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EVALUATION OF INFRASTRUCTURAL INTERVENTIONS FOR RURAL POVERTY ALLEVIATION

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Foreword

By mid-1997, the Asian and Pacific region had experienced two or more decades of rapid economic growth. In some cases this growth had led to improvements in the standard of living of the less well-off members of society. In general, however, poverty remained widespread. With the onset of the financial and economic recession in East and South-East Asia, the situation deteriorated and major setbacks were experienced.

In most countries of the region, the vast majority of the population lives in rural areas. It is in these areas where the incidence of poverty is highest and the standard of living is lowest. Lack of access to social and welfare services, such as health, drinking water, sanitation and education, and to employment, markets and other economic opportunities is a major contributing factor to poverty and low standards of living.

In the light of the above, ESCAP, with financial assistance from the United Nations Development Programme (UNDP), executed a pilot project on participatory planning of rural infrastructure in two zones of Oudomxai Province, Lao People's Democratic Republic. The project was designed to fit within and cooperate closely with the Integrated Rural Accessibility Project (IRAP) of the International Labour Organization (ILO). The ESCAP component comprised a number of elements, including implementation of a participatory approach to identifying and planning infrastructure interventions; direct transport or transport saving interventions; technical assistance in the areas of agriculture, watershed management, micro-enterprises, and savings and credit schemes; the development of guidelines for policy makers on participatory approaches to rural infrastructure development; and the development of training-of-trainers manual for using participatory approaches in rural infrastructure development.

The project benefited from a management structure which included a number of "cluster" countries. Through the sharing of experience, these countries made considerable contributions to and learned from the activities undertaken during the project.

The Asian Institute of Transport Development (AITD) contributed directly to the successful implementation of the project. Its contributions included undertaking a study on evaluation of infrastructural interventions for rural poverty alleviation and hosting the Regional Seminar-cum-Cluster Country Meeting on Participatory Planning of Rural Infrastructure, held from 5 to 8 May 1998 at New Delhi. ESCAP is pleased, therefore, to bring out this publication jointly with AITD. I am particularly encouraged by the high

level of cooperation between ESCAP and AITD in the spirit of the Memorandum of Understanding between our organizations.

It is clear that many development projects and even integrated development projects in rural and underdeveloped areas, guided by traditional economic cost-benefit analyses and top-down approaches, are not achieving their desired results. It is being increasingly recognized that projects and programmes need to encompass both social and institutional dimensions which demand the participation of all members of society, i.e. all concerned stakeholders. The programme of work of the ESCAP secretariat is designed to embrace this wider perspective and we look forward to continuing our assistance to the members and associate members of the Commission in these areas.

Adrianus Mooy
Executive Secretary
ESCAP

Preface

Project analysis through the cost-benefit method is one of the most widely used techniques for setting out decision rules for the selection of one or a combination of projects in a manner that resource allocation will be optimal and efficient. Developmental projects have been guided largely by the exigencies of such analyses.

Developing countries have also tended to follow the maxim that if enough is invested, rapid growth will result. It was taken for granted that growth through massive industrialization would also automatically lead to a reduction in poverty. 'Trickle down' theories held sway and skewed growth was not considered a serious possibility. Consequently, an important policy formulation within this intellectual framework was that, until the early 1970s, alleviation of rural poverty, at least as a direct economic objective, did not receive much attention.

The emphasis was - and, sadly, even today tends to be - on conventional cost-benefit analysis which usually fails to capture the spin-off benefits that accrue from the creation of rural infrastructure. In a project which produces physical goods, it is quite easy to value the produce by taking market prices. Also, in most industrial projects costs are clearly identified and the output is repetitive which means that, given a technology, it is easy to calculate the stream of costs and benefits that will flow.

This, however, is not the case with rural infrastructure. An infrastructure project aimed at poverty alleviation in rural areas will, of course, have some conveniently measurable direct and tangible benefits but, in the main, the benefits which accrue from such projects are more often than not indirect and intangible. Rural infrastructure projects also trigger a number of forward and backward linkages whose benefits cannot be directly or indirectly measured and quantified as is the case with activities like rural roads, irrigation, health, education, housing, etc. This characteristic of rural infrastructure has led to the realization that multiplier effects and employment generation effects need to be incorporated in the analyses.

The economic and social consequences of rural unemployment and poverty are more than the wage income foregone. Thus, income created for poor rural households and their energy/fuel gaps covered need to be 'valued' more completely. Again, rural infrastructure plays a strong mobilizational effect. While at the aggregate level macro resources of government savings or foreign exchange may be scarce, rural infrastructure

can mobilize latent unmobilized resources for development.

Another aspect which has to be kept in mind is the lumpiness of investments in infrastructure projects which makes measurement even more problematic. Given limited resources, policy makers have to make decisions about choosing from projects without having a full perception of the benefits that will accrue. Overall, therefore, the outcomes have tended to be suboptimal. A great deal of effort is needed to build a systematic methodology specifically suited to the evaluation and selection of infrastructural interventions designed to deal with poverty alleviation in rural areas.

This study was undertaken for United Nations ESCAP by Dr. G. S. Bhalla with the financial support of UNDP. Dr. Bhalla is a well known economist, who has been a Member of the Indian Planning Commission. He is presently Professor Emeritus, Jawaharlal Nehru University and Adviser, Asian Institute of Transport Development. He was ably assisted by Prof. Gurmail Singh of the Punjab University in researching the material and for offering valuable comments on the early drafts of this publication. The publication also benefited from the deliberations of the Regional Seminar-cum-Cluster Country Meeting on Participatory Planning of Rural Infrastructure, held in New Delhi in May, 1998.

The study starts from the premise that positive externalities must play a critical role in the selection of projects which may fail the tests of conventional cost-benefit analysis. Drawing heavily on India's rich and varied experience in the matter of rural poverty alleviation, it sets out a more inclusive methodology with a view to aiding the creation of rural infrastructure from the standpoint of the multiplier effects such as infrastructure can generate. It concludes that of all the various strategies, the sustained creation of rural infrastructure in the form of rural roads, irrigation, storage, etc are possibly the most effective in terms of overall results.

It is important to note here that while the UNIDO guidelines have been quite useful in this regard as they have considerably helped in dealing with the redistribution of income and the measurement of merit and demerit goods, they have not captured, in adequate measure, the developmental impact of rural infrastructure projects or the benefits that accrue to the poor. This study seeks to bridge that gap.

It recommends, as the first step, a cost-benefit analysis of all financial and social costs and benefits of rural infrastructure projects. The second step, it suggests, should be the assignation of distributional weights for determining the likely benefits across the full range. Next, it concludes that policy makers should be apprised of the full range

of possible outcomes. Last but not the least, it recommends that there should be devolution of economic powers to local bodies so that project selection becomes more meaningful.

The Asian Institute of Transport Development (AITD) fosters inter-country cooperation by sharing its expertise and facilities with its member countries from the Asia Pacific region. It also disseminates findings of important research studies on issues having a bearing on balanced and sustainable development. This publication, which has been brought out by the Institute jointly with UN-ESCAP, is an effort in that direction.

K. L. Thapar
Director
AITD

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I have to express my deep gratitude to the ESCAP staff involved in the project for their interest in the study and their valuable comments on the earlier drafts of this publication. I am grateful to Professor Gurmail Singh of the Punjab University for his help and assistance in carrying out the study. My grateful thanks are also due to Professor Sheila Bhalla and Mr. K. L. Thapar for their helpful suggestions. I would also like to acknowledge that I benefited immensely from the deliberations of the Regional Seminar-cum-Cluster Country Meeting on Participatory Planning of Rural Infrastructure held during 5-8 May 1998 in New Delhi.

G. S. Bhalla

Abbreviations

ADB	Asian Development Bank
AITD	Asian Institute of Transport Development
BCA	Benefit-Cost Analysis
CVM	Contingent Valuation Method
CV	Contingent Valuation
DCF	Discounted Cash Flow
DEA	Data Envelopment Analysis
DRC	Domestic Resource Cost
EIA	Environment Impact Assessment
ERP	Effective Rate of Protection
ESCAP	Economic and Social Commission for Asia and the Pacific
GDP	Gross Domestic Product
GNP	Gross National Product
GEA	General Equilibrium Analysis
GIS	Geographic Information Systems
H. Index	Head Count Index
HYV	High Yield Variety
IFPRI	International Food Policy Research Institute
IRDP	Integrated Rural Development Programme
I-O Models	Input-Output Models
IRR	Internal Rate of Return
JRY	Jawahar Rozgar Yojana
LTC	Least Total Cost
MFALA	Marginal Farmers and Landless Labour Development Agency
NB	Net Benefits
NEB	Net Economic Benefits
NFB	Net Financial Benefits
NGO	Non-Governmental Organization
NPV	Net Present Value
P.G. Index	Poverty Gap Index
PV	Present Value
SBCA	Social Benefit-Cost Analysis
SC/ST	Scheduled Castes/Scheduled Tribes
SFDA	Small Farmers Development Agency
SPG Index	Squared Poverty Gap Index
TFP	Total Factor Productivity
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
WTP	Willingness to Pay

1

Introduction

Most of the developing countries in Africa and South Asia and some countries in South America are characterized by low levels of per capita income, low resource productivity, non-availability of modern technology in the production process, lack of skills and training, and, more serious, burgeoning population. In all development literature, rapid economic growth is recognized to be the most effective instrument for raising the standard of living of the masses and eradicating poverty. Rapid economic growth, in turn, depends on the level of investment, state of technology and availability of skilled labour and entrepreneurship.

During the 1950s and 1960s, a high growth strategy was deliberately adopted by most developing countries not as an end in itself but "as an activist interventionist strategy" to eradicate poverty. Basing themselves on the experience of industrialized countries in the West, the developing countries came to the conclusion that it would not be possible for them to eradicate poverty without rapid diversification of the economy and without achieving a significant acceleration in their overall sectoral growth rates. According to this view, rapid growth would succeed in pulling up the poor through widening the production base and through the provision of productive employment to hitherto underemployed or unemployed labour force[1] (Bhagwati 1988).

It was further argued that rapid growth would, in addition, also enable the government to mobilize resources out of incremental income for further investment for growth and for social expenditure on education and health. Therefore, most developing countries adopted policies that ensured rapid growth of gross domestic product (GDP) for maximizing national product. For maximization of growth, national economic planning was widely adopted.

By the 1970s, the development experience of these countries turned out to be quite mixed. While a few of them achieved high growth combined with rising per capita income and a significant decline in poverty, many others were only able to record low

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[1] Jagdish Bhagwati likes the phrase "pull up" better than "trickle down." This is because the improvement in the status of the poor is not a favour as implied in the trickle down (benign neglect), but it is the process that enables them to participate in the production process through availability of gainful employment (Bhagwati 1988).

to moderate growth with no significant reduction in poverty. The policy of active State intervention combined with relatively open trade regime and large foreign investments resulted in high growth in many East Asian countries as also in China after it reoriented its economic policy in 1978. Notably, the growth rates recorded by these countries also resulted in perceptible decline in poverty. On the other hand, by the 1970s, it was apparent that many developing countries in South Asia and Africa were unable to achieve any significant rise in living standards or to make a visible dent on poverty. Although, generally, the incidence of poverty was slowly declining in their case also, yet rapid population growth in some of these countries resulted in a perceptible increase in the number of rural and urban poor. The only exception to this were some well-endowed subregions within these countries (Punjab in India, central plains of Punjab in Pakistan, etc.) which experienced high growth rates in agriculture and a reduction in rural poverty as a result of successful adoption of new technology after the mid-1960s.

The failure to achieve the goals of equity and large-scale persistence of poverty and unemployment resulted in a rethinking of plan priorities in many countries. Several extreme views were expressed. According to some critics, planning with its primary concern with only growth was an inappropriate strategy for eliminating poverty because it ignored equity considerations, had an anti-agricultural bias and concentrated attention on investment in heavy industrial sector with limited linkages effects. It was argued that "development from below" strategy was more appropriate for meeting the needs of the rural poor as against the "top down" strategy pursued so far by these countries. This was because the main objective of bottom up strategy was full development of a region's resources and human skills for the satisfaction of basic needs of all strata of regional or national population (Stohr 1981).

Another variant of growth-equity strategy was to concentrate not on growth of GDP but on human development through devoting a major proportion of investment resources to education and health in rural and urban areas. The objective was better health and increased level of literacy and human welfare and increased labour productivity. It was claimed that this strategy yielded rich dividends in the case of Sri Lanka and Kerala in India where, as a result of large investments in health and education, human development indicators showed significant progress.[2]

It is worth pointing out that both the theoretical premise as well as the empirical evidence to support the assertion that direct attack on poverty was a superior strategy ~~than growth strategy wa~~s very weak and erroneous. Theoretically, even if direct attack

[2] That the strategy had started facing difficulties and had become unsustainable in Sri Lanka has been brought out by Bhalla and Surjit (1988).

on poverty did result in yielding quick results in terms of reducing poverty, it was not sustainable over a long period since enough resources could not be generated from anywhere without growth of the economy unless substantial foreign aid was available on a continuing basis – an impossible situation for big countries.

It is interesting to note that, during the 1980s, the indirect route of eradicating poverty through rapid growth was once again recognized as the only sustainable strategy of poverty reduction and the difficulties of traversing the direct route to eradication of poverty were being increasingly appreciated. Simultaneously, structural adjustment programmes introduced in many developing countries during the 1980s emphasized the role of the private sector, assigned a limited role to the public sector and advocated its privatization.

The growth equity debate has enriched the development literature and also influenced policy and its orientation. In response to some of these criticisms and the objective reality of the prevalence of large-scale poverty and unemployment, the policy makers in these countries gradually started changing and amending their development strategies. Thus, along with indirect growth strategy for improving the well-being of the lowest income groups, direct policies for the eradication of poverty also became an important complement in most developing countries. The general consensus was for a strategy advocating "redistribution with growth" or "growth with equity".

For example, India's Fifth Five-Year Plan included, along with growth, *Garibi Hatao* (Poverty Eradication) as one of its central objectives. Many other countries also adopted a mixed strategy and allocated large resources in schemes designed for rural development aimed at benefiting the rural poor. As a result, many anti-poverty programmes were launched by these countries. In some countries like India, these anti-poverty programmes had two essential aspects : one, raising the productivity of the self-employed through asset creation; and two, generating employment through special employment programmes and encouraging labour-intensive patterns of production in the economy.

At the same time, it was realized that besides low incomes, the poor also lacked adequate access to some public utilities like public health, safe drinking water, sanitary facilities, education, etc. that are crucial for better health and productivity. Therefore, the 1970s witnessed, in addition to promoting investments for growth, initiation of programmes for augmenting the productivity of the self-employed, generation of employment opportunities through public works, food for work programmes, public distribution of food items and various nutrition programmes, and extension and expansion of essential

public services like health, water, education, electricity, roads, etc. (India 1974, and World Bank 1978).

Over the years, many a lesson have been learnt at the practical level. Besides, the growth strategy itself has tended to become more oriented towards the welfare of the poor. The multilateral lending agencies have started giving importance to direct poverty eradication programmes. Simultaneously, in many projects, including infrastructure projects dealing with transport, irrigation, power, etc., poverty concerns have been explicitly built in. In many countries, the national governments have started introducing policy-induced pro-poor bias in the growth process through selective policies like land reforms, and reforming or building institutional mechanisms like special credit facilities for rural areas and for the poor, and special schemes for disadvantaged sections of the population.[3]

In the direct route which consists of provision of education, health, sanitation, and other social infrastructure, there has been a deliberate pro-poor bias aimed at giving special consideration to the poor through subsidies, stipends and reservations. More importantly, in many cases there has been a deliberate attempt to build growth objectives in the direct anti-poverty programmes, and many growth oriented programmes, like rural transport, irrigation and rural electrification, have been given a pro-poor orientation and are also being frequently included in the anti-poverty programme.

One of the most important examples is the Million Wells Scheme in India which was conceived as a part of the direct poverty reduction programme called the Integrated Rural Development Programme (IRDP). Simultaneously, an attempt is also being made to focus even the indirect growth oriented programmes of infrastructure development like rural roads, irrigation, etc. primarily on poverty alleviation. Building of a rural road in a poor locality in preference to a well endowed area is an example. Thus, in many cases, the programmes are being so designed as to simultaneously fulfil the growth and equity objectives.

The decision regarding the size of allocation to growth programmes and anti-poverty programmes is a political decision that is taken during the budget-making process. In a democracy, it is expected to reflect the behaviour of the voters, both rich and poor, as interpreted by the party in power. It is sometimes suggested that quite often political decisions favour the rich as against the poor, since most of the techniques that are used for the selection of a project, like benefit-cost analysis, involve adding the gains and losses to all affected groups on the same basis and it involves a selection orientation

[3] For example, in India, special programmes have been instituted for the uplift of the scheduled castes and scheduled tribes, tribals, etc.

against low income groups (Gannon et al. 1997). Then, what is the way out. In a democracy, ultimately decisions have to be taken through a democratic process and through voting. But both the policy makers and the public could be better informed about the likely distributional implications of alternatives. The lending agencies while providing loans for projects could also contribute to project reorientation towards the poor through built-in norms or, sometimes, through explicit conditionalities favouring poverty orientation of the project. But such conditionalities could be ineffective and sometimes counterproductive because of lack of popular support. Democratic decentralization of political power and its devolution to the village level and local level participation in the decision-making process through village level elected bodies (like *Panchayats* in India and Pakistan) is one of the preferred democratic methods for selection of pro-poor projects. Decentralization has a special advantage since village-level elected functionaries are likely to be more responsive to the needs and demands of the poor. These functionaries could be helped through the dissemination of relevant information on the likely distributional implications of a given project.

On the other hand, in a traditional semi-feudal set-up, the rich may completely dominate local institutions and use them for grabbing more power and common property resources. Certain built-in mechanisms like reservations for the low castes, the poor and women could counteract these forces. Finally, and most importantly, the project selection can become pro-poor only if the poor get organized and are able to assert their rights. Howsoever benevolent a State may be, it is ultimately the prevailing power structure in the rural and urban areas that plays a decisive role in the decision-making process. It is in this context that the organizations of poor peasants, the rural workers' unions and other non-governmental organizations (NGOs) can play a useful part in organizing the poor and empowering them. To sum up, in a democracy, there are no short-cuts to decentralization and devolution of political and financial powers to local governments. Building strong movements of the poor and involving them in the decision-making process through their active participation, could contribute significantly to the objective of giving a pro-poor content to the planning process.

Given that it has been decided to launch pro-poor schemes, a further problem is to choose between various types of anti-poverty programmes, like building of rural infrastructure, namely, roads, rural electrification, irrigation; direct disbursement to the poor; public distribution system and provision of subsidized food; distribution of food stamps; provision of education and primary health; provision of subsidized inputs for increasing agricultural production; employment-generating programmes; asset creation for generating income streams over a period of time; credit for purchase of a cow or buffalo or a cycle rickshaw; repair kits for tubewells; training for self-employment, etc. The task, therefore, still remains of sub-allocating funds budgeted for social programmes

and anti-poverty programmes into their various components. A further decision pertains to the distribution of different programmes among various layers of the government, that is, among the federal government, the states and local bodies after decisions regarding financial devolution have been taken. In some countries like India, Pakistan and Sri Lanka, constitutional provisions exist as to the devolution of resources and distribution of functions between the central and the state governments. Devolution to local bodies is not that common, except in some countries like Sri Lanka and now India where a beginning has been made in this direction.

Project analysis through benefit-cost method is one of the most widely used techniques for setting out decision rules for selection of one or a combination of projects given their respective benefits and costs, the overall objective being to bring about the most efficient use of given scarce resources. But this is easier said than done. In a project which produces physical goods, it is quite easy to value the produce by taking market prices. Further, in most industrial projects, it is very easy to evaluate the likely benefits, since the output is repetitive, i.e. given a certain technology, engineers will be able to tell the likely quantum of output over specified periods of time. In its conceptual frame, the conventional social benefit-cost analysis (BCA) also generally underlines the need for measuring the "secondary benefits", "externalities", "linkages" and "intangible effects". However, in practice, despite the recognition of their importance, these are seldom considered (Little and Mirrlees 1974).

Generally, infrastructure or social overhead capital refers to basic public services and facilities which provide an environment for productive activities of individuals and groups in society. An infrastructure project aimed at poverty reduction in rural areas has no doubt some easily measurable direct and tangible benefits. However, the main benefits to flow from these projects are likely to be indirect and intangible. Further, their main merit is that they generate lots of externalities and also have impact through linkages.[4] Although these benefits pose difficult measurement problems, it is these which are likely to be of paramount importance in rural infrastructure projects like building rural roads, irrigation, education, health and housing, which are aimed at overall economic development and poverty reduction in rural areas.

For example, it is not possible to directly quantify all the benefits that are likely to flow from a rural road, which is likely to foster economic activity through increased connectivity and access to other services like education and health. Again, an irrigation project besides leading to increases in output also creates many externalities in the form of raising the water table in surrounding areas and improvement or degradation of the environment. The benefits of education are not only improvement in the skills of labour

and earning capacity of the labour force, but also reduction in crime and a better social life (UNIDO 1972). Again, the likely benefits of poverty reduction are increase in welfare, increase in the capacity of parents to send their children to school, and increase in the efficiency and productivity of the workforce owing to better health. These benefits are also intangible and are not amenable to easy measurement. Besides, these are not repetitive since some of the programmes are completely new and some others might have different outcomes if they operate in a different socio-economic milieu. For example, in the case of rural roads, the outcome would depend on the regional pattern of development, the density of population, the nearness to a market or industrial town and the mobility of the labour force.

The measurement problems get further exacerbated because most of the infrastructural projects are lumpy in nature, have externalities and quite often produce public goods where user charges are difficult to collect because of free riding. In their case, valuation creates innumerable theoretical and practical problems. BCA is neither a foolproof recipe nor a substitute for clear thinking and explicit value judgement. It is a useful way to organize information. Uncertainty about future outcomes would remain even after benefits and costs have been estimated and compared. BCA is useful insofar as it lays down the first principles for improving public allocation of scarce resources.

To recapitulate, given limited resources, policy makers have to make decisions about choosing from among various growth and anti-poverty projects. For this, it is important to measure benefits and costs carefully and set out decision rules as clearly as possible.

Benefit-cost analysis tries to deal with measurement problems in a systematic manner. This analysis does not provide perfect answers but tries to reduce the extent of arbitrariness in the calculation of relative benefits and costs of alternative projects and, thereby, is an aid in the decision-making process. The analysis is useful as it can make the decision-making process less arbitrary and help public authorities make a choice from among numerous competing projects. But the conventional analysis also underplays, if not disregards, most of the indirect benefits like externalities, linkages and other intangibles which are characteristic of a rural (or urban) infrastructure project. An attempt is made here to first briefly describe the main contribution of rural infrastructural projects like rural roads, irrigation, rural electrification, credit, market, agricultural research

[4] According to Ahmed and Donovan (1992), "Four conditions that define infrastructure provide a basis for common understanding : (i) the services provided facilitate or are basic to economic activity, (ii) the services are usually public goods because of common externalities, (iii) the services cannot be imported, and (iv) investments tend to be indivisible or lumpy."

and extension. This is followed by a critical examination of the conventional benefit-cost methodology and some of its limitations in terms of dealing with the measurement of benefits and costs of an infrastructure project aimed at poverty reduction in rural areas. Finally, an attempt is made to suggest some additional and supplementary methodology to deal with the specific problem of measurement of benefits from an infrastructure project aimed at poverty reduction in rural areas.

Given a vast amount of literature on benefit-cost analysis, some justification must be given for yet another essay on the subject. The rationale for the present attempt lies in the fact that most of the existing literature has concentrated on well designed projects operating in, more or less, known areas. Although some very perceptive work has also been done on rural infrastructural programmes for reducing poverty, a great deal of effort is still needed to build a systematic methodology specifically suited to the evaluation and selection of infrastructural interventions designed to deal with poverty eradication in rural areas; more so, because, keeping in view the prevalence of high incidence of rural poverty in many developing countries, their governments are incurring huge expenditure on anti-poverty and employment-generating programmes in rural areas. The present study is a modest attempt towards working out such a methodology.

This study is divided into seven chapters. After the introduction in chapter 1, chapter 2 briefly describes the goals and objectives of infrastructural interventions in rural areas. Chapter 3 on the impact of rural infrastructural investment reviews in broad terms the experience of various countries as to the importance they accorded to infrastructural investment and the benefits realized as a result of infrastructural and associated investments. Since the measurement of benefits and costs poses a serious problem, chapter 4 deals with the classification of benefits and costs into private, social, pecuniary and non-pecuniary, the main conceptual problems faced in the measurement in each case and the proposed solutions. It also contains a brief discussion of the methodologies used for the measurement of social benefits and costs, and numerous complexities and conceptual problems involved in their measurement. Given difficulties of assigning exact quantitative values to social benefits and costs, building up of independent indicators by the experts could provide a good approximation to the calculation of these benefits and costs. These are discussed in chapter 5. Chapter 6 gives the methodology and mathematical calculation for determining benefit-cost ratios and net benefits. Given the broad mathematical formulation, the techniques of evaluation of infrastructural investment, and the complexities involved in the measurement of social benefits as suggested by various experts in benefit-cost analysis like Little and Mirrlees and Dasgupta, Sen and Marglin (UNIDO method) and other scholars are described briefly in this chapter. Finally, chapter 7 gives the main conclusions of the study.

2

Goals and Objectives of Infrastructural Interventions in Rural Areas

Types of Infrastructural Investment in Rural Areas

The term "infrastructure" has been variously defined by scholars[5]. Infrastructure development is often divided into two categories, namely, directly productive economic infrastructure and social infrastructure. The distinction between these two is often made on the basis of their differences in the production process, as discussed below.

Economic Infrastructure

Economic infrastructure produces services that directly facilitate and are basic to the carrying out of a wide variety of economic activities. These are generally priced low, are subject to public control or regulation and investment therein is characterized by lumpiness. Rural infrastructure, therefore, includes investments that directly and indirectly affect productivity in agriculture and other rural non-farm activities. The main categories of economic infrastructural activity are investments in rural electrification, rural credit institutions, scientific agricultural research and extension, flood control and drainage, irrigation works, rural roads, rural transport, markets for inputs and outputs, storage structures and warehousing facilities, common property resources, and watershed development. In addition, it includes infrastructure for developing allied and non-farm activities like dairy development (i.e. improvement of milch animals, milk collection and chilling centres) and agro-processing and other village industries and crafts. While some infrastructures like irrigation, credit and agricultural research enable the adoption of new technology, some others, like transport, provide intermediate services to facilitate interaction between productive activities.

