In this chapter an attempt has been made to analyse the theory of cost-benefit analysis which is synthesised criterion and most relevant tool for project appraisal. In number of countries it is used as practical tool for assessing desirability of projects and this theory is used in the present study too.

DEVELOPMENT OF COST BENEFIT THEORY:

Most of the literature of cost-benefit theory is of recent origin; though the underlying theory of cost benefit analysis concerning the measurement of net utility gain to the society from public work can be traced back to the famous article by French Engineer Jules Dupuit, in the "Measurement of Utility of Public Work," published in 1844. In the United States of America, from where most of the recent literature has originated, its genesis can be traced in the River and
Harbour Act of 1902, and it was explicitly mentioned in River and Harbour Act of 1920. When integrated projects for the development of irrigation, power, and flood control, began to be undertaken on a large scale, the concept assumed an immediate importance.

The practical aspect and an important document of cost benefit analysis is from the introduction of Flood Control Act of 1936 in United States of America. The first systematic attempt to apply the cost benefit analysis to public economic decision seems, however, to have taken place on the other side of Atlantic. As a result of public investment activity in USA, specially in water resource development which set forth explicitly, as standard criterion, that the authorisation of water resources development projects should be made after satisfying that benefits exceed costs "to whomsoever they may accrue". However the act of 1936 did not spellout the criterion by which benefits and costs were to be measured. The several public agencies with responsibilities in the area of water resources development, took this task upon themselves. It was natural that each agency developed the appraisal criterion for evaluation of projects, favourable to its own programme, and therefore, disagreement about this criterion arose among various agencies. The practice of making analyses then spread out to other agencies concerned with water development project. By the end of Second World War, agencies had broaden their criterion by bringing: (i) secondary and indirect benefits
and costs in the theory of cost-benefit analysis and (II) by intangible benefits of cost-benefit analysis. The precise meaning of cost benefit still remained obscure, however, the various USA agencies, responsible for water resources projects frequently used diversified and loosely defined cost benefit criterion. Only recently in the 'Green Book' of 1950 by the sub-committee of Federal Inter Agency River Basin Committee for Water Resource Development, a systematic shape was given to cost benefit theory. This theory was then quickly followed by another attempt at formalisation in the Bureau of Budget Circulars A-47 of 1952. On the cost benefit theory, numbers of critical comments came out in various journals throughout 1950's and the turning point came in 1958 with simultaneous publication of works by Ecrstein, Mclean and Krutilla. 8

In United States of America, application of cost benefit criterion is more in the field of water resource development, in United Kingdom, the technique is used mostly for the transportation project and up to some extent has been frequently used in other fields of public investment also i.e., in public health, urban development, industries, outdoor recreation, research and education etc. 9 In last few decades its importance has increased due to large scale development of the technique of Operational Research which enables comparison of inter related issues in precise manner. 10
In U.K., cost benefit analysis was introduced later than U.S.A. Pearce gives two main reasons for late introduction of the theory viz., (1) theory was not extended to transport investment and (2) politically important issue in U.K. until late in 1950's. In USA cost-benefit analysis originated as an administrative tool and was used by Crop of Engineer in the field of water resource development. Hammond in his historical survey, 'Benefit Cost Analysis and Water Pollution Control' remarks that its formulation was purely American and it was originated as administrative device and owing nothing to do with economic theory.

The theory and application of cost benefit analysis have made considerable advance during the last some few decades. The OECD manual (1968) and UNIDO guideline (1972) gave powerful impact by providing a systematic position of conceptual issues involved in cost benefit analysis.

DEVELOPMENT AND APPLICATION IN INDIA:

India is leading in the use of cost benefit theory among the developing countries. The application of cost-benefit method is tried in connection with the development of nuclear power, approval of Family Planning Programme, television system, evaluation of management education etc.

Some of the studies in the field of cost benefit analysis, like those of Bhakra Nangal and Hirakund, had limited utility because the projects were appraised when they were nearly completion. Research Programme Committee (RPC),
Planning Commission also came out with some studies where cost benefit analysis were used. From RPC's work on Five Irrigation Projects in India, it is clear that total benefits from irrigation rates were not much but irrigation has far-reaching benefits than water rates, therefore, the Committee suggested way of assessing feasibility of irrigation projects in India with cost benefit analysis, rather than traditional criterion of financial return of projects. Since then the cost benefit method is generally used by Planning Commission and by researchers in place of financial rate of return.

