIC: ANNUAL V.O.C. SAVINGS/VEHICLE

KE '000'

TABLE 5.31

Total Traffic Volume		VEHICLE CATEGORY	DUNDORI - OL JORO OROK LENGTH = 30.2 Km.			DUNDORI - OL KALOU LENGTH = 23.0 Km.		
			V.O.C. Rate G2 (Sh/Km)	Savings per vehicle journey (SH)	Savings per vehicle per annum (£)	V.O.C. RATE G2 (Sh/Km)	Savings per vehicle journey (SHS)	Savings per vehicle p.a (£)
1981 - 1983	1000 - 1700 v.p.d.	C	0.64	1.55	28.29	0.64	1.18	21.54
		LG	0.68	1.64	29.93	0.68	1.25	22.81
		MG	1.43	3.45	62.96	1.43	2.63	48.00
		HG	2.61	6.31	115.16	2.61	4.80	87.60
		B	1.51	3.65	66.61	1.51	2.78	50.74
1987 - 1989	Above 1700	C	0.64	0.77	14.05	0.64	0.59	10.77
		LG	0.68	0.82	14.97	0.68	0.63	11.50
		MG	1.43	1.73	31.57	1.43	1.32	24.09
		HG	2.61	3.15	57.49	2.61	2.40	43.80
		B	1.51	1.82	33.22	1.51	1.39	25.37

1994 - 1996

NOTE: UNDIVERTED TRAFFIC (V')

A. When V_T = 1000 - 1700 v.p.d.

Without situation: V.O.C. = L x 1.08 C_0 x V'

With situation: V.O.C. = L x 1.00 C_0 x V' (when V' <1000)

Savings = L x 0.08 C_0 x V' where L = distance

B. When V_T > 1700 v.p.d.

Without situation: V.O.C. = L x 1.12 C_0 x V'

With situation: V.O.C. = L x 1.08 C_0 x V' (When V' $\geq$ 1000 < 1700)

Savings = L x 0.04 C_0 x V'

B E N E F I T S

UNDIVERTED TRAFFIC: TOTAL V.O.C. SAVINGS
K£ '000'

TABLE 5.32

YEAR	UNDIVERTED TRAFFIC DUNDORI - OL JORO OROK						UNDIVERTED TRAFFIC DUNDORI - OL KALOU						
	C	LG	MG	HG	B		C	LG	MG	HG	B		TOTAL
1974													
1975													
1976													
1977													
1978													
1979													
1980													
1981	7.13	12.51	6.11	0.23	1.13								27.11
1982	7.84	13.77	6.67	0.35	1.27								29.90
1983	8.63	15.14	7.24	0.35	1.33								32.69
1984													
1985													
1986													
1987	6.21	10.97	5.11	0.23	0.96								23.48
1988	6.77	11.98	5.52	0.29	1.03								25.59
1989	7.39	13.05	5.97	0.29	1.13								27.83
1990													
1991													
1992													
1993													
1994							2.58	10.04	3.98	-	8.23		24.83
1995							2.82	10.93	4.32	-	8.94		27.01
1996							3.08	11.91	4.70	-	9.64		29.33

TABLE 5.33 JOURNEY TIMES ON VARIOUS ROUTE SEGMENTS

	Length (km)		Journey - times (in mins.)				
			C	LG	MG	HG	B
1. NAKURU-BAHATI Bit. II	14.5	Speed	80	70	65	60	65
		"	10.88	12.43	13.38	14.50	13.38
2. BAHATI - T. FALLS, G.2	52.0	"	60	55	50	40	45
			52.00	56.73	62.40	78.00	69.33
3. NAKURU - LANET Bit. II	5.2	"	90	70	65	60	65
			3.47	4.46	4.80	5.20	4.80
4. LANET-DUNDORI (Tarmac end)	15.9	"	80	65	60	55	60
			11.93	14.68	15.90	17.35	15.90
5. LANET-DUNDORI (Junction)	14.9	"	80	65	60	55	60
			11.18	13.75	14.90	16.25	14.90
6. DUNDORI-OL JORO OROK G.2	30.2	"	70	60	55	50	55
			25.89	30.20	32.94	36.24	32.94
7. DUNDORI-OL KALOU G.2	23.0	"	65	60	55	50	55
			21.23	23.00	25.09	27.60	25.09
8. OL KALOU-OL JORO OROK Bit.II	24.0	"	90	70	65	60	65
			16.00	20.57	22.15	24.00	22.15
9. OL JORO OROK-T.FALLS Bit.II	11.1	"	90	70	65	60	65
			7.40	9.51	10.24	11.10	10.24
10. NAKURU - GILGIL Bit.II	105.1	"	90	70	65	60	65
			70.07	90.90	97.02	105.10	97.02
11. T.FALLS (edge to town centre) Bit.II	1.0	"	60	55	50	40	45
			1.00	1.09	1.20	1.50	1.33
12. BAHATI-T.FALLS (Proposed Road) Bit.I	43.0	"	80	65	60	55	60
			32.25	39.69	43.00	46.91	43.00

(b) TIME SAVINGS

The most important factor in computing journey-time savings were the average speeds for the various types of vehicles on the different routes or route segments. Table 5.33 presents the average speeds for the different vehicle types and the average journey times on the various route segments. The average speeds were easy to determine, given the lengths of the route segments and the average journey times on each of the segments. The speeds derived from the survey data were compared to those obtained by using the MOW staff vehicles. There were only minor differences.

The rates at which time savings were evaluated were the estimated average wage rates for people travelling in the different types of vehicles. The rates are given in the second-last column in Table 5.34:

	Average Speeds (k.p.h.)		Journey Time (mins.)		Time Savings (Min)	Average Wage Rate (SH/HR)	Value of Time Savings p.a. £
Vehicle Type	Present Route	Proposed Route	Present (51.1Km)	Proposed (43.0Km)			
C	60	80	51.10	32.35	18.85	19.98	114.56
LG	55	65	55.75	39.69	16.06	2.72	13.29
MG	50	60	61.32	43.00	18.32	1.92	10.70
HG	40	55	76.65	46.91	29.79	0.80	7.24
B	45	60	68.13	43.00	25.13	12.30	94.02

TABLE 5.34

The time savings were calculated for vehicle trips rather than for persons travelling in the vehicles. It would have been an impossible task to estimate the numbers of present and future road users. On the other hand, the number of vehicle-trips were readily available once traffic volumes were established. All those travelling in a vehicle were treated as one vehicle-trip. The wage rate corresponding to each vehicle type (as shown in Table 5.34) applies to the occupants in a given vehicle in that vehicle category as a group constituting a "trip". It is thus the number of trips, not persons, for which time savings were estimated. It was thought the other half of the total number of trips would largely be homeward return journeys on which time saved would be spent as leisure time.

As in computing VOC savings, only half of the wage rates was applied in the calculation of the value of time savings for Generated traffic. The total annual savings for Normal and Generated traffic are given in Table 5.35.

Time savings for Diverted traffic were arrived at in a similar manner. The calculations and the resulting values of expected savings in working time are shown in Tables 5.36, 5.37 and 5.38. No time savings were computed for Undiverted traffic for the simple reason that it was not anticipated that if the proposed road were not built:

either (1) that the existing roads would have deteriorated to such an extent,

or (2) that there would have been so much traffic

that there would have been significant increases in journey time.