Social Infrastructure

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[5] Infrastructure generally includes both physical and social overhead capital. In that broad sense, infrastructure would include public utilities, ports, water supplies and electricity (Lewis 1955); transport, public utilities, schools and hospitals (Higgins 1959); transport, power, law and order, education, public health, communications, water supply, irrigation, and drainage (Hirschman 1959).

Social infrastructure includes activities like access to schools, primary health centres, safe piped drinking water, sanitation, pavement of streets and building of community centres. While investment in economic infrastructure primarily plays a complementary role in increasing productivity of existing assets, generating more employment for labour and providing increased access to urban markets including labour markets, investment in social infrastructure results in creating a healthy working environment as well as facilitating human capital formation in rural areas.

Objectives

In most developing countries, the main objective of planning and development policy is growth with equity. Investment in rural infrastructure constitutes an important component of national planning and thereby subserves the various objectives decided upon by the policy makers. For example, the main objectives of the Ninth Five-Year Plan of India are higher rates of growth of output and employment, human development, eradication of poverty, development of social sectors, minimizing economic disparities and correcting regional imbalances, building self-reliance, empowerment of the poor and women, food security, environmental sustainability and promoting people's participation in government (India 1998).

The multinational agencies have also adopted growth, sustainability and poverty reduction as the main goals for their project assistance. For example, the UNIDO Manual (UNIDO 1972) states several goals like increasing aggregate consumption, income redistribution, generating employment, improving environment, rural area development and self-reliance as the main goals of development policy and project aid. Similarly, UNDP and other donors have adopted sustainable human development, including poverty alleviation, employment, environment, good governance, and women's development as their goals and objectives.

There are certain types of infrastructural investments like in rural transport, irrigation, new technology, etc. which benefit all sections of rural society with certain time lags. But there are others, like development of air transport, that are almost completely biased towards the rich. A popular view is that, in general, benefits from rural infrastructural projects accrue to all sections of the rural society, perhaps more or less in proportion to their asset base or political clout. However, most empirical studies bring out that the poor also benefit a great deal because of the availability of more employment opportunities. But, a careful targeting, like giving of subsidized credit to the poor, could result in a flow of greater benefits to the rural poor.

Various objectives of rural infrastructural development are given below.

Growth with Equity

Growth with equity has become the avowed objective of development and planning in most developing countries. The basic aim of infrastructural development is to promote growth and to the extent the infrastructure is located in rural areas, which generally have higher incidence of poverty, any gains in productivity consequent to the increased investment in infrastructure are going to benefit the poor also.

However, in the initial stages, it is the rich who are likely to benefit the most from an infrastructure project. This is because the distributional impact of infrastructural development would depend both on the prevailing institutional set-up, social relationship and political power structure and, particularly on the land distribution pattern prevalent in the rural areas. One of the most important institutional factors is land distribution. For example, the benefits of irrigation infrastructure would flow, more or less, in proportion to the distribution of land in the village. Hence, in countries and areas like China, the Republic of Korea, Taiwan Province of China and the states of Kerala and West Bengal in India, where land reforms have been implemented, the poor are also likely to benefit, unlike in areas where land is concentrated in the hands of a few landlords. In the latter case also, irrigation may benefit the poor indirectly, as the demand for labour and wages rises as a result of agricultural development. But this would also depend on the various other factors like capital intensity of the production process and the introduction of labour displacing technologies.

The development of transport infrastructure plays an important role in the growth process through increasing mobility of resources and increasing factor productivity. Transport infrastructure saves time and decreases the cost of transportation, and, thereby, helps both the rich and the poor. Transport development in rural areas strengthens linkages between towns and the countryside. Along with irrigation, it helps adoption of new technology by reducing the cost of inputs and marketing of outputs. It helps the rural poor by increasing their accessibility to schools and health centres and enables them to obtain non-farm employment in far-away places (Chadha 1994).

It is often argued that because of relatively lower valuation of time by the poor compared with the rich, the poor would benefit more from non-mechanized transport while the rich would benefit more from mechanized transport and would be willing to pay more for it for saving time. Therefore, while the poor should get non-mechanized transport, the time-saving mechanized transport should be for the rich. However, this extreme argument has serious implications. It is true that in a traditional set-up, the poor are almost entirely dependent on low level supportive mechanisms of infrastructure.

However, with economic development and the availability of regular wage employment in secondary and tertiary sectors, transport development enables the landless labour also to commute quickly to save time. Thus, even for the poor the value of time changes very quickly. This points to the need for development of public transport facilities that are made available to the poor at reasonable prices. Hence, equity considerations in the development process should not become a means for the perpetuation of technological dualism. This underlines the need for taking a more dynamic view in the valuation process.

Besides physical distance, socio-cultural and economic conditions are sometimes identified as major determinants of access to infrastructural services (World Bank 1994). Transport and communications also tend to shatter some of the social prejudices by increasing interaction with the town and also enable many so-called high caste but poor cultivators who avoid the stigma of undertaking manual work within the village (Thorner and Thorner 1962) to move out to obtain wage employment in other places.

The choice from among various projects with differing objectives is normally based on benefit-cost analysis. As will be discussed later, in many cases where the benefits and costs are intangible, and in some cases which involve value judgements, pure benefit-cost approach has to be tempered with decisions taken through the political process. It is sometimes suggested that the political process itself may favour the rich against the poor. So, how can equity considerations be directly built in the project selection? This issue also needs to be discussed.

Increasing Productivity

Developing countries are characterized by low levels of productivity of land, labour and capital in almost all sectors of the economy, in particular, in agriculture and allied sectors in rural areas. Infrastructural development does not directly raise productivity, but provides the necessary preconditions for increasing it. Given an appropriate institutional set-up, infrastructural investments help to shift the production frontier outwards. Infrastructural interventions like investment in rural transport, irrigation, rural electrification, rural credit, roads and communications, regulated markets, agricultural research and extension, land reforms, education and health, and investment in common property resources are universally acknowledged as the most important sources of increasing productivity of resources in both farm and non-farm sectors in rural areas.

For example, the development of transport infrastructure plays an important role in expanding the product and factor markets, in reducing the costs of marketing agricultural produce and in transmission of price thereby increasing farmers' profitability and reducing

labour market imperfections by cutting down interlocking between land, labour and credit in rural markets. The expansion of product and factor markets is generally instrumental in promoting specialization in production both in agricultural and non-agricultural activities. Economically backward villages which could not interact with towns earlier had to specialize in the production of low value perishable produce or cheap foodgrains for a limited local market because of lack of transportation. With the availability of transport infrastructure, they start producing for the larger market. This gives them an incentive to increase their productivity and incomes (Ahmed and Rustogi 1987).

Along with other infrastructure, transport development accelerates the adoption of new technology by making inputs cheaper and increasing interaction with extension agents, and also helps in marketing the surplus produce. The two rival states of Punjab and Haryana which pioneered the green revolution in India had a running competition in claiming to be first in achieving some landmarks relating to the building of rural infrastructure. While Haryana claimed to be the first to have provided electricity to each village, Punjab claimed to be the first to have connected each village with a metalled road.

In most developing countries, a majority of the rural population still depends on agriculture with low productivity. Land reforms remove the barriers to agricultural development by removing institutional constraints like outmoded land relations including large scale prevalence of tenancy and create necessary incentives for increasing productivity in agriculture.

Again, irrigation infrastructure is a prerequisite for the adoption of new seed-fertilizer technology for increasing productivity in agriculture. The experience of most of the East Asian and South Asian countries brings out that the adoption of new technology enabled the farmers to record significant increase in their productivity and income and also enabled the agricultural workers to obtain more employment at higher wages. The existence of road and transport infrastructure facilitated the farmers to sell their surplus produce in market towns without incurring exorbitant costs. Credit infrastructure entitled all categories of farmers, including the small and marginal farmers, to purchase necessary inputs. This resulted in significant increases in the income levels of all categories of cultivators and agricultural labourers. This also enabled these countries to improve their food security which had been seriously impaired during the 1960s.

Most important, in many instances, rapid agricultural development triggered growth in secondary and tertiary sectors through input, output and consumption linkages, thereby resulting in higher labour productivity and wages. The existence of other infrastructures like rural roads, transport and communications, collection centres and, above all, rural

electrification provided the necessary prerequisites for growth of on-farm and non-farm activities in rural areas. There is sufficient empirical evidence that a consistently high agricultural growth and consequent higher growth in the secondary and tertiary sectors through the multiplier effect in some regions of Asia made a significant dent on rural poverty (Ahluwalia 1978). Hence, by all accounts, rural infrastructure played a major role in increasing productivity and contributed to rural development.

Access of Women to Infrastructure

It has been found that in spite of the existence of physical and social infrastructure, certain disadvantaged groups like poor children and some women are unable to make use of infrastructural services like education and health care (World Bank 1994). For poor children, education does not become available because they have to work for a living. For women, social prejudices preclude them from making use of these services. The result of their inability to access the social services is increased morbidity, lower education, and continued ill health.

Consequently, improving the access of women to education and health infrastructure is recognized as one of the important measures to improve socio-economic conditions of women (Calvo 1994; Levy 1996; World Bank 1994).

Market Extension

Infrastructural investment in rural roads, transport and communications has profound effect in establishing links between rural and urban areas and thereby augmenting existing production activities through input, output and consumption linkages. This takes place through diversification of economic activities, increase in mobility and accessibility of both output and factors of production. The most important impact is because of the increase in labour mobility due to increased accessibility and the establishment of road networks. This enables workers to move to higher wage occupations in non-farm urban labour markets and results in increase in rural wages.

Environmental Sustainability

Sustainable development is the development that lasts (ADB 1997). Keeping in mind that sometimes growth can be oblivious to environmental considerations and that environmental degradation makes the future generations worse off by degrading the earth's resources and polluting the earth's environment, the objective of sustainable development has now been universally accepted. It is also increasingly appreciated that the cost of

maintaining the sustainability of the environment ought to be borne by the present generation.

But there is no agreement on the major causes of non-sustainability. One point of view has put high population growth and poverty as the main cause of degradation. It is argued, for example, that the reason why the poor today degrade their environmental resource base is that their poverty forces them to discount future incomes at unusually high rates (Bardhan 1996). Others have argued that it is the low rates of return on private investment in the resource base owing to institutional failures which are mainly responsible for degradation of the environment (Dasgupta 1998). Some others have asserted that high rate of population growth is the main cause of depletion of natural resources like land, water and other resources. On the other hand, some scholars have argued that it is the insecure property rights of peasants and persistence of semi-feudal relationships along with the decline in common land in the villages, that have gradually deprived the poor of an important source of income. The lesson is that it is only the empowerment of local governments with adequate representation of the poor which can act as an effective counterweight to forces that erode environment and reduce the availability and access to common property rights. An impact evaluation of 25 World Bank agricultural projects brought out that there was a very high correlation between the involvement of local community institutional arrangements and the long-term sustainability of bank investments.

However, sometimes local communities are also likely to take a short-sighted view regarding environmental implications because of lack of awareness and high value accorded to present income as against future income. For example, in Rajasthan, India, village common lands were found to have declined by 25-60 per cent over a period of about three decades, ironically because of unimaginative implementation of land reforms (Jodha 1995). Again, in Orma in north-western Kenya, there took place a large-scale privatization of common grazing lands with the consent of elders. The willingness to change transaction costs was brought about by cheaper transportation and widening markets (Ensminger 1990).

The environmental benefits and costs may not be measurable in all cases; therefore, it is difficult to put an economic valuation on their outcome. But the costs should be made as explicit and transparent as possible to enable the policy makers to form informed judgements. Generally, for any major project where environmental effects are likely to be large, and for specific projects designed to improve the environment, any economic valuation should include environmental BCA.

Income Redistribution and Augmentation

Historically, in almost all countries, public works programmes like the building of roads

or canals have been initiated during periods of distress to provide employment to poorer people. This continues even today in the modified form of special employment programmes which are designed in many countries to help the rural poor. It is done either through the provision of assured minimum earnings like food for work or through employment-generating schemes including employment guarantee schemes.

Special anti-poverty programmes have also been designed with a view to improving the productive base of weaker sections. For small and marginal farmers, quite often, inputs like fertilizers, water for irrigation, electricity and credit are supplied at subsidized rates.

The nature and composition of the promotional efforts depend on the composition of the population of the poor in a given rural setting. For example, if the majority of the poor, such as small and marginal farmers and agricultural labour, are directly or indirectly dependent on agriculture, investment in infrastructure aimed at improving agricultural development like irrigation, electricity, credit, and transport should be assigned priority, keeping in view their demand and supply. More important, sometimes, as in India, irrigation infrastructure constitutes an in-built component of the direct anti-poverty programmes. For example, under the Million Wells Scheme in India, the government gives money for an employment programme for the purpose of digging wells or tubewells only for the poor. Similarly, the Indira Awaas Yojana is also a part of the employment programmes where houses are built for the poor and scheduled caste families.

Provision of Minimum Needs

Investment in social infrastructure aimed at providing basic minimum needs indirectly leads to poverty eradication by providing a better working and living environment, physical health and human capital formation amongst the poor. In most cases, poverty itself is manifest in inadequate social infrastructure services like safe drinking water, sanitation, housing, health, family welfare, rural electrification, rural schooling and training institutions. For example, unsafe drinking water, lack of sanitation and unhygienic housing are directly related to the prevalence of water-borne, human waste related and air-borne diseases like dysentery, cholera, diarrhoea, tuberculosis, bronchitis, influenza, malaria and measles. Therefore, investment in water supply, sanitation and housing shall considerably augment the earning capabilities and nutritional status of the population not only through reduction in the incidence of disease and morbidity but also through reduced birth rate, better physique, saving on medical costs, expanding working time, and minimizing productivity losses. Similarly, human capital formation through formal education and training is considered to be the most potent weapon against poverty.

Self-Reliance

Another important objective of investment in infrastructure aimed at poverty reduction is to make the poor self-reliant and capable of meeting their basic needs out of their own resources. There is enough empirical evidence to show that the landless labourers, small and marginal farmers and the village artisans that produce traditional goods and services constitute the hard core of rural poverty in most of the developing countries (World Bank 1990). Therefore, policies aimed at self-reliance should address specific requirements of the hard core poor. The foremost policy of self-reliance is the redistribution of existing assets (mainly land in rural areas) among the landless or near landless farmers through land reforms of the type implemented in mainland China, Taiwan Province of China, Republic of Korea and in some states of India. However, implementation of land reforms and land redistribution requires strong political will, which is not evident in most developing countries.

Alternatively, the goal of self-reliance can be accomplished by improving the productivity of the existing asset base of the rural poor. This requires, apart from supplementary policies, helping the poor to overcome the impediments of low returns from assets and increasing the productivity of their land by adopting modern technology. One of the major contributions of the new seed-fertilizer technology was that it was land augmenting and, as such, to some extent, eased the disadvantage of small and marginal holdings. Still another way to achieve the goal of self-reliance is to supplement the productive base of the poor through the provision of productive assets to the self-employed. Simultaneously, the landless poor can be provided employment through employment guarantee schemes. The asset-creating and employment generation programmes should be accompanied by development of credit infrastructure especially catering to the needs of the rural poor for supplying them adequate and subsidized credit. The creation of specialized financial institutions assumes significance in this regard because supply of credit to the poor involves high risk and carries exorbitant interest rates. The task of the special financial institutions would be to identify impediments to enhancing the productivity of existing assets and to find ways and means to overcome these and simultaneously to promote viable economic activities for the rural poor. The Gramin Bank of Bangladesh which provides credit at reasonable rates to the poor to enable them to become self-reliant by undertaking productive activities is one of the most cited success stories of the operation of a specialized agency of the type required to serve the rural poor.

Improvement in Common Property Resources

Income flows from village common property resources like village common land, woodlands and local forests, grazing lands, water resources and village ponds. Inland and coastal fisheries are an important source of supplementary income for the rural poor. In

particular, common property resources constitute an important complementary source of income to the poor population in ecologically fragile, arid, mountainous and unirrigated regions (Jodha 1986 : 95). The income earned by the rural poor from the sale of fuel wood, water for irrigation, fodder and other commercial grasses, berries and nuts and gum forms a significant proportion of their earnings (Dasgupta 1998).

The main objective of investment in these resources is to augment the flow of benefits to the village population in general and to the poor, in particular. Most of these investments, like those in forests and common property rights, not only augment income but also help to check degradation of the environment and other natural resources. However, quite often, the fact that the poor do not possess any assets and do not have a regular source of income from wage employment often leads to excessive exploitation of these natural resources and can damage the environment. Further, in a village hierarchy, there is always the possibility of the cornering of benefit flows from more remunerative common property resources by the rural rich. Suitable measures have to be taken to counteract these negative features.

Empowerment of Local Government and Community Participation

Decentralization of power and empowerment of local government and communities are important components of democratic functioning and extension of democracy to the grass-root level. Community participation in the development process at the local level directs the bias of development towards local problems and the local poor.

There are two aspects of empowerment. One is political power delegated to local bodies through appropriate legislation. The other and an equally important aspect of empowerment is the devolution of financial resources to these bodies. Without these financial powers, their ability to initiate development projects for growth and poverty eradication remain just on paper. In India, recently, with the passing of the 73rd Constitutional Amendment Act, state governments have enacted enabling legislation providing for elected bodies at the village, intermediate and district levels, with adequate representation from the weaker sections and women. State finance commissions have also been constituted in all the states with a view to developing financial resources for the local bodies, including municipal committees. The *Panchayats* and *Panchayat Samitis* (elected bodies at the village level and at the level of cluster of villages) have been given necessary powers and authority to enable them to function as institutions of self-government with the responsibility of preparing plans for economic development and social justice and implementing them. It is such institutions which can be expected to undertake infrastructural and other employment-generating activities for helping the rural poor.

However, adequate care must be taken to ensure that the rich, who are generally well entrenched in the rural hierarchy, do not use the local government as an instrument for grabbing more power and resources for themselves. The Indian model (73rd Constitutional Amendment) that reserves 22.5 per cent seats in the local governments for the scheduled castes and scheduled tribes and 33 per cent for women in every *Panchayat Samiti* (local government at the level of cluster of villages) can act as an important antidote to the rich power grabbers and could be emulated by other countries.

Integrating Infrastructural Investment with National Planning

Infrastructural investment constitutes the hard core of national planning and a large proportion of plan resources are generally devoted to its development. Since these projects operate at different layers of government and in different agro-climatic regions, there is need for a careful selection of projects and their proper integration with the national plan. The plan priorities ought to be worked out keeping in view the broad objectives set out in the national plan. The detailed disaggregated schemes should be formulated in the light of variations in agro-climatic conditions, occupational composition of the population, varying economic opportunities, availability and requirements of infrastructure and other constraints.

Local planning strategy has to proceed in three stages. The first stage is to take an inventory of physical endowments of the area and to identify the potential and constraints vis-a-vis optimum utilization of existing physical and human resources. Data on numerous aspects like availability of underground water, resource endowments like availability of minerals, forests and other resources and socio-economic variables may have to be collected from secondary sources and also by employing modern scientific techniques like satellite imagery and remote sensing and mapping by using geographic information systems (GIS). In the second stage, viable activities relating to agriculture and allied sectors like animal husbandry, floriculture, horticulture, fishing and agro-processing should be identified. The main objective should be to undertake those projects which lead to the welfare of the local people, in general, and the disadvantaged and the poor, in particular, keeping in view the availability of resources. Other important aspects like long-term viability, flow of benefits to the targeted population and environmental impact have also to be given due consideration in local area plan formulation.

In any multilevel planning exercise, projects at the local level have to be integrated with the plans at the district, state and national levels. At every step, the viability and availability of resources along with technical soundness has to be kept in mind. Finally, all state-level plans have to be further integrated with the national plan within the framework

of available resources and national planning priorities and objectives.

Growth-Equity Trade-off

In all developing countries, there are competing demands on limited resources. In the process of planning also, resources have to be allocated to various programmes, including those designed for different types of infrastructure and direct anti-poverty programmes, and there is always a trade-off between growth and equity objectives. The choice between various competing projects becomes quite difficult. This is because the choice depends not only on the quantum of benefits and their time profile, but also on the indirect and intangible nature of benefit flows over a period of time in a dynamic context. For a policy maker, what is needed is a decision rule that enables him to make rational choice from among a whole set of programmes that range between direct anti-poverty programmes, anti-poverty cum growth programmes and indirect growth programmes. There is also a need to develop a criterion for making a choice among numerous programmes and projects that serve the given objectives. Thus, growth-equity trade-off becomes a crucial policy issue.

In classical literature, the choice between growth and equity objectives was supposed to take into consideration not only the present values of costs and benefits but also their impact in terms of future streams of income from alternative investments. It is often argued that owing to their higher marginal propensity to consume, increased distribution in favour of the poor tends to reduce the rate of savings in the economy, thereby adversely affecting investment and incentives for the future (Sen 1962).

On the other hand, it has been argued that additional demand due to higher consumption consequent to the pro-poor distribution of income, would generate additional demand for domestic production that would lead to creation of more jobs and hence stimulate growth through the multiplier effect. Furthermore, redistribution strategy would improve the productivity of the existing labour force because of better nutrition intake, education, training, etc. made possible by higher incomes. This would augment the future productive capability of manpower. However, if the benefits accrue after a long time gap, the present value of benefits would work out to be quite small.

The choice among various infrastructural programmes is often based on benefit-cost analysis. But benefit-cost analysis of infrastructural programmes poses several difficulties because of complexities of identifying multifaceted benefits and measuring them in a dynamic world. For example, in a study of transport in Bangladesh, the benefit-cost ratio of improving a deteriorated road to paved road worked out to be 1.19 on the basis of existing traffic

but as much as 3.48 when the projected increase in traffic was taken into account (Chowdhury and Hossain 1985). A static analysis based on user-cost saving and existing volume of traffic does not take into account the effects of changes in traffic likely to result from increased agricultural output and consequent increase in secondary and tertiary activities because of input, output and consumption linkages. Some of these concerns were sought to be taken into account by the multiple criteria appraisal method designed by some scholars for studying the aggregate benefits and costs. But this aspect will be discussed later. Although some techniques like input-ouput multiplier method may capture some of these effects, in general, their valuation is based on arbitrary value judgements of policy makers or experts.

It is often argued that infrastructural development has a built-in pro-rich bias. The argument is that any benefits of development, including those from infrastructural development, are distributed as per the distribution of assets amongst the poor and the rich. For example, it is argued that green revolution mainly benefits the rich because they have more land and have command over larger resources. However, the poor do derive benefits since they own more labour and effects on employment and wage rates must also be considered in the calculation of the relative costs and benefits. Because of growth of secondary and tertiary sectors in response to the growth in agriculture, wage incomes generally rise faster than other incomes. Wages also rise because the supply of labour from rich households is reduced as the rich withdraw their labour when their incomes increase. Further, the poor also benefit from labour intensive allied activities like animal husbandry and also from growing high-value crops on their plots. Even the direct anti-poverty programmes are more effective in areas where infrastructure is developed. Besides, certain programmes like Gramin Bank in Bangladesh by providing credit to the poor make a significant contribution in increasing their income.

Finally, a choice on grounds of equity would require assigning of distributional weights to various sections of society. But, as discussed earlier, the valuation of benefits becomes quite difficult in a dynamic setting and their use for determining distributional weights is quite complex and could pose innumerable problems. In the absence of standard methodologies, the choice of weights would ultimately depend on value judgements by the experts or policy makers. It would certainly be more helpful if the extent of arbitrariness is reduced by devising appropriate methodologies. This aspect will be discussed later.

Distributive Impacts – A Taxonomy of Scenarios

Some scholars have tried to build a taxonomy of scenarios regarding the distribution of gains between different sections of the people say, the rich and the poor in the village, as follows :

The Win-Win Scenario

The win-win scenario could be neutral, that is, when there is no change in income distribution and the project benefits everyone proportionately; relatively retrogressive when all groups gain but the rich gain proportionally more than the poor; and, finally, relatively progressive when the project benefits the low income group more than the rich relatively.

The Win-Loss Scenario (but wins exceed losses)

The Rawlsian Progressive is a case when the project benefits the poor the most and may or may not benefit others. Should it benefit the rich also, it becomes a win-win situation, otherwise it is a win-loss situation. The absolute progressive scenario would be the one where the project benefits the poor but makes the rich worse off. On the other hand, the absolute regressive is the case where the project benefits the rich but makes the poor worse off.

The various scenarios have been brought out in figure 2.1 below.

In this figure, lines EF and AA_1 show the quantum of benefits accruing from a project and its trade-off between the rich and the poor at various points on these lines while the line OC shows the existing income distribution. At C, out of 80 units of benefits, 60 go to the rich and 20 to the poor. A movement from C to D is regressive and to B is progressive. With gains rising from 80 to 100, if no intervention is made, the point A represents win-win relatively regressive distribution whereas a movement to A_1 represents win-win progressive movement. Various other points show alternative scenarios.

Figure 2.2 illustrates that projects in sectors A and B are more progressive but involve lower net gains than the projects in transport and C sectors. Selection of projects with desirable distribution impact (in sectors A and B) save redistribution costs specifically in countries having rudimentary and costly tax systems and high distribution costs. For example, between two competing projects B and A_1 (in figure 2.1), project B should be preferred to A_1 if the opportunity cost of direct income transfer is more than 20, the amount by which the net present value of A_1 (100) exceeds the net present value of B (80). Otherwise, A_1 would be preferable to B.