Besides most of the efforts were restricted to the appraisal of the big projects only, thus doubt is always raised about the relevance of application of cost benefit technique in evaluating large projects over minor and medium projects, since major projects change overall economy and it is difficult to gauge the net effects of the project in overall changes.

CONCEPTUAL FRAME WORK:

The theoretical foundation of benefit cost analysis rests on perfect competition model, where paratian optimum conditions are assumed to optimise the welfare of the community through optimum allocation of resources. Thus, benefit cost analysis is a variant of marginal analysis with one important difference. Many programmes are justified at different levels of implementation rather than at marginal points. For example, in a state or country where degree of social and
economical backwardness is higher, extra market benefits and costs are likely to be higher, leading the desirability of accepting the projects without consideration of cost and benefit at the margin. This consideration is of greater importance when choice of any projects are connected to social benefits and social costs.

Prest and Turvey while commenting on the marginal condition came out saying that maximum welfare condition is likely to be fulfilled throughout an economy under perfect competition where social rate of time preference and the marginal social rate of return from investment would coincide. A single interest rate would then serve both to compare benefits and costs of different dates. But in real world the optimum condition does not exist.  

FORMS OF COST - BENEFIT ANALYSIS:

Forms and problems related to benefit cost analysis have been discussed by many authors such as Steiner, Eckstein, Marglin, Feldstein, Haveman etc. They have suggested that costs and benefits are time stream of consumption forgone and achieved by the project, but the authors have followed different methods for measuring them. For deciding the desirability of any project, three major criteria are suggested by Eckstein. They are: (1) to compare difference between benefits and costs, (2) to compare the rate of return on investment and (3) to compare the ratio of benefits to costs.
In the first criterion, since the scale of the project would be numerator it would show greater benefits over costs in the case of larger projects and thus would obviously favour large projects over small projects. In the second criterion, the stress is mainly on financial investment, and hence it would represent only a partial picture, and rate of return criterion comes into conflict with benefit-cost ratio and gives different result. The rate of return criterion says nothing about the size of projects and one may prefer a bigger project with higher internal rate of return but lower absolute net benefits. By and large Planning Commission has recommended the last criterion i.e. ratio of benefits to costs, and rejected the first two for deciding about the desirability of projects. This assumes that while calculating the benefits and costs, all primary, secondary, intangible and tangible benefits and costs are taken into consideration.

In this connection, it is important to note the views of sub-committee of Federal Inter Agency River Basin Committee, which said that the objectives should be to maximise net benefits, not to arrive at maxim benefit cost ratio.

Davission W.I. suggested two different forms of benefit cost criterions. (1) ratio may be presented as the ratio of total benefits to total costs estimated over life of the project and (2) the form of benefit cost ratio expressed
as the relation between annual benefits and annual costs.

Davission further states that ratio of annual benefits and annual costs is widely used which is not correct as it tends to give future benefits and costs the same weight as present benefits and costs. When present price is used and adjustment for uncertainty (i.e. predictable uncertainty) is not made, therefore, there can be under estimation or over estimation of project's benefits and costs.

Krutilla had favoured Davission's criterion as it takes into account total budget expenditure rather than total investment, and subject to certain constraints (e.g., physical income distribution, administrative, budgetory etc.) maximises the present value of difference between gross benefit cost ratio. This formulation is based on sub-committee principle, according to which, in order to determine the scale of development, separable segments of the project should be added as long as their benefits exceed their costs.

Hammand has treated the above as wrong criterion of maximising net benefits. He has explained with numbers of example that it is impossible to choose on economic grounds between projects, having equal benefits and costs. However, this question arises only when comparison of two projects are made.

Feldstein with his social opportunity cost criterion produces a complicated expression for the present worth
of a project. He says that analytical difficulties may not arise if neither of the following conditions exist, viz., (1) A project benefits are reinvested or (2) that part of funds are used for projects which would otherwise have been invested. However, these conditions make the analysis useless for practical purpose. On the question of (i) maximisation of benefits at present value and (ii) maximisation of rate of return, Mishan has rightly concluded that, the logic of the former appears unassailable, while due to discrepancy later is rejected. In the case of single purpose project, it is the benefit cost ratio which will prove its economic feasibility.

