APPENDIX II

PART I - AN INTRODUCTION TO PROJECT EVALUATION

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Project Evaluation and Planned Development

The main aim of economic policy is essentially to maximize human welfare, while the principal factors of production – land, labour, capital, etc., – can be combined in various ways. One's real objective ought to be to assemble them in such a manner as to produce the greatest possible benefits for a given cost. This would lead to increased productivity. Also, the rest of the economy will benefit as these are the prerequisites to a maximum rate of economic growth.

The fundamental requirement for the success of planned development is the proper choice of various courses of action which, taken together, will allocate to best use the total supply of available resources. These courses of action may be alternative means for promoting overall economic development through the satisfaction of different needs of the economy or alternative ways of satisfying a single need among a multitude of requirements that a Plan seeks to fulfil. Such alternative courses of action always require the commitment of resources, and the resources once committed cannot be used elsewhere. Their commitment has the opportunity cost of other uses sacrificed.

The achievement of the objective of efficient resource allocation is made possible only through careful economy studies of all technically feasible alternative ways of satisfying the various needs of the economy. An economy study assigns a value to each predicted physical consequence of each alternative course of action and proceeds through a systematic and orderly computational procedure to condense these values into a relative index of aggregate worth. Thus a complex set of alternative possibilities is ultimately reduced to a group of numbers such as benefit cost ratios, which can be ranked in order of magnitude for deciding relative merit.

To the technologist, such alternative courses of action invariably take the form of 'projects' designed to serve various purposes, and projects are also the basic units for decision-making in the investment of the nation's resources. Project evaluation essentially consists of a comparison between the events predicted to occur if a project is implemented and those predicted to occur if it is not implemented, thus, requiring the application of the 'with and without' principle rather than considering events occurring before and after implementation of a project. The events predicted to occur are commonly referred to as benefits and costs according as they result in gains to the economy or otherwise, and the evaluation of a project then reduces to an analysis and comparison of its benefits and costs.

The test of economic feasibility is satisfied if the total benefits that result from a project exceed those which would have occurred in any event even without the project by an amount in excess of the project cost. Therefore, considering the role of project evaluation in planned economic development, the objective of economy studies is to force the decision-makers into an objective evaluation of the merits of each proposed project and thereby encourage an improved allocation of public funds.

Benefit-Cost Analysis

Benefit-cost analysis is used for three broad purposes:

1. To assess the economic characteristics of a particular project;
2. To determine which of a number of projects designed to serve a given purpose results in the largest ratio of benefits to costs; and
3. To determine which of a number of projects designed to serve different purposes confers the largest net benefits (excess of benefits over costs) on the economy as a whole.

In practice, however, benefit-cost analysis has been almost wholly undertaken for the first purpose, and the true significance of the various benefit-cost parameters are normally not fully recognised. They could be of limited value when they are computed mechanically for an individual project unless, for technical reasons, only one project can be undertaken to achieve a given objective. When the technique is used for the second and third purposes, some of the parameters may have a greater significance than the others, while a more complete evaluation would require studies of the economies and diseconomies of scale, incremental benefits and costs, optimization of net benefits, different sequences of project or programme implementation, etc.

Benefit-cost analysis really attempts to do, more methodically, what people are doing every day when they make decisions about the future. A businessmen in the private sector, for example, is always searching for the most profitable alternative. The project evaluator in the public sector faces a similar challenge leading to the maximization of benefits. The latter's objective must always be to select the most economic alternative. When assessing the merits of alternative possibilities or proposals, the decision-maker must attempt to answer a number of questions:

(a) Which projects are feasible from a technical point of view?

(b) Which projects can also be defended on economic grounds? (i.e., will the benefits they produce exceed the costs involved?)

(c) Which among these alternatives is the most economic project, taking into account different basic assumptions as to market conditions, wage levels, interest rates, etc.? (i.e., which has the largest benefit/cost ratio?)

Of course, there are some who are of opinion that the single requirement that benefits exceed costs unduly restricts worthy development projects. Others suspect that project planners inflate benefits and ignore costs in order to justify projects and thereby appease special interest groups if not for other reasons. There must also be sceptics who wonder whether a calculated benefit/cost ratio is really a proof of economic merit or merely some number concocted to gain more widespread acceptance of a decision already made on some other basis. Finally, those who might object to specific analytical findings of an economy study consistently lay greater stress on the value of non-economic social goals and not economic efficiency.