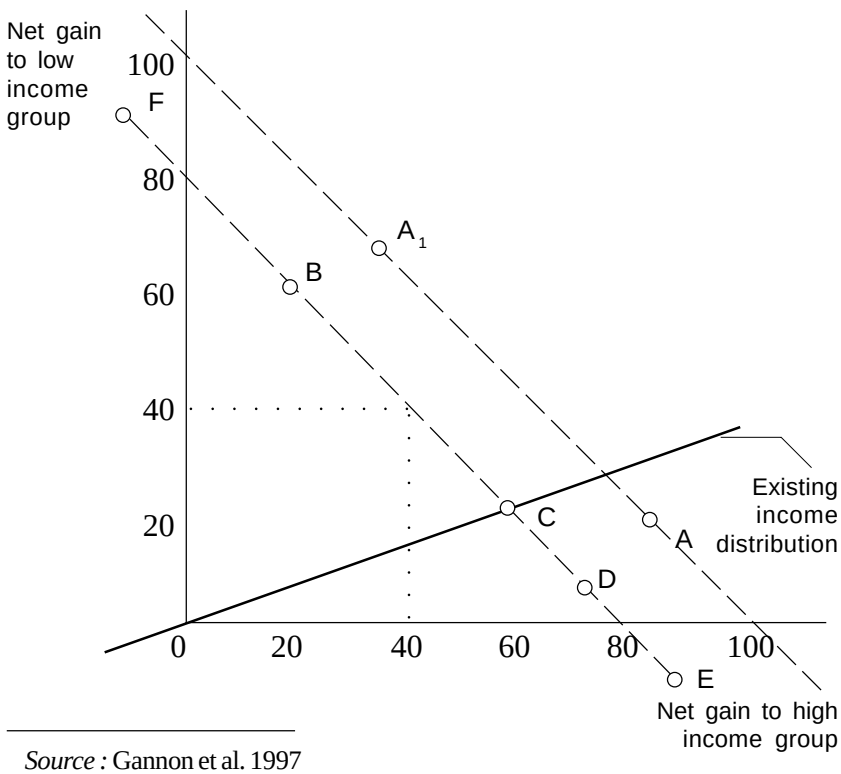
Short Term Gains vs Environmental Degradation

It is widely acknowledged that during the 1950s and 1960s most investment projects

in developing countries paid very little attention to environmental concerns. In quite a few cases, investment in industrial projects led to numerous negative externalities like air and water pollution. The existing laws on pollution or emission of chemical or toxic matter were not effective and their lax implementation made the environment around industrial units extremely polluted. Rapid and unplanned urbanization added to these problems through creation of large-scale slums and unhygienic living conditions because of inadequate availability and tardy development of urban infrastructure in housing, water, sewerage, transport and electrification.

The environmental concerns were also neglected in the case of rural projects. For example, investment in irrigation projects aimed at increasing agricultural productivity and income of the cultivators often led to the cutting down of forests for extension of arable land, waterlogging and salinity of soil. Expansion of irrigation also sometimes led to excessive use of chemical fertilizers causing increasing nitrate level in water and salinity in the soil beyond permissible levels. Similarly, the excessive use of pesticides contributed to air and

Figure 2.1. Distribution of a project's net benefits

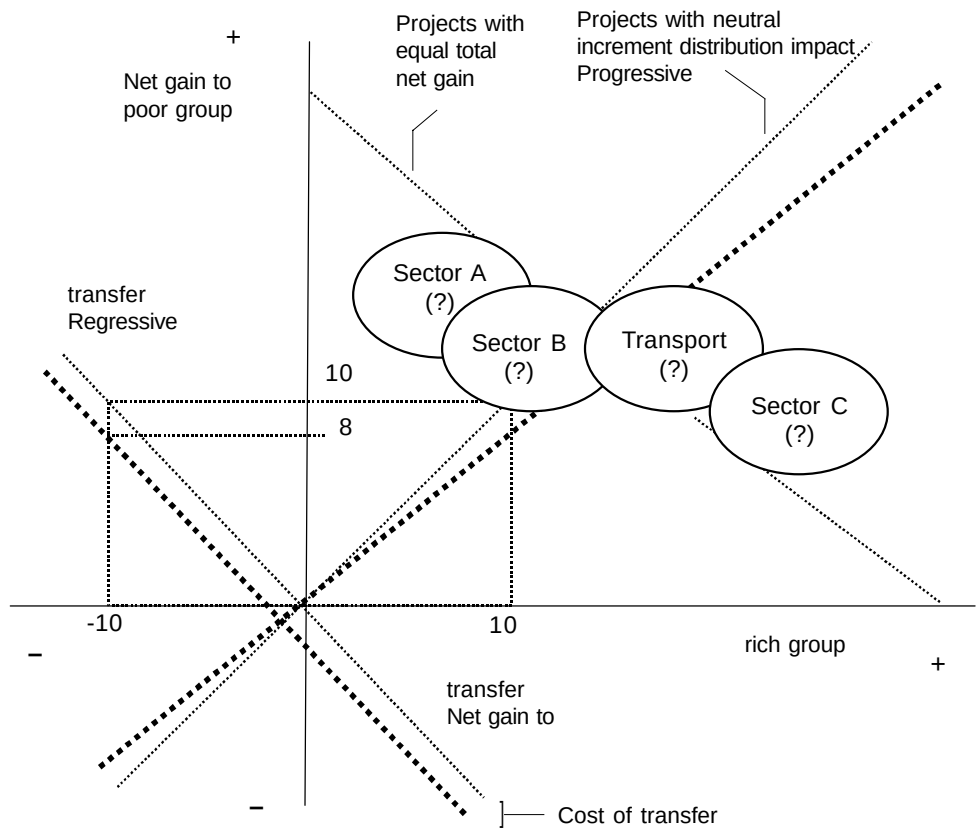


Source : Gannon et al. 1997

water pollution in the first instance, and residual overdoses in foodgrains and vegetables caused human morbidity and mortality. Similarly, excessive watering for irrigation in some

soils led to increase in salinity in these soils. It also lowered the water aquifer level, thereby increasing the cost of pumping and water availability. These and similar other activities that were oblivious of the environmental concerns have been threatening the long-term viability of natural resources and ecosystem. Due consideration of such issues in project investment not only enhances their sustainability but also augments long-term project gains, even though it involves sacrifice of some short-term gains.

Figure 2.2. Efficiency and distributional impact of project options across sectors (hypothetical)



Source : Gannon et al. 1997

Summary and Conclusions

Infrastructure development plays an indirect but crucial role in the development process through promotion of growth by increasing the productivity of factors employed in the production process. Infrastructural investments generally constitute the core of

development planning in most developing countries and large resources are allocated to investment in infrastructure like transport, electrification, irrigation, communication, research and development and social overheads like education and health. In addition to promoting growth, infrastructural investments are quite often assigned numerous other objectives like attainment of equity, appropriate income distribution and augmentation, provision of minimum needs, market extension and improvement of common property resources.

Recently, infrastructural investments are increasingly being used by the national governments to achieve poverty reduction in rural areas. Multilateral agencies also provide various loans for projects that are specifically designed to help the rural poor. In order to make infrastructural investment more efficient and pro-poor, rural infrastructural investment needs to be integrated with the national planning and local bodies have to be strengthened with a view to decentralizing the choice and execution of these projects by local authorities. Finally, it has to be recognized that the growth objectives of infrastructural development may conflict with the equity objective. Hence, the nature of trade-off between growth and equity has to be analyzed with a view to resolving the conflict and making the interventions pro-poor without losing the important objective of faster growth of the economy. The second important trade-off is between growth and environmental degradation. It has to be recognized that the debate on development versus environment sometimes tends to become highly emotional and quite often excessive enthusiasm for environmental protection tends to become anti-development. On the other hand, sometimes genuine environmental concerns are completely brushed aside in the name of development. Some of the environmental concerns which have now emerged as a major issue in debates on development have not received due attention in most developing countries. Even the existing laws for control of pollution are seldom applied rigorously because of lax administration, with the result that industrial growth has led to increasingly serious damage to land, water and some other natural resources. Policy makers need to appreciate the seriousness of the problem and ought to conceive and implement right and balanced policies for addressing these concerns.

Infrastructure plays a strategic but indirect role in development, and, more so, in poverty eradication. Furthermore, quite often, poverty eradication is not the sole objective of most infrastructural projects, but constitutes one among many other objectives. Associated with it is the complex process of interrelationships through which the flow of benefits from infrastructural intervention emerges and affects poverty. For example, road projects are often aimed at increasing accessibility. Since accessibility, in turn, is likely to increase labour mobility and expand the job market, the effect on poverty reduction is indirect. Problems also arise owing to joint project benefits. This is because the projects usually have numerous other objectives in addition to poverty reduction. For example, a transport project not only makes the carrying of goods and passengers much cheaper by

reducing the cost of transportation, it also increases accessibility of the poor to schools and to health centres. The question is how to calculate separately the benefits and costs of each set of contributions made by the project (a case of joint products). This makes the measurement of their contribution towards poverty reduction quite difficult. The next chapter will discuss in greater detail the impact of infrastructural investments on income, employment and wages and earnings of the poor.

3

Impact of Rural Infrastructural Investment

Introduction

Infrastructural investments in transport (roads, railways and civil aviation), power, irrigation, watersheds, hydroelectric works, scientific research and training, markets and warehousing, communications and informatics, education, health and family welfare play a strategic but indirect role in the development process. Unlike sectoral development, of, say, agriculture or industry, infrastructure does not directly increase output, but makes a significant contribution towards growth by increasing the factor productivity of land, labour and capital in the production process. Theoretically, economists proceed from the premise that the creation of infrastructure by generating external economies leads to widespread benefits.

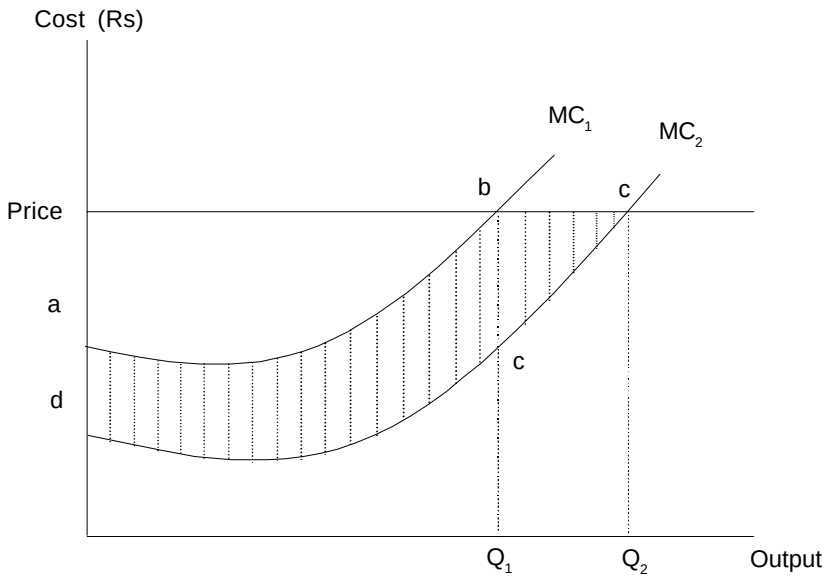
Figure 3.1, which shows the shift of the marginal cost curve, brings out the effects of infrastructure development on cost saving and increase in production in a competitive market. With improvement in infrastructure, there takes place a downward shift in marginal cost curve. This results in a total cost saving of an area abcd for the certain level of output Q_1 and an increase in output from Q_1 to Q_2. It may be pointed out that this is a simple abstraction. It does not take into account the process and sectoral interaction through which benefits accrue and also does not say anything about social developments, such as effects on consumption patterns, health and family planning. The cost reduction is the outcome of an interaction between directly productive inputs of other firms. Infrastructural investments like rural roads, for example, bring about reductions in transaction costs, improved diffusion of technology, increased specialization, better input and output prices, and improved entrepreneurial ability (Ahmed and Donovan 1992).

The crucial role of transport in economic development has been universally accepted. For example, the rural urban linkages and the pull effects of urban growth centres have long been recognized to be essentially dependent on transport and communications linkages. Again, transportation and communications were the central foundation for the opening up of new colonies like Australia and America (Ruttan 1984). Owen (1987) used a cross-

country comparison of the levels of passenger and freight with per capita income and demonstrated that the level of mobility in a country roughly reflected the level of the country's wealth. According to von Thunent, transport improvements reduce the cost of moving agricultural products to market and, therefore, extend the market, thereby encouraging cultivation, etc. Rural transport also has an important impact on the rural economy. Investment in rural roads and transportation results in reducing the cost of transportation of goods and passengers and tends to increase the share of farmers in the final realization of farm produce, thereby increasing their welfare.

There is also general agreement among scholars that the development of physical and institutional infrastructure, like investment in irrigation, and scientific research and

Figure 3.1. Infrastructure provision and the efficiency of production



extension is a precondition for the adoption and diffusion of new agricultural technology. This, in turn, increases the income of all categories of cultivators as also of landless agricultural labourers. Not only that, the existence of infrastructure like roads, communications and transportation is considered to be critical for the growth impulse generated by agricultural development through input-output linkages. The increased income of cultivators and landless labour leads to a diversification of their consumption basket, thereby giving fillip to consumer goods industries and services.

The diffusion of agricultural technology is also facilitated by infrastructural development in transport and marketing. Travel by extension workers becomes much easier. Farmers

can easily move to the demonstration farms and interact with the scientists. The access to modern inputs also becomes easier. Farmers can readily obtain high yield variety (HYV) seeds and fertilizers. Similarly, they can also take advantage of the repair facilities for the implements in market towns and other bigger towns.

The enhanced mobility of labour induced by infrastructural development, such as the opening up of rural roads, helps the rural poor in commuting to work and travelling to jobs where the wages are relatively higher. It also helps small and marginal farmers in moving away from their villages, where manual work is looked down upon, to far away places where they enjoy relative freedom from such inhibitions. Transport development also helps the small and marginal farmers to grow vegetables and other high value crops on their tiny plots and to find a market for these in nearby towns. Linkages also help the richer sections to divert their investment from limited credit markets to non-agricultural activities in rural areas or in towns. This also helps in providing additional employment to rural labour. The reduction of marketing margins has far-reaching consequences for the comparative advantage enjoyed by a country and for its competitive strength in the world economy. Again, access to institutional services like health care, education and credit becomes much easier. This helps not only in increasing productivity but also in reducing credit constraints which are the main instrument of exploitation in the rural setting. Thus, by increasing the income of the rural people, infrastructural development can also be instrumental in breaking the stranglehold of moneylenders and reducing the impact of interlocking between land, labour and credit markets (Ahmed and Hossain 1990).

Finally, changes in prices and expansion of demand brought about through infrastructural investment have an important influence on the pattern of household consumption. This is for two reasons. First, with the price differences between local and imported goods becoming less, there is some diversification of consumption demand. Second, much of the latent demand becomes realizable with the opening up. For example, the latent demand for services, mainly by the rich, becomes effective demand with the result that the multiplier effects and linkages of household demand to the second and third round of activity becomes stronger.

The Impact of Infrastructural Intervention on Poverty Reduction

The impact of infrastructural intervention on poverty reduction takes place both

directly and indirectly. The indirect impact is through its contribution to the growth of the economy. The three most important infrastructural investments that go a long way towards alleviating rural poverty, namely, transport development and irrigation, credit, and scientific research are briefly discussed below.

Role of Transport in Poverty Reduction

Development of the transport sector like other infrastructure sectors leads to increase in factor productivity in various sectors by increasing accessibility and reducing transport costs. In general, transport development focuses on increasing efficiency and growth, although in some cases like connecting rural link roads to tribal or remote areas it may directly focus on poverty reduction. It is, however, notable that even growth oriented transport development projects make important contribution to poverty reduction

Transport projects can be divided into (a) those focusing on poverty; (b) those focusing on efficiency and growth; and (c) efficiency-cum-poverty projects. It is sometimes difficult to measure the impact of transport on poverty reduction since it involves many links within the general equilibrium framework.

It is recognized that sustained economic growth leads to alleviation of poverty. Transport provides intermediate services which facilitate interaction between productive activities. Transport development reduces the cost of assembling inputs, including capital and information, for production from different locations, thereby reducing the cost of production. Further, it facilitates the diffusion of technology through increased speed of dissemination of know-how. The output prices also get reduced, thereby leading to increase in demand and promotion of regional and international trade. It also enables agriculture to commercialize, industry to specialize and the economy to enjoy benefits of scale. It also promotes diversification of the economy. Thus, the crucial role of transport development in stimulating growth is universally acknowledged. There is a strong consensus that good transport is a necessary condition but not a sufficient condition for economic growth. On the other hand, economic growth increases demand for transport.

Investment in the transport sector generates income-earning opportunities for the poor by creating jobs for unskilled labour in construction and maintenance of transport infrastructure. In addition to employment, investment in rural transport results in transport induced lower prices of consumer goods that bring relief to the poor. Further, by lowering prices of agricultural inputs, it helps poor farmers to modernize their production pattern. It also leads to higher realized price for farmer's output because of reduced transportation costs. Furthermore, increased accessibility also leads to increased well-being through facilitating higher personal mobility and diversification in socio-economic activities that results

from increased flow of information and increased use of transport services due to reduction in the cost of service delivery to the rural poor. Investment in transport, however, may have adverse impact on the poor through the environmental degradation that needs to be taken care of in transport investment planning. Diagram 3.2, at the end of the chapter, brings out how the lack of access to transport facilities and services perpetuates the vicious circle of poverty and low income operating in rural areas in developing countries. Lack of transport facilities results in low agricultural productivity, high transport costs, low profit margins, higher spoilage and loss of goods during transportation and, hence, lower levels of income and increased poverty.

Infrastructure Development, Agricultural Growth and Poverty Reduction

Rural infrastructure development, like irrigation, electrification, credit, roads and communication, regulated markets and agricultural research and extension are essential prerequisites for modernization and growth of agriculture in developing countries. The growth of agriculture, in turn, results not only in increasing the productivity and income of all categories of farmers, but also in providing greater employment to rural labour. The employment elasticity of agricultural growth was found to be positive and quite high in almost all states of India during the post-green-revolution phase. However, recently, in some highly developed agricultural states like Punjab and Haryana and also in Kerala, where wage rates are relatively high, labour is increasingly being substituted by capital and the employment elasticity of agricultural growth has become either very low or even negative (Bhalla, S. 1998). This notwithstanding, agricultural growth induces growth of labour-intensive manufacturing activities in rural areas that provide employment to the poor in allied and non-farm occupations. There is sufficient evidence to indicate that the growth of agriculture has a significant impact on reduction in poverty (Ahluwalia 1978).

Growth of manufacturing has also a positive effect on employment and reduction in poverty, although because of the high capital intensity of modern manufacturing, the employment effect may not be very large. For example, in the case of the textile industry in India, during the rationalization period of the 1980s, the absolute employment tended to decline even when textile output was increasing. But the development of the tertiary sector in general leads to more employment.

The direct effect of infrastructural investment can be in various ways. First, during the construction phase of infrastructural projects like roads, watershed development, construction of irrigation dams or powerhouses, the poor are provided employment and income-earning opportunities. Again, the most important contribution of transport is that

of improving accessibility of socio-economic activities to the rural population and the rural poor and, to that extent, they benefit. The role of road construction for disaster management is universally recognized.

The availability of health infrastructure tends to reduce infant and child mortality, as well as fertility rates and leads to eradication of certain diseases (World Bank 1993). Health infrastructure contributes to growth in several ways: (a) reducing production costs; (b) permitting the use of natural resources as accessibility increases; (c) enrolment of children in schools; (d) freeing resources that would have been spent on treatment of prevalent diseases (World Bank 1993); (e) education, health and age of women at marriage, leading to a decline in birth rates, infant and child mortality rates; and (f) enhancing women's ability to improve their own life and status as well as the lives of their children.

Infrastructure and Poverty Reduction – The Process

The process through which infrastructural investment reduces poverty is quite complex, has numerous dynamic links and operates through different income groups and affects them differently. Consequently, tracing the pattern of distribution of benefits of different types of investment projects across various income groups and geographical regions generally poses serious difficulties.

The first impact is indirect through its contribution to economic growth. The impact of growth on the rural poor would depend on several factors like the type of infrastructure, the nature of services, and the location of the project. It also depends on the operating environment, such as market structures, the degree of imperfections and government regulations.

For example, an irrigation project is likely to increase the productivity and incomes not only of the rich but also of the poor, small and marginal farmers. Thus, it has an indirect impact on poverty through growth of agriculture. In the second round, it affects the landless labour by providing more employment in agriculture and later in the allied manufacturing and services sectors. Canal irrigation leads to a rise in the water table thus bestowing a benefit on the farmers living close to the canal. It may also result in environmental damage through increased salinity and degradation of soils unless accompanied by proper drainage.

Transport project development leads to accessibility of services to all sections of population. It also creates employment both during its construction as well as for its maintenance. Poverty gets reduced if the jobs become available to the unemployed.

It may also have a negative environmental impact on the poor since they are the most vulnerable and cannot take risks. The dynamic process through which transport benefits are transmitted to the poor is illustrated through diagram 3.1, taken from Louis Berger International, Inc. (1979) as reproduced by Gannon and Liu (1997). Diagram 3.2 at the end of this chapter brings out the main constraints that can arise in the absence of rural transport.

Empirical Evidence

Numerous measurement difficulties notwithstanding, some empirical studies have tried to calculate the impact of investment in rural infrastructure like transport, irrigation and watershed development on growth and poverty eradication.

For example, many studies have tried to bring out the historical role of transport in the process of economic development. But the calculation of its impact poses serious problems because of the difficulties in measuring the capital stock and other aggregative variables pertaining to transport. The aggregate analysis undertaken by some scholars brings out that the development of transport infrastructure has a significant positive effect on economic growth although the effect is indirect and relatively long term. The positive effect is treated as suggestive only and specific to the area from where data has been collected. Many studies find correlation of per capita gross national product (GNP) with passenger and freight transport volumes. The conclusion is that transport development plays a very important role in the growth process (Owen 1987). In a case study of Palanpur village in Uttar Pradesh, it was shown by Longust and Stern (1993) that the availability of rail transport had helped the villagers to commute to towns of Moradabad and Chandausi for employment and thereby improved their living standards.

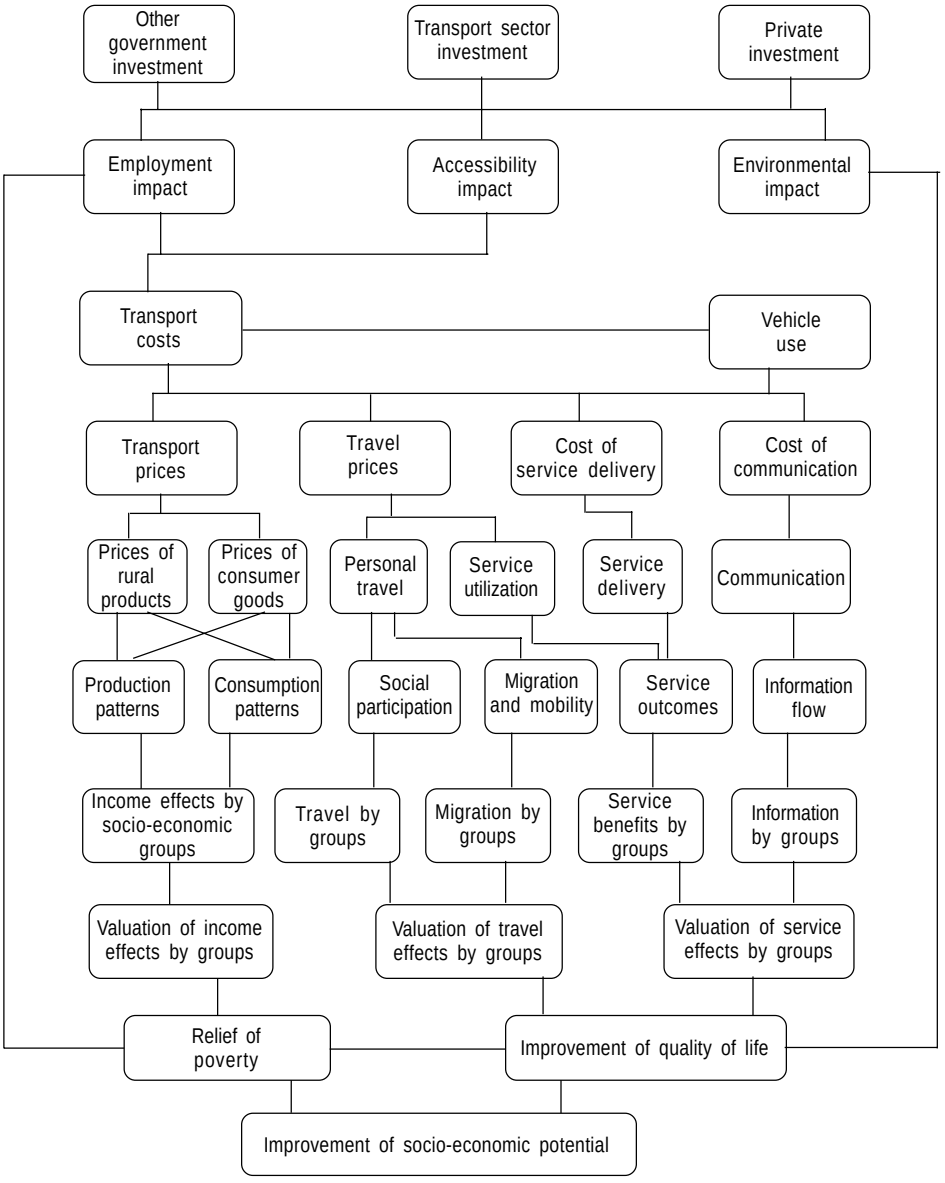
Several empirical studies have tried to calculate the effect of infrastructure on productivity and incomes in rural and urban areas. Some of these are described below.

Aggregate Production Studies

One of the most important aggregate studies was by Antle (1983), who undertook a cross-sectional study of 47 less developed countries. He used the Cobb-Douglas production function and found a strong positive relationship between infrastructure and aggregate agricultural productivity. His conclusion was that transport and communication infrastructure contributed to the explanation of aggregate agricultural productivity across a sample of developed countries.

The second aggregate study was that by Binswanger et al. (1987) which involved a

Diagram 3.1. Economic impacts of transport investments



Source : Louis Berger International, Inc. (1979), Study of Transport Investment and Impact on Distribution of Income in Remote Area : Phase I, A report prepared for the United States Agency for International Development.

cross-country analysis of annual data (1969-1978) collected from 58 countries. The authors found positive and significant correlation between aggregate and crop production functions and the two road variables in the pooled country analysis. The elasticity of fertilizer demand with respect to road density was found to be quite high and roads were also found to have directly contributed to both growth of output and use of fertilizers (Binswanger et al. 1987). There is some criticism of this methodology since the shifter variables like road density and pavements seem to be capturing the other country effects also (Ahmed et al. 1990).

A recent study at the International Food Policy Research Institute (IFPRI) has undertaken a comprehensive analysis of the impact of infrastructure on poverty in rural India by looking at the relationship between government expenditure incurred on R and D, irrigation, roads, education, power, soil and water, rural development, health and family welfare, and the impact of each of these expenditures on the incidence of poverty in rural areas by employing a simultaneous equation regression model. The study is based on time series of state-wise data on poverty, rural employment, wages and government expenditure on specified infrastructures. By using a simultaneous equation regressive model, the authors bring out that government expenditure on roads had the highest impact on reduction of poverty, followed by that on welfare, health, rural development, education, and soil and water (Fan, Hazell and Thorat 1998).