Even after accepting benefit cost ratio as a criterion for selection of project, decision also has to be taken on either of the three possible variants. They are:

1. Ratio of primary costs to primary benefits,
2. Ratio of total benefits to total costs and
3. Ratio of annual benefits to annual costs.

For developing nation like India one may have to consider even potential benefits and realised benefits which would indicate the gap between expectation and performance while calculating the possible benefits and costs. The inquiry may indicate negative value to start with but in long run, as the further utilisation of capacity created is ensured with passage of time, it may prove beneficial.
Irrigation Commission (1972) endorses the use of primary benefit cost ratio as a criterion for judging the irrigation projects and recommended that any irrigation project with benefit cost ratio of greater than 1.5 should be accepted from economic point of view, and a lower limit of 1.0 benefit cost ratio should be acceptable for irrigation projects in drought prone affected area only.

**BASIS OF COMPARISON:**

It is emphasised that the analysis of project with benefit cost criterion should be done either (1) with project situation and without project situation or (2) before and after project situation. The "With" and "Without" situation is widely used in India. The principal advantages of the variant of "with-without" situation is that, it duly eliminates the influence of changes other than those of irrigation. Thus, the problem of price adjustment have not to be tackled, nor has one to worry unduly about the problem of weather differences, likewise, it eliminates the effect of any other development that may have taken place since the commencement of irrigation projects. While comparison of situation existing before the project is built and that expected to prevail after the project has been developed will ignore the advancement that may be expected to be made in the same time period without public resource development. Eckstein in his study "Water Resource Development" stated that this situation (with-without) is no more than restatement of fundamental analytical idea that
any action be evaluated in terms of difference it makes. On the same logic ex-ante evaluation of project will be far more desirable than ex-post one in cost benefit analysis. However, the ex-post evaluation, can be used for taking decision for projects other than that which is of similar nature. This situation (ex-post) is much more complicated in the analysis compared to the ex-ante situation.\textsuperscript{43}

**PROBLEMS RELATED TO THE MEASUREMENT:**

A number of problems are involved in measuring costs as well as benefits for an irrigation projects. As discussed earlier, it is possible for economist to measure the tangible benefits and costs of a project, but in this respect there are number of problems to be faced. They are, (i) selecting appropriate price, (ii) assumption of rate of interest, (iii) estimation of risk and uncertainty, (iv) estimation of project life, (v) calculation of depreciation, in the case of multi-purpose projects allocation of joint cost, extent of intangibility, the measurement of secondary benefits and measurement of externalities etc.\textsuperscript{44} These are to be taken into consideration while making benefits and cost calculation.

**CLASSIFICATION OF BENEFIT AND COST:**

When the calculation of benefit cost ratio of any project is made, the classification of costs and benefits can be made into two parts i.e., primary costs (or associated costs and project costs) and secondary costs. Similarly benefit is defined as primary benefits and secondary benefits.\textsuperscript{45}
The sub-committee of Federal Inter Agency River Basin Committee had set down standard definition of costs and benefits which are now universally followed. The researchers in their work use these standard definitions which are as follow:

(i) **Project Costs**: Project costs are goods and services (land, labour and material) used for the establishment, maintenance and operation of projects including allowance for induced adverse effects whether or not compensated for. In the case of irrigation, the project cost should be the cost of making irrigation water available to farmers.

(ii) **Associated Costs**: Associated costs are value of goods and services needed over and above, those included in the costs of project itself, to make the immediate products or services of projects available for use or sale. The farmer's cost of producing wheat (other than any charges for the irrigation water) would also be included as associated costs.

(iii) **Secondary Costs**: Secondary costs are the value of any goods and services other than those covered by projects. This include the costs of further processing of the immediate products or services of projects and any other costs over and above projects and associated costs steaming from or induced by projects. In respect of irrigation project, for
example, the cost of transporting the wheat, elevator and milling costs, bakery costs, and costs of distribution to consumer, would be secondary costs.

(iv) **Secondary Benefits**: Secondary benefits are the values added over and above the value of immediate products and services of projects as a result of activities stemming from or induced by the projects. In the above example, the value of bread over and above the value of its wheat content would be secondary benefits.

(v) **Intangible Benefits**: Intangible benefits are all such benefits that cannot be expressed in monetary terms.