B E N E F I T S

NORMAL AND GENERATED TRAFFIC: TOTAL TIME SAVINGS

TABLE 5.35

IN K£'000'

YEAR	NORMAL TRAFFIC						GENERATED TRAFFIC						
	C	LG	MG	HG	B		C	LG	MG	HG	B		TOTAL
1974													
1975													
1976													
1977	13.06	1.71	0.59	0.01	1.50		0.63	0.09	0.03	0.00	0.09		17.71
1978	14.55	1.90	0.64	0.01	1.70		1.09	0.15	0.05	0.00	0.14		20.23
1979	16.38	2.15	0.71	0.01	1.79		1.66	0.21	0.07	0.00	0.19		23.17
1980	18.33	2.42	0.78	0.01	1.97		1.83	0.24	0.07	0.00	0.19		25.84
1981	20.51	2.70	0.86	0.01	2.16		2.06	0.27	0.09	0.00	0.24		28.90
1982	22.57	2.98	0.93	0.02	2.35		2.29	0.29	0.09	0.00	0.24		31.76
1983	24.86	3.27	1.02	0.02	2.63		2.52	0.33	0.10	0.01	0.28		35.04
1984	27.27	3.60	1.10	0.02	2.82		2.75	0.35	0.11	0.01	0.28		38.31
1985	30.01	3.96	1.21	0.03	3.10		3.04	0.39	0.12	0.01	0.33		42.20
1986	32.99	4.36	1.32	0.03	3.38		3.38	0.43	0.13	0.01	0.33		46.36
1987	35.97	4.74	1.42	0.03	3.67		3.67	0.47	0.14	0.01	0.38		50.50
1988	39.29	5.17	1.53	0.04	3.95		4.01	0.51	0.15	0.01	0.42		55.08
1989	42.73	5.63	1.66	0.04	4.23		4.35	0.59	0.16	0.01	0.42		59.82
1990	46.63	6.14	1.79	0.04	4.61		4.75	0.60	0.18	0.01	0.47		65.22
1991	50.86	6.70	1.94	0.04	4.98		5.16	0.66	0.19	0.01	0.52		71.06
1992	55.45	7.30	2.09	0.05	5.36		5.61	0.72	0.20	0.01	0.56		77.35
1993	60.37	7.96	2.26	0.05	5.83		6.13	0.78	0.22	0.01	0.61		84.22
1994	65.87	8.68	2.44	0.06	6.30		6.70	0.86	0.24	0.01	0.66		91.82
1995	71.71	9.45	2.63	0.07	6.77		7.27	0.93	0.26	0.02	0.71		99.82
1996	78.24	10.30	2.84	0.07	7.33		7.96	1.02	0.28	0.02	0.75		108.81

TIME SAVINGS

TABLE 5.36 DIVERTED TRAFFIC: ANNUAL TIME SAVINGS/VEHICLE

Present	Proposed	VEHICLE CATEGORY	Average Journey time (in mins.)		Time savings (in mins)	Average wage rate (Sh/Hr)	Time savings per vehicle p.a.(£)
			PRESENT	PROPOSED			
DUNDORI - OL JORO OROK							
33.2 Km Bit.II	15.4 Km Bit. II	C	49.69	44.03	5.66	19.98	34.40
		LG	59.94	53.10	6.84	2.72	5.66
		MG	65.08	57.46	7.62	1.92	4.45
30.2 Km G2	43.0 Km Bit. I	HG	71.39	62.76	8.63	0.80	2.10
		B	65.21	57.58	7.63	12.30	28.55
DUNDORI - OL KALOU							
PRESENT	PROPOSED	C	60.28	44.03	16.25	19.98	98.76
56.2 Km Bit.II	- do -	LG	72.38	53.10	19.28	2.72	15.95
		MG	78.38	57.46	20.92	1.92	12.22
23.0 Km G2		HG	85.65	62.76	22.89	0.80	5.57
		B	78.51	57.58	20.93	12.30	78.30
GILGIL - OL JORO OROK							
PRESENT	PROPOSED	C	71.07	44.03	27.04	19.98	164.33
106.1 Km Bit. II	- do -	LG	91.18	53.10	38.08	2.72	31.50
		MG	98.22	57.46	40.76	1.92	23.80
		HG	106.60	62.76	43.84	0.80	10.67
		B	98.35	57.58	40.77	12.30	152.53

B E N E F I T S

DIVERTED TRAFFIC: DUNDORI-OL JORO OROK & DUNDORI-OL KALOU

TABLE 5.37 TOTAL TIME SAVINGS IN K£'000'

YEAR	DIVERTED TRAFFIC DUNDORI- OL JORO OROK						DIVERTED TRAFFIC DUNDORI - OL KALOU						TOTAL
	C	LG	MG	HG	B		C	LG	MG	HG	B		
1974													
1975													
1976													
1977	2.55	0.36	0.12	-	0.31		3.85	0.24	0.01	-	-		7.44
1978	2.86	0.40	0.14	-	0.34		4.35	0.27	0.01	-	-		8.37
1979	3.20	0.45	0.15	-	0.37		4.84	0.30	0.02	-	-		9.33
1980	3.61	0.50	0.16	-	0.40		5.43	0.35	0.02	-	-		10.47
1981	4.02	0.56	0.18	-	0.46		6.12	0.38	0.02	-	-		11.74
1982	4.44	0.62	0.20	-	0.49		6.72	0.43	0.02	-	-		12.92
1983	4.88	0.68	0.22	-	0.54		7.41	0.46	0.02	-	-		14.21
1984	5.37	0.75	0.24	-	0.57		8.10	0.51	0.04	-	-		15.58
1985	5.92	0.83	0.26	-	0.63		8.99	0.57	0.04	-	-		17.24
1986	6.50	0.91	0.28	-	0.69		9.88	0.62	0.04	-	-		18.92
1987	7.09	0.99	0.30	-	0.74		10.76	0.69	0.04	-	-		20.61
1988	7.71	1.08	0.32	-	0.80		11.65	0.75	0.04	-	-		22.35
1989	8.39	1.17	0.35	-	0.86		12.74	0.81	0.05	-	-		24.37
1990	9.15	1.28	0.38	-	0.94		13.93	0.88	0.05	-	-		26.61
1991	9.98	1.40	0.41	-	1.00		15.11	0.96	0.05	-	-		28.91
1992	10.87	1.52	0.45	-	1.08		16.49	1.05	0.06	-	-		31.52
1993	11.87	1.66	0.48	-	1.17		17.97	1.15	0.07	-	-		34.36
1994	12.93	1.81	0.52	-	1.26		19.65	1.24	0.07	-	-		37.48
1995	14.10	1.97	0.56	-	1.37		21.43	1.36	0.07	-	-		40.86
1996	15.38	2.15	0.61	-	1.48		23.31	1.48	0.07	-	-		44.48

B E N E F I T S

DIVERTED TRAFFIC: GILGIL - TOTAL TIME SAVINGS

TABLE 5.38 IN K£'000'