Country and Village Studies

Some studies have also tried to find the relationship between infrastructure development and agricultural growth by using country or village level data.

The impact of infrastructural investment on increasing agricultural productivity and incomes of farmers, improving their access to market, and providing more employment thereby contributing to poverty reduction has also been brought out by some country and village level studies. Most of these concentrate on the impact of the development of rural transport (in conjunction with other rural infrastructure) on increase in agricultural and other sectoral output and incomes and consequent reduction in poverty.

Evenson (1986) used farm-level data for the Philippines from 1948 to 1984 to estimate the effect of public investment in farm level output supply and input demand. Roads were found to have a positive effect on aggregate output per farm, as well as on fertilizer use. The output elasticity with respect to roads worked out to be as high as 0.31. But strangely enough, he found negative elasticity of output with respect to rural electrification.

In their pioneering study of Bangladesh, Ahmed and Hossain (1990) chose a sample

of 130 villages across all the agro-climatic zones of the country. These villages were divided into two groups according to the aggregate index of accessibility to village of various services like markets, schools, banks and administration. Villages with better access were found to be significantly better off in a number of areas including agricultural production, household incomes, wage incomes of the landless labour, health, and the participation of women in the economy. For example, they found that development of infrastructure had a positive effect on the marketing of agricultural produce. The development of infrastructure enabled cultivators to obtain a slightly higher price for their produce and to buy a larger proportion of consumption needs from the market as compared with the undeveloped villages. The land market was also found to be tighter in developed villages where small and marginal farmers were able to move to non-agricultural jobs by selling their tiny plots of land as compared with the underdeveloped villages where such farmers stuck to their land for want of alternative opportunities.

In low income villages, infrastructure development improved access to institutional credit significantly (sevenfold), shifted the allocation of credit from unproductive to productive activities, and hastened the growth of mercantile capital in rural areas. Infrastructural investment did not lead to a significant improvement in literacy rates, but it did have a significant impact on health conditions and on acceptance of family planning practices. Infrastructure development also enabled the small and marginal farmers, who could not leave cultivation, to have increased access to non-farm activities. The effect of infrastructure on diffusion of modern technology was found to be quite extensive. An indirect effect was that infrastructure also led to slightly higher savings through its income-enhancing impact.

By far the most important conclusion of their study was that contrary to the often expressed view that development of rural infrastructure is likely to aggravate rural poverty, such development helped alleviate poverty in Bangladesh by increasing agricultural and wage income of landless and small landowning households (Ahmed 1987).

The study by Barner and Binswanger (1986) analysed data from 108 Indian villages for the period 1966-1980 to study the effect of rural electrification and infrastructure on agricultural productivity and input use. Population was the main deciding factor among village demographic characteristics for the location of infrastructure like banks, schools, agricultural services and transport. Rural electrification was found to lead to an increase in agricultural productivity by bringing about improvement in irrigation through the use of pump-sets. Electrification also led to improvements in processing and technology transfer.

The study by Binswanger et al. (1987) used data from 85 selected districts of 13 states of India to examine the role of rural infrastructure like rural roads, banks, and education

in agricultural investment and output. The authors used a reduced form regression model with fixed-effects technique to avoid simultaneity and measured the impact of various factors on agricultural productivity and growth. Their results confirmed the conclusions arrived at by many scholars that, whereas prices did have a positive and significant impact on increase in aggregate agricultural output, the impact as measured by the elasticity was too small. On the other hand, the impact of infrastructural variables like credit, irrigation and education was much greater. Improved road investment enhanced agricultural output quite significantly (elasticity of about 0.20). Availability of education infrastructure and rural banks played an overwhelming role in determining investment. Availability of banks was found to be a more important variable that determined fertilizer demand and crop output than the interest rates. Regulated markets and primary education increased output while electricity promoted investment in irrigation infrastructure. The study also brought out that the availability of electricity along with increase in agricultural output also stimulated the growth of grain mills in the countryside (Binswanger 1992). With its combination of random and fixed-effects analysis, the study has contributed to a greater understanding of the interrelationships between infrastructure and agricultural production. However, according to critics, because it is in aggregate numbers, the study is unable to shed light on individual farmer decisions (Ahmed and Donovan 1992).

A study by Levy (1996) examined the socio-economic impact of improvements to rural roads in Morocco. The study compared conditions in the areas of the project roads, 5 to 10 years after project completion, to the situation prior to improvements ("before-after" the project), and to the conditions in comparison to the roads that were located nearby and were not subject to improvements during the project period ("with-without" the project). The study found that the benefits of paving rural roads extended considerably beyond the improvement of road use efficiency in terms of lower cost and higher quality. The extended benefits included major changes in the agricultural economy, including higher output, transformation of the agricultural output mix from low-value cereals to high-value fruit, and increased use of modern inputs, especially fertilizers. Moreover, improved access to education and health facilities increased enrolment rates in rural schools, as well as led to higher frequency of visits to health care services, and enabled the recruitment of professional personnel to staff schools and health facilities. The impact on women was especially beneficial and girls' enrolment in primary schools more than trebled in the project zone a few years after the completion of the project. Again, positive feedback from higher rural incomes possibly contributed to reverse causality. The effect on poverty reduction among all cultivators, including the small and marginal farmers, was also positive and significant. This was the experience in Africa, where trading margins are much higher than in Asia, partly because of the thinness of individual surplus and partly because of lack of rural roads and transportation.

Many empirical studies have brought out the contribution of infrastructure to agricultural transformation and the consequent impact of new agricultural technology widely adopted during the 1960s and the 1970s on the growth of income, income distribution and poverty reduction in the green revolution regions in many Asian countries. One of the earliest studies was by Bell, Hazell and Slade on the experience of Malaysian development. The study brought out that infrastructural development had direct effect on increasing income and also led to large indirect benefits through the operation of multipliers. The multiplier effect, in the context of a Malaysian rural area, was equivalent to 75 cents out of a dollar's worth of incremental income that was the indirect effect of an original investment in infrastructure (Bell, Hazell and Slade 1982).

The impact of the green revolution in India has been intensively studied by various scholars. Once again, all of them have stressed the important role that irrigation and other rural infrastructure played in bringing about technological transformation in many areas in India. In their study, Bhalla et al. brought out that because of sectoral linkages associated with rapid agricultural growth, several sectors of the Punjab economy were generating high input, output, and consumption multipliers. For example, in the case of dairy products, the value of direct, indirect and induced income multipliers was as high as 16.5 and for textiles 14.2. The authors concluded: "Punjab was able to pioneer the green revolution and thereby transform its agriculture. Its rapid agricultural growth was due primarily to the state's large investments in irrigation, power, roads, communications, and other rural and urban infrastructure" (Bhalla et al. 1990).

The positive correlation between the levels and growth of agricultural development and availability of irrigation has been extensively noted by scholars. Irrigation promotes growth first, through increasing intensity of cultivation, second, by leading to yield increases, and third, through its impact on cropping pattern. The elasticity of area increase with respect to irrigation was found to be as high as 0.5 by Dhawan (1988) for the country as a whole. But, most important, assured irrigation was considered a precondition for the adoption of high-yielding Borlaug seed-fertilizer technology.

In a detailed study of Indian agriculture, Kumar and Rosegrant first computed the growth of total factor productivity (TFP) and then decomposed the growth of TFP into several components like infrastructure, canal irrigation, balanced use of fertilizers, terms of trade and research and extension (through a regression analysis). Market infrastructure, research, canal irrigation and balanced use of fertilizers were found to be the most important sources of growth of TFP. The marginal returns to public investment in research on various crops like rice were found to be very high, particularly in the eastern and southern regions (Kumar et al. 1994).

Barker and Hayami (1967) put forward a hypothesis that improvements in physical and institutional infrastructure were the best vehicle for achieving self-sufficiency in commodity production in the long run. Since they require large investments and long gestation periods, subsidies and price support may appear to be attractive alternatives (Sambrani 1982). Important steps in the prescription of Barker and Hayami for improving physical and institutional infrastructure were technological improvements, easing credit constraints in the case of small holders and dissemination of scientific knowledge through research and extension. Some authors pointed out that since irrigation was essential for the adoption of new technology, it had to be developed through canals and tubewells. Tubewell irrigation was credited with being less capital intensive than canals, more flexible, and less wasteful of water (Vohra 1974). But, being costly, to begin with, only rich farmers could afford to dig tubewells (Kahlon and Grewal 1974; Bapna 1973; and Frankel 1971).

Vaidyanathan (1991) found that because of extensive use of new technology under irrigated conditions, productivity was much higher in irrigated tracts as compared with unirrigated tracts. According to Rao (1994), between 1970-71 to 1989-90, 43million tons of additional foodgrains output could be attributed to irrigation. The uneven spread of assured irrigation across regions was the main reason for large variations in their agricultural development (Bhalla and Alagh 1979). That irrigation leads to greater stability is also brought out by several scholars. Dhawan found that the coefficient of variation of yield declined during 1971-1984 for irrigated crops compared with the unirrigated crops (Dhawan 1993). Rao (1994) also concluded that irrigation per se led to reduction in instability. It is also argued that by generating more biomass, irrigation contributed to ecological conservation and sustainability. On the negative side, excessive irrigation could lead to submergence of forests, waterlogging and salinity. On balance, with appropriate intervention, it was possible to reap the benefits of irrigation and bring about higher sustainability (Rao 1994).

Some scholars have also argued that irrigation serves the interest of equity. For example, Rao feels that to the extent irrigation results in higher agricultural growth and more employment, it leads to reduction in poverty (Rao et al. 1988; Ahluwalia 1978). Rao (1994) has also argued that irrigation from public sources like canals and state tubewells has been more equitable than irrigation through private tubewells which are biased towards the rich farmers.

Further, studies conducted in several Asian countries and areas like Taiwan Province of China, mainland China and India (Punjab) confirm that the best strategy for strengthening farm and non-farm linkages and development of rural non-farm activities is investment in rural infrastructure, in general, and in rural road networks, in particular (Mellor 1976; Saith

1986).

Finally, rural infrastructural development leads to interaction with the outside world and movement of people which results in the gradual removal of many superstitions and taboos. This, in turn, tends to weaken many of the attitudinal barriers to growth and modernity (Malenbaum 1962).

Summary and Conclusions

Infrastructure plays a crucial but indirect role in the development process through its contribution to increasing productivity of factors. Its primary role is to promote growth. But since growth has an indirect impact on poverty reduction, infrastructure also helps to alleviate poverty.

Several empirical studies have brought out clearly the impact of rural infrastructure on rural growth and reduction in poverty. A review of transport projects shows that in Bangladesh, India, and Ghana, the development of transport increased accessibility, widened markets and promoted growth of rural economy. Simultaneously, the development of transport benefited the rural poor.

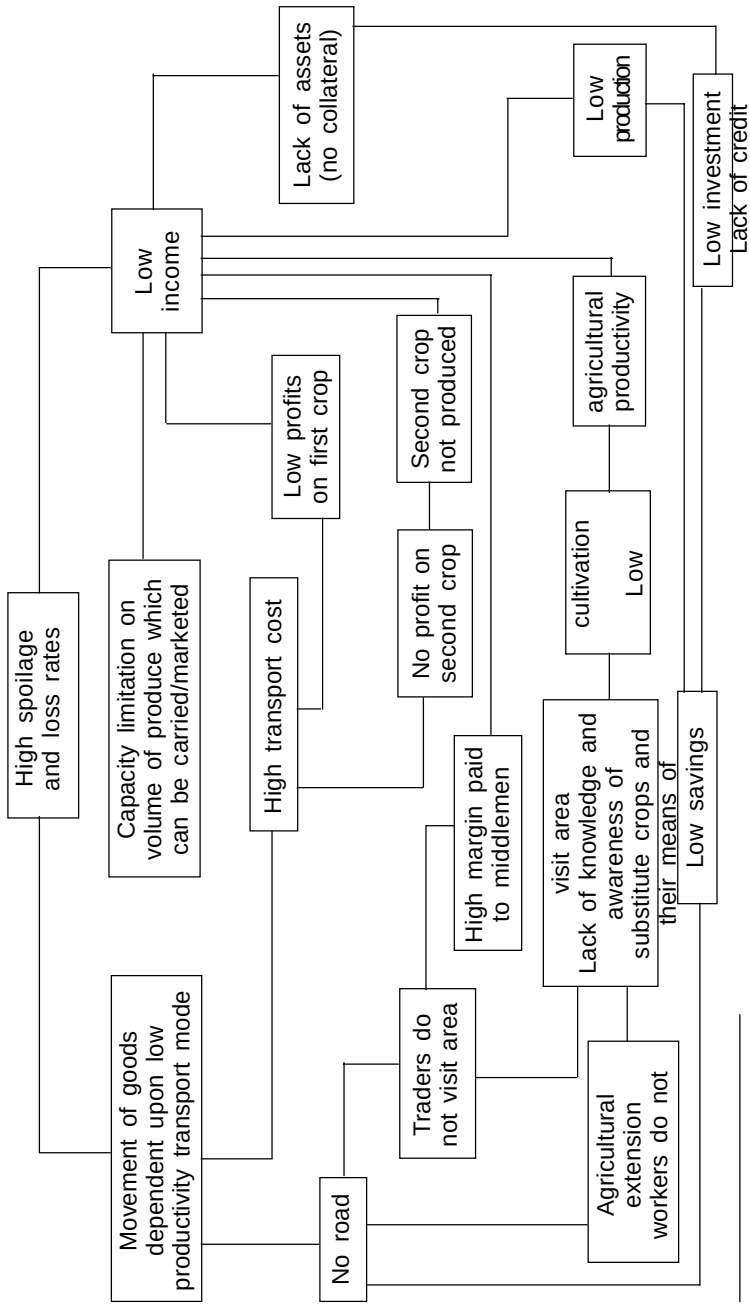
Again, various studies in India and Bangladesh have brought out that investments in rural infrastructure were instrumental in enabling farmers to adopt new technologies in agriculture and promoted the growth of the economy. This, in turn, not only led to increases in the productivity and income of the poor, small and marginal farmers, among others, but also resulted in providing more employment to the landless labour both in agriculture and in allied and non-farm activities. The most important impact of agricultural development was the triggering of growth in the secondary and tertiary sectors through input, output and consumption linkages. This accelerated the growth of the economy and also resulted in raising the demand for labour, and increasing wages and income of the rural labour force. Besides other methods, input-output multiplier analysis has been used by some scholars to capture all these impacts comprehensively.

Since most of the benefits to the poor accrue as a result of a chain of linkages, it becomes essential to capture these linkages, if the benefits of infrastructural investment to the poor are to be fully comprehended. This is because the income generated from such projects is not only the direct payoff that accrues in the process of agricultural growth but also includes the indirect effects of further increase in income generated from other sectors in the economy in a general equilibrium framework.

As will be discussed in the next chapter, the conventional benefit-cost analysis does

not generally include backward and forward linkages. For example, Little and Mirrlees (1977) do not very much favour spending too much time on measuring backward linkages, perhaps because of the problems of their arbitrary inclusion and measurement. But problems also arise because of difficulties in computing the total chain of benefits by preparing laborious input-output tables. However, there still remains the need for an appropriate methodology for capturing direct and indirect benefits likely to accrue to the poor as a result of rural infrastructural investment. Further, problems also arise because of trade-offs between efficiency and equity and unequal distribution of benefits. The various methods of dealing with these and other problems will be discussed in the next chapter.

Diagram 3.2. Vicious circle of lack of access to transport facilities and services



Source : ESCAP Secretariat

4

Measurement/Enumeration of Benefits and Costs

Introduction

The main objective of this chapter is to describe briefly the methodologies of measuring benefits and costs frequently used in the benefit-cost analysis (BCA). A discussion about measurement of infrastructural benefits involves, first, exact definitions and enumeration of all benefits and costs and their classification in appropriate categories and, second, the valuation of benefits and costs and the consideration of problems involved therein and, finally, the quantification of the indirect impacts and effects of infrastructural interventions. In view of the fact that all economic and social benefits arising out of a project are not easily amenable to measurement, and further that these have distributional implications, a great deal of discussion has gone into finding practical ways of tackling this problem. A systematic way to approach this problem is to first classify benefits and costs into various logical categories and thereafter to deal with each type one by one. A related step would be to develop a clear understanding of what one is trying to measure in BCA, including which benefits and costs are allowable and which are not. The process through which the impact of infrastructural interventions on the rural poor works out is quite complex and, therefore, special efforts have to be made to capture the various impacts.

An attempt is made in this chapter to provide a critical review of the methodology commonly used in BCA. In particular, it will examine if the existing methodology is capable of capturing adequately the "impact effects" and "development effects" of an infrastructure project on the poor. An attempt will also be made to suggest some modifications to the existing methodology and alternate methodologies for attaining this objective.

Enumeration/Classification of Benefits and Costs

Scholars have classified benefits and costs into several categories. A brief description of the classification together with a discussion of specific measurement issues, as adopted by Musgrave and Musgrave (1989), is given below.

Real or Pecuniary

The first distinction is between real (non-pecuniary) and pecuniary benefits and costs. The real benefits are the benefits derived by the final consumers of the public project and are to be balanced against the real cost of resources withdrawn from other uses. On the other hand, pecuniary benefits and costs arise because of changes in relative prices resulting from the economy's adjustment to the provision of project services and changes in resource demand. The pecuniary benefits and costs are a zero sum game as gains and losses accruing to some individuals are offset by the losses and gains of others.

Although most scholars do not consider pecuniary benefits to be relevant for benefit-cost calculations, keeping in view the need for attaching distributional weights to the particular gains and losses resulting from a project, it is not appropriate to ignore them.

Direct and Indirect

All real benefits and costs are then divided into two categories, namely, direct and indirect or primary and secondary. Direct benefits (or costs) are those which are derived directly from the project, while indirect benefits are those which are not directly related but are by-products of the project. For example, investment in an irrigation project may have increased crop production as an immediate objective but it is likely to have an important bearing on soil erosion, flood control, beautification of the area and so on. Tracing such indirect or secondary benefits may be difficult but these need to be included in social benefit-cost analysis (SBCA).

Social versus Private

Private benefits refer to the flow of benefits to an individual and social ones are those which accrue to society and, therefore, include indirect benefits and costs. For example, an individual industrialist may pollute the environment and may not pay for it, but society has to bear the entire cost.

Tangible and Intangible (Market and Non-market and Monetary versus Non-monetary)

Direct and indirect benefits and costs are then further classified as tangibles and intangibles. The benefits and costs which can be valued in the market are called tangible whereas those which cannot be thus valued are termed "intangible". Most social benefits such as the beautification of an area, reduced crime rates, enlightenment of society, social prestige, and costs like air pollution and environmental degradation, and destruction of wild life are examples of intangible benefits and costs.

Inside versus Outside (Internal versus External)

The benefits and costs of the project that accrue within the jurisdiction in which the project is located are categorized as 'inside' or 'internal' whereas those which spill over or overflow the project jurisdiction are termed as 'outside' or 'external'. For example, the building of Bhakra Dam on Sutlej River in Punjab (India) not only prevents floods within the Indian territory but also in the neighbouring Pakistan. While both inside and outside benefits and costs should be taken into account in benefit-cost analysis, interstate, and, in some cases, intercountry cooperation is needed for this purpose.

Intended versus Unintended

Sometimes a distinction is made between 'intended' and 'unintended' benefits. For example, big projects which are spread over large areas and lead to major changes in habitation and land and water use are likely to have important ecological effects which may not have been foreseen by the planners. It has become quite popular to include these as externalities. However, it is suggested that these be called unintended rather than external and further that these are outside the realm of economics until their probability is established (Little and Mirrlees 1974).

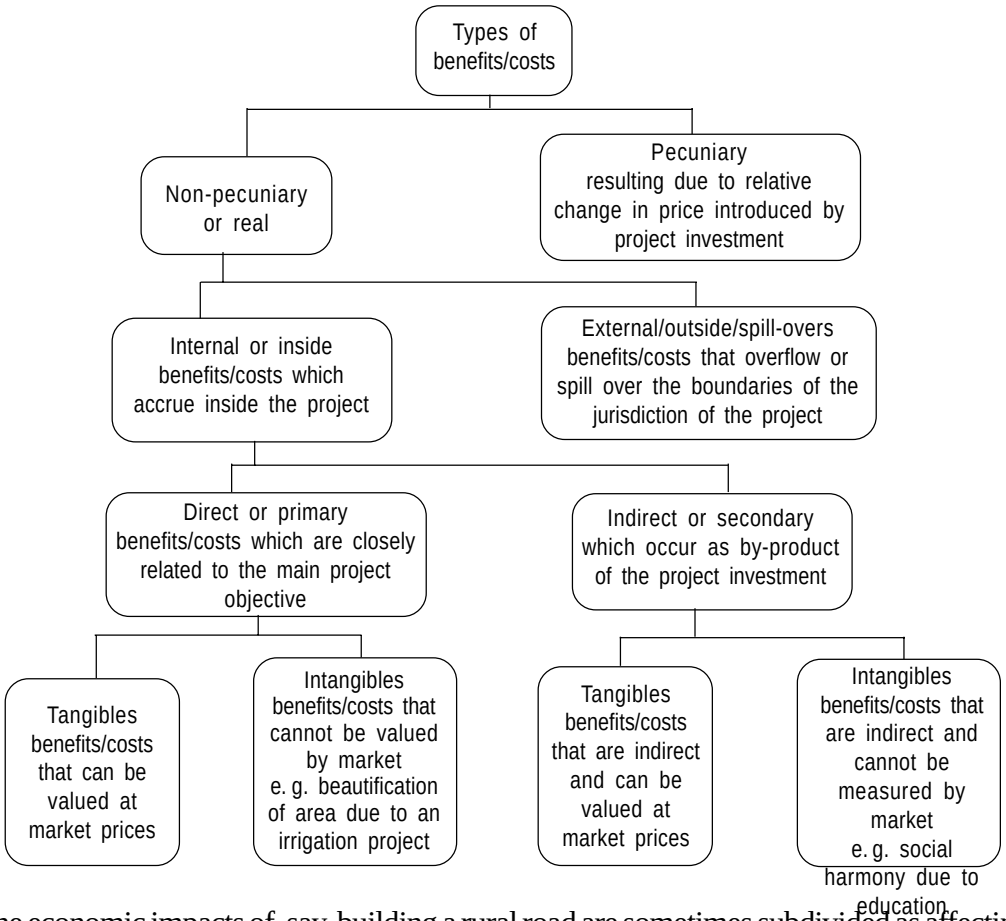
The classification of benefits into various types, as discussed above, is summarized in diagram 4.1.

Effects and Impacts

Sometimes, a subtle distinction is drawn between user benefits flowing from an infrastructural project and the economic impact over a period of time. For example, rural link roads lead to economic impact almost from the day construction begins. However, the road generates transportation user benefits only after it has been completed. But the total benefit of building a road in terms of the impact on increased mobility and access takes place only over a period of time. As Perera (1990) states : "In other words, the stream of benefits flow over time with the economic effect not fully felt in the region until production and marketing economies and costs savings resulting from the improvements are incorporated into freight rates, pricing structures and production levels".

The numerous effects of a transport project could be classified into transport user benefits which start flowing after the completion of the project, and the economic impacts which start occurring almost from the day construction begins. Economic impacts measure the secondary effects of capital expenditures on the regional economy. These are generally categorized as direct on-site impacts, indirect impacts arising out of off-site economic activity, and induced impacts which are multiplier effects of direct and indirect impacts.

Diagram 4.1. Classification of benefits



The economic impacts of, say, building a rural road are sometimes subdivided as affecting the following areas: business and industry; residential; tax revenues; regional and community development; and resources.

The effect on business growth is generally positive and so is the effect on tourism and recreation, although in the latter case there may be negative environmental costs. Amongst the various sectors, the effect on agriculture is pronounced since transport leads to improved market accessibility resulting in increased profitability; encourages conversion of agricultural land to non-agricultural uses; and brings about increase in agricultural productivity through use of better techniques. The effect on the residential sector is also generally positive and besides direct impact on building of houses, the induced or secondary effects of residential construction are quite important. There are implications for tax revenues and property taxes also, since land values generally rise as a result of transport development. Experience shows that the level of development induced by a newly constructed corridor

is often greater than anticipated. Over time, changes take place in public service which lead to changes in net public expenditure on these services and public expenditure on replacement of displaced public facilities. Further, transport projects cause a draft on all the primary factors of production, namely, land, labour and capital and other scarce resources like energy and current inputs thereby determining their allocation among various sectors. Transport also facilitates economic development in rural areas and promotes regional growth. Finally, the effects of right of way acquisition could be negative because of loss of land, loss of jobs and redistribution of jobs (Perera 1990). Table 4.1 gives a classification summary of the envisaged economic impacts of transportation improvement and development.

Fundamentals of Project Evaluation and Benefit-Cost Analysis

The fundamental principle of benefit-cost analysis is to reinforce the Kaldor-Hicks criterion by maximizing net social benefits[6]. In this sense, it is closely related to the consumer and producer surplus.

Consumer and Producer Surplus

The linkage between project evaluation and consumer and producer surplus is brought out by figure 4.1.

Given a demand curve for a commodity, it is obvious that the consumers are willing to pay a relatively high price for the first unit. If the price falls from P_1 to P_2, the original consumers gain because they are able to obtain the good while paying a lower price. The total gain or consumer surplus is measured by the area $P_1P_2BAP_1$. Consumer surplus can be estimated by forecasting the quantity demanded of a good or service from its price elasticity of demand, population, and per capita income. According to UNIDO (1978), "in practice, however, it may be safe to ignore consumer surplus, for projects are often marginal in that they have a minor impact on total consumption or on the price paid". Nevertheless, the consumer surplus approach is useful in the appraisal of those utilities which are rationed or whose supply prices are controlled by the government and also of those goods and services, like rural roads, primary education and public health, which are supplied free of charge (ADB 1997).