Some writers have referred to costs as direct and indirect and similarly made distinction between direct and indirect benefits and each of these is treated separately. 46

Mostly the evaluation is done from the point of view of society as whole. In such cases the value of social costs and social benefits are taken into consideration on the basis of opportunity cost analysis. 47 Generally, it is maintained that if present cost of particular project is, at least equal to, but not less than benefits of its alternative project use, the given project may be approved for construction.
If the project forms a part of the programme, while measuring costs - benefits, the entire programme instead of the individual project, is taken as unit. The programme approach is becoming increasingly popular due to the integrated way in which it evaluates the economic benefits for an area. \(^{48}\)

**THE RELEVANT PRICES:**

The price level should reflect the exchange value of goods and services and it should take into account the variation in their availability in relation to demand. In other words, it should reflect real cost to the society. Specific consideration should also be given if there is, shift from deficit to surplus state in a particular commodity of services. \(^ {49}\) In short, adjustment need to be made to the expected prices of inputs and outputs to allow for the anticipated changes in relative prices of the item involved, but not for expected changes in general in price level. \(^ {50}\)

It is recommended by Charan in his work that current prices be used for costs to be incurred in near future, such as construction, and average long run prices to be used for all other costs as well as benefits, \(^ {51}\) since valuation of goods and services done in terms of market prices is considered inadequate in reflecting secondary costs and secondary benefits. To avoid this, UNIDO and OECD approaches suggest the shadow prices which reflect society's real gain and costs. This type of procedure (average long run prices or shadow prices) is
particularly important for ex-ante evaluation, for ex-post evaluation, prices of resources to be used for construction purpose should be adjusted for particular year by the correlation co-efficient of costs with benefits on the specific year.\(^52\)

**CHOICE OF INTEREST RATE:**

The choice of interest rate for the design and evaluation of public projects is perhaps the most difficult problem and yet one of the most important one faced in this field. Two kinds of rates are suggested for this,\(^53\) (1) rate of return on private investment and (2) interest of government borrowing fund. It has been also suggested that public projects should earn rate of return equal to good private investment and hence the interest rate which is equal to private rate of return should be used in cost-benefit analysis. Eckstein further argued that capital used in public projects be used in private project instead, where it would earn a high rate of return as that of in private investment.\(^54\)

Government borrowing rate is popular and generally accepted because it is the cost of the government's financial investment and also because it can be regarded as the "risk free rate of interest". Yet despite the recent empirically founded belief in the interest elasticity of private investment, none has demonstrated that the marginal efficiencies of such investment actually equals the interest rate.\(^55\) A direct attempt to measure marginal rate of interest is, therefore, required.
Even if such rate is estimated, it would be relevant only in so far as the cost is evaluated exclusively on the basis of displaced private investment. Krutilla and Eckstein have suggested different opinion to this problem. According to them, alternative to public investment should be tax cut and then considered the way, in which likely tax cut would affect income groups and further asked how national recipients would utilise their hypothetical receipts and, once this is known, finally a weighed average rate of return can be estimated.

In conclusion it can be said that discussion about rate of interest does not cut much ice in most of the empirical studies and one has not been able to discover any case where there was any convincingly complete application of such notion. Eckstein in his study concluded that "The choice of interest rate must remain a value judgment." Nor does an idea about allowing for future change in interest rate seem to receive much attention. In practice most usual kind of procedure is to select an interest rate or rates on the basis of observed rate prevailing at the time for calculating present value. Krutilla expected benefits and costs stream be evaluated with 9.5% rate of interest. Colin Clerk has said that irrigation in India must yield 10% because this is what capital can yield in industry and commerce in a country. He also said that officially prescribed rate seems clearly to be low against the suggestion of Clerk. As against this, it is argued by Ansari Nasim that it does not seem appropriate to compare such long lasting capital of investment in irrigation with
respectively \(^2\) short lasting capital in industry and commerce. In the case of India, the rate of interest is 5 per cent and is known as productive rate and 10% as reflecting scarcity of capital by Resarch Programme Committee\(^3\), Planning Commission, India.