YEAR	DIVERTED TRAFFIC GILGIL												
	C	LG	MG	HG	B	TOTAL	C	LG	MG	HG	B		TOTAL
1974													
1975													
1976													
1977	4.44	0.41	0.19	-	-	5.04							
1978	4.93	0.44	0.21	-	-	5.58							
1979	5.42	0.50	0.24	-	-	6.16							
1980	6.24	0.57	0.26	-	-	7.07							
1981	6.90	0.63	0.29	-	-	7.82							
1982	7.56	0.69	0.31	-	-	8.56							
1983	8.38	0.76	0.33	-	-	9.47							
1984	9.20	0.82	0.34	-	-	10.36							
1985	10.02	0.91	0.40	-	-	11.33							
1986	11.17	1.01	0.43	-	-	12.61							
1987	12.16	1.10	0.45	-	-	13.71							
1988	13.15	1.20	0.50	-	-	14.85							
1989	14.46	1.29	0.55	-	-	16.30							
1990	15.61	1.42	0.57	-	-	17.60							
1991	17.09	1.54	0.62	-	-	19.25							
1992	18.57	1.70	0.69	-	-	20.96							
1993	20.38	1.86	0.74	-	-	22.98							
1994	22.18	2.02	0.79	-	-	24.99							
1995	24.16	2.21	0.86	-	-	27.23							
1996	26.29	2.39	0.93	-	-	29.61							

(c) MAINTENANCE COST SAVINGS

The savings in annual costs of maintaining the present Bahati-T. Falls road were obtained by subtracting the estimated annual cost of maintaining the proposed tarmac road from the cost that would have been incurred to maintain the present road if the proposed one were not built. The basic calculations were given in the section dealing with the computation of project costs. The estimated maintenance costs for the existing and proposed roads are given in Table 5.18. The resulting savings in maintenance costs are as shown in Table 5.40 which also summarizes the values of the three principal benefits.

SUMMARY OF V. O. C. SAVINGS AND TIME SAVINGS

TABLE 5.39

IN K£'000'

YEAR	NORMAL		GENERATED		DIVERTED AND UNDIVERTED DUNDORI-OL JORO OROK		DIVERTED AND UNDIVERTED DUNDORI-OL KALOU		DIVERTED - GILGIL		TOTAL V.O.C. AND TIME SAVINGS	
	V.O. C. SAVINGS	TIME SAVINGS	V.O.C. SAVINGS	TIME SAVINGS	V.O.C. SAVINGS	TIME SAVINGS	V.O.C. SAVINGS	TIME SAVINGS	V.O.C. SAVINGS	TIME SAVINGS	V.O.C. SAVINGS	TIME SAVINGS
1977	117.69	16.87	6.07	0.84	42.51	3.34	16.84	4.10	25.27	5.04	208.38	30.19
1978	131.74	18.80	10.36	1.43	47.46	3.74	18.94	4.63	27.99	5.58	236.49	34.18
1979	145.93	21.04	14.91	2.13	52.59	4.17	21.68	5.16	31.14	6.16	266.25	38.66
1980	162.58	23.51	16.26	2.33	58.05	4.67	24.38	5.80	35.19	7.07	296.46	43.38
1981	180.10	26.24	18.38	2.66	101.81	5.22	27.07	6.52	38.79	7.82	366.15	48.46
1982	198.37	28.85	19.88	2.91	111.85	5.75	29.77	7.17	42.39	8.56	402.26	53.24
1983	217.74	31.80	22.68	3.24	122.79	6.32	32.47	7.89	46.43	9.47	442.11	58.72
1984	237.05	34.81	24.18	3.50	98.21	6.93	36.11	8.65	50.48	10.36	446.03	64.25
1985	262.03	38.31	26.76	3.89	108.17	7.64	40.01	9.60	55.90	11.33	492.87	70.77
1986	286.82	42.08	29.18	4.28	118.33	8.38	43.61	10.54	61.28	12.61	539.22	77.89
1987	311.30	45.83	31.58	4.67	161.58	9.12	47.50	11.49	66.20	13.71	618.16	84.82
1988	338.62	49.98	34.98	5.10	175.07	9.91	51.41	12.44	72.08	14.85	672.16	92.28
1989	426.41	54.29	43.61	5.53	190.16	10.77	56.54	13.60	78.83	16.30	795.55	100.49
1990	464.10	59.21	47.47	6.01	177.14	11.75	61.33	14.86	84.66	17.60	834.70	109.43
1991	504.43	64.52	51.51	6.54	192.41	12.79	66.43	16.12	92.29	19.25	907.07	119.22
1992	548.05	70.25	56.15	7.10	208.88	13.92	73.08	17.60	101.33	20.96	987.49	129.83
1993	595.40	76.47	60.88	7.75	227.06	15.18	79.37	19.18	110.30	22.98	1073.01	141.56
1994	647.79	83.35	66.32	8.47	246.68	16.52	117.83	20.96	119.27	24.99	1197.89	154.29
1995	703.34	90.63	72.01	9.19	268.24	18.00	128.04	22.86	130.07	27.23	1301.70	167.91
1996	824.15	98.78	84.36	10.03	291.51	19.62	139.02	24.86	141.32	29.61	1480.36	182.90

S U M M A R Y O F B E N E F I T S

IN K£'000'

TABLE 5.40

YEAR	VEHICLE OPERATING COST SAVINGS	TIME SAVINGS	MAINTENANCE COST SAVINGS		TOTAL BENEFITS
1977	208.36	30.19	-		258.57
1978	236.49	34.18	3.34		274.01
1979	266.25	38.66	3.34		308.25
1980	296.46	43.38	19.58		359.42
1981	366.15	48.46	3.34		417.95
1982	402.26	53.24	-15.79		439.71
1983	442.11	58.72	19.58		520.41
1984	446.03	64.25	3.34		513.62
1985	492.87	70.77	3.34		566.98
1986	539.22	77.89	19.58		636.69
1987	618.16	84.82	3.34		706.32
1988	672.16	92.28	-15.79		748.65
1989	795.55	100.49	19.58		915.62
1990	834.70	109.43	3.34		947.47
1991	907.07	119.22	3.34		1029.63
1992	987.49	129.83	19.58		1136.90
1993	1073.01	141.56	3.34		1217.91
1994	1197.89	154.29	-15.79		1336.39
1995	1301.79	167.91	19.58		1499.29
1996	1480.36	182.90	3.34		1666.60

COST-BENEFIT ANALYSIS

TABLE 5.41 KE'000'