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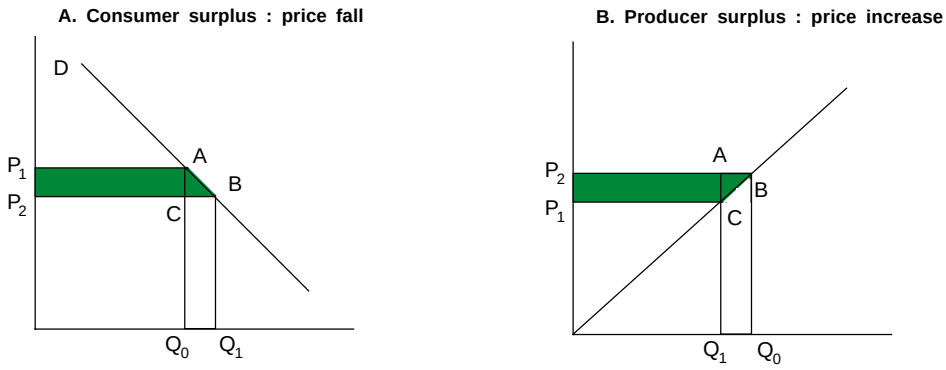
[6] The Kaldor-Hicks criterion states, "In any choice situation, select the policy alternative that produces the greatest net benefit." (Gramlich 1990).

In the case of producer surplus, with a price increase from P_1 to P_2, the gain is measured by $P_1P_2BCP_1$. The decision rule for maximizing the net benefits or consumer surplus depends on whether the situation is one of fixed or flexible budgets, and whether the expenditure is to be incurred on lumpy or divisible projects. In general, the choice is based on using one of the three criteria, namely, maximizing net benefits (B-C); attaining the highest B/C ratio and attaining the highest internal rate of return (IRR). For the most typical case of lumpy projects and fixed budgets, the recommended rule is to choose the

Figure 4.1. Consumer surplus and producer surplus



project that maximizes net benefits (Musgrave and Musgrave 1989).

Measurement of Benefits and Costs

After the identification and classification of projects, the next stage for evaluating the performance of projects is the measurement of their benefits and costs. Since benefits and costs accrue over time, the following steps are required:

(a) Valuation of benefits and costs when they occur;

(b) Choice of discount rate to find the present value (PV) of the future streams of benefits and costs.

Valuation of Benefits and Costs

Intangible Benefits and Costs

The intangible benefits and costs associated with a project may relate to society or to private individuals. The main problem in valuation is that while tangible benefits and costs can be evaluated by taking their market price, the benefits and costs in the case of intangibles cannot be determined by market price. This is because in their case, quite

Table 4.1. Classification summary – economic impacts

Class	*Category*	*Effects*	*Direct*	*Indirect*	*Induced*	*Temporary/ Permanent*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Business and industry	Facility construction	Expenditure on labour and materials for construction	x	x	x	T
		Secondary effects induced by direct expenditure		x		T
		Losses to firms in the vicinity				T/P
	R-O-W acquisition	Loss of jobs and services due to relocation	x			
		Redistribution of jobs and services within the corridor		x		T
		Loss of land	x			P
	Business growth	Expansion of existing businesses	x	x	x	P
		Attracts new businesses or labour	x	x	x	P
		Deters businesses that depend on remoteness	x	x	x	P
	Tourism and recreation	Expansion of existing businesses	x	x	x	P
		Deters businesses that depend on remoteness	x	x	x	P
		Diverts potential businesses	x			P
	Agriculture	Increase or decrease in productivity and profit	x			T
		Encourages conversion of land to other use		x		P

Contd..

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Mining and forestry	Improved accessibility to markets	x			P
Residential	Regional economy	Replacement and relocation of housing needs		x	x	T
		Attracts additional workers and families		x	x	P
Tax revenue	Property taxes	Loss of tax revenue due to acquisition	x			
		Changes in property value and associated tax revenue		x	x	P
	Public service needs	Requires additional expenditure			x	P
Regional and community	Region	Changes in public revenue and expenditure				?
		Gain or loss in direct incomes				?
		Environmental changes	x			T
	Community	Changes in pattern of community growth		x		?
Resources	Land materials and labour	Covered under R-O-W acquisition	-	-	-	-
		Covered under effects of facility construction	-	-	-	-
	Energy	Consumption associated with direct, indirect and induced effects	x	x	x	P

Source: Perera 1990

often, there are no market prices. For example, it is difficult to get a market value for clean air, the beautification of an area, social prestige, self-reliance of individuals or society, or preservation of rural society. Similar problems arise, for example, in the evaluation of the costs of death or injury resulting from road accidents or the benefits from highway improvement to an individual.

One way out is to measure their value through a political process. For example, the budget allocated for any project, say, beautification of an area, art and culture, environment preservation, and defence represents the value assigned by society to these activities. In the case of accidents or death, indirect valuation methods of income foregone may be adopted and used to approximate the value of the loss (Musgrave and Musgrave 1989).

Tangible Benefits and Costs

Not many measurement problems arise in the case of tangible benefits and costs. In their case, market prices can provide a correct answer. However, the assumption is that the market is perfect and the market prices represent their real transfer prices or opportunity costs. Another implied assumption is that income distribution is not very skewed and, hence, the marginal utility of money across social groups does not vary substantially. However, these assumptions are not generally fully satisfied and market imperfections are specially marked in developing countries. Consequently, market prices are distorted and do not provide an accurate indicator of costs and benefits to society in these countries. In their case, scholars have suggested the use of economic accounting prices or shadow prices for valuation of foreign exchange, capital and labour, as well as output. These are briefly discussed below.

Developing Economies – Specific Problems

Foreign Exchange. Official exchange rates in many developing countries are overvalued. Further, countries adopt various types of trade barriers, such as export or import restrictions, export or import taxes and subsidies. Therefore, it is suggested that border prices be used as shadow prices for traded inputs and outputs. For large countries, where demand and supply are not independent of price, marginal revenue or cost to the country in foreign exchange should be used. This requires that suitable methods be devised and conversion factors be carefully worked out for each item of traded goods. The prices of non-tradables could be derived from those of tradables by using appropriate ratios. Although, for some countries, multiple conversion ratios have been worked out for different commodities, generally a single conversion ratio for foreign exchange is being used extensively in BCA (Little and Mirrlees 1990).

Taxes. Market prices include various taxes like licence fees, import duties, sales

tax, excise taxes and duties. The tax component of the price represents the financial costs to consumers but does not reflect their social or economic cost for the country as a whole. It is, therefore, argued that taxes should not be included in computing project costs.

Wages. In developing countries, there is surplus labour and unskilled labour is generally unemployed or underemployed, particularly in the agricultural sector. It is, therefore, argued that in these circumstances market wages do not represent real wages. It is further asserted that the existence of institutional factors like minimum wage legislation in agricultural and non-agricultural sectors or in urban areas tend to push actual wages generally above their competitive levels. Therefore, in project valuation, it becomes desirable to adjust labour costs. It has been suggested that shadow price for labour should be such that it lies in between the wages for unskilled labour in agriculture and for those in the industrial sector. However, there has recently been a rethinking in this matter as it is recognized that rural labour markets are quite active in developing countries. Hence, actual wages prevailing in the rural areas are said to reflect the opportunity cost of labour in rural areas and the same holds for urban areas (Little and Mirrlees 1990).

The recommended decision rule is, therefore, to treat prevailing market wage rates discounted by a conversion factor estimated from an overall study of the economy, as the shadow wages or opportunity cost of labour. Furthermore, this estimation should depend, in particular, on a judgement that *public income is more valuable at the margin than private income*[7] (Little and Mirrlees 1990).

Interest. In general, capital is undervalued in most developing countries and the cost of capital in terms of interest is set much below the shadow price of capital. The overvalued exchange rate makes foreign capital much cheaper. Similarly, most infrastructural investments in developing countries are financed either by government or by multilateral aid agencies. The interest rate charged on investment in such cases is commonly less than the economic cost of capital. Furthermore, the administratively set interest rates are generally kept low to encourage investment. According to Little and Mirrlees (1990), "the accounting rate of interest should be high (or low) enough to be expected to ration investment projects in the whole economy to the funds available – a rate that could well vary over time, but in no case using a discount rate less than the rate available in the international capital market."

[7] The presumption that public income is more valuable than private income is based on the argument that governments used additional revenues for furthering socially profitable investment to a greater extent than private income earners; second, that raising tax revenues involves collection costs, and also creates distortions. These presumptions are sometimes challenged on the ground that public expenditure could be wasteful and that it is possible to devise efficient tax system. On balance, however, private income generally benefits relatively the rich, while public income is likely to benefit the poor. Hence, the relative value of private income to public income is correspondingly lower (Little and Mirrlees 1990).

Distributional Considerations – Equity and Efficiency. In heterogeneous societies, benefits and costs in most project investments, specifically infrastructure related investments, rarely flow equally across all social groups or remain confined to the region of their location. The obvious question in such cases is whether the flow of benefits and costs to target and non-target population groups or regions should be treated equally or in a differential manner and whether or not distributional weights should be attached to net benefits flowing to different regions or population groups. Once such differences are allowed, an immediate question arises regarding the selection of different social or income groups and the assignment of a proper set of weights for each group. Weights are a simple, clear way of expressing the distributional bias of a decision maker towards some groups and away from others.

Distributional weights can be derived from a marginal income utility schedule or social utility rule. Useful clues about the weights might also be obtained by examining the past project decisions or the structure of the tax system and differences in the tax rates applied to different income groups. The prevailing tax-liability distribution can then be used to derive the marginal income utility schedule. One of the proposed methods of deriving weights is to first derive the marginal tax rate for each income bracket and then to divide it by the overall average income[8] (Haveman 1965).

In practice, it is difficult to derive a social income utility function. However, it may be desirable for the government to state explicitly the weights it wants to use. This would impart consistency in the use of weights for BCA. A suggested weighting diagram is contained in the following table where families below poverty line (an income of about Rs 15,000 per annum in India) are given far higher weights than families with higher income.

Table 4.2. Suggested weights for benefit-cost analysis

Income (per annum)	*Marginal social weights*
Under Rs 15,000	10
Rs 15,000 - Rs 40,000	5
Rs 40,000 - Rs 100,000	2
Over Rs 100,000	1

[8] The formula is :

Marginal tax rate = changes in the income tax paid per return in consecutive tax bracket/change in average adjusted gross income per return.

Weightage factor = Marginal tax rate/overall average income.

Similarly, a significantly lower internal rate of return (IRR) may be used for choosing a rural road project that connects a town with a remote tribal village than is to be used for selection of other road projects.

Alternatively, the decision maker can use his own intuition based on his knowledge about other countries and common sense to devise decision rules. For example, the decision rule may be to assign double the weight to money gains by the poor as compared with the non-poor groups. Caution is, however, needed as to the selection of weights since distributional weights by their very nature are subjective and open to manipulation. These limitations notwithstanding, assigning of distributional weights in favour of the poor has been generally advocated by scholars (UNIDO 1978; Little and Mirrlees 1974).

After assigning weights, the net benefits (NB) are recalculated by multiplying the income accruing to each group (Δ yi) by a weight (wi), where i = 1,2,.....m; that is,

$$\text{Net benefits} = \Sigma\, wi\, \Delta\, yi$$

A simple illustration (table 4.3) is where defined groups of rural poor people are weighted 1.2 and everyone else is weighted 1.0. This might be the case for new benefits from a rural road or social forestry project. As a consequence, the two alternatives may be ranked one way on the basis of efficiency alone and in the reverse order when the distributional weights are added to the analysis.

Table 4.3. Net present value (NPV) from two projects with and without weights for distributional goals

	Project 1	*Project 2*
Unweighted efficiency	200x1 = 200	175x1 = 175
Weighted efficiency	(190x1) + (10x1.2) = 202	(25x1) + (150 x 1.2) = 205

Project 1 is skewed towards middle and upper class beneficiaries, while project 2 is skewed towards the poor. Despite being considerably less efficient in net present value (NPV) terms, project 2 appears modestly superior in terms of weighted net benefits (Kerr et al. 1997).

It is sometimes suggested that weights are inappropriate for project appraisal as

the biggest drawback to weights is that consistency is unlikely across the array of public projects in complex societies like India. Weights also are very volatile if set by an open political process.[9] It is suggested that, instead, attention be concentrated on tracking the distributional outcomes of project alternatives together with developing efficient projects that benefit low income groups (Kerr et al. 1997). Another suggestion given is that a more effective way of realizing this kind of transfer towards the poor is by using graduated income taxes rather than establishing weights for each project in society (Gramlich 1990).

But these criticisms do not take into account the ground reality in developing countries. First, in a democracy, final decisions about distributional weights have to be taken by the political authority and there is no reason to believe that its judgement in this matter would be poorer than that of a bureaucrat or an expert. Second, it is very difficult to introduce an optimum tax subsidy regime and, besides, any such mechanism also introduces its own distortions. Quite often, projects like the provision of rural road connections to tribal villages can only become viable if distributional weights are assigned to them. Similarly, appropriate weights have to be assigned to other high priority programmes like the provision of drinking water to rural areas, public distribution of foodgrains to remote areas, etc.

Social Benefit-Cost Analysis

Social benefit-cost analysis (SBCA) is a methodology for evaluating projects specifically designed for the welfare of either the entire community or nation or a section thereof. The increasing application of benefit-cost analysis (BCA) in public investment, especially in infrastructure and public utilities, arises from the fact that because of serious distortions in market prices, the usual financial benefit-cost approach does not reflect the true social valuation of benefits and costs. (It may be pointed out that as against the financial analysis, the economic BCA does take into account social valuation and, hence, sometimes social benefit-cost analysis is also called the economic BCA). More specifically, the need for social benefit-cost analysis in preference to market valuation arises mainly due to the

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[9] Another way of looking at weights is to estimate Okun's (1975) leaky bucket ratio, 1/(1-c), where the weights are selected to make the weighted net benefits just equal to the unweighted or most efficient net benefits.

That is, if

$0=NB=wp\Delta Yp+\Delta Yp$, or $\Delta Yp=-\Delta Yp/wp$, then
$\Delta Yp=-(1-c)\Delta Yp$, or $wp^*=1/1-c)$

The weight, wp* is required to make a redistribution equal to the most efficient project without weights. This allows project alternatives to be evaluated so that projects that are not justified on either efficiency or distributional grounds are eliminated.

following reasons:

(a) Risk and uncertainty
(b) Market imperfections
(c) Externalities
(d) Concern for savings and investment
(e) Concern for redistribution
(f) Concern for merit and demerit goods
(g) Concern for environment and environment impact assessment (EIA)

(a) *Risk and Uncertainty*

In most project investments, there are risks and the outcomes are not certain. Scholars sometimes distinguish between risk and uncertainty. In the case of risk, both the possible outcomes and the probability of each outcome is known and, therefore, the expected outcomes can also be calculated. One of the simple methods is to adjust the discount rate for uncertainty and raise it by a suitable margin.

It is more difficult to handle uncertainty. This is because in the case of uncertainty while possible outcomes are known, their probability of occurrence is not known. Sometimes, game theory is used to understand uncertainty in competitive markets.

Historically, risk and uncertainty were relatively neglected in BCA, and according to some scholars, this neglect encouraged large-scale projects. It is sometimes argued that the preference given to large irrigation projects (like Aswan Dam) has led to environmental damage and a bias towards the rich and neglect of small holders (Kerr et al. 1997). Many other scholars (e. g., Rao 1994) have argued the other way. But this controversy notwithstanding, the discount rate has to be adjusted for risk and uncertainty, although the adjustment should not be excessive. Little and Mirrlees (1990), for example, argue for " allowing for uncertainty only to the extent that the profitability of the project was expected to be correlated with the general state of the economy". There is no single rate of interest, and uncertainty and risk reflect themselves in the differences in the short- and long-term rates of interest.

(b) *Market Imperfections*

Under the imperfect market conditions prevailing in most developing countries, actual prices rarely reflect social values; hence, some other prices have to be used. Distortions could also arise because of excessive government intervention in factor and product markets. Some frequently cited examples are:

Minimum wage laws resulting in higher wages, mainly for industrial workers, than would prevail in a competitive market;

Agricultural price support programmes;

Administered price mechanism for agricultural and industrial inputs and outputs, licensing, and control on movement of commodities;

Public distribution of essential goods and services;

Overvalued currency and regulation of foreign exchange often resulting in a premium on unofficial transactions;

Domestic market protection – Import and export quotas, tariffs, canalization of imports/exports, etc. resulting in a wide divergence between domestic and world prices of factors and products;

Capital market imperfections resulting in large gaps between market rates of interest and the maximum rate of interest chargeable by financial institutions.

The suggested solution in most of the above cases is to use shadow prices in place of the prevailing market prices.

(c) *Externalities*

Some projects, especially investments in infrastructure like roads, transport, irrigation and public health, create externalities for which the project itself is not likely to receive any benefits or income, but the benefits generated by it and accruing to society may be very large. A conventional BCA that undertakes only a monetary valuation of project benefits ignores indirect benefits on the plea that there may not be any boundaries to these externalities and also because quite often they are intangible and difficult to measure. This could significantly reduce the assessment of the benefits of infrastructural projects for the rural poor and, thus, render them unviable. Similarly, quite often the negative externalities like effluents discharged by a chemical plant in a river polluting downstream flow of water, or air pollution by a thermal plant leading to increased incidence of disease which are not taken into account by financial BCA are very much included in the social benefit-cost analysis (SBCA).

(d) *Concern for Savings and Investment*

Two projects having the same net profit may yield different consumption and savings effects. It has been argued that from a social point of view, in most developing countries

which are capital-scarce, projects yielding more savings should get priority, as it would enable these countries to undertake higher investment and hence higher consumption (and savings) in future compared with projects which yield higher current consumption. Such concerns for the distribution of benefits between the present (consumption) and future (savings) can well be taken care of by SBCA by giving higher values to projects yielding higher future benefits by using a lower discount rate. Simultaneously, public income is given more value than private income or private consumption as the former is expected to be used for furthering socially profitable investments to a greater extent than private income.

(e) *Concern for Income Distribution*

In the financial analysis of projects, it rarely matters how the project benefits are distributed among different sections of the society. However, from the social point of view, equity considerations may have to be deliberately built into the project evaluation. This implies that a rupee benefit going to the poor is more valuable compared to a rupee benefit to the rich. Concern for such interpersonal income distribution assumes added importance in respect of investment in the projects aimed at poverty eradication currently undertaken in most developing countries. SBCA incorporates such societal concerns by placing a higher value on benefits shared by poor people and/or poor regions.

(f) *Concern for Merit and Demerit Goods*

Similar to the concern for income distribution, SBCA makes an adjustment for merit goods by attaching a premium to the valuation of merit goods like education, arts and culture, beautification of an area and nutrition. Similarly, goods commanding less social value than the financial value, like intoxicants, pollutant industries, etc. require downward adjustment in valuation.

(g) *Concern for Environment and Environment Impact Assessment (EIA)*

Sustainable development is development that lasts. Environmental degradation makes future generations worse off through natural resource degradation and, therefore, current generations should take the responsibility of compensating for these losses. The environmental benefits and costs may not be measurable in all cases; therefore, it is difficult to place an economic valuation on their outcomes. But the costs should be made as explicit and transparent as possible to enable the policy makers to make informed judgements. This is particularly important for major projects where environmental effects are likely to

be large.

Three conceptual problems which arise in the environment impact assessment are: first, the choice of an appropriate technique; second, the definition of the boundary of the analysis, since most impacts include externalities; and third, defining a time horizon. As in other valuations, society's time preference, which is bound to be lower than a market-based discount, is preferable.

Some of the methods which are commonly employed to value environmental costs and benefits are market prices, costs of replacement, surrogate markets and surveys. Another method used is transference modeling, that is, inferring costs and benefits from other places and transferring these to the given situation. In all cases, the financial values calculated are translated into economic values using the same numeraire.

In cases like land degradation, or air pollution, the market method values the loss in productivity of land, the impact on health measured in terms of loss of earnings or the cost of medicines. But these measures are partial since they depend solely on income losses. Similarly, the expenditure incurred on compensating for environmental degradation could be taken as a proxy for costs of replacement. Alternatively, environmental degradation could be valued through its effect on the market, say, on property values and wages (surrogate markets). But, if there are imperfections in the market or other constraints, this method may not give correct results. Surveys could help in quantifying the environmental damage.

The calculation through benefit transference involves first, the selection of appropriate literature for emulation; second, the adjustment of values calculated in the literature to local conditions; and third, setting these values in the context of a financial, rather than an economic, analysis framework using the same numeraire as used for other projects. Direct questions can be asked as to what valuation people place on environmental degradation or beautification of an area where markets do not exist. Such surveys can be employed to determine the amenity value of species or land markets and to determine willingness to pay for better access to clean water and improved sanitation. Governments could usefully internalize the benefit-cost of environmental outcomes through a proper tax-subsidy regime (ADB 1997).

Choice of Discount Rate

In all projects, benefits and costs accrue over time. In order to make them comparable, it is necessary to find their present value, that is, the future flows have to be converted into their present equivalents by applying an appropriate discount rate. Theoretically, future

annuities or increments to benefits and costs ought to be discounted by the opportunity cost of capital. The government may proceed by taking a discount rate equal to the time preference of private consumption or it may choose to have a social discount rate of its own. The private time preference for consumption is often used as it reflects consumer choice between present and future consumption. Further, given perfect markets, this market rate of interest is efficient as it also equals the marginal efficiency of capital.

Both these methods have been suggested by experts. For example, according to the UNIDO method, the discount rate is the decline in the value of consumption over time, i.e. the consumption rate of interest. According to the Little-Mirrlees method, however, the discount rate is the fall in the value of investment and, therefore, the marginal productivity of capital should be the accounting rate of interest.

If d is the discount rate by which future value Vt in the year t is to be discounted, then the present value Vo is:

$$Vo = \sum Vt / (1+d)t$$

A major problem with the private rate of discount is that, in developing countries, because of the prevalence of market imperfections, the market rate of interest does not indicate the scarcity price of capital correctly. There is no single rate of interest and uncertainty and risk reflect themselves in the differences in the short- and long-term rates of interest. An average of different rates is sometimes suggested.

But there are more important criticisms of the private rate of discount and hence the social rate of interest is often suggested. It is pointed out, for example, that private individuals are myopic and underestimate the importance of saving, and they do not care about future generations. It is argued that for future incomes to be larger, the saving rate should be set such that the equilibrium path of the economy produces the maximum level of consumption for all generations. Hence, the social rate should be below the private rate of interest with a view to encouraging investment.

On the other hand, it is pointed out that apart from the question of appropriate rate of discount, for every public sector investment, there is the question of opportunity cost of withdrawal of resources from private use. The social cost equals the loss for current or future consumption. Besides, resources withdrawn also result in reduced resources for private investment and this may also involve some costs. These considerations point to the desirability of assigning slightly higher values to the cost of capital and not setting too low a value to the discount rate if the choice is to adopt a social instead of private rate of discount (Little and Mirrlees 1974).

To sum up, BCA aims at maximizing net benefits from a project. For this, it undertakes a careful enumeration of benefit flows over time and calculates their value either at market or preferably at shadow prices. The social benefit-cost analysis also takes into consideration the concerns about income distribution. Despite problems in the valuation of social benefits, SBCA does try to assign distributional weights as well as weights for merit goods. However, assigning values to externalities or giving weights to distributional programmes is a very complex exercise and may involve value judgements by political authorities. Preparation of some clear guidelines would help the policy makers to make a more informed choice, thereby reducing the degree of arbitrariness. But despite their recognition, in actual practice, quite often the social aspects are simply ignored in BCA.

Another serious problem that arises is that of ignoring the "development effects" and "impact effects" of an infrastructure investment. A rural infrastructure investment not only results in increased efficiency in one sector, but also generally sets into motion economic activity in other sectors of the rural economy through direct, indirect and induced linkages. For evaluating infrastructure projects that are aimed at poverty reduction, these effects are sometimes considered the most important.

Contingent Valuation Method

Unlike the case of traded commodities where prices indicate the buyers' and sellers' preferences, no such parallel evaluation mechanism is available for the evaluation of public "goods and bads". Nevertheless, several different practical methods are available and used to overcome this problem. The contingent valuation method (CVM) is one of the empirical and widely used methods. This is essentially a survey method in which responses to valuation questions are contingent upon the existence of a particular hypothetical market detailed to the respondents by the investigators. CVM collects potential preference information from potential beneficiaries or affected households regarding their maximum willingness to pay (WTP) for the provision of project goods or services or the minimum compensation the household requires if the project is not implemented. An iterative bidding approach is generally followed to find out maximum willingness to pay or required minimum compensations. For example, a potential beneficiary from a water supply project in a locality may be asked to pay Re 1 per gallon of water supply. If he refuses to pay, the bid is lowered to say Re 0.5 per gallon. If he accepts, then the bid is raised further. The highest rate acceptable to the respondent is his WTP or contingent valuation (CV). This method was employed to get information on the value of health infrastructure in some villages in Solan (Himachal Pradesh) in India. The contingent value quoted for health services was quite high.

There are a number of problems associated with this method. The well-known problem is the free rider problem whereby the respondents conceal their true willingness to pay in order to pay low prices. They generally overstate their true WTP to secure a large supply of public goods if they perceive that they can still manoeuvre and continue to pay less charges. Biases introduced by implied values contained in the questionnaire or shown by the interviewer give the respondent clues as to the answers he should get. Again, the mis-specification of outcomes by the interviewers poses additional problems and prompts the respondents to give biased answers (Mitchell and Carson 1989). However, such biases can be minimized by trained and skilled investigators.

Measuring Benefits of Transport Development

The benefits accruing from transport development have been studied by many scholars. The traditional methods for capturing these benefits are as follows:

(a) The national income benefits criterion;

(b) Cost saving approach;

(c) Shipper's saving approach;

(d) Rents or land value approach.

(a) *National Income Approach*

Conceptually, it is the well-being of the citizens of the country both at present and in the future that should constitute the overall criterion for measuring the benefits of a project. Accordingly, it is the increase in the country's per capita income attributed to, say, a transport project and to complementary investments which is the primary measure of that investment. The problem with the income criterion is that it ignores genuine welfare and does not account for free goods like leisure and air. There may be some legitimate social objectives like political unity, income redistribution, saving and investment which are not captured by the national income method and which require some value judgements. It is because of its inability to take into account the non-economic or intangible benefits that increase in national income (or per capita income) cannot provide a criterion for making a comparison among projects. In spite of these limitations, it has been suggested that the analyst should (a) make every attempt to quantify the benefits in money or physical units where they exist; (b) determine the cost of alternative means of achieving the same objectives; and (c) describe in as specific terms as possible the intangible benefits which are not measurable (Harral 1968).

(b) *The Cost Saving Approach*

The cost saving approach tries to measure the savings that accrue to producers as a result of transport development and reduction in transport costs. This would include the savings accruing due to the present traffic as well as to traffic which would have developed without transport improvement, both near the transport facility and elsewhere in the economy.