However, benefit-cost analysis provides a logical framework for the evaluation of one or more courses of action and it is also a comprehensive method for dealing with a number of factors, some of which may be highly conjectural in nature. At the same time, it continues to be an excellent tool for the evaluation of alternative projects or programmes with the ultimate objective of selecting the one which would be the most suitable under a wide range of circumstances.

Definition of Benefits and Costs

Benefits and costs can only be measured with respect to some goal. Each alternative course of action involves the investment of resources. Benefits measure the effectiveness of the action in achieving the goal. Any commitment of resources precludes the use of the same resources elsewhere resulting in other benefits foregone. Costs measure the effectiveness of the sacrificed action in achieving the goal.

Theoretically, benefits and costs may be based on any desired goal. As shown below, the objective in practice is the maximization of economic efficiency or national income. However, numerical estimates of benefits and costs with respect to other goals are sometimes also included in economy studies although, strictly speaking, such effects cannot be measured in the same units as efficiency benefits or efficiency costs. Combining the two types involves a value judgement on the relative merits of the goals.

The Economic Efficiency Objective

The improvement of human welfare or satisfying all reasonable human needs is generally accepted as the essential, over-riding purpose of planned development through efficient resource allocation. Since each specific human need presents a specific goal, the ideal resource allocation would be achieved by adopting a policy which leads to the maximization of some unanimously accepted index of total human welfare. In fact, welfare economics, which is the science of determining how available resources may be best used to promote human welfare, provides a mathematical formula called a 'social welfare function' for such an index in terms of any number of social goals (some of which may be conflicting in nature), as well as weighting factors indicating the relative influence of the various goals in determining human satisfaction and happiness.

Ideally, then, the benefits and costs have to be measured with respect to a goal which is clearly defined and is a widely accepted social welfare objective. However, when one considers the social goals related to economic development and the diversity of opinion on their relative desirability, it becomes clear that an ideal social welfare function can never be developed for general use as a guide to the decision-making associated with project evaluation. Consequently, 'income' has gained wide acceptance as the sole index of individual and social welfare, the resulting approximation then implying that social welfare improves as the aggregate national income increases. Therefore, in practice, benefits and costs, as well as the familiar criteria used in project evaluation such as the benefit/cost ratio, internal rate of return, etc., are all based on the concept of the maximization of economic efficiency ,or to attain the maximum economic welfare with the available resources.

According to the increase of national income criterion, the difference in aggregate national income with and without a given project, during its useful economic life, is regarded as the economic contribution made by the project. The optimum project is the one most effective in increasing national income. However, a single project or even a group of moderately sized projects to be undertaken in a single time period will have such small effects upon the total national income of a country as to be immeasurable with available measurement techniques. Hence, in practice, only the net project benefits or the excess of benefits over costs are taken into consideration as the net contribution of a project to national income. This is an approximation to the increase of national income criterion and a second approximation to the economic welfare criterion.

Basis for Comparison of Benefits and Costs

In regard to the comparison of benefits and costs in a benefit cost analysis of a public project, the question arises as to which benefits should be compared with which costs. The benefits can include primary and secondary benefits and these could be the gross value of production resulting from project implementation and operation or the gross value of production less the production costs. The costs may include only the project investment and operation and maintenance costs borne by the State or even the production costs of the project beneficiaries. Further interpretation of the economic efficiency criterion provides a basis for the comparison of project benefits and costs.

If the criterion of economic efficiency is taken as the maximization of the contribution made by a project to the growth of the economy as a whole as measured by the GNP, for instance, then all costs by whomsoever they may be incurred should be compared with the gross benefits. The present value of the excess of benefits over costs over the useful economic life of the project is an indication of the contribution made by the project towards increase in the Gross National Product.

This version of the economic efficiency criterion is compatible with the broad national economic point of view because all costs, whether public or private, are

treated as costs to the economy. Also, projects in different sectors in the economy can be directly compared as the costs of inputs which are different for different types of projects are all included with the project costs.

On the other hand, if the criterion of economic efficiency is taken as the maximization of the contribution made by a project to the growth of the economy as a whole per unit of scarce public capital, with the possibility in mind that some of that scarce capital may be used in other projects or sectors of the economy as well to hasten economic growth, the costs to be compared with the benefits should be only the costs incurred by the State. The benefits are 'net' benefits or the gross value of production less the private production costs.