The rate of discount or social rate of time preference can also be accepted instead of rate of interest. But there are two types of difficulties in social rate of time preference. First, how to determine it? Another difficulty with this is a different rate of interest would be used in public agencies and private sectors.\(^4\) For the first problem, according to Marglin this does not pose serious difficulties and one can set about it by choosing the growth rate for an economy and hence determines the rate of investment (on the basis of Marglin's capital output ratio). The rate of discount must be equal with the marginal productivity of investment. Regarding the second type Hiroscheleifer has suggested\(^5\) that government should take action to push down the market rate of interest to the level of social rate of interest so that all investment decision whether in the public or private sector should be taken on the same basis. While applauding this idea in principle, some writers reasonably feel that in private sectors, economist still have to deal with sub-optimisation problem.\(^6\)
ADJUSTMENT FOR RISK AND UNCERTAINTY:

There is no reason to argue that public investment projects are free of uncertainty. The allowance for uncertainty can be made: (1) in the assumption about length of project life, (2) in the assessment of annual level of benefits and costs and (3) in the discount\(^67\) rate. If the main risk is that there may be certain day of reckoning when benefits disappear or costs soar, the first type of adjustment is needed. The second concept is more appropriate when the risk of dispersion of output (or input) is irregular, rather than regularly distributed with time. The third concept is more appropriate when certainty is strictly compounding function of time. Higher rate of interest (i.e. 10%) can cover the risk that arise on account of uncertainty as to whether projects will be able to produce benefits right through its estimated working life or not.\(^68\) In this respect generally government borrowing rate is used as it is risk free rate.

PROJECT LIFE AND DEPRECIATION:

For calculation of depreciation there are three methods, viz. (i) straight line method, (ii) sinking fund methods and (iii) declining balance and some year of digits etc.\(^69\) Any of the above methods are necessary to calculate the depreciation of project cost, in order to replace the original equipment at the end of the economic life. The difference between straight line method and sinking fund method is that, in sinking fund method interest is earned on money while in case of straight line method no such provision is there.
Before choosing the depreciation method it is necessary to assume the project life. Estimation of length of life is highly subjective method, depending upon assessment of physical length of life, technological changes, shift in demand, emergency of competitive product, and so on. Some investigations show that different assumptions about length of project life do not affect the viability of schemes to an enormous extent. The economic life of projects is generally less than the physical life of projects and never more than the estimated physical life. Some project's life is imposed for various reasons viz. (1) it is important that all agency use the same limit as the period of analysis in order to produce comparable benefit cost ratio, (2) the risk of benefit, remote in times, are extremely large and should, therefore, be disregarded altogether, as most of the experts have suggested that economic life of projects should be 50 years. In fact, economic life of projects is a matter of value judgment. In the light of problem of different countries, upper limit has been kept up to 100 years.

**ALLOCATION OF JOINT COST:**

In the case of the single purpose project where, charges for projects product are based on the value of product and services and when all cost of project are non-reimbursable, question does not arise of joint cost. The problem arises in the case of multipurpose project where generally two methods are adopted: (1) use of capacity (in case of water facility), (2) costs remaining benefits method. Generally the second
method is preferred, where joint cost is allocated on the basis of cost remaining benefits in different water utilization purpose.

EXTERNALITIES:

External effect is an abbreviation for external economies and diseconomies. These externalities have been treated as external effect of a project and emphasis has been laid on their inclusion in the analysis. McKean divides them into two categories: (1) Technological spillover, and (2) pecuniary spillover.

The essential point is that progenitors of public investment projects should take into account the external effects of their action in so far as they alter, the physical production, possibilities of other procedure, or the satisfaction that consumers can get from given resources, they should not take side effects into account that are confined to the prices of products or factors. However, it is difficult to maintain such distinction in practice. While evaluating the projects one should try to take into account the obvious technological spillover such as the effect of flood control measure or storage dam on productivity of land in vicinity.