(c) *Shipper's Saving Approach*

This measures the increased profits accruing to transporters located near the facility and also elsewhere who ship over the given facility, because of the saving in expenditure on maintenance and wear and tear.

(d) *Rents or Land Value Approach*

The rents refer to the increased profits of transporters. The development of transport is also expected to increase income accruing as rent to owners of land and other realty near the transport facility (Harral 1968).

Measuring Transport Benefits – Recent Developments

Recently, there has been an attempt to broaden the analysis by capturing all the benefits of road construction in a development context. Two cases have been considered. In the first case (case I), the road is built in an area where the existing traffic is high. In the other case (case II), the road is built in an area which is underdeveloped and very little traffic originates from there.

Case 1. Benefits of Road Construction in an Area with High Traffic – User Cost Estimates

User cost saving is one of the popular traditional methods of measuring benefits. What is measured is the cost reduction of users as a result of transport development. This might include time saving also. It is argued that the user cost method is the correct method in a situation where the level of activity is already substantial or expected to be substantial because of ongoing and planned rural development. In this case, the demand for traffic ("without" project traffic) justifies this activity and the benefits are largely road user savings on normal traffic and the magnitude of benefits is comparatively small.[10]

Figure 4.2 gives both the benefits of normal profits as well as those accruing on

account of development. This situation is analogous to the consumer surplus approach.

Case II. Benefits of Road Construction in an Area with Very Low Traffic and Economic Activity

A more relevant situation in the context of rural road development is the one where the road is to be built in an area having inadequate traffic and low levels of activity in the area of influence. In such a situation, it is preferable to focus directly on basic economic changes rather than to look for possible changes in traffic volume. The argument is as follows. Road development leads to cost savings on the part of the farmers, the largest producers in backward areas. The enhanced access to markets for inputs and outputs results in cost savings for the producers and increases their surplus. The benefits due to cost savings are represented by the shaded rectangle in figure 4.3a.

Transport development also brings the benefits of access to more markets. (Devres 1980). Farm income increases also lead to additional activity in the manufacturing and services sectors and trade and commerce are particularly benefited. Hence, in this case, the development effects are crucial and should be captured. The size of the developmental benefits to agriculture is illustrated in figure 4.3a by the triangle under the demand curve.

Figure 4.3b shows identical benefits in an alternative manner in terms of increased price realized by the farmer and his increased welfare. In the Agricultural Supply Curve, Q_1 is the without project output and P_1 the farm gate price. The farmers get savings from the reduction in transport costs and the real farm gate price rises to P_2. This leads to an increase in production from Q_1 to Q_2. In this case again, while the shaded rectangle represents cost savings to the farmers on normal output, the shaded triangle captures the gains on newly generated output.

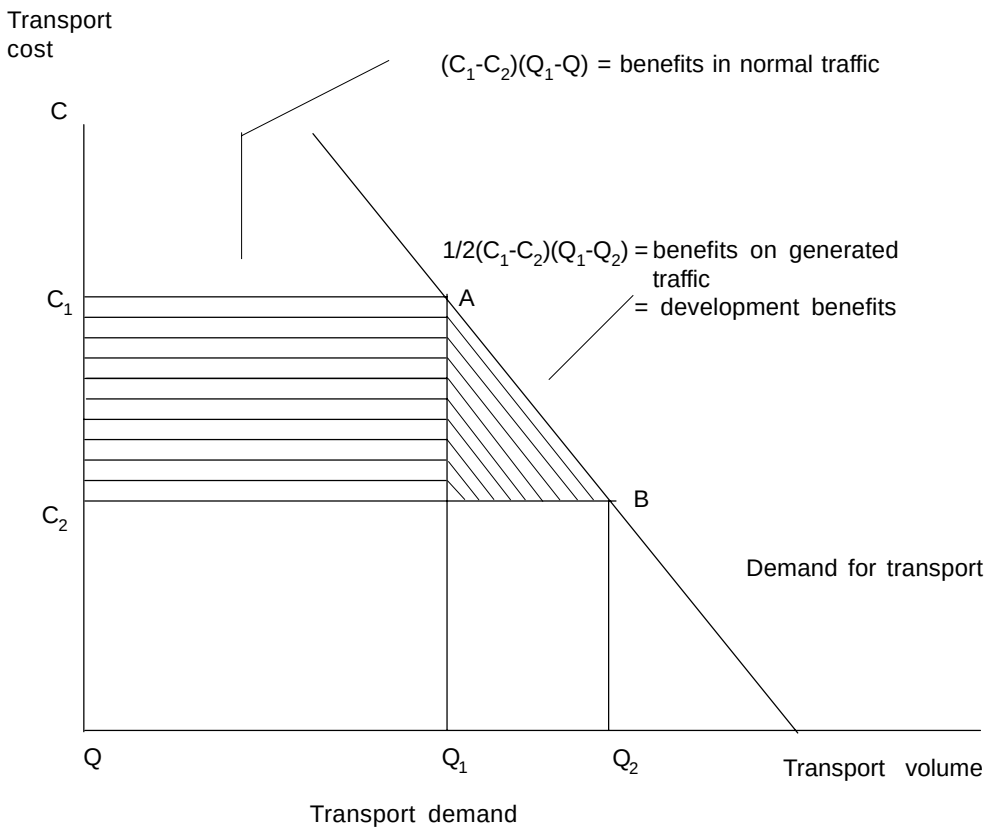
It is significant to note that benefits calculated through transport demand and agricultural supply curve are identical. Hence, the two benefits must not be added together, but may be used to cross-check each other. This also brings out the equivalence of the two methods for measuring benefits of transport development.

Economic Analysis – Producer Surplus Approach in Transport BCA

[10] The World Bank roads project discussed by King (1967) uses user cost saving to measure benefits. The time saved and saving in vehicle operating costs are the other methods used (see Van der Tak and J. de Weille 1969; Cobb et al. 1984). Mexican road project which calculated the total savings of time and vehicle maintenance savings gave an economic rate of return (ERR) of 11 to 18 per cent (King 1967). Unquantified other benefits would raise ERR to 20 per cent.

A more realistic case is the one where road development in conjunction with agricultural growth in a backward area triggers a spurt in economic activities in the area. In this case, the transport cost reduction may lead to a downward shift in the supply curve in agriculture from MC_1 to MC_2 (figure 4.4) thus increasing the producer surplus. At the new price P_2, output would increase from Q_2 to Q_3. With two effects together, output increase from Q_1 to Q_3 and the producer surplus or farm level benefits are represented by the shaded area in figure 4.4.

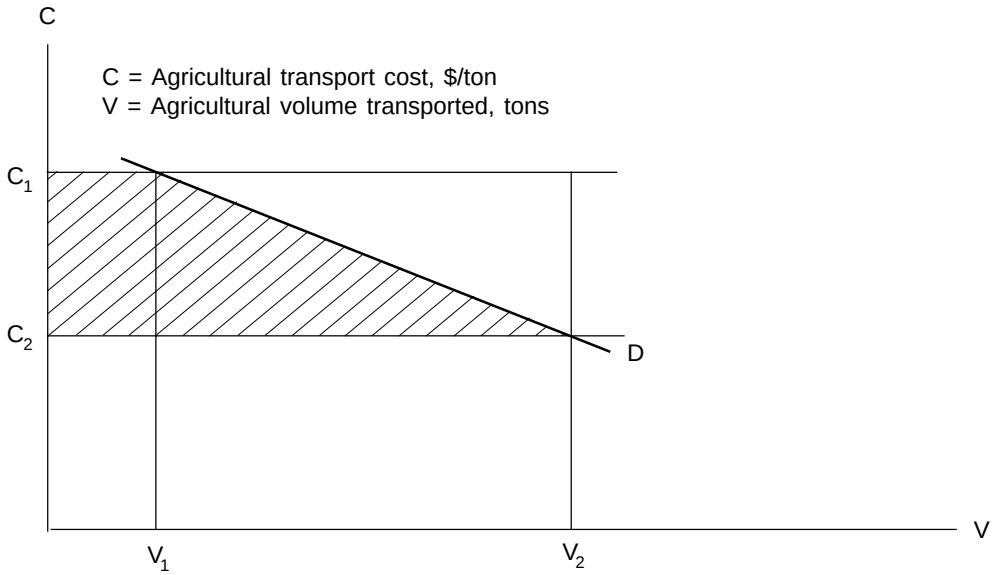
Figure 4.2. Transport demand function for case I



It may be noted that there could be less surplus if all the benefits of transport cost reduction are not passed on to agriculture and are retained by transporters or traders.

A few empirical studies bring out that the benefits from producer surplus could be substantial. For example, the benefit-cost ratio for an El Salvador project was found to be 3:1 because of the increase in shrimp marketing and cotton production. Sometimes,

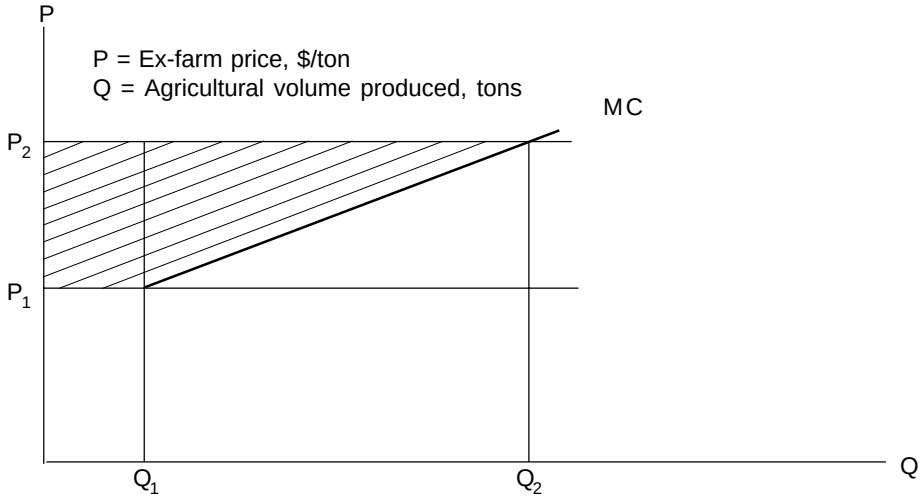
Figure 4.3a. Transport demand for case II



user cost saving and producer surplus were combined to obtain a benefit-cost ratio (Chanmari and Beehakker 1984). It was acknowledged that this might involve double counting.

Equivalence of National Income, Producer Surplus, Consumer Surplus Approaches

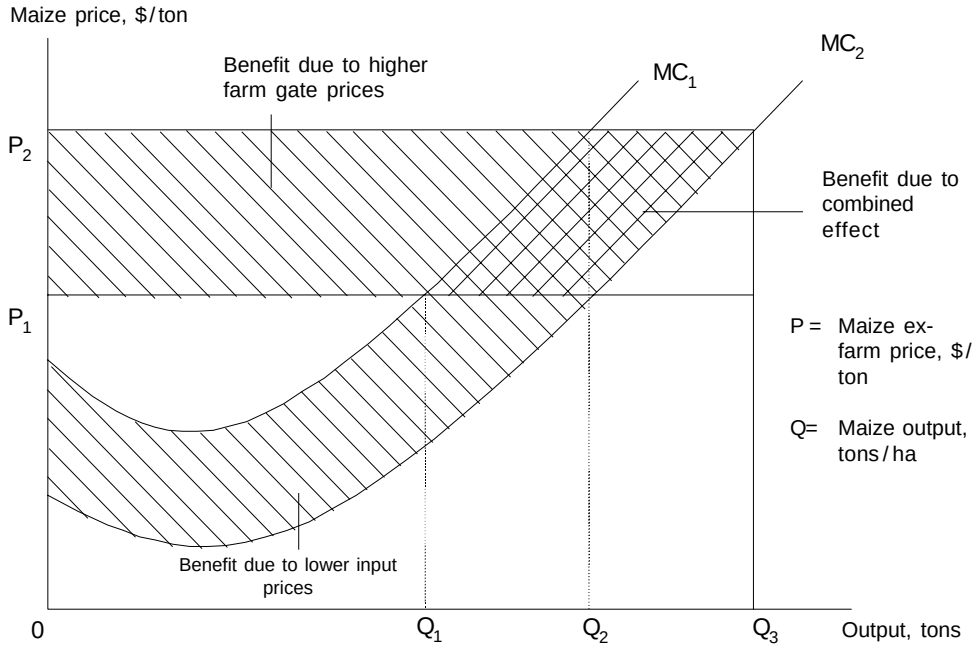
Figure 4.3b. Agricultural supply for case II



In a transport project, the general methods used for measurement are the national income approach, the cost saving approach, the shipper saving approach and the rents or land value approach. Conceptually, the cost saving approach is the same as the consumer surplus approach, and the shipper saving approach is the same as the producer surplus approach.

It has been shown by several scholars that the three approaches, namely, the national income approach, the user cost approach and the producer surplus approach are actually equivalent (Harral 1968; World Bank Staff working papers Nos. 241 and 362). In a transport project, it is sometimes more convenient to employ the user cost saving or shipper saving approach instead of determining the national income or value added. The equivalence of consumer surplus (user savings) and the producer surplus approaches has already been brought out in figure 4.3a and figure 4.3b. The point is that one should avoid duplication and double counting and be careful in using either one or the other approach. Different approaches may, however, be used for cross-checking the results.

Figure 4.4. Production of maize in year N



Integrated Economic Analysis

It is generally recognized that overall rural development, including development of

agriculture, non-farm manufacturing and services in rural areas, takes place as a result of the integrated and simultaneous development of power, irrigation, rural roads, regulated markets and scientific research and extension. In this situation, the impact is synergistic in nature, where the contribution is made by each factor in combination with other factors. It is, therefore, difficult to isolate the impact of a single factor. For example, in a rural area, agricultural growth could perhaps be a more important contributor to the growth of traffic than even the reduction in the cost of transport and accessibility provided by the rural road analysis approach. Integrated economic analysis is especially useful for the appraisal of infrastructure projects providing goods and services that are directly utilized for production (World Bank 1976).

Project Evaluations – The Current Practice

Ahmed and Hossain (1990) have undertaken an inventory of the types of analysis used in 45 appraisals and evaluations of rural infrastructure projects. The inventory shows that the evaluators have not followed any uniform methodology for undertaking the numerous evaluations of projects. Of the 45 projects, 29 were transport projects, 10 electrification, 3 integrated rural development, 1 irrigation and 2 communication projects.

Table 4.4, which lists the various methods used for project evaluation, brings out some interesting facts. It is clear that the user cost savings (user surplus) or producer consumer surplus generation are the most commonly used methods for project analysis. In addition to quantitative methods, qualitative methods are also being used generally by the United States Agency for International Development (USAID) and some other donors.

Table 4.4. Types of analysis used in project appraisals and evaluations

	--- --- FUNDING AGENCY --- ---			
Analysis	*World Bank*	*USAID*	*Other*	*Total*
Consumer (user) surplus	8	0	1	9
Producer surplus	1	3	0	4
Producer-consumer surplus	7	3	0	10
Financial	3	0	0	3
Qualitative	0	6	2	8
Other	3	3	1	7
Total	22	15	4	41

Source : Ahmed and Donovan 1992

Summary and Conclusions

Benefit-cost analysis deals with measuring the stream of benefits (costs) of a public project and appropriately discounting these to obtain their present value. That there exist some serious and unresolved problems in the measurement of benefits and costs in the conventional BCA has been clearly brought out in the above analysis. Most of the measurement problems relate to the evaluation of indirect benefits and intangibles. The evaluation of the benefits of infrastructural investments for the eradication of poverty poses similar and perhaps more serious problems. There are several reasons for this. First, the benefits are generally indirect and, quite often, they are intangible. Second, the impact reflects the joint outcome of several infrastructural investments and, as such, isolating the individual benefits becomes difficult. Third, the distribution across social groups is not easy to measure and the assigning of distributional weights raises the usual problems of subjectivity, value judgements and biases. Finally, many infrastructure investments have important growth effects that express themselves in "economic impact" and "development impact". These are not captured by BCA. Quite often, even SBCA fails to take account of impacts which might constitute the main contribution of infrastructural projects to development. Another measurement problem arises because the benefits are not only indirect and intangible, they emerge through a complex process and are generated jointly by a combination of rural infrastructural projects over a period of time, and are interdependent on growth of agriculture and emergence of surpluses, growth of secondary and tertiary employment and benefits from social services. It is very difficult to find a comprehensive method of measuring separately the specific contribution made by each infrastructure like transport, rural electrification, irrigation and rural markets.

All infrastructural projects like transport, irrigation, power and credit affect different income groups differently. In transport development, projects that are intended to promote general mobility may result in very different outcomes in terms of which groups receive (and retain) the net benefits. Similarly, the benefits of public irrigation or rural institutional credit may be monopolized by the rich and the powerful. Understanding the distributive impacts of a project is important if the project's success is measured by its contribution to poverty reduction. There is a need to keep the distributive impact of projects in mind. Choices should be based on socio-political value judgements of what is in a community's or society's best interest. According to Gannon and Liu (1997), "Generally, this calls for presentation of key information on these trade-offs to policy makers in a form that facilitates decision-making."

Scholars have suggested the use of the producer surplus approach for determining

the benefits of rural transport projects in areas where, to begin with, the traffic volume is not very large. The benefits of the shift in the supply curve brought about by transport and enhanced efficiency in agricultural production is said to be captured by that method in a satisfactory manner. But, to be able to capture the producer's surplus, data are required for deriving the supply curve before and after the project. Further, as has been discussed earlier, there could sometimes be a duplication in the enumeration of benefits because of the equivalence of the income method, the consumer surplus method and the producer surplus method. Some scholars have argued that the input-output multiplier method could be employed usefully for measuring the economic impact and the development impact. But, as will be discussed in the next chapter, in order to truly capture these impacts, three preconditions have to be satisfied. These are (a) the specific investment would not have happened in the absence of the specific project investment being considered; (b) the specific investment uses resources that otherwise would have remained unemployed; and (c) the specific investment does not displace economic activity that would have otherwise taken place. Obviously, these are fairly stringent preconditions.

Keeping in view the above problems, one has perhaps to look beyond conventional BCA to be able to find a satisfactory method of measurement with the aim of apprising the policy maker of various trade-offs among projects. Constructing indicators of development is one such tool that can provide useful additional information to the policy makers for making a choice from among a set of infrastructural projects aimed at poverty reduction in rural areas. These will be discussed in the next chapter.

5

Indicators of Benefits of Infrastructural Interventions

Introduction

The previous chapter highlighted the main limitations of conventional BCA. It was brought out that, despite its robustness, it failed to capture all the indirect and intangible benefits and the externalities that emerge in the process of interaction among various sectors consequent to infrastructure intervention in rural areas. One of the supplementary methods that have been suggested by the scholars is the development of independent indicators that try to capture the multidimensional impact of rural infrastructure investment. To be useful, the indicators designed for capturing the numerous benefits should be clear, unambiguous, quantifiable and easily measurable. Further, the indicators should be monotonic, that is, a positive change in these should imply a consistently positive or negative change in what is intended to be measured. Some scholars would also like these to be monetizable, but, perhaps, that condition could be very restrictive (Islam 1982).

A rural infrastructure project generates several direct and indirect developmental impacts. For example, a rural road project when completed results in increased accessibility, development of secondary and tertiary activities, and a decline in the incidence of poverty. Again, the initiation of special programmes for marginal and small farmers in countries like India, Bangladesh, Nepal and the Philippines yields numerous direct and indirect benefits in the form of improved farming practices; better repayment performance; and increased income, employment, self-reliance and family welfare. Specific indicators have been suggested for measuring the degree of achievement in each of these areas (India 1981; Islam 1982).

The indicators of development or of poverty reduction could be direct or indirect. For example, increase in accessibility due to road construction could be measured by the reduction in cost of transportation. Economic development could be measured directly by increase in per capita income. The indirect indicators of development could be increase in life expectancy, increase in the level of living and self-reliance.

In many countries, the debate on poverty has generated a vast literature on the

appropriate definition of poverty, development of measures of incidence of poverty and development of indicators capable of capturing the impact of any programme on poverty reduction. The direct indicators of the incidence of poverty are based on the minimum threshold level of living (known as the poverty line) defined in terms of the ability of a household to meet minimum per capita calorie requirement or the equivalent in terms of minimum per capita income or per capita expenditure per day. Among the direct indicators, "head count ratio", defined as the proportion of population below the poverty line is the most commonly employed indicator of poverty. The other direct indicators are the "Sen index", "poverty gap index", "squared poverty gap", and "per capita income or expenditure", which capture the depth and severity of poverty among the poor and their level of living. On the other hand, the indirect indicators of poverty reduction include increase in employment, improved production practices and increased self-reliance. The impact of rural infrastructure investment on poverty reduction can be traced through both direct and indirect indicators of poverty by comparing the changes therein before and after or with and without the project situations. The indicators of development or of poverty reduction could, therefore, provide extremely useful information for supplementing benefit-cost analysis.

Monitoring and Evaluation of Anti-poverty Programmes

In most developing countries large resources are being devoted to anti-poverty programmes, and there has emerged in some of these countries an elaborate system for evaluating many of these programmes. The two most important indicators frequently used are the extent of financial and physical achievement. Financial achievement is often measured by looking at the expenditure incurred as a percentage of total allocation made for the programme. The physical performance gives much better idea about the benefits flowing from infrastructural investment. For example, in an employment scheme, the total employment generated is an important indicator giving the extent of benefits from the scheme. Similarly, the additional employment generated and the number of employees belonging to economically and socially backward sections of the population (like Scheduled Castes and Scheduled Tribes (SC/ST) in India) and the number of women employees, are the other relevant indicators. The infrastructural services generated in physical terms, such as kWh of electricity generated, irrigation potential, number of rooms constructed in a school or beds in a hospital, also give a measure of the project's benefits.

Detailed evaluation procedures have been laid down for the two most important anti-poverty programmes, namely, the Integrated Rural Development Programme (IRDP)

and the Jawahar Rozgar Yojana (JRY) operating in India. The IRDP is one of the oldest anti-poverty programmes initiated in 1980 with the objective of providing credit based productive assets like milch animals, irrigation equipment, carts, handloom, shops, etc. to the identified poor in rural areas in order to enable them to augment their income and, thereby, rise above the poverty line. In the case of IRDP, there could be several financial and physical targets. The more important among the latter are the number of beneficiaries crossing the poverty line through the incremental income generated, the recovery rate of the loans advanced by the banks, and the subsidy credit ratio which measures the extent to which these programmes are becoming dependent on credit rather than on subsidy. The negative benefits could be measured by the percentage of the defaults in debt repayment.

The second programme, namely, Jawahar Rozgar Yojana (JRY), is an employment-generating programme initiated in 1989 by combining several earlier such programmes. The main objective is to provide wage employment to the rural poor and unemployed for creation of community assets like roads, tanks, irrigation bunds and watershed development. Recently, the Million Wells Programme and the Indira Awaas Yojana (Housing Programme) have become the most important components of JRY. In the first round, the number of wells dug under the Million Wells Programme and the total houses built for the poorer sections under the Indira Awaas Yojana are useful indicators of direct benefits. In the case of infrastructural investments, indirect benefits should also be calculated from additional agricultural output obtained from digging out a well and the imputed value of rent generated as a consequence of building a house. Similarly, the benefits of minor irrigation works created through an employment programme like the Watershed Development Programme could also be measured by looking at increased agricultural output due to the availability of irrigation. Watershed development also has an impact on the improvement of the environment, prevention of soil degradation and afforestation. Suitable indicators for each of these outcomes would need to be devised for calculating the overall impact of a watershed development project.

The experience in many countries brings out the importance of a broader approach for monitoring infrastructure projects in rural areas. For example, in India, the Ministry of Rural Development has evolved a comprehensive system of monitoring and concurrent evaluation of major rural development programmes like the Integrated Rural Development Programme, Jawahar Rozgar Yojana, Employment Assurance Scheme, Land Reforms and Rural Drinking Water Supply Programme. Concurrent evaluation studies are contracted out to independent researchers to assess the impact of poverty alleviation programmes. The Ministry undertakes the following types of monitoring:

Progress reports. These consist of monthly indicator sheets and six-monthly comprehensive progress reports.

Release procedure. This consists of receipts of matching grants from the states, utilization reports and audit reports before release of the next instalment.

Intensive inspections. These consist of inspections by senior level state and implementing agency officers.

Review and monitoring. This is done by committees and groups of high level officers at the state and central levels.

Review meetings. These take place at the headquarters.

Concurrent evaluation reports.

Standing committees and consultative committees of the Parliament.

Some of the procedures mentioned above are used extensively for evaluation and monitoring of project performance (India 1995).

Impact Monitoring and Performance Indicators

Some scholars have developed impact monitoring and performance indicators for evaluating the impact of transport infrastructure which offers numerous benefits to the rural poor. These methods can also be used for measuring the benefits of other infrastructural investments for poverty reduction in rural areas. Two general approaches are the cost surrogate method, and the behavioural approach. The cost surrogate method is quite simple and is widely used. But to use it, one ought to know the income distribution among the affected persons before the project and also the level of use of road and infrastructure service by each group. The benefit desired by each income group is estimated by multiplying the average level of use by the particular income group and the unit cost of providing the service. This benefit is then compared with pre-project income level as an indicator of welfare improvement among the various income groups (Meerman 1979; Selowsky 1979).

The behavioural approaches resulting from the project could be measured within a general equilibrium framework. However, for this, the data requirements are very demanding. This is particularly true in the case of transport which has very wide linkages in the flow of benefits to various classes, including the poor. Because of their huge data demands, both the impact monitoring and performance indicator methods are not very

cost-effective.

An alternative suggestion is to use a small set of performance monitoring indicators which can give information at low cost. Three categories of indicators are suggested: (a) input indicators that measure the means by which the project is implemented; (b) process indicators that measure the extent to which the project is delivering what it is intended to deliver; and (c) impact indicators that measure the project's impact upon the living standards of the project beneficiaries. For most transport projects, the indicators that measure the poverty impact fall into the third category.