YEAR	COSTS				BENEFITS			
	TOTAL COSTS	Discounted @ 14%	Discounted @ 17%	Discounted @ 18%	TOTAL BENEFITS	Discounted @ 14%	Discounted @ 17%	Discounted @ 18%
1975	944.50	947.50	947.50	947.50				
1976	1235.88	1084.11	1056.31	1047.41				
1977	242.56	186.65	177.19	174.21	238.57	183.58	174.28	171.34
1978	4.79	3.23	2.99	2.92	274.01	184.96	171.09	166.76
1979	4.79	2.84	2.56	2.47	308.25	182.51	164.51	159.83
1980	4.79	2.49	2.18	2.09	359.42	186.68	163.93	157.10
1981	4.79	2.18	1.87	1.77	417.95	190.42	162.92	154.81
1982	23.92	9.56	7.97	7.51	439.71	175.71	146.51	138.02
1983	4.79	1.68	1.36	1.27	520.41	182.46	148.21	138.43
1984	4.79	1.47	1.17	1.08	513.62	157.94	125.02	115.82
1985	4.79	1.29	1.00	0.92	566.98	152.91	117.93	108.35
1986	4.79	1.13	0.85	0.78	636.69	150.64	113.20	103.08
1987	4.79	0.99	0.73	0.66	706.32	146.63	107.36	96.91
1988	23.92	4.36	3.11	2.78	748.65	136.33	97.25	87.07
1989	4.79	0.76	0.53	0.47	915.62	146.22	101.63	90.19
1990	4.79	0.67	0.45	0.40	947.47	132.74	89.91	79.11
1991	4.79	0.59	0.39	0.34	1029.63	126.54	83.50	72.98
1992	4.79	0.52	0.33	0.29	1136.90	122.56	78.79	68.21
1993	4.79	0.45	0.28	0.24	1217.91	115.21	72.10	61.87
1994	23.92	1.98	1.21	1.03	1336.39	110.79	67.62	57.60
1995	4.79	0.35	0.21	0.17	1499.29	108.42	64.49	54.36
1996	4.79	0.31	0.18	0.15	166.60	106.33	61.66	51.50
		2255.11	2210.37	2196.46		2999.58	2311.91	2133.34

14/100 + 1235.88

12.35

14

0

14 A 0

4 9 3 5

3 9 0

SENSITIVITY ANALYSIS: I

TABLE 5.42 K£'000'

YEAR	COSTS x 1.10				BENEFITS		
	Discounted @ 14%	Discounted @ 16%	Discounted @ 17%		Discounted @ 14%	Discounted @ 16%	Discounted @ 17%
1975	1042.25	1042.25	1042.25				
1976	1192.53	1172.00	1161.94				
1977	205.32	198.30	194.91		183.58	177.31	174.28
1978	3.56	3.38	3.29		184.96	175.56	171.09
1979	3.12	2.91	2.81		182.51	170.25	164.51
1980	2.74	2.51	2.40		186.68	171.11	163.93
1981	2.40	2.16	2.05		190.42	171.53	162.92
1982	10.51	9.31	8.77		175.71	155.57	146.51
1983	1.85	1.61	1.50		182.46	158.73	148.21
1984	1.62	1.39	1.28		157.94	135.08	125.02
1985	1.42	1.19	1.10		152.91	128.53	177.93
1986	1.25	1.03	0.94		150.64	124.41	113.20
1987	1.09	0.89	0.80		146.63	119.01	107.36
1988	4.79	3.82	3.42		136.33	108.70	97.25
1989	0.84	0.66	0.58		146.22	114.64	101.63
1990	0.74	0.57	0.50		132.74	102.23	89.91
1991	0.65	0.49	0.43		126.54	95.76	83.50
1992	0.57	0.42	0.37		122.56	91.18	78.79
1993	0.50	0.36	0.31		115.21	81.16	72.10
1994	2.18	1.57	1.33		110.79	79.65	67.62
1995	0.38	0.27	0.23		108.42	76.55	64.49
1996	0.34	0.23	0.19		106.33	73.83	61.66
	2480.65	2447.32	2431.40		2999.58	2510.79	2311.91

SENSITIVITY ANALYSIS: II

TABLE 5.43 KE'000'

YEAR	COSTS				BENEFITS x 0.90		
	Discounted @ 14%	Discounted @ 16%	Discounted @ 17%		Discounted @ 14%	Discounted @ 16%	Discounted @ 17%
1975	947.50	947.50	947.50				
1976	1084.11	1065.45	1056.31				
1977	186.65	180.27	177.19		165.22	159.57	156.85
1978	3.23	3.09	2.99		166.46	158.00	153.98
1979	2.84	2.65	2.56		164.27	153.22	148.06
1980	2.49	2.28	2.18		168.02	154.00	147.54
1981	2.18	1.97	1.87		171.38	154.38	146.63
1982	9.56	8.46	7.97		158.14	140.01	131.86
1983	1.68	1.46	1.36		164.21	142.82	133.39
1984	1.47	1.26	1.17		142.14	121.57	112.51
1985	1.29	1.09	1.00		137.62	115.68	106.14
1986	1.13	0.94	0.85		135.58	111.96	101.88
1987	0.99	0.81	0.73		131.97	107.11	96.62
1988	4.36	3.47	3.11		122.70	97.83	87.53
1989	0.76	0.60	0.53		131.60	103.17	91.47
1990	0.67	0.52	0.45		119.47	92.00	80.92
1991	0.59	0.45	0.39		113.89	86.18	75.15
1992	0.52	0.38	0.33		110.30	82.06	70.90
1993	0.45	0.33	0.28		103.69	75.74	64.89
1994	1.98	1.43	1.21		99.71	71.68	60.86
1995	0.35	0.25	0.21		97.58	68.89	58.04
1996	0.31	0.21	0.18		95.70	66.45	55.50
	2255.11	2224.87	2210.37		2699.65	2262.65	2090.73

SENSITIVITY ANALYSIS: III

TABLE 5.44

K£'000'

	YEAR	COSTS x 1.10				BENEFITS x 0.90		
		Discounted @ 14%	Discounted @ 16%	Discounted @ 17%		Discounted @ 14%	Discounted @ 16%	Discounted @ 17%
	1975	1042.25	1042.25	1042.25				
	1976	1192.53	1172.00	1161.94				
	1977	205.32	198.30	194.91		165.22	159.57	156.85
	1978	3.56	3.38	3.29		166.46	158.00	153.98
	1979	3.12	2.91	2.81		164.27	153.22	148.06
	1980	2.74	2.51	2.40		168.02	154.00	147.54
	1981	2.40	2.16	2.05		171.38	154.38	146.63
	1982	10.51	9.31	8.77		158.14	140.01	131.86
	1983	1.85	1.61	1.50		164.21	142.85	133.39
	1984	1.62	1.39	1.28		142.14	121.57	112.51
	1985	1.42	1.19	1.10		137.62	115.68	106.14
	1986	1.25	1.03	0.94		135.58	111.96	101.88
	1987	1.09	0.89	0.80		131.97	107.11	96.62
	1988	4.79	3.82	3.42		122.70	97.83	87.53
	1989	0.84	0.66	0.58		131.60	103.17	91.47
	1990	0.74	0.57	0.50		119.47	92.00	80.92
	1991	0.65	0.49	0.43		113.89	86.18	75.15
	1992	0.57	0.42	0.37		110.30	82.06	70.91
	1993	0.50	0.36	0.31		103.69	75.74	64.89
	1994	2.18	1.57	1.33		99.71	71.68	60.86
	1995	0.38	0.27	0.23		97.58	68.89	58.04
	1996	0.34	0.23	0.19		95.70	66.45	55.50
		2480.65	2447.32	2431.40		2699.65	2262.35	2090.73

5.33 COMPARING THE COSTS AND BENEFITS

The cost and benefit streams were discounted at 14% to determine the net present worth (NPV) of the proposed road project. This discount rate, the Ministry of Finance and Planning reckons is the opportunity cost of capital in the public sector in Kenya. At 14% the project has a net social benefit of some £744,470.