Spillovers have figured prominently in the justification of large scale public investment project in less developed country. Specially in the case of infra-structural project. The pecuniary effects represent transfer payment between
different section of the community brought about by changes in relative prices resulting from the project or by tax-subsidy measure that used to finance it. The second referred to uncompensated effect of the project in question on production possibilities elsewhere in the economy or on the satisfaction of consumers. 79

SECONDARY BENEFITS:

The secondary benefits consist of some part of the external effect. Sub Committee has defined that "Secondary benefits are the value added over and above the value of immediate products or services of project as a result of activities stemming from or induced by the project." In the case of irrigation projects these benefits are divided into induced benefits and stemming benefits. The profit expected to accrue from different enterprises between the farmers and final consumers from handling, processing, and marketing is known as stemming benefits. 81 In the irrigation projects the stemming benefits will be increased benefits to grain merchants, transports concerns, millers, bakers and so on. While induced benefits are the profits of all enterprises from supplying goods and services for the increased in farm purchased for family living and production expenses. Artner Maas 83 has different opinion about the secondary benefits. He says that in project analysis which is induced or secondary benefits, there are no such things as secondary benefits. According to him the phase has been used in the benefit cost literature, in fact, a benefits in support of an objective
other than efficiency. The real problem concerning the secondary benefits, is thus a matter of second best allocation problems.84

INTANGIBILITIES:

Some costs and benefits cannot be quantified and others, although, they can be quantified, but cannot be valued in any market sense, such costs and benefits have been called intangibilities.85 In popular usages intangibilities are sometimes used to mean that a goods have nearly infinite value. A goods valued off from their alternatives and no matter what is forgone that commodity is assumed to have a higher price.86

APPLICATION OF TECHNIQUES:

Water Resources Projects: Cost benefit analysis is applied in many studies, they are, water resources, transport projects, land use schemes, health, education, research, and defence. It is not possible to study all of them here, one has to be selective in this respect in order to keep the analysis meaningful and manageable. Our study will mainly focus attention on the study of water resource technique.

Irrigation: Since it is not possible to ascertain directly the price, at which water could be sold upon the completion of consumer surplus, the direct benefits of projects have to be estimated by87: (i) Agricultural production in the area to be irrigated by the project before or without projects, (ii) Agricultural production in the region after or with projects.
In irrigation projects as mentioned earlier, cost can be of three types viz., (i) project cost or capital cost, (ii) operating cost and (iii) cost of agricultural production with and without irrigation.

**Flood Control:** Aversion of flood losses are the major flood control benefits. These benefits can be direct as well as indirect. Flood control benefits arise from preventing direct and indirect damages. The direct damages are (1) Destruction of properties and assets, crops, animals etc., (2) Damages to production, (3) Damage to human life and properties. Indirect damages are (1) cessation of business communication and other economic activities and (2) under utilisation of land obviously the initial charges must be included. The most difficult point in any such complication is likely to be cost of land acquisition for reservoir.

**HYDRO ELECTRIC POWER AND SCHEMES:**

The standard way of measuring the value of extra electricity generated by public-hydro-electric schemes, is to estimate the savings realised by not having to buy from an alternative source. This method seems simple but it can raise all sort of complicated issues, when one can compare single alternative i.e., single hydro electric versis single private steam plant, and secondly, by considering the implication of adding another source to a whole supply system. Such public schemes may or may not have competitive condition and may fail to reflect opportunity cost. Private sector charges may not
be relevant for public sector power enterprise because of different interest rates and taxes, applicable or due to control to which one or other system might be subjected.\textsuperscript{92}

MULTI-PURPOSE PROJECT:

Multi-purpose projects have more than one purpose. A construction of dam on river may satisfy the purpose of irrigation, power, flood control, navigation and recreation etc. Obviously the choice becomes much\textsuperscript{93} wider. Not only does one has to look at the cost benefit data for, say, different size of hydro-electric station, but one has also to take different combination of, say, irrigation and navigation improvement. Calculation of costs and benefits may also be more complicated in multi-purpose projects.

Apart from the above mentioned approach in the Cost Benefit, there are two main approaches to project evaluation in developing countries; the UNIDO method and the Little and Mirlees Method (L.M. approach), commonly known as the OECD method.\textsuperscript{94} The methodology generally followed by the World Bank and known as Square Van Dev Tak (SVT) approaches is a variant of the LM approach. Since above mentioned approaches are not used in the present study, only the salient features of these two approaches are summarised here.