The selection of a set of indicators will differ from one project to the other depending on their objectives. In general, it is always better to have a few key indicators for evaluating the performance of a project. For a rural road transport project that aims to improve accessibility to basic social services, a key indicator would be the average travel time and cost of travel to facilities, such as markets, schools, health care facilities, and primary transport networks (rail station, long-distance bus station) for different trips by different modes. Another measure would be the reduction in the number of days per year when travel is not possible, say, due to floods or bad weather. For a transport project designed for poverty reduction in rural areas, the following indicators have been suggested (Gannon and Liu 1997):

Average household income	
Total household expenditure	
Household transport expenditure	
Journey to work	Frequently used mode(s); motorized and non-motorized
	Number of round trips per day
	Out-of-pocket cost
	Average travel time per round trip
Other trips	Frequently used mode(s)
	Number of round trips per day
	Out-of-pocket cost
	Average travel time per round trip

Percentage of population affected by project	
Project impacts	Increased service availability
	Reduced impassable days (p.a.)
	Increased speeds
	Shorter distance
	Lower out-of-pocket cost
	Higher level of comfort
	Worsened environmental quality

Independent Indicators Approach

An infrastructural investment in rural areas generally results in promoting growth through increasing factor productivity and in providing basic services like education and health to the rural population. Its impact on poverty reduction depends on the extent to which it is able to provide productive employment and higher income to poor households and raise their living standards. While investment in physical infrastructure like irrigation directly augments earnings of the poor farmers and landless labourers by increasing land productivity, investment in social infrastructure, like rural schooling, indirectly helps the poor in augmenting their earning capabilities and hence enabling them to rise above the poverty threshold in the long run. Therefore, the poverty ameliorating impact of rural infrastructure can be examined by measuring the changes brought about by it through various household specific socio-economic indicators particularly designed for the poor households. The main indicators for capturing poverty reduction and income augmentation impact of infrastructure investment are indicated below.

Direct Indicators	**Comments**
Reduction in Poverty	
Head count index (H index)	Captures the changes in incidence of poverty defined as proportion of poor households who crossed the minimum level of living, i.e. the poverty line, defined alternatively as minimum calorie requirement per capita per day or its equivalent amount

	of income or expenditure per capita per day, necessary to meet minimum energy requirements.
Poverty gap index (P.G. index)	Captures the depth of poverty, i.e. the average shortfall of income or expenditure of the poor to cross the poverty line. P.G.=Sum (per capita income-poverty line)x100/poverty line)
Squared poverty gap index (SPG index)	Captures the severity of poverty among the poor. It is square of the index individual poverty gaps.
Sen's index	In addition to capturing the incidence of poverty (H index) and depth of poverty (poverty gap i.e. P.G.), Sen's index tries to capture the distribution of income (Gini Coefficient, G) amongst the poor. Sen's index = H[P.G. + (1-P.G.) x G]
Per capita income	Accounts for estimated increase in income or level of consumption or expenditure.

The above indicators are particularly relevant for those infrastructural investments that directly affect the earnings, incomes and consumption levels of households living in their area of influence. These indicators could help in the evaluation of the poverty reduction impact of projects like irrigation works, watershed development, rural transport, rural credit, electricity and investment in agricultural research and development. However, in order to do so, there is a need to undertake a comprehensive survey of earnings and consumption patterns of households in the project area before and after or with and without project investment. However, should either of the two years be an abnormal agricultural year, an evaluation of project investment based on the data for two points of time would give a misleading impression of the poverty reduction impact of project investment. This problem occurs mainly in income approach based indicators. In such cases, income based indices ought to be supplemented by consumption based indices of poverty.

Indirect Indicators

The direct measures of poverty discussed above have been criticized for introducing a mechanistic approach to poverty alleviation. It has also been argued that the income, consumption, and nutrition approach fails to capture the changes in the access of the poor to services like education, health, safe drinking water and sanitation or other qualitative

changes, such as perceived well-being and self-reliance of the rural poor, introduced by the project investment. An alternative measure of poverty is the lack of ability to attain a minimum standard of living (World Bank 1990). This broader approach supplements income- or consumption-based poverty measures with other indirect indicators of well-being such as life expectancy, mortality rates (both infant and under 5) and other health related indicators, and school enrolment rates (World Bank 1990; and Dreze and Sen 1996).

In a paper presented at an ESCAP Workshop, Islam presented a group of indicators that could be used to measure the benefits of the rural scheme, Small Farmers Development Agency (SFDA), in Bangladesh. These indicators related to income, employment, self-reliance, family welfare, people's participation, repayment performance, self improvement, improved production practices, command over fixed production assets, impact on other agencies and involvement of women.

The importance of the broader approach has been demonstrated by several studies. For example, a resurvey of two villages of the state of Rajasthan in India brought out that even though real per capita income in the terminal year declined, there were significant improvements in other indicators of economic well-being, such as expanding economic opportunities, increased consumption of goods with high income elasticity, investment in lumpy consumer durables and reduced reliance on patrons (Jodha 1986).

The supplementary indirect indicators, other than those based on income or consumption, that can be included in the broader approach to evaluate the poverty reduction impact of project investment, are:

Employment. Direct employment benefits are (a) additional employment generated by the project; and (b) its positive effect (if any) on rural wage rates.

Direct employment benefit indicators are employed for concurrent evaluation of employment generation programmes (such as Jawahar Rozgar Yojana) for the rural poor in India (India 1994).

Indirect or secondary employment benefits of infrastructural investment that flow in the long run include (a) occupational diversification from primary towards secondary and tertiary sector jobs, (b) increase in the wages of rural workers due to labour migration to urban and sometimes prosperous rural areas, (c) increased female work participation, (d) decreased male-female wage differentials, etc.

These indirect benefits are specially relevant for infrastructural investment like rural transport, rural schools and training institutions.

Improvement in agricultural production practices. Indicators of improvement in agricultural production practices include (a) increased proportion of cultivated area under high-yielding seeds, (b) increased per hectare chemical fertilizers, pesticides, weedicides, etc., (c) increased area under irrigation, (d) increased use of machinery, (e) increased area under high value commercial crops, and (f) growth in total factor productivity.

Improvement in non-agricultural production practices. Increased use of machines and other elements of new technology by village artisans and rural industries.

The indicators for agricultural and non-agricultural production practices are useful for evaluating project investment undertaken to improve the well-being of the rural producers, such as village artisans and small and marginal farmers who constitute a significant proportion of the rural poor in developing countries. For example, Small Farmers Development Agency (SFDA) and Marginal Farmers and Landless Labour Development Agency (MFALA), which were set up in India to improve conditions of these target groups, yielded positive results in improving the productivity of assets belonging to the rural poor.

Self-Reliance. The main indicators of self-reliance are (a) acquisition of fixed production assets like land, milch animals, poultry birds, agricultural machinery, and implements like tubewells, tractors and other implements by agricultural households and productive assets by village artisans, (b) release of mortgaged land or other assets, (c) increased proportion of household expenditure as also of productive investment met from own resources, (d) decrease in interlocking of factor and product markets, e.g. a decrease in the degree of bondedness of labour and advance sale of crops, (e) increased access to institutional credit, and (f) timely repayment performance of advances or loans.

These indicators can be utilized to evaluate the benefits from infrastructural investment. In fact, self-reliance of the poor is a very robust indicator of the long-term poverty reduction impact of any infrastructure in general and of rural credit in particular.

Improved housing. Shelter being one of the three basic needs of humans (the other two being employment for food security and minimum clothing), improvement in housing conditions is a sure sign of the improved well-being of the poor. The main indicators of improved housing are (a) increased ownership of dwellings, (b) improvement in the structure of the dwelling house, e.g. from mud-walls to bricked or semi-bricked or wooden structures with proper ventilation and natural light arrangements, (c) use of electricity for lighting

purposes, and (d) additional per capita covered area.

The improved housing conditions capture the benefits from almost all projects but assume added significance in housing related infrastructural investment. Indira Awaas Yojana (provision of housing to poor households belonging to the scheduled castes and scheduled tribes) is one of the important investments under the anti-poverty employment generation programme in India.

Drinking water and sanitation. The main indicators are (a) increased access of the poor to sources of safe drinking water, (b) improvement of rural sanitary conditions for the poor (measured through improved water drainage, sanitary latrines, etc.), and (c) increased availability of public curative measures such as anti-malaria drive and immunization.

Health and family planning. The main indicators that can be usefully employed to capture increased well-being of the poor in this regard are (a) increased accessibility to health and family welfare services (resulting in time saving and, hence, reduced delivery cost of the line agency services), (b) decline in both infant and under-five mortality rates, (c) decline in morbidity rate among the poor (measured as number of days saved due to reduced sickness as well as savings on account of lesser expenditure on curative medical treatment), (d) increased longevity (or life expectancy), and (e) decline in birth rates due to adoption of family planning practices by the fertile age group couples.

These indicators are specially relevant for infrastructural investment in public health and family planning projects. However, some of these indicators like reduction in morbidity and mortality rates are also related to increased availability of safe drinking water and improvement in sanitary conditions.

Nutrition. Apart from the direct indicators of overall nutrition deficiency (proportion of population below minimum level of nutritional requirements), the indirect indicators of nutritional deficiency, specially among the children and pregnant mothers, are also closely related with the prevalence of poverty. Some of these indicators are (a) decline in the proportion of underweight children (measured alternatively as weight-for-height, weight-for-age), (b) decline in the proportion of population suffering from anaemia (specially pregnant mothers), and (c) decline in the proportion of low weight by birth babies (an indicator of maternal malnutrition).

These poverty related indicators of malnutrition are specially relevant for evaluating the projects aimed at improving the nutrition level of the poor, in general, and of the children and pregnant mothers, in particular.

Human capital indicators. The main human capital indicators related to increased well-being of the poor are (a) increased net enrolment rates among the primary and the secondary school age group children of poor households, (b) decline in the school drop-out rates, (c) increase in the literacy rate specially of the secondary and above level of education, and (d) increase in the proportion of technically trained personnel.

The above indicators are specially important for evaluating project investment in education and training infrastructure. It may, however, be noted that besides investment in education, etc, these indicators also reflect the secondary impact of almost all income augmenting infrastructural investments like irrigation, rural credit, and rural transport. In fact, the human capital index is one of the three indicators used to calculate the composite index of well-being, like the "human development index" (UNDP 1995) and "public quality of life index" (Morris 1979).

People's participation or empowerment. (a) Increased representation and participation of the poor (especially women) in the decision-making process in rural democratic institutions, (b) increased rights of accessibility to the poor (especially women) to village common property resources like collection of firewood, grasses for the cattle and cattle grazing rights on common grazing lands, (c) increased involvement of the poor in project planning, implementation and management, in general, and in poverty eradication projects, in particular.

These indicators are specially relevant for evaluating the poverty reduction impact of projects related to the development of common property resources like integrated watershed development projects in India.

Environment. (a) Increased area under forest and other common lands, and (b) declined degradation of soil, forests, water and biological resources.

This is not an exhaustive list of indicators that try to capture the poverty ameliorating impact of project investment. The list is amenable to modification with the addition of some area-specific or project-specific indicators. Similarly, all these indicators may not be relevant for all the rural infrastructural projects. The choice of indicators for evaluating the poverty reduction impact depends on the availability of data and their relevance in a particular situation.

Combining Indicators

The individual indicators such as an increase in per capita income and employment

provide a useful measure of impact of project investment for reducing poverty from different angles. However, to provide an overall index of poverty reduction, these are required to be combined into a simple composite index capturing the overall effectiveness of project investment on numerous variables. But formulation of such a composite index is not so easy. Combining of various independent indicators involves two problems. The first problem is related to the scale of measurement as different indicators are measured in different units/scales. The second problem is related to the assigning of weights to different indicators in formulating a composite index. The problem of scale effect can be removed by conversion of the chosen variable to a discrete scale or by standardization or by converting it to normal scale with zero mean and unit variance or normalizing it with respect to mean. Once the bias in measurement is removed, the crucial problem is of assigning weights to each indicator in the composition to reflect its relative importance. One simple solution to the weightage problem is to assign equal weights to all indicators as has been done in computing the Human Development Index (UNDP 1995) and Public Quality Life Index (Morris 1979).

However, an equal weightage scheme could lead to misleading conclusions and ambiguous policy decisions. For example, giving equal weights to primary education, reduction in child mortality and provision of safe drinking water involves strong value judgement which may be difficult to defend in a given socio-economic context. It is more appropriate to derive weights on the basis of degree of association (correlation) of indicators with the phenomenon under consideration. The "principal component analysis" is one of the approaches that can be usefully applied in determining the weights. This method enables an analyst to determine a vector (known as the first principal component) that is linearly dependent on constituent variables and has maximum squared correlation with variables. It can be shown that this vector explains the maximum possible variance among the constituent indicators. The composite index can, therefore, be obtained by linearly combining the standardized (free from scale bias) variable values with weights given by the eigen vector associated with the largest eigen value of the correlation matrix (Kundu 1978).

The main advantage of a composite index is that it provides an easy decision rule for the policy makers. However, being aggregated, it fails to give information on its various components which may be quite revealing and important.

Summary and Conclusions

An infrastructure investment aimed at poverty reduction in rural areas generates numerous net benefits which are likely to accrue to all sections of the rural society, including the poor. Benefit-cost analysis is a useful technique that attempts to measure systematically

not only all the tangible benefits but also the externalities and the intangible effects that emerge out of the project. Theoretically, BCA is also expected to account for distributional considerations as well as concerns for measuring merit and demerit goods. However, despite its robustness, in practice, BCA generally does not fully capture all the externalities and intangible benefits, particularly the development impacts that emerge as a result of rural infrastructure investment.

One of the supplementary methods suggested by the scholars is the development of independent indicators that try to capture the multidimensional impact of rural infrastructure investment. To be useful, the indicators designed for capturing the numerous benefits of such investment should be clear, unambiguous, quantifiable and easily measurable.

Some of the frequently used indicators are the ones that try to measure the impact of a rural infrastructure project on the development of the region and on raising the incomes and welfare of the population, including the poor living in its area of influence. The direct measures of poverty, like the poverty ratio and Sen's index, can provide information on the extent to which the incidence of poverty has been reduced as a result of the project investment. A precondition is that information must be available for both the "with" and "without" situations. A broader approach to evaluation of the poverty reduction impact of rural infrastructure includes indicators related to employment and unemployment, improvement in production practices, self-reliance, housing, drinking water and sanitation, health and family planning, nutrition, human capital formation, people's participation or empowerment, and the environment. Choice from among these indicators depends upon the type of project investment, the availability of data and the ultimate aim of the investment. These indicators can be employed as independent evaluators as well as a supplement to direct indicators of poverty reduction or of rise in per capita income.

There are some limitations associated with indicators. First, a large number of indicators could be designed for capturing the effects of, say, a rural infrastructure investment, and sometimes these tend to become quite general and descriptive. Second, in many instances, the indicators for, say, development may not move in the same direction. Keeping in view these limitations, various independent indicators are sometimes combined into a composite indicator. Designing such composite indicators is a complicated task. The main problem lies in assigning weights to different indicators in the composite scheme. The way out is either to assign equal weights that can sometimes lead to serious policy implications or to assign politically determined weights that again suffer from subjectivity bias. An ideal situation would be to derive such indicators as are free from subjectivity bias. However, it is not possible to do so although indicators can be designed in such a way that these are not inconsistent with the basic assumptions. The principal component analysis is one

of the useful statistical techniques that are extensively employed to derive weights for different independent indicators.

Despite its obvious attraction, a single combined and aggregated index of benefits has certain serious limitations. A policy maker always prefers detailed briefing regarding the benefits that are likely to accrue to a particular constituency (preferably his own constituency) of any infrastructural investment like rural roads, irrigation projects, building of a school or hospital. He would like to know, for example, the increase in connectivity and saving in time, the physical capacity of admitting students in a school, the number of beds in a primary health facility and so on. He is not impressed by rather sophisticated indices like "human development index" or other similar composite indices. Hence, it is preferable that, despite duplication and repetitiveness, detailed indicators of the benefits and impacts of rural infrastructure investment on development and on poverty reduction should be prepared and furnished to the policy makers.

To sum up, the main rationale of the indicator approach arises from the assumption that it recognizes the importance of externalities like the development impacts of a project on the poor and tries to describe these in a systematic manner. It has, however, to be appreciated that indicators are not a substitute for BCA; these only provide supplementary information to BCA. This chapter examined the importance of the indicators approach for measuring benefits (costs) of an infrastructure project; the following chapter is devoted to a brief discussion of the techniques for evaluation of infrastructural interventions.

6

Techniques for Evaluation of Infrastructural Interventions

Introduction

There are several standard techniques for measuring the benefits and costs of a project. These are briefly discussed below. First we take the conventional techniques of benefit-cost analysis (BCA) as developed by Little and Mirrlees and by UNIDO. This is followed by several other methods recently suggested by scholars.

Benefit-Cost Analysis – An Attempt at Capturing Social Benefits and Costs

The benefits from a project investment flow over a period of time. Similarly, while a large proportion of fixed costs may be incurred over a period of a few years, many other costs of an investment for a project in operation are also incurred over time. Once projected annuities of cost and benefit flows from project investment are estimated, these have to be discounted appropriately with a view to determining their present value. This is because due to time discount by consumers, future income streams do not have the same value as the current ones. Finding present value of annual streams is, therefore, an essential step for private or public authorities for enabling them to evaluate whether any project investment is worthwhile or for ranking the alternative investment projects for making investment choices.

Among the various appraisal criteria, the three most commonly used methods for comparative evaluation of projects are, calculating (a) net benefits through discounted cash flow (DCF), (b) internal rate of return (IRR), and (c) benefit-cost ratio. These alternatives are briefly discussed below.

Discounted Cash Flow (DCF) and Net Present Value

The discounted cash flow method tries to find the present value (PV) of the future stream of income and costs. The first step is to determine quantitatively, the annual stream

of benefits in terms of goods or services likely to flow to the recipients from a project over its entire life period. The second step is to discount the future cash flows back to the present. The rationale for discounting future earnings to the present occurs because of the time value of money, i.e. present consumption is valued more than future consumption and similarly for the capital investment. This discounting is independent of inflation. If it is possible to forecast the rate of inflation accurately, this should be added to the discount rate. However, it is not possible to predict the annual streams of income after taking inflation into account and, therefore, all future predictions are done in terms of current prices.

As discussed earlier, in the developing countries, the prevailing market rate of interest may not truly reflect the opportunity cost of capital; hence, the use of the shadow price of capital should be more appropriate. This issue will, however, be discussed later.

Given that the discount rate is r, the net present value is :

$$NPV = \sum \frac{(Rn - Cn)}{(1+r)^n}$$

Where (Rn) is the expected revenue in year n; (Cn) is the expected financial cost incurred by the project in year n; n is the expected life of the project; and r is the cost of capital or rate of discount.

In cases where profit maximization is the main objective of investment, projects with positive NPV are accepted. NPV is also expressed as B – C where B and C are the present value of benefits and costs, respectively.

Though conceptually sound, this method of measurement suffers from two main limitations. First, NPV of an investment stream is very sensitive to the choice of discount rate. As such, the ranking of different investment streams undergoes a change with any small change in discount rates. Hence, the need for choosing an appropriate discount rate is quite essential for a correct estimation of NPV. Second, NPV being an absolute measure does not indicate anything regarding the rate of return or efficiency of investment. On the other hand, with a given amount of available resources to be allocated to public projects, NPV can constitute a useful criterion for choosing a combination that makes the best possible allocation of these resources (Musgrave and Musgrave 1989).

Internal Rate of Return

The internal rate of return (IRR) is that rate of discount which equates the present value of the annual stream of benefits to the supply price of the project (or the present value of annual stream of costs). It is, therefore, the built-in yield or profitability of a project and is measured through discounted cash flow method.

Let B_0, B_1, B_2... Bn be the net cash flow stream over a period n where B_0, B_1...Bn >=0. Then IRR i.e. r is that discount rate which satisfies the following equation:

$$B_0 + \frac{B_1}{(1+r)} + \frac{B_2}{(1+r)^2} + \ldots + \frac{B_n}{(1+r)^n} = 0$$

IRR provides useful information to entrepreneurs in judging their yields on investment. Therefore, investors can take decisions by comparing IRR with any target return they may have set in advance to accept or reject projects. Furthermore, it also helps investors in choosing from among many different investment projects by comparing their IRRs.

There are some problems with IRR. First, IRR can be an irrelevant criterion in some cases where either the net returns fluctuate or these turn out to be negative in any one year. Second, in many cases, one could obtain multiple values of IRR.[11] Moreover, IRR is only a rate and does not give any indication of total net benefits of an investment in absolute terms which may be more relevant for the entrepreneurs. Third, ranking by IRR could differ from the ranking obtained through market price and this could give confusing signals to the investor. It is primarily for these reasons that IRR approach is not commonly used.

Benefit-Cost Ratio

Another criterion for selection of projects is benefit-cost ratio (B/C), which measures the ratio of present value of benefits to that of the present value of costs. A choice is made provided :

$$B/C >= 1$$

Since B/C is a ratio, it does not give an idea of absolute net benefits that are expected to accrue from a project. Hence, for choosing a combination of projects, sometimes absolute net benefits, that is, B – C criterion is preferred to B/C.

Methods of Project Appraisal

UNIDO Method

The UNIDO guidelines provide a comprehensive framework for appraisal of projects

[11] A n degree equation could yield n solutions, some with complex roots.

and examine their desirability and merit by using different yardsticks in a step-wise manner. The desirability is examined from various angles, such as the impact on (a) financial profitability of utilization of domestic resources, (b) savings and consumption pattern, (c) income distribution, and (d) production of merit and demerit goods.

These different aspects are examined in five stages, each stage leading towards a social benefit-cost of the project. Stage one measures financial profitability from detailed integrated standard analytical tables enumerating various costs and benefits at the market price and examines profit viability from investors' point of view. Stage two adjusts the financial costs and benefits to various distortions introduced by market imperfections by valuing costs and benefits or net benefits in terms of economic efficiency or shadow prices. For shadow prices, it categorizes project inputs and outputs into "traded", "tradable" and "non-traded". For traded and tradable, the guidelines use the border prices (f.o.b/c.i.f) as the relevant shadow prices, whereas non-traded inputs and outputs are broken down into their components and each tradable subcomponent is valued at border prices, and so on. The residual non-traded components of commodities are valued at domestic willingness to pay criterion and the labour is valued at shadow wage rate. Stage three is designed to examine the impact of projects on savings and consumption which are of vital consideration in the choice of alternative investments in labour-intensive and capital-intensive projects. If saving is assigned great importance, as should be the case in capital-scarce countries, this stage recommends the rate for adjustment for savings by which the social value of a rupee/dollar investment exceeds its consumption value. Stage four is important for those countries that regard income redistribution in favour of weaker sections and backward regions as desirable objectives. The guidelines suggest weighting net benefits to various income groups or regions that reflect the judgement of politicians or the planners. Finally, in stage five, the UNIDO analysis suggests a methodology for necessary adjustment of the deviations in economic and social values and difference between the efficiency and social value of project output, say, between good and bad or merit and demerit goods.

It has been claimed that the analysis of merit and demerit goods is not designed for "purists in economics who think that economics should be devoid of political or subjective judgements" (UNIDO 1978).

Little - Mirrlees Method

The seminal work of Little and Mirrlees on benefit-cost analysis systematically develops a theoretical basis for the analysis and its underlying assumptions and lays down step-wise procedure for undertaking benefit-cost studies of public projects. The mathematical formulation is identical to the UNIDO method except for differences in assigning value to discount rates and accounting for imperfections and other market failures

and social considerations.

Like UNIDO guidelines, the Little-Mirrlees method also suggests valuation of project investment at opportunity cost (shadow prices) of resources to correct distortions due to market imperfections. Both methods make use of border prices to correct distortions but with a major difference. While Little and Mirrlees express the numeraire in terms of border prices in foreign currencies, the guidelines recommend that foreign exchange values be calculated in terms of domestic currency. Little and Mirrlees have also suggested an elaborate methodology for calculating shadow prices of non-tradables. Use of detailed input-output tables is suggested with a view to tracing down the chain of all non-traded and traded inputs that go into their production. However, in the case of non-availability of detailed input/output tables, a conversion factor based on the ratio of domestic costs of representative items to world prices of these items could be used for approximation of shadow prices of non-traded resources. Little and Mirrlees believe that in all less developed countries, one of the major criteria for the choice of a project should be its ability to generate savings and, hence, the Little-Mirrlees method suggests the use of "accounting rate of interests" to calculate present worth of future annuities of savings and consumption. Guidelines, on the other hand, do not make any adjustment for consumption and saving impact of project investment. Unlike the five stages of UNIDO, the Little and Mirrlees procedure is relatively more practical, although, unlike guidelines, it does not provide sufficient insights by examining project investment from different angles.

Domestic Resource Cost (DRC) or Bruno's Method

This method of project appraisal proposed by Michael Bruno is based on determining the domestic cost of resources used in the production of foreign exchange in the benefit-cost analysis of the project. By using input/output method, annual costs are divided into two parts; value of all inputs (including capital) into foreign exchange equivalent and labour cost. A rate of interest on capital is assumed to estimate direct capital cost (capital input in project) and indirect capital cost (due to additional investment in other sectors to meet input demand of the project). Output is valued in terms of foreign exchange.

Labour cost of foreign exchange is $(O - K^* r)/W$ where O is the value of output in foreign exchange; K is direct and indirect use of capital in foreign exchange (it includes both working and invested capital); r is assumed rate of interest on capital; and W is direct and indirect wage bill.

According to this method, project ranking, selection or rejection should be done on the basis of a comparison of labour cost of foreign exchange among various projects with their shadow exchange rates as calculated by the above method.

Project appraisal by Bruno's method has several advantages. First, it is a short-cut method because it considers single year full capacity operation of the project. Second, it is concerned with projects producing fully or near fully traded outputs. Third, it ignores any disequilibrium in labour and capital (savings) markets. Finally, it is concerned mainly with correcting distortions arising from tariff, import restrictions and exchange rates.

Effective Rate of Protection (ERP)

Like Bruno's method, this method of project appraisal is also a short-cut method and deals with trade distortions, that is, it measures the extent to which any project is protected against international competition. The percent rate of effective rate of protection (ERP) by this method is:

ERP = [value added at domestic prices/value added at world prices -1] X 100

Here, value added is the difference between the selling price in international market and input costs including payment to labour and capital by the projects. To estimate value added at world prices, inputs are divided into tradable and non-tradable inputs. While tradables are valued at world (c.i.f.) prices, the non-tradables are valued at domestic prices only. The selling prices are world prices and are at c.i.f for imports and f.o.b for exports. A high value of ERP indicates high protection whereas a negative and low value of ERP implies that the project does not enjoy any protection.

This method, like Bruno's method, attempts to reveal distortions in the domestic factor market. However, it ignores distortions prevailing in the international market due to both imperfections and high degree of instability. Furthermore, the method only measures the trade distortions while it ignores the efficiency of resource utilization by the project.