The scarcity of Government funds is the over-riding consideration where governmental investment has to be allocated to the larger development projects which are in any case essential for the growth of the economy. The second version of the economic efficiency criterion is therefore applicable in the evaluation of large-scale projects in the public sector. Under this approach, the contribution made by the project represents an increase in national income. At the same time, when capital is considered as the only scarce factor of production, the internal rate of return under this approach represents the economic efficiency of a project to its full extent. Meanwhile, in order to make the project benefits compatible with project investment, the benefits are sometimes limited to the primary or direct benefits only.

If project benefits and costs are recorded in a consistent and uniform manner with the foregoing factors kept in mind, it would be a simple matter to evaluate a project according to both versions of the criterion of economic efficiency.

Comparison of Alternatives

If it can be shown that the total benefits of a given project or programme exceeds its total costs, it may be said to have passed the minimum test of economic feasibility. If this is the only possible way in which the specified need can be served, then this particular project or programme will also be the most economic solution in sight. However, if the most efficient course of action is not to be overlooked at the outset, recognition of the full range of potential alternatives is of paramount importance. Alternatives are often available to provide given benefits and all reasonable possibilities should be considered and assessed accordingly.

Enthusiasm for a particular project can sometimes obscure the fact that other alternatives exist. For example, in the case of the Industrial Co-operatives Project, other alternatives would be the enlargement of production capacity of the State Hardware Corporation or even importing mammoties from abroad. Similarly, when one is considering an irrigation project, designed to increase paddy production, possible alternatives might be programmes for the more intensive cultivation of existing irrigated paddy lands or for cultivating new lands under or above command of an existing irrigation canal through better water management and more economical use of irrigation water.

Enthusiasm for a particular project may also lead to the claim that it is desirable simply because its benefits exceed its costs. Sometimes, the mere size of the project net benefits is also taken as a valid measure of economic desirability. However, when a particular project is considered in isolation, the mere existence of net benefits is not sufficient.

Even a large excess of benefits over costs falls far short of being a final proof of economic efficiency. Only that project or programme with the highest benefit/cost ratio among all the available technically feasible alternatives is the most economically desirable.

Having thus used the benefit/cost ratio for comparison of alternatives as a measure of relative rather than absolute merit, the final step is the optimization procedure which permits the maximization of net benefits. This is because the most economic use of a given resource rarely corresponds to the scale of development where the benefit/cost ratio is at a maximum. Usually there is something to be gained by increasing the size of the project and maximizing net benefits up to a point where the benefit/cost ratio is still just above that of the next best alternative. At this point, the net project benefits or the excess of benefits over costs is the maximum attainable, and the incremental benefit/cost ratio becomes closest to unity.

It is also possible to compare projects or programmes designed to serve different purposes such as the development of irrigation or the expansion of the fishing industry, the purpose being to decide which confers the largest net benefits on the economy as a whole. Here too, the question of efficient resource allocation arises and the real test of optimum use is found in the answer to the question – Could these resources be used more efficiently elsewhere by another public agency, and in the satisfaction of an alternative need? In other words, the project analyst must recognise that society is searching for a course of action which maximizes benefits relative to costs.

Much of the value to be gained from benefit-cost analysis will not be realized unless estimated benefits and costs are actively used and the various decision criteria based on the concept of economic efficiency are properly applied to select the best course of action among several possible alternatives according to the principles of engineering economy and project optimality.

Equivalence Calculations

Investments in any type of enterprise are not attractive unless it seems likely that they will be recovered with interest; the interest should be at least the return that could be obtained from comparable alternative investments under the prevailing circumstances. Recovery of investment capital means that the total annual receipts over the useful economic life of an enterprise on which a certain amount of capital is invested now should be sufficient to pay for all the annual running expenses and also to make available a sum of money at the end of that period which is equivalent to the

present investment. If money did not have a time value, this could be represented algebraically as follows for a project requiring investment C and annual operation and maintenance costs c, and yielding annual benefits b over a useful economic life of n years:

$$C = \Sigma\, bt - \left(\Sigma\, ct + C\right) = \Sigma\,(b - c)t - C$$

The introduction of the time value of money into economy studies reflects the need to recover capital with a return. Hence, when money has a time value, and the receipts and disbursements occur at different points of time in the future, it is necessary to somehow make them comparable or equivalent. Thus, when the time value of money is taken into account, through the use of an interest rate i, the amount accumulated at the end of the n-year period which is equivalent to the present investment becomes – $A = C(1 + i)^n$ so that the above equation becomes:

$$C = \Sigma\, \frac{(b - c)\ t}{(1 + i)\ n} - \left[\frac{A}{(1 + i)\ n}\right]$$

in terms of the present values of all three items of the equation.