OECD APPROACH OR LM METHOD:

L.M. Methodology\textsuperscript{95} consists of breaking down both projects input and output into three broad categories:
(i) Traded goods and services
(ii) Non traded goods and services
(iii) Unskilled labourers

All traded goods are valued at their world prices. For an imported good, it is marginal import cost while for an exported good it is marginal export revenue, which are used to value the goods of world prices. Use of world prices for input and output, except they are imported or exported, are valued at their world prices^{96} and converted into domestic currency value by exchange rate. L.M.'s argument is that such an estimation of costs and benefits taken from different sets of prices lead to distortion. So, L.M. recommends that all costs and benefits should be estimated from one set of prices, viz., world prices.{^97} In the case of non-traded goods,^{98} the marginal social cost of providing little more of that good is considered as a shadow price of the commodity. Shadow prices for unskilled labour depends on (1) labour's opportunity cost, (2) the industrial wage rate and (3) shadow price of investment, a natural parameter.{^99}

UNIDO METHODOLOGY:

UNIDO Method of projects appraisal can be broken down into five stages as follow:

(1) Calculation of Financial Profitability at market prices.
(2) Shadow pricing of resources to obtain the net benefit at economic prices.
(3) Adjustment for project's impact on income distribution.
(4) Adjustment for project's impact on saving and investment.
(5) Adjustment for the project's production or use of goods
whose social values are less than or greater than their economic value.\footnote{100}

A good technical and financial\footnote{101} analysis of a project's economic value.\footnote{100} is required before meaningful economic evaluation is done. In the case of stage two, shadow prices are required since market prices do not reflect the relative scarcity values of various goods and services, since goods which are valued at broader prices would include major input and output and non traded input with foreign exchange component, it may become necessary to evaluate the foreign exchange impact of the project so that an adjustment can be made by an appropriate premium, assuming that foreign exchange is more valuable than indicated by official exchange rate.\footnote{102}

In the case of income distribution according to Sinha and Bhatia, when income goes to some groups or some regions, it is more valuable than when it goes to some other groups or regions. This view has to be taken into account while planning for regional balance. It is necessary to use adjustment factors that reflect these differential values. This may require giving explicit weights that reflect the percentage premium attached by society to income flows to groups below or above some reference level, of income. However, the value placed on income distribution objective through project selection has to be examined carefully and applied uniformly so that a better appreciation of the alternatives in terms of broad social objectives may be attained.\footnote{103}
For the measurement of impact on savings and consumption, it is needed to determine the distribution of income by different income groups and use their corresponding marginal propensity to consume. It is necessary to adjust the net present value of a project to account for the differences between the efficiency and social value of resources. An upward adjustment may be required if the social value of goods is (e.g. Tobacco, alcohol, cosmetic etc.) made in the net present value.

SIMILARITIES:

There are some common features in the UNIDO and L.M. approach which are presented as follows:

(1) Both approaches give importance to shadow prices to measure the social value of benefits and costs.

(2) Both recommend the use of present value as the correct criterion in judging industrial projects.

(3) It has been shown that choice of numerise in the two cases make no difference to present evaluation. The UNIDO approach recommends measuring B/C ratio in terms of aggregate consumption while L.M. Method used investment as a unit of measurement.

(4) Traded goods play an important role in determining the evaluation of projects.

For the calculation of B/C ratio with one of the above approaches in irrigation projects, one need the value of following parameters.
SOCIAL RATE OF DISCOUNT:

Social rate of discount can be defined as the marginal rate of substitution between consumptions at consecutive points of time. It reflects the weight that society put on future consumption vis-a-vis present consumption. There are some factors which are commonly accepted for determining social rate of discount (SRD). They are: (1) society's present level of consumption, (2) the expected growth of consumption, (3) the expected growth of population, (4) the rate at which marginal utility of consumption diminishes, (5) society's time preference.

SHADOW EXCHANGE RATE:

In most of the developing countries, foreign exchange is always a scarce resource on account of balance of payment problems. The usual administrative solution to the balance of payment deficits is to resort to exchange control. UNIDO gives a simple formula for calculating an average shadow exchange rate based on a given year's data as follow:

\[
\text{SER} = \frac{(m + Ti) + (x + Sx)}{M \times X}
\]

Where, SER is shadow exchange rate
OER is official exchange rate
m = C.I.F. value of imports
x = E.O.B. value of exports
Ti = Import tax revenue
Sx = Export subsidies.
World Bank\textsuperscript{109} has different formula than this. In place of SER, World Bank used standard criterion (SCF) which is applied to the price of non traded goods and consumption to make them comparable with traded goods. The SCF is as follow:

\[
SCF = \frac{x + m}{x + Sx + m + Tm}
\]

Where, $x =$ F.O.B. value of export at the official exchange rate  
$m =$ C.I.F. value of import at OER  
$Sx =$ Export subsidies and  
$Tm =$ Import duties.