Using the World Bank criterion, the project has an economic internal rate of return (IRR) of 17.62% and Benefit-Cost (B/C) ratio of 1.33. On the basis of all the three criteria the proposed investment is worth undertaking. Even if the cut-off rate were set slightly higher - say at 15% the proposed road project would still be a desirable investment. The details of the discounted values are given in Table 5.41. The following computations demonstrate how the above three indices were derived:

1) Net Present Worth

Benefits and costs discounted - @ 14%

$PV_{14}(B) = 2999.58$ where PV_{14}= discounted PV @ 14%

$PV_{14}(C) = 2255.11$

$NPV_{14} = 744.47$

2) Internal Rate of Return

Derived by interpolation:

$PV_{17}(B) = 2311.91$

$PV_{17}(C) = \underline{2210.37}$

101.54

$PV_{18}(B) = 2133.34$

$PV_{18}(C) = \underline{2196.46}$

$- 63.12$

By interpolation

$$IRR = r_1 + [r_2 - r_1]\left[\frac{NPr_1}{NPVr_2 - NPr_1}\right]$$

Where $NPVr_2 - NPVr_1$ = absolute difference between $NPVr_2$ and $NPVr_1$

$$= 17 + [18 - 17]\left[\frac{101.54}{-63.12 - 101.54}\right]$$

$$= 17 + \left(\frac{101.54}{164.66}\right)$$

$$= \underline{17.62}$$

3) Benefit/Cost Ratio

$$\frac{PV_{14}(B)}{PV_{14}(C)} = \frac{2999.58}{2255.11}$$

$$= \underline{1.33}$$

The proposed road project has passed the test of acceptability - and that with only three benefit items considered. The MOW in their calculations included a somewhat conservatively determined value for possible induced agricultural output and came out with a NPV of £893,620 and a B/C ratio

of 1.41 - both of these at 14%; and an IRR of 18.50%. But the way the induced agricultural benefit was derived left much to be desired - and as the above calculations indicate the inclusion of the value of expected net induced agricultural output does not materially alter the degree of acceptability of the proposed road investment. The Ministry made no effort to estimate the value of possible induced economic activity in industry or tourism; reductions in potential accidents or secondary effects.

5.34 SENSITITIVY ANALYSIS

A very simple sensitivity analysis was attempted. It consisted simply of a consideration of how the economic worth of the project would be affected if its costs were to rise by 10% and benefits were to fall by 10%. Three possibilities were considered:

(i) Costs rise by 10% (C x 1.10)
Benefits remain unchanged ($B = k_1$)

(ii) Costs remain constant ($C = k_2$)
Benefits fall by 10% (B x 0.90)

(iii) Costs rise by 10%
Benefits fall by 10%.

The effects of these assumptions on the above three indices of the economic worth of an investment are summarized in the following table:

Costs	Benefits	Net Present Worth @14%	Net Present Worth @16%	Net Present Worth @17%	B/C Ratio @ 14%	IRR %
C x 1.10	B = k_1	518.93	63.47	-119.49	1.21	16.35
C = k_2	B x 0.90	244.54	37.48	-119.64	1.20	16.24
C x 1.10	B x 0.90	219.00	-184.97	-340.67	1.09	15.02

TABLE 5.45 (a)

The project would definitely be uneconomic if the cut-off rate were as high as 17%. At 16% it would just be a marginal project if assumptions (i) and (ii) hold and undesirable if (iii) holds true. According to the MOW calculations the project would be rejected if the cut-off rate were 18%, and only marginal at 17%. The table below shows the effect of including the agricultural benefit, given the three assumptions:

Costs	Benefits	Net Present Worth @14%	Net Present Worth @ 17%	B/C RATIO @ 14%	IRR %
C x 1.10	B = k_1	675.11	26.52	1.28	17.1
C = k_2	B x 0.90	591.15	2.25	1.27	17.0
C x 1.10	B x 0.90	392.64	-211.89	1.15	15.9

TABLE 5.45 (b)

Although theoretically more plausible, a more sophisticated sensitivity analysis would have been impracticable for

this case study in the light of the paucity of information on the various aspects of the case study project.

C H A P T E R V I

THEORY AND PRACTICE REVISITED

In this concluding chapter an attempt will be made to highlight the extent to which the hypothesis made in an earlier chapter is borne out by what has been presented in the preceding four chapters. In the statement of hypothesis it was suggested that there are two basic sources of cost/benefit measurement problems. One is the way some of the items of road project costs and benefits are defined. The second is in the measurement procedures that have been proposed and used to date.

The ultimate root cause of both of these problems is in the nature of the costs and benefits. Project costs in CBA are Social Opportunity Costs (SOCs). The benefits are in the nature of Consumers Surplus (CS). Essentially CS is a saving: that part of the willingness-to-pay that is unrevealed or unrealized as producer's revenue. The benefits of a road are thus savings on some items of cost.

6.1 ESTIMATING COSTS

Given the definition of project costs as SOCs the first problem in measuring them is to identify the best forgone alternative uses for project inputs. In some cases it will be

relatively easy to locate such uses; in others - and perhaps in the majority of cases - it will be difficult and largely a matter of subjective judgement. This point is brought out more forcefully if one keeps in mind that in fact, CBA, unlike micro- or macro-economic theory, is Normative Economics. Objectivity in matters of what should or should not be is very difficult to establish and maintain because normative issues invariably involve value judgements. Value, whether in Economics or in some other sphere of life is a very intricate matter to deal with. Defined in utilitarian terms, value is intrinsically immeasurable. And yet it is this very element that ultimately must be the criterion to guide choice of the best alternative uses of economic resources. If the aim in project evaluation is to determine how best to deploy society's scarce resources in such a manner as to maximise social benefits - and social benefits are essentially CS - then indeed strictly speaking, there can be no objective measurable and verifiable criterion for selecting the best or next best alternative resource use(s). This, coupled with the possibility that a resource might have a large number of alternative uses forms a fairly formidable factor in the evaluation of alternative resource uses. Moreover, in dynamic economic circumstances no one use or set of uses can remain the best or next best at all times. With the shift in emphasis on what is the next best use of a resource there is also a change in the opportunity cost value of that resource. The consequence of this is that it becomes very difficult to obtain adequate and reliable data for evaluating resource uses.

The theoretical framework described earlier presented details of the theoretical proposals on how to measure costs. The proposals represent what is conceptually plausible. The case study on the other hand attempted to demonstrate what is empirically possible. In some cases it seems the gap between what is conceptually sound and what is feasible in practice is unbridgeable. Such would seem to be the case with the determination of the opportunity cost of some project inputs. Thus, as exemplified by the procedure for calculating the shadow wage rate for unskilled labour in the Little-Mirrlees system, ultimately the opportunity cost of this category of labour can not be established solely by means of objective economic criteria and procedures. The attitude of the government towards current and future consumption must be taken into account when calculating this shadow wage rate.

The ideal approach to measuring the costs of a public sector project would be to estimate the opportunity cost of each project input separately. This is because the opportunity cost values of the inputs differ to the extent that their best alternative uses are not identical.

6.11 CONSTRUCTION EQUIPMENT

The SOC of capital equipment used in road construction would, in principle, be the reduction (properly adjusted to reflect social valuation) in the expected market value of the equipment. In practice not only may it not be possible to establish correctly the opportunity cost of construction

equipment but also estimates of the reductions in the discounted values of the equipment may not be - and usually they are not - available for two possible reasons:

1. To be able to estimate the expected value of a piece of equipment one would need to know firstly the expected economic life of the equipment, and secondly the trends in the price(s) of its output(s). For all that anybody can tell both of these two are anything but simple to estimate.