The interest calculations needed for making irregular streams of receipts and disbursements comparable are referred to as equivalence calculations. There are three methods of comparing such streams of receipts and disbursements of an individual project or the streams of net recepits of two or more alternatives if one wished to make the streams equivalent to each other. All three methods will lead to the same conclusions regarding the merits of the individual project or relative merits of the alternatives provided they are correctly applied. These three methods are briefly discussed below.

1. *The Present Worth Method* This method involves the use of an appropriate discount rate–usually a stipulated minimum attractive rate of return – as the interest rate. It is a common method used in project evaluation when the benefits and costs vary irregularly as in the case of most large-scale projects. This is especially true of irrigation projects which often have fairly long periods of gestation relative to the total project life, during which the yearly benefits, O & M costs, production costs, etc., may have a gradual build-up before full development is attained. In this method, the benefit and cost streams are both converted (or discounted) to their 'present worths' at some common point of time, usually at date of project completion, using the appropriate discount rate.

2. *The Annual Cost Method* This method also requires the use of an appropriate discount rate and it is more convenient than the former in some instances. i.e., Although in actual practice the annually recurring costs of a project will never be exactly the same in each year of its life, it is found good enough for most practical purposes merely to estimate average annual values of the expenditures (as well as the benefits), and to treat them as though they were uniform. Comparison on the basis of annual costs and annual benefits is then simplified because only the project's investment cost has to be converted to an equivalent uniform annual series over the useful economic life of the project using a single compound interest factor. This is the real advantage of this method although, as its name implies, it is frequently used for comparing mutually exclusive alternatives (providing similar benefits) on the basis of their annual costs.

In order to convert the project investment C into an equivalent uniform annual figure over the life of the project, it is necessary to use an appropriate discount rate as well as to take into account any prospective salvage value of the capital assets of the project as at the end of that period. The equivalent uniform annual cost id also the annual cost of capital recovery with a return. When there is no salvage value to be taken into account, it may therefore be obtained simply by multiplying the project investment by the relevant capital recovery factor, but a different method is employed when there is a prospective salvage value S. The more common among several available methods is the method known as the sinking fund depreciation plus interest on first cost. According to this method, the annual cost of capital recovery is given by:

$$ca = (C - S) \times \left[\frac{i}{(1 + i)^n - 1}\right] + Ci$$

where the term within square brackets is the sinking fund factor for interest i and period n years.

This is also equivalent to:

$$c_a = (C - S) \times \left[\frac{i\,(1 + i)^n}{(1 + i)^n - 1}\right] + Si$$

where the quantity within the square brackets is the corresponding capital recovery factor.

Since the capital recovery factor is always equal to the sinking fund factor plus the interest rate, the equivalent uniform annual cost for use in the annual cost method will be correctly obtained by multiplying the investment cost by the capital recovery factor whenever the project assets have no salvage value at the end of the assumed period of analysis. In fact, the assumption of zeor salvage value is commonly implied when a major public sector project is assumed to have a useful economic life of 50 years or more.

3. *Prospective Rate of Return Method* In this method, the calculated rate of return is compared with a stipulated minimum attractive rate. Benefit-cost comparison using the present worth and annual cost methods involves the assumption of an appropriate discount rate by the project analyst (if none were stipulated) which should be at least the minimum rate of return that is attractive under the prevailing circumstances. Due to the complications involved in selecting the appropriate rate of discount, the prospective rate of return is often preferred to the profitability indicators of the other two methods because it seems more appropriate to compute the rate of return than merely to determine whether or not a given investment meets some undoubtedly carefully chosen, but frequently uncertain standard of effectiveness.

In this country, for example, the rates of return on investment in the public and private sectors differ greatly, and the Ministry of Planning has stipulated for public sector investments a provisional rate of 10 per cent per annum as representing the marginal opportunity cost of capital to the economy while, at the same time, recommending the parallel use of a rate of 6 per cent per annum in a second analysis of each project being evaluated. Under such circumstances, the economic desirability of a project could be established by ascertaining by how much the prospective internal rate of return exceeds both the presumably pessimistic and optimistic estimates of the minimum attractive rate of return on investment. However, such excess, though sometimes incorrectly called the rate of return, is not the prospective rate of return on investment.