Here it is to be noted that\textsuperscript{110} both the criterion have been developed primarily for the evaluation of industrial projects but in some cases it is applied to irrigation project too.
NOTES AND REFERENCES


(5) Ibid, pp. 16-17.


(8) Prest A.R. & Turvey R. Op. Cit. 177. The works of the authors are cited as follows:


(9) Ibid., pp. 177-200.
(15) The report of the Committee was named as "Criteria for Appraising the Feasibility of Irrigation Project, Report of Dr. D.R. Gadget.
(16) On Medium Irrigation RPC has done work on Bar and Nal Ganga Project which are Ex-ante works, but works are few in numbers. Afterwards on Minor Irrigation some works were also during last few decades. They are:
(1) Cost Benefit Analysis of Tubewells Irrigation in Deoris District, Banaras Hindu University, 1971. 
Pioneer Work was done by Otto Eckstein, Kruttila and McKean, are based on the assumption of perfect competition, though these authors have raised doubt on this assumption on the ground of market perfection, rate of externalities, nature of secondary benefit, social choice, collective goods etc. For detail see Otto Eckstein, Op. cit. pp. 19-109.


This can be seen in their contribution cited in the bibliography at the end of the study.

After development of Cost Benefit Analysis in U.S.A. there are various approaches emerged which have their own method of evaluation and have lot of controversies about specific criterion among them.


As long as we are concerned with single projector two or more projects where costs are the same, the rate of return is adequate but in the situation more than one projects with different cost, the rate of return fails to provide correct choice as an absolute measure.
(30) Ibid.
(32) Federal Inter Agency River Basin Committee.
(36) In the present case Benefit Cost Ratio is more applicable since this study aimed at evaluation of individual single purpose project.
(38) Ibid, p. 52.
(43) Charan A.S. Op. cit. p. 54. Also most of the study done by Planning Commission are based on Ex-post analysis.
(44) Ibid, p. 54.
In the case of present study, the study is restricted to the direct primary benefit and indirect primary benefits and costs. The definition of these benefits and costs are given in the previous chapter.

For detail see, Raj K.N. Some Economic Aspects of Bhakra-Nangal Project, Asia Publishing House, Bombay, 1960, also see the RPC Report, p. 55.


Ibid.


Ibid, p. 89.

Ibid. p. 90.


In the case of Water Resource Project, it will depend upon type of project, nature of construction, maintenance, nature of catchment and amount of silt carried down and silt storage provided.


In the case of Asian countries, in Regional Technical Conference of ECAFE held at TOKYO in May, 1954, maximum life indicated was 100 years. RPC have also supported the similar life period where there are authors such as Raj R.N. Eckstein, Kambhu who suggested 50 years life period for Economic assessment.

Eckstein Otto, 91-94.

Since the project of present study is single purpose project it is not desirable to discuss the problem of allocation of joint cost in detail for detail see Huffman R.G. 207-209.


Ibid. p. 68.
(82) Ibid.
(84) Ibid. 21.
(90) Prest A.R. & Turvey R. 181.
(92) Ibid. p. 75.
(93) Prest A.R. & Turvey R. 185.
(94) Following books provide a details for both the approaches:

OECD APPROACH:


(96) Ibid.


(100) Guide to Practical Project Appraisal (UNIDO), 1978.

(101) For the details of these stages please see Guide to Practical Project Appraisal, 1978.


(105) An attempt is only made to summarise the very common features of both the approaches.

(106) The following formula adopted from Mishra & Bayer (1972), Appendix III, I may be used to express the dependence of SRO on these factors:

\[ \text{SRD} = (1 + \tilde{g})^{-e} - 1 + \text{RTP} \]

Where \( \tilde{g} \) is the growth rate of per capita consumption

\( e = \text{elasticity of diminishing marginal utility of consumption, and} \)

\( \text{RTP} = \text{Pure time preference} \).


(109) World Bank: Economic and Social Analysis of the Chao Phya Irrigation Improvement Project - II Staff working paper, No. 299 (October, 1978).

(110) In the case of Sardar Sarovar Project, World Bank Approach is used by TCS, 1983.