2. Then there is the problem of determining the percentage decline in the expected value due to usage of the equipment on a given construction project.

This ideal method would obviously be impracticable. The economic life of equipment is partly a function of physical wear and tear but largely a function of obsolescence. Whereas the rate of wear and tear can be estimated with reasonable accuracy, that of obsolescence - particularly in conditions of rapid technological changes - is too difficult to gauge. The implication of this must be that it is also just as difficult to estimate the economic life of the equipment. Consequently, measuring the value of economic depreciation in the manner suggested in the theoretical framework is impracticable.

If the construction of a road is awarded to a foreign contractor the foreign exchange component in the economic depreciation of his construction equipment must be shadow-priced. The shadow-pricing procedure would consist of establishing the value of what goods and services the domestic economy must forgo

so as to generate the amount of FE necessary to pay for the services of the equipment. Assuming economic rationality on the part of the contractor this amount of FE would at least be equal to the estimated decline in the expected value of his equipment.

Thus, bringing the FE element into the evaluation process does not make any difference to the basic definition of the social cost value of the services of construction equipment. But it does introduce a new problem: that of identifying the appropriate items which the home economy gives up in order to earn the FE. There is no label on FE funds to indicate which sum was earned by which items exported or import items displaced.

6.12 CONSTRUCTION MATERIALS

The procedure for valuing construction materials will depend on whether the materials are imported or produced locally. If they are imported their FE cost would be shadow priced at the domestic value (gross of any subsidies or net of all indirect taxes) of the goods exported or imports displaced to earn it. Locally procured materials would be valued at their domestic prices - appropriate adjustments being done to the market values, to take into account the effects of domestic subsidies and indirect taxes. Ideally, since most materials are purchased in markets that are far from being perfectly competitive, their market values should also be adjusted for price distortions arising from market imperfections by valuing them

at what they would have sold for in a perfectly competitive market. In practice this is clearly impossible. Perfect competition is a hypothetical model that so far has only existed in the imagination of economic theorists. Consequently, the project evaluator must be content with shadow-pricing as the only feasible way of dealing with price distortions arising from market imperfections. In the case study the shadow pricing of construction materials took the form of a 10% indirect tax deduction from total construction and maintenance costs. But this adjustment is not good enough because it does not specifically relate to materials. It implies that there was a 10% tax on all the project input items which of course is not the case. Only some of these might have duties imposed upon them but it was difficult to determine the tax rate on each of them. Moreover, maintenance costs were estimated and given as lumpsum amounts: no detailed breakdowns of them such as those shown in Table 5.15 for construction costs were available to enable the computation of indirect taxes on each item. Ideally, distortions in the market prices of materials due to monopolistic influences or other market imperfections should also be removed from the construction and maintenance costs. However, in the absence of a criterion for the identification of such distortions or a procedure for their removal the only adjustment done to the costs in the case study was the elimination of indirect taxes. It was assumed there were no subsidies on the materials or any other input item.

6.13 LAND AND LABOUR

The valuation of unskilled labour is a particularly troublesome exercise whether one adopts the willingness-to-pay approach or the World Prices method. The services of skilled (foreign) personnel, under the willingness-to-pay approach would be valued much in the same way as imported materials. Locally procured labour services should in principle be valued at the minimum wage rate(s) the workers would be prepared to accept.

If this were all that was to be done to establish the economic cost of local labour, the main problem would be to obtain the appropriate amount and quality of information on the minimum wage rate that workers would accept in order to take up a job on a road project. Unfortunately, this minimum wage rate would be a private opportunity cost value and would have to be translated into a social cost. Most problems relating to the evaluation of unskilled labour are in this conversion of private or financial labour costs into social costs. Little and Mirrlees in their model have proposed a fairly structured procedure for estimating the shadow wage rate. But they also recognize the limitation to the procedure posed by the need to accommodate government policy towards present and future consumption. Procedural rigor must, therefore, give way in the face of this unquantifiable but crucial consideration in the determination of the shadow wage rate.

The Willingness-to-pay method on the other hand, beyond stating in general terms that the shadow rate is (or should be) the minimum rate of remuneration workers would be willing to accept, provides no definite method of how this minimum acceptable rate is to be determined. There is only one way to go about this: empirical investigation.

The estimation of the economic value of land is similar to that of unskilled labour. Price ceilings in the land market imposed by the Governmnet as well as socio-political factors militate against "free" land transactions in this country. This means that land market prices fail to reflect the true social value of land. The land that will be acquired from farmers for the construction of the proposed Bahati-T. Falls road will probably be paid for at Government land rates which do not even reflect market prices for land, let alone the social cost value of it. So even though the cost of land will be an insignificant proportion of the total construction costs for the road the fact still remains that insignificant proportion will be a poor approximation of the social value of the land. In principle, the social value of the land would be the minimum price land-owners would accept or conversely the maximum price prospective land buyers would be willing to pay for the land. But given Government price controls and social influences on the land market, market land prices in particular areas would not be reliable indicators of the value of land to the economy. In the case study the cost of land was not treated as a separate

item for the simple reason that it was not considered to be large enough to merit such treatment.

The effects of Government land policy appear to be confined to matters of price control and, unlike the case of unskilled labour, such policy would not be as an important consideration in the definition and computation of the shadow price of land as it is in the calculation of the shadow wage rate for unskilled labour (especially in the Little-Mirrlees system). Fortunately, under the willingness-to-pay approach, apart from adjustments for taxes or subsidies (if any) on land transactions, no other adjustments would be necessary.

6.14 ADVERSE SPILLOVERS

The problems associated with the evaluation of external effects were set out in detail in preceding chapters. Perhaps the only significant one of them would be increased risk of accidents on the new road. The other ones would probably not be large enough to justify undertaking the complicated evaluation process required for them. It should be noted here in passing that the MOW does not normally bother measuring spillover effects whether important or unimportant. The main reason seems to be that they do not have staff competent enough to do this. They do, however, acknowledge the substantial cost to the country resulting from road accidents.

Spillover effects are perhaps the best of project effects for which the gap between the measurement procedures

proposed in theory and the measurement procedures employed in practice is likely to remain unbridgeable for a long time to come. The reasons for this are both conceptual and statistical.

In the case study no attempt was made to estimate the spillover effects that the proposed road would produce for reasons stated in Chapter IV.

Thus, despite the inaccuracies that might result and the conceptual objections that might be raised, construction and maintenance costs were treated as lumpsums. It was fully realized that this aggregative treatment was much less accurate than estimating the opportunity cost values of each input item separately, but the approach was found to be more practicable and time saving. Usually the project evaluator must choose between accuracy in cost estimation on one hand and practicability and getting usable results on time on the other. For the MOW it is the latter that carries the day. They have two reasons to explain this choice:

1. doing a very accurate estimation would require more sophisticated Cost-benefit analysts than are available in the Ministry at present.

2. they normally have only a short time in which to write and compile their loan applications to the project financiers (chiefly the IBRD and ADB).

The time limitation was an important consideration in the writing of this thesis.