Aggregate Approach – Measuring Infrastructural Impact on Poverty Reduction

This approach is based on calculating the share that accrues to the poor in total net economic benefits of the project as a whole. The analysis begins by calculating both financial as well as economic benefits and costs that accrue to all the beneficiary

groups. The main groups in the case of rural infrastructural investments are : farmers, other self-employed (in non-agriculture activities), labour, consumers, project managers, government and private suppliers of project inputs and credit. Then the group wise difference between net economic benefits and financial benefits is added to each group's net financial benefits to obtain distribution of net economic benefits by groups. The sum of the net benefits of all individual groups constitutes the total net benefits generated by the project. From the share of each individual group, net benefits that accrue to the poor are assumed to be in their proportion in the group. The project's effectiveness, i.e. the poverty impact ratio of project investment is estimated as the share of the poor in the total net economic benefits of the project. The poverty impact ratio is quite useful in forecasting project effectiveness, especially at the selection stage and for projects supplying quantifiable outputs. However, it does not provide much information regarding mechanism and qualitative nature of the impact, i.e. in terms of changes in socio-economic aspects of poor population, especially on projects like health and educational investment (ADB 1997).

Table 6.1 brings out detailed methodology of measuring the poverty reduction impact of a water supply project in rural areas. The first step is to work out the expected financial returns at market prices. The second step is to work out economic returns at shadow or accounting prices. The differences between net economic benefits (NEB) and net financial benefits (NFB) is then distributed by group among consumers, government/ economy and labour. The potential benefit of the poor in the net economic returns (benefits) is calculated by using certain predetermined assumptions.

Table 6.1. Poverty impact ratio for water supply project (PVs at 12 per cent)

(Rs million)

A.	*Distribution of project effects*	*Financial returns*	*Economic returns*	*Difference*	*Consumer*	*Government/ Economy*	*Labour*
	Output	1000	1800	800	800		
	Capital costs	650	600	50		150-100	
	Electricity	330	250	80		80	
	Labour	80	56	24			24
	Total	-60	894	954	800	130	24

B.	*Poverty impact ratio*	*Consumers*	*Government / Economy*	*Labour*	*Total*
	Beneficiaries				

NEB – NFB	800	130	24	954
Financial returns		-60		-60
Benefits	800	70	24	894
Proportion of the poor	0.25	0.50	0.333	
Benefits to the poor	200	35	8	243

Poverty impact ratio : 243/894=0.271 or 27 per cent

Source : ADB 1997

The table is self-explanatory. The difference of Rs 954 mn between economic and financial returns is given in column 4. This consists of : (i) consumer surplus of Rs 800 mn (the difference between the "without project" cost of water and the "with project" expenditure on piped water (plus the value of water consumed and not paid for); (ii) government tax revenues from capital imports of Rs 150 mn minus loss in the economy to the government of Rs 100 mn through overvaluation of the exchange rate (net Rs 50 mn); (iii) government tax revenue from electricity production of Rs 80 mn; (iv) benefits to labour of Rs 24 mn (wages of Rs 80 mn less opportunity cost of Rs 56 mn). The total net benefits of Rs 894 mn are divided among the consumers (Rs 800 mn); government/ economy (Rs 50 mn+Rs 80 mn – Rs 60 mn loss on account of financial returns as per column 2=Rs 70mn); and labour (Rs 24 mn).

Finally, the share of the poor in NEB of Rs 894 mn is determined as per the following assumptions : 25 per cent share of the consumer surplus (benefit); 50 per cent share of the return to government/economy; and 33 per cent of the share of surplus for labour.

Multiplier Input-Output (I-O) Models

This approach essentially traces out the multiplier effect of investment projects on output of all interrelated industries or interrelated sub-sectors of the economy. The economy is divided into various sub-sectors or industries and a matrix containing inter-industry inputs and outputs is constructed. The multipliers try to capture the impact of both direct and indirect changes in the final demand of any single industry on the output of each industry through the use of Leontief inverse. A closing of the matrix with respect to consumption enables the calculation of impact of increased consumption (induced impact) in addition to direct and indirect impact as a result of increase in final demand. Input-output analysis is a powerful tool for impact studies as it can comprehensively capture direct, indirect and induced linkages of any investment.

But, there are a few problems. First, input-output tables are very cumbersome to construct. Second, unless detailed tables exist, aggregation of sectors poses problems.

Third, the model assumes fixed input coefficients for each sector employing a uniform technology of production. Fourth, input-output models are static in nature and fail to take into account dynamic effects of an investment. On the other hand, the dynamic input-output models depend on very rigid assumptions about capital coefficients. Finally, to be able to capture the multiplier benefits, the model must satisfy three strict conditions: one, the specific investment should not have happened in the absence of the specific project investment being considered; two, the specific investment uses resources that otherwise would have remained unemployed; and three, the specific investment does not displace economic activity that would have otherwise taken place.

General Equilibrium Analysis (GEA)

GEA is concerned with the study of the impact of any change in the context of the interdependence of all economic units and all sectors of the economy, within the general equilibrium framework. GEA is akin to ripple effect caused by any disturbance in the water of a pond and its consequence for water redistribution. The main rationale for GEA is that because of interrelationships among all sectors of the economy, a policy change in one sector would disturb all other sectors which, in turn, would lead to a state of disequilibrium. General equilibrium is finally achieved when all economic units of the various sectors settle down and simultaneously find a new level of equilibrium. GEA tries to analyse economic system as a whole and studies the second, third, and higher order effects of any event or economic change.

For example, a rural road project would, in the first instance, result in direct or general traffic benefits to road users flowing from reduced transportation costs. Reduced transport costs benefit all sectors of the economy and promote their growth. Again, sectoral growth like the growth of agriculture would further generate multiple effects through input, output and consumption linkages. GEA is not, however, suitable for appraisal of small projects in which the supply effect is not very strong and is incapable of creating notable disequilibrium in other related sectors or economic units. Input-output analysis is one of the examples of general equilibrium analysis.

Econometric Approach

This approach is essentially an ex-post appraisal of a project. Based on the empirical cross section and/or time series data, it estimates partial effect, say, of infrastructure on agricultural output while keeping all other factors constant. One has to have a hypothesis on causal relationships. This can be tested through an appropriate regression model by using the available data. Econometric approach is specially useful for studying the nature and significance of an independent factor or even a dependent event and also the

quantification of partial relationships between the two (Binswanger et al. 1993). However, this approach is of limited use from the investor's point of view, since it does not address the basic question of the likely project benefits or returns on investable resources.

Least Total Cost Analysis

The goal of least total cost (LTC) analysis is to minimize the total societal cost of meeting specific service needs. This approach focuses on the selection of least cost project from mutually exclusive projects supplying output which is identical in quantity and quality. Given the same quantum of benefits, the aim of LTC analysis is to minimize the present value of total societal cost for meeting the service needs that are either provided by mutually exclusive projects' investments or by alternative options for the projects that differ in design, size, technology, time phasing and location, etc.

For example, choosing between geothermal and coal-fired plants supplying the same quantity of electricity, and also between irrigation alternatives through surface water and underground water projects or construction of powerhouses generating same amount of electricity at different locations on a river. The total societal cost should be based on economic prices and should include all costs associated with the construction and operation of a project over its entire life, including environmental effects. However, in case benefits from mutually exclusive projects differ in quantity and/or quality, project estimates are required to be normalized for comparison.

The least total cost analysis accounts for the full cost of each alternative. The societal costs include all costs associated with constructing and operating a resource over its life time, including environmental effects, and comprises all the money spent by producers, consumers and other parties including taxpayers. Benefits are simply treated as negative costs and dis-benefits are considered positive costs. LTC calculations refer to the trade-offs that individuals and societies make between users of resources or "benefits foregone". For example, time spent is a cost in terms of benefits foregone; there is no separate measure of cost that is distinct from evaluation of benefits (Litman 1997).

In the case of a transport project, the aim is to measure access and, for this purpose, some measure of quantity of access has to be formulated. In LTC, valuing the scarcity sources that would be involved in bringing people together for economic activity does this. In this context, alternatives like relocation of services or populations, or communications like virtual access become important. The costs are normated through a normalization process like cost per access. LTC is becoming almost obligatory in the United States of America with several amendments relating to clean air and minimum pollution (Howe

1997). Still, this approach has limited utility for a number of reasons. First, it is confined only to selecting the lowest cost project without going into the feasibility of project investment, since even the least total cost does not always mean that costs cannot exceed benefits. Second, this approach is not useful where output from projects cannot be quantified and also where the outputs are non-homogeneous in quality. This applies to infrastructural projects dealing with health and education (ADB 1997). Third, although it is a comprehensive method that tries to capture the effects of externalities like noise and pollution, the evaluation of the positive and negative effects of a project (like new road connection) depends on the value judgement of local authorities.

Multiple Criteria Analysis

Multiple criteria analysis is another technique of project appraisal that takes into consideration more than one criterion at a time while selecting or evaluating alternative investment projects. This methodology is more suitable for tackling decision problems where impact cannot be measured on a cardinal system, i.e., where qualitative aspects have come to the fore. In such cases, this approach need not make stringent assumptions related to a market oriented (price based) evaluation. Usually, multiple criteria approach requires two types of data sets, viz., impact matrix P(i*j) of i-rank alternatives into j-criteria and a set of W(1*j) of political weights attached to j-criterion effects. However, the main problem with this technique is subjective judgement in the choice of political weights because, in many choice situations, W is not unique. Different criteria carry different subjectivity weights or political considerations for various interest groups like decision-making agencies, consumers, and multiple interest groups, in expressing explicit trade-offs (Hinloopen et al. 1983).

Data Envelopment Analysis

Data envelopment analysis (DEA), which has its base in efficient frontier concept, developed in portfolio theory during the 1950s is now being increasingly used as a tool for general productivity analysis in diverse fields like army recruitment centres, public health care, and infrastructure projects. DEA provides a framework both for formulation and interpretation of compound measures that comprehend the multiple performance measures associated with multidimensional nature of infrastructure performance and linking these back to the budgeting process. Recognizing the interconnectivity of planning performance measures and efficiency analysis, DEA makes use of historical data on benefits and costs for efficiency analysis to identify the best benchmark performers (that have the highest composite efficiency) while making use of efficiency optimization techniques, such as linear programming. The three main specific features of DEA are (a) it avoids total

subjectivity in weighting of various inputs and outputs (e.g. weighting of income distribution and adjustment for merit goods and bads), (b) it uses input data in original or natural units (avoids conversion problem of inputs and outputs into monetary equivalents), and (c) it includes external considerations (uncontrollable factors affecting performance). DEA also quantifies potential resources and production improvements for the rest and identifies the peer group, i.e. those that perform near efficiency frontier. DEA can also be used as multi-criteria approach, as it combines both efficiency analysis based on historical data and alternative selection decisions based on projected estimates from selection decisions (Hagquist 1996).

Summary and Conclusions

The main objective of benefit-cost analysis (BCA) is to provide a satisfactory method of evaluating the economic and social benefits and costs of projects in developing countries (UNIDO 1978). The standard technique consists of obtaining the present value of annual streams of benefits and costs by using the market rate of interest and to either calculate the benefit-cost ratio (B/C) or, alternatively, by finding the net present value (NPV or B-C). Another method employed for comparison is to calculate that rate of discount (called the internal rate of interest, IRR) which makes the present value of net benefits equal to zero. One of the difficulties with IRR is that it can have multiple values under certain circumstances. Despite certain subtle differences in their interpretation, B/C, NPV and IRR ratios could be considered essentially as being different ways of addressing the same problem. Although numerous techniques exist for the evaluation of public projects, the basic framework suggested by Little and Mirrlees (1974) and by UNIDO guidelines (1972) constitutes the main basis for measuring social benefits and costs.

The standard BCA techniques like the Little and Mirrlees (1974) and the UNIDO guidelines (1972), proceed systematically to deal with various measurement problems. The measurement of direct benefits and costs does not pose any major problems. But developing countries are characterized by numerous market imperfections. In their case, the use of shadow prices or accounting prices is suggested to find the right value of benefits. The indirect benefits and externalities arising out of a project pose more serious problems. Equally serious problems arise when the project benefits are sought to be adjusted both for redistribution of income in favour of the poor and, further, for the production of merit or demerit goods. Although these problems were recognized in the very beginning in the Little and Mirrlees manual (1968) and by scholars like James and Lee (1971), the main contribution of the UNIDO method is that it has extended the analysis further by going through a five-step approach starting with a financial appraisal and suggesting distributional

weights in favour of the poor and ending in making adjustments for merit and demerit goods.

Most of the rural infrastructure investments designed for poverty reduction are characterized by large indirect benefits and externalities, and often the development impacts of an infrastructural project may be quite important. Moreover, in many cases, the distribution of their benefits to the poor is the avowed objective of rural infrastructure projects. Appropriate techniques of measurement ought to address the problem of measurement of indirect benefits, externalities and development effects of an infrastructure. The UNIDO guidelines went quite far in dealing with the redistribution of income and the measurement of merit and demerit goods, but did not deal with the problem of capturing the development impact of a rural infrastructure project and measuring the benefits that accrue to the poor.

The aggregate approach deals with the problem of distribution of benefits to the poor. It extends the BCA analysis a little further by making a useful distinction between economic and financial benefits or returns and by suggesting a methodology for the distribution of benefits among various categories, including the poor, according to certain predetermined assumptions.

However, the questions of externalities and the development impact of rural infrastructure project are not fully resolved. The main objective of numerous other methods is to capture the overall impact of any infrastructural intervention on the rural poor. The general equilibrium framework and the multiplier input-output models trace out the full impact of a project on income and employment by studying the interlinkages between various sectors and working out the effects of input, output and consumption linkages. Another criticism of input-output impact models is that these models, instead of taking only the incremental effects, ascribe the entire stream of benefits to the new project. Other methods like the least cost analysis, the multiple criteria analysis and data envelopment analysis also try to use alternative methodologies mainly concentrating on the achievement of given objectives with minimum cost or maximum efficiency. All benefits (negative costs) and costs including environmental costs are monetized by using certain (subjective) valuations decided by the local authorities.

All of these methods have their own merits and limitations. The Little and Mirrlees and UNIDO guidelines provide the basic techniques for determination of benefits and costs. The recognition of social benefits and costs because of imperfections, attention given to externalities, and the weighting suggested for income redistribution and for measurement of merit/demerit goods and concern for the future and for environment is a

major advance on pure financial analysis. These developments also mark a major step towards recognizing the need for extending the analysis further and widening it to be able to capture the benefits accruing from rural infrastructural projects like rural roads, irrigation, credit, etc. But, perhaps, these method do not go far enough. It appears that the GEA and the multiplier input-output method go much farther in capturing the total impact of infrastructure investment on income and employment and are, therefore, considered very useful methodologies by some scholars. But these do have very massive data requirements and are tedious to construct. These methods have also been criticized as they do not concentrate on the effects of a single project but go wide afield by trying to capture the impact of all interrelated infrastructure and could thereby overestimate the benefits of a given investment.

The policy makers, in addition to making use of these techniques, would like to have a set of simple rules of thumb that should enable them to choose from among competing rural infrastructure projects. For a rural infrastructure project, details like the expected generation of additional employment, the likely increase in land productivity and income, the expected impact on reduction of poverty, the likely pattern of income distribution, and the expected impact on environment, readily attract the attention of policy makers and also enable them to take appropriate decisions.

To sum up, the standard BCA techniques are important since these bring to light the relative importance of benefits and costs of infrastructure projects. Numerous supplementary techniques provide methodologies for capturing the effects of externalities and development in a partial or general equilibrium framework. It needs to be emphasized that there are no perfect and simple solutions to capture the full impact of externalities and development. The pendulum can swing widely either by capturing too little or by capturing too much by attributing all the conceivable benefits of the interrelated projects to the given investment. Ultimately, the political authority has to use its judgement, keeping in view the likely benefits and costs of infrastructure projects to the economy.

7

Conclusions

Growth with equity has become the policy paradigm in most of the developing countries. It is generally recognized that rapid economic growth is the most dependable and potent method of alleviating poverty and raising the living standards of the population. However, keeping in view the large-scale prevalence of poverty, illiteracy and ill health in these countries, policy makers along with pursuing the growth objective, also undertake direct programmes which are expected to make a dent on poverty, unemployment, illiteracy and morbidity, both in rural and urban areas. In many cases, investments in infrastructural projects are used as an effective instrument to simultaneously subserve the twin objectives of promoting growth and equity. And investments in rural infrastructure like rural roads, irrigation, power, credit, markets, education, primary health, along with promoting growth, are specifically aimed at reducing poverty and increasing the social welfare of the rural people through the provision of merit goods.

Given scarce resources, the decision as to how many such projects ought to be chosen for investment is primarily arrived at through the budgetary process. But, there are many crucial questions regarding the choice from among the various socially desirable projects. First, given certain resources, there is a question of choosing between primarily growth oriented infrastructural projects and projects that have equity and poverty removal as their main aim. It becomes a difficult choice because most of the growth oriented programmes also lead to poverty reduction with a time lag. It is also discovered that the impact of growth on poverty reduction is generally more sustainable. Further, some of the poverty focused programmes could also lead to building of productive assets and sometimes creating infrastructure. Second, and more importantly, choice has also to be made from among various anti-poverty projects, say, between a rural transport project, irrigation, rural electrification, or building of a school or primary health centre, public distribution of essential items of consumption and direct distribution of doles to the poor. The question then arises as to how to choose between various anti-poverty programmes and how to sub-allocate funds budgeted for anti-poverty programmes into the various components. In a federal set-up, decisions have also to be taken as to the regional pattern of location of these projects and the distribution of selected projects among various layers of government, namely, the federal government, the state governments and the local

bodies.

Benefit-cost analysis (BCA) is a powerful tool that enables policy makers to make a choice from among competing projects through the comparable valuation of their benefits and costs. The comparison is made either by calculating the net present value of each project or by determining its yield (or internal rate of return). This is fairly simple in situations where benefits and costs are measurable in a competitive market. However, measurement of benefits poses difficult problems in most developing countries which are generally characterized by various imperfections and numerous distortions in their factor and product markets due to protection, controls and other government interventions. Hence, market prices fail to reflect the true opportunity costs. Problems also arise because social benefits and costs differ from financial benefits due to the existence of externalities, concern for savings, concern for income redistribution, and concern for merit and demerit goods.

Market price distortions are often sought to be corrected through the use of shadow or accounting prices. In general, border prices measured either in foreign currency (Little and Mirrlees 1974) or in domestic currency (UNIDO 1972), are taken as the shadow prices of tradables. In the case of non-tradables, conversion ratios are derived by using detailed input-output tables. Further, rules of thumb have been developed by several scholars and other multilateral organizations which have tried to work out multiple ratios of domestic to border prices of a large number of commodities for many developing countries. But, in practice, a single conversion ratio is often employed in most countries' BCAs (Little and Mirrlees 1990). Attempts are also made to measure the intangibles and the externalities, although, in this case, the approach is generally quite conservative. UNIDO (1972) also advocates the use of distributional weights to address the concern for income distribution and valuation of merit and demerit goods.

But despite all the theoretical niceties of BCA, in actual practice, serious problems arise with respect to the valuation of infrastructure projects that are aimed at poverty reduction in rural areas. This is because of several reasons. First, although an infrastructure project may lead to poverty reduction directly, say, by providing employment to unemployed poor labour during the construction stage, its major contribution is indirect through increasing the factor productivity of resources in the economy. For example, a rural transport project increases accessibility, brings down production cost by reducing transport charges for movement of raw materials and finished products and also increases the access of the poor to social services like education and health. Second, besides numerous visible benefits, the most important contribution that infrastructure makes is through its development impacts on the rural economy and these impacts are not generally captured by the benefit-cost analysis. Third, the effectiveness of rural infrastructure increases significantly when it works

in conjunction with other infrastructure projects. For example, a rural road does contribute to increases in accessibility by itself, but when rural link roads are built along with the development of irrigation, which, in turn, leads to significant increase in agricultural output and incomes, its contribution to increase in resource mobility and intersectoral linkages is very high. The synergistic effect of infrastructure projects is much higher than their own contribution. Hence, in most cases, rural infrastructure projects produce joint goods and calculation of a single project's benefits becomes quite difficult. Fourth, the impact of any project on increase in income, employment and poverty reduction permeates the entire economy over a period of time through a complex process of intersectoral, input-output and consumption linkages.

Finally, although, to begin with, the distributional impact of a rural infrastructure project is tilted towards the rich, who own a major share of productive assets in a rural setting, yet, over time, the poor, small and marginal farmers and landless labour also start benefiting a great deal due to the availability of more productive employment. Therefore, the income distribution impact can be quite complex. Some rural infrastructure projects, like rural credit, can be specifically designed to subserve the interests of the rural poor. But, in actual practice, institutional credit, that is made available, is shared by all the groups, although the poor farmers are often charged subsidized interest rates.

Benefit-cost analysis does suggest assigning of distributional weights to take care of income distribution. Further, some positive adjustments have to be made in the market values in the case of merit goods where the social value exceeds the economic value and vice versa in the case of demerit goods (flooding of a farmer's field by a hydroelectric project, in which case he has to join the urban labour force). In these circumstances, assigning of weights to merit goods is often suggested. In actual practice, as has been brought out by several reviews, analysts generally undertake a careful economic and social evaluation and only pay lip-service to equity and merit or demerit goods.

One of the major problems with assigning the weights is that these are based on the value judgements of the executive in charge of the project or the political decision maker, and this could lead to serious bias. In a democracy, there is no question that the ultimate decision regarding weights has to be taken by the political authority. But, the question remains: can the policy makers be provided with some additional information that would help them in making this choice. It is in this context that numerous alternative and supplementary methods have been suggested for valuation of infrastructure projects aimed at poverty reduction in rural areas.

Bruno's DRC, and the determination of the effective protection rate are devices

that deal with the problem of divergence between domestic and border prices of commodities and can be treated as a part of the conventional BCA. The contingent valuation method that tries to capture the respondents' valuation of a project's benefits of, say, a rural road project or health infrastructure, is an attempt to avoid subjective valuation of benefits to the poor by trying to get their own perceptions about the likely benefits of a prospective project. Another method that claims to avoid subjectivity is the data envelopment analysis. This method consists of identifying the best yield points making an envelope by using techniques like the linear programming model. Hence, the decision rule is to choose points on the envelope, since all the points that lie inside are inferior to those on the envelope. Although it is claimed that linear programming method does not permit value judgements, yet even this method would need some value judgement in setting up the objective function or in introducing the constraints.

Some other methods that try to capture comprehensively the impact of an infrastructural project are the general equilibrium methods and, particularly, the input-output analysis. The input-output impact analysis is a useful tool which captures comprehensively the impact of infrastructure development on income and employment. But the method is quite laborious as its data demands are very heavy and it involves the construction of large input-output tables and their frequent upgrading. Further, unless care is taken to measure the impact of incremental investments, the input-output model could exaggerate the benefits, since it makes certain strong assumptions regarding the attribution of the entire stream of benefits to a new project.

An attempt is sometimes made to look at the impact of infrastructural investment on the poor by building suitable indicators of socio-economic development. In general, these are performance indicators that could provide the policy makers some idea about the usefulness of a programme and any benefits that are likely to flow from it. These indicators could be divided into different categories like economic indicators and social indicators. Among the economic indicators, the important ones are: income, employment, self-reliance, command over assets, production practices in agriculture and non-agriculture activities, and the incidence of poverty. The more important social indicators are: minimum needs and family welfare which include housing, drinking water, health, education, people's participation, involvement of women and environment.

Having delineated various indicators, the next step is to find out some ways of combining them. Several methods have been suggested. The simplest method is used by the Human Development Report where three indicators of human development, namely, longevity, literacy and income are first standardized to a 0-1 scale and then averaged without assigning any weights to them. But a more systematic method of combining

indicators is by using principal component analysis. Principal component analysis tries, in the first instance, to make all indicators scale free by standardizing them and then assigning them appropriate weights by using a square correlation matrix.

However, despite its obvious attraction, a single combined and aggregated index of numerous benefits has some serious limitations. A policy maker always prefers detailed briefing regarding the benefits that are likely to accrue from an infrastructural investment. Sophisticated indices like the human development index or other similar composite indices do not serve his purpose. Hence, it is preferable that detailed indicators of development are prepared and furnished to the policy makers.

Another important development that could improve the execution and evaluation of rural infrastructure projects is devolution of political and economic powers to local bodies, provided these are not biased towards the rich. Duly elected local functionaries at the village level with due representation from the poor and women are likely to be more sensitive to the needs and demands of the poor. These functionaries could be helped through the dissemination of relevant information on the likely distributional implications of a given project. Finally, and most importantly, the project selection can become pro-poor only if the poor get organized and are able to assert their rights. Howsoever benevolent a state may be, it is ultimately the prevailing power structure in the rural and urban areas that plays a decisive role in the decision-making process. It is in this context that the organizations of poor peasants, the rural workers' unions and other NGOs can play a useful part in organizing the poor and empowering them. In a democracy, there are no short-cuts to decentralization and devolution of political and financial powers to local governments. Building strong movements of the poor and involving them in the decision-making process through their active participation, could contribute significantly to the objective of giving a pro-poor content to the planning process.

To sum up, one would like to find an ideal solution for measuring the benefits of rural infrastructure projects for poverty eradication. However, there do not appear to be any perfect answers in this regard. But some of the suggestions made can be recapitulated. The first step in any evaluation exercise should be to undertake a careful benefit-cost analysis. This should include both financial as well as economic and social evaluation bringing out clearly all the assumptions made for measuring intangibles and externalities. This should also clearly bring out separately the total financial and social costs likely to be incurred on the project. The second step is to assign distributional weights for the likely benefits of the project. In this connection, there is a clear need to recognize the supremacy of the political authority in the decision-making process relating to the assignment of distributional weights among the poor and the non-poor while selecting and evaluating a rural infrastructure

project. The third step is to build careful indicators of numerous benefits/costs that are likely to flow from a rural infrastructure investment. The policy maker should be apprised of the likely impact of infrastructure investment, both in terms of benefit-cost analysis as well as in terms of detailed indicators that try to capture the various facets of socio-economic development, including poverty reduction in the region. This should help him in making an informed judgement regarding the selection of an infrastructure project aimed at poverty reduction. Finally, a devolution of political and economic powers to local bodies could considerably improve the selection, execution and evaluation of rural infrastructure projects aimed at poverty reduction in rural areas. Community participation in the development process at the local level changes the focus of development towards local problems and the local poor.