6.2 ESTIMATING BENEFITS

Defining the benefits of a road project as savings has at least one important merit that it makes it possible for the project analyst to employ readily available and familiar analytical tools of economic theory. The treatment of road users' costs in all their different forms - vehicle operating costs, journey time, risk of accidents, etc. - as the price road users have to pay in order to have and utilize a better road is the basic justification for defining the net benefit to road users as CS (or "road users' surplus"). Similarly from the point of view of society as a whole savings in the costs of maintaining an existing road (to be replaced by a new one) are, for practical purposes, a road users' surplus.

However, this definition of net benefit does not apply equally well to all road benefit items. Induced economic (e.g. agricultural, industrial) production or increased comfort to users of a new smooth surfaced road can be regarded as CS only if their total or partial absence is seen as a cost - i.e. a price society would have to pay if the new road is not built.

A major source of difficulty in evaluating the benefits of a road project is that the services of a road are a public good for which it is not possible to establish a market price - and hence a demand curve, which is the economic tool for determining the magnitufe of CS. The willingness-to-pay for the services of a road by its users is in terms of as varied items

as VOCs, journey time, road maintenance costs, risk of being injured or killed in the course of a journey, possible adverse spillover effects, etc. Strictly, it should be the value of savings or reductions in all these items that constitute the benefit society derives from having a road. Together the items are the "price" that road users in particular and society at large have to pay for that benefit.

The second general source of difficulty is in the diversity of the type of benefit items. No one particular measurement procedure will do for all (or even most) of the items. In other words, each item raises different evaluation problems and calls for a different measurement approach. The diversity in the kinds of benefit merely augments the range of problems the project analyst has to cope with, thereby reducing his ability to concentrate on the measurement problems of individual items.

Generally, it is easier to measure savings in VOCs, journey time, and road maintenance costs as road users' surpluses either by algebraic or geometric techniques. But reductions in potential road accidents, induced economic activity and secondary effects cannot easily be estimated by these techniques. For reductions in these benefit items to be regarded as savings or road users' surpluses one would need first to establish what would be:

1. the total number of accidents on the existing road

2. the total extent of lack of economic development

3. the total magnitude of unfavourable spillover effects

that society would suffer if the proposed road is not built. If this cannot be done it is impossible to determine the magnitude of the reductions or savings in these three items.

6.21 VOC SAVINGS

Vehicle operating costs consist of a number of various items - fuel and lubricants, vehicle depreciation and maintenance, tyre wear, etc. - the values of which have to be averaged to obtain a single VOC rate. Reductions in this average rate can then be used to calculate the VOC savings resulting from the construction of a new road or improvement of an old one. In practice this calculation is far from being simple. It was not possible to obtain the mechanics of the method MOW used to calculate their VOC rates. But the following extract from a report by the Chief Engineer (Roads) affords one a glimpse into the possible nature and extent of the problems the MOW engineers had to tackle in estimating the rates for the various vehicle types:

> "In order to make an absolute evaluation of the grades of road where different operating costs pertain, a detailed rating system has been devised for roads in Kenya. This rating is more subjective in its approach than a plain comparison of the quality of one road against that of another. It is believed that the operating costs on gravel roads depend mainly upon a combination of seven different factors, each of which has a greater or lesser influence on operating costs. Their relative influences are indicated

by the maximum number of points that can be scored for each factor. Any road to be studied is subjected to an inspection whereby points are allocated on the scale for each factor, the sum of these representing the operating costs on the road relative to zero points (for a completely unimproved track, G0) and 68 points (for a fully engineered high speed gravel road, G4).

The factors recorded and the maximum points allocated to each are detailed below:

F A C T O R	Maximum Number of Points
(i) Riding quality	16
(ii) Gradient	12
(iii) Drainage	12
(iv) General quality	8
(v) Horizontal alignment and sight distances	8
(vi) Width	4
(vii) Rainfall	8

The whole scale of roads between a G0 and a G4 road is .... divided into five grades: G0, G1, G2, G3, G4 such that the operating cost differential between any two grades is constant. A scale of 68 different operating costs could be adopted but the accuracy of the allocation judgement does not warrant a greater degree of accuracy than the five different grades chosen. With this detailed method the evaluator can reliably achieve consistent absolute grading results on many different roads though his range of accuracy for any one road may vary as much as 5 to 7 points. However, since all roads are 'slotted' into one of five grades with approximately 14 points in each, any inaccuracies are, on average, eliminated and

> subsequent calculations of total operating costs are made no less accurate by this simplification."

In the absence of any knowledge about the details of the mechanics of this method of computing VOC rates it would be spurious to attempt a critical assessment of the method. But the Chief Engineer's claim that it can and does yield accurate results does not sound very convincing. If as he admits, the points scheme relies significantly upon subjective judgement there is no way of verifying that in fact the VOC rates obtained by using the system are accurate. To be able to determine the degree of accuracy and reliability of the method one would need to have a criterion of comparison say in the form of established or standard VOC rates - which is precisely what does not exist in Kenya or anywhere else in East Africa. Whatever might be the exact nature of the method the MOW used to derive their VOC rates, it is emphasized here that the accurate estimation of vehicle operating costs is too difficult a task to be adequately dealt with in the manner outlined by the Chief Engineer. Although the above description of the points system does not throw sufficient light, for example, on how the maximum points were assigned to the different factors or on how one moves from the points to the actual derivation of the rates, there is some reason to suspect that behind the mask of apparent sophistication in the method, there lies arbitrariness and subjective guesses. This much is implicitly admitted in the above description. Moreover, given the known lack of personnel qualified in the appraisal of

transport projects it is likely that either the method of computation or the data that were used were not of a quality that could ensure the high degree of accuracy that the Chief Engineer claims.

6.22 TIME SAVINGS

The two major difficulties in estimating time savings are:

1. Determining the amounts of time saved by road users. This estimation depends crucially on two other factors:

   (i) distance travelled - which is always readily available

   (ii) speed - this can only be established on an average basis which in turn means the amounts of journey time must also be averages.

On the whole this is a relatively minor difficulty and the inaccuracies due to the fact that the amounts of time saved are average amounts would have insignificant effects upon the final results.

2. Establishing the rates at which the time savings are to be valued. The accepted notion that the value of time saved by a given category of road users is the rate of earnings for that category is founded on the assumption that, generally, there are two broad uses for time - work or leisure - which in itself is a good enough assumption. This implies that the value of either of the two uses is the price of the other, so that the value of leisure time saved would be the earnings one forgoes by not working. This would probably cause little measurement

difficulty. But the converse of it - i.e. that the value of one's working time savings is the value of the leisure he forgoes if he takes up a job does not so easily lend itself to measurement. Time savings would therefore be difficult to evaluate in this fashion.

The easier way out, which is used in practice is to determine the economic value of working time in terms of one's earnings in his best alternative occupation. But even this is not so simple to determine in practice as it sounds in theory. In practice few people know what would be their best alternative occupation. When this ignorance is coupled with labour market imperfections and high rates of unemployment, evaluating working time savings at market wage rates can hardly be said to yield a correct social valuation of time savings.

The earnings rates that were used in evaluating time savings in the case study were obtained from the Ministry of Finance and Economic Planning. To what extent they reflect market opportunity values of the time expected to be saved by road users would require some empirical verification. Secondly, whether the reduction of the financial labour costs by 50% (in Table 5.18) correctly converts them to social costs is an arguable point. The assumption that the shadow wage rate in this country is only some 50% of the market wage rate requires verification.

6.23 SAVINGS IN MAINTENANCE COSTS

The problems of estimating road maintenance costs are similar to those of estimating construction costs. The only exceptional feature of maintenance costs is the assumption that in the absence of the proposed road the costs would rise in steps rather than continuously as traffic volume on the present roads increase. This assumption - made more for computational convenience than for reasons of logic - may understate or overstate the maintenance costs and hence give erroneous estimates of the savings in maintenance costs.

6.24 ECONOMIC DEVELOPMENT

The non-savings benefit items such as induced economic production or comfort to travellers raise problems of measurement that are slightly different from those of the savings benefits. Increased economic activity and comfort are positive effects and do not conveniently fit into the general definition of benefits as savings. The only way these items could be regarded as savings would be if:

1. the absence of the proposed road would occasion society some form of sacrifice or cost

2. building the road would reduce this social cost, so that the net increase in production is indeed a reduction in the sacrifice

The measurement difficulty associated with this way of looking at the non-savings benefits is self evident. In the first place if the absence of the developmental benefit is a "cost" one would like to know just how big this sacrifice is. Without this knowledge there is no way of telling what would be the size of the saving in it that would result from the construction of the proposed road. An indirect way of going about this is to regard the net increase in economic activity as a measure of the cost of non-development arising from not building the proposed road. In other words, this induced production associated with the new road is equivalent to a reduction in the deprivation that society would suffer for not building the new road. Only in this manner would it be possible to avoid the need to know the total amount of the social deprivation associated with not undertaking the proposed project. In this manner also the

general definition of a road project's benefits in terms of CS is also applicable to its developmental effects as well as to other non-savings benefits like comfort to road users.

If it were necessary to evaluate the direct growth effects of the proposed road project in the case study the estimation procedure would have been simply to forecast the expected net increase in economic activity and to value them at their estimated shadow prices. The most troublesome hitch in this would have been in forecasting possible increases in output. This is more a procedural than a conceptual problem: but it is an important one. However, the problem would probably not so much be that reliable forecasting techniques would be lacking; rather it would be that the amount and quality of statistical information necessary for accurate and reliable forecasts of output increase would not be readily available. Secondly, while the evaluation of final output items would be fairly straightforward, that of increases in the production of intermediate products would have to be handled with some caution to avoid double counting. In practice it would be best not to attempt to evaluate intermediate products at all on the assumption that their value would ultimately be incorporated in that of final products.

6.25 REDUCED RISK OF ACCIDENTS

Since evidence seems to suggest that road improvements in this country tend to increase rather than reduce road accidents, the proposed road improvement will inflict upon the

country a net cost in terms of increased risk of accidents on the new road. In that case the increase in potential accidents would be a negative spillover effect. But whether there would be an increase or reduction in the risk of accidents on the new road and whether this increase or reduction is treated as a direct or external effect of the road project would neither reduce the range nor alter the nature of the measurement problems related to road accidents.

The probable number of road accidents that might be avoided or the likely increase in such accidents that might be occasioned by improving a road can be estimated reasonably accurately. There is generally adequate statistical material in the records of traffic police for doing this. Determining the rate at which to value the increases or reductions in potential road accidents is a different and more difficult problem. The suggested willingness-to-pay method of evaluating them at the road users' or society's CV is good enough in principle. In practice no one knows the value of this CV.

Road accidents were not considered in the case study largely because it was not thought they would be an important element whether as a social cost or benefit in the appraisal of the proposed road. Probably information regarding accidents on the existing roads linking Nakuru and T. Falls would be scanty since these are not very important in terms of their usage. But even if there was abundant information on accidents

on the roads it would not have been of much help since it would not tell anything about the rates at which reductions or increases in accidents should be valued.

For much the same reason it was not considered that the environmental and other effects of the proposed road project would be large enough to merit being evaluated. Although real, these effects do not easily lend themselves to quantification and, secondly, there are no market prices at which they could be valued easily. For purposes of this paper it would have been impracticable to determine the appropriate rate of valuation for them. The best that could be done was, therefore, simply to acknowledge their probable significance when and where necessary without attempting to measure them.

SUMMARY

From what has been said above, three distinct problem areas can be identified. The first one is that of identifying what are the costs and benefits of a road project. The principal difficulty in this with regard to costs is to determine what is (or should be) the best alternative use for a project input item. This, as we have seen, is more easily accomplished in theory than in practice. An important source of difficulty in this respect is the need to incorporate unquantifiable variables such as government policy and other value judgements in deciding what is or would be best for society. In view of this it would be difficult to evolve an

objective criterion for such a decision. Since the benefits of a road project are in the form of cost savings, one of the significant problems in identifying them is to tell which are the cost items in which savings may be regarded as benefits.

The principal benefits of a road are reductions or savings in the costs of utilizing it. However, not all benefits are cost savings. Other benefits such as induced economic activity are direct positive effects and are easily recognizable.

On the whole, identifying road project cost/benefit items is usually a relatively easy matter. The major problem is in evaluating them. In principle there are two aspects to measuring project costs: firstly, determining resource opportunity costs values, and secondly, converting these into social values. The first one of these aspects involves determining the financial or private cost of an input in its best alternative use. In practice, as a working assumption the market price of an input may, unless there are good reasons for one to think otherwise, generally be regarded as a good enough measure of the private opportunity cost value of an input. The second aspect entails establishing a procedure for adjusting resource market prices to reflect the value that society (rather than individuals) attaches to economic resources - i.e. a mechanism for shadow pricing the resources. This is probably the most important and most difficult step in measuring a project costs in CBA. Since road project benefits

are mainly savings in costs the problems of measuring them are similar to those of measuring the project costs except that it is the reductions in these costs that are of interest to the appraiser. The cost savings would normally be valued at market prices, suitably adjusted to reflect social valuation. To date it would appear a satisfactory procedure for shadow-pricing cost and benefit items has as yet to be devised. The existence of diverse proposals as to how this should be done is living testimony of this unsatisfactory state of affairs. The apparently simpler willingness-to-pay method of valuing them at what people are prepared to pay for them is conceptually a very sound idea. But it is very difficult to obtain sufficient or the appropriate empirical data about some items. On the other hand, not all economists agree on the validity of the measurement procedures of the more complicated Little-Mirrlees approach. Nor has its complexity been a creditable quality in terms of acceptability to project analysts. The third problem area is the statistical one of inadequacy of data for project evaluation. This is a problem that can be overcome only in the long run. One hopes that with the passage of time and with the increasing need for more and accurate information the research effort will be itensified. In the meantime, however, the project appraiser will have to do with the little information he can glean from his hurried field investigations. In the area of road project appraisal the MOW now have under way a regular data gathering program partly to provide information for cost benefit analyses to back up

their loan applications and partly to fill the "information gap" that today seriously hampers rigor in the appraisal of their projects.

This paper has endeavoured to focus attention on the first two of these problem areas. It was inevitable, however, to make references to the third. The object has been demonstrate the main source(s) of the limitations that bedevil road project evaluation. And in doing this, the emphasis has been on the proposition that it is the nature of the costs and benefits of a road project - hence the manner in which they are defined - that gives rise to the identification and measurement problems which so much frustrate the efforts of road project analysts.

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