The prospective rate of return method involves the comparison of benefit and cost streams as before, using either a present worth or an annual cost approach, but requires a trial and error method of computation to arrive at the rate of return. Under the present worth approach, the annual net cash flow (yearly benefits minus yearly costs, some positive and some negative) are discounted to zero date using discount rates until one of the trial discount rates makes their total present worth equal to zero. Hence, this technique is commonly referred to as the discounted cash flow method. The annual cost approach is less commonly adopted for this purpose, but use of this method also requires trial and error computations.

Criteria Based on Economic Efficiency

These decision-making criteria constitute the project analyst's tools of trade and they have to be used with a full awareness of the limitations inherent in their general application. Some of these which are commonly applied in the course of project formulation, comparison of alternatives and in project evaluation are the benefit/cost ratio, the total net project benefit, internal rate of return and the minimum cost criterion. These are adequately dealt with below.

1. *Benefit/Cost Ratio.* When the present worth method is employed, the benefit/cost ratio is the ratio of the total present worth of benefits to the total present worth of costs, both referred to some common point of time. If the benefits and costs are discounted to the date of project completion, only the yearly benefits and current costs need to be discounted, and the equivalent value of the project investment costs as at the date of project completion has to be added to the present woth of current costs to obtain the total present worth of project costs.

The same equivalent value of the project investment costs is used even when employing the annual cost method because the uniform annual benefits only begin to accrue from the date of project completion. However, the equivalent value of the investment costs must be converted into equivalent uniform annual cost over the period of analysis, which, when combined with the uniform annual project current costs, permits a proper comparison with the uniform annual benefits to obtain the benefit/cost ratio. The benefit/cost ratio obtained from the ratio of annual benefits to annual cost will then be the same as that obtained from the present worth method.

The significance of the benefit/cost ratio for selection of projects for inclusion in a Government's budget becomes readily apparent when it is expressed in terms of all the uniform annual benefit and cost items that are important from the broad national viewpoint. i.e.,

$$B/C = \frac{b_p + b_s}{c + c_a + c_i + b_{sf}}$$

The numerator includes the project's primary benefits b_p, and any traceable secondary benefits b_s, while the denominator is made up of all possible costs to the economy. These include the annual project current costs c, the equivalent uniform annual project investment cost c_a, a uniform annual interest cost, c_i, which represents the return from alternative investment opportunities based on their primary benefits only (or in other words, representing the opportunity cost of the capital resources committed to the project), and any traceable secondary benefits foregone, b_{sf}, as a result of choosing this particular project over its next-best alternative.

The last two terms in the denominator are included because government funds are scarce and, consequently, subject to budgetary constraints, accordingly limiting the total number of projects that can be taken up with the available funds. A second reason is that funds allocated for alternative purposes have a net national income-producing potential under any one of the alternatives available for consideration. On this basis, the real value of the funds and other resources committed to a project under consideration would be measured by the benefits produced by a reasonable alternative way of utilizing the same resources, or even together with any other additional resources.

The numerator of the equation can be regarded as the gross increase of national income (if the primary and secondary benefits are net of direct and associated production costs, respectively) contributed by a project. The denominator can be regarded as the gross increase of national income of the specified alternative way of using the same resources, which is the real value of the resources committed to the project under consideration. Hence, if the benefit/cost ratio is greater than unity, the project is justified for inclusion in the Government's budget.

If the specified alternative is regarded as a yardstick in the manner that a thermal power plant is treated in the evaluation of hydro-power projects, the real meaning of the benefit/cost ratio is the comparison of the gross increase of national income between the proposed project and the yardstick project. Benefit cost ratios, when uniformly applied, are the principal criteria for comparing mutually exclusive alternatives. However, in the simplest case, where only project is available for achieving a given purpose, the benefit/cost ratio justifies the acceptance of the project, but the total net project benefit should be maximized thereafter in order to arrive, at the maximum economical

scale of development. In all other cases, the benefit/cost ratio plays the leading role in the ranking of alternatives, after which an incremental analysis must be carried out to determine the best among them.

One limitation in the use of the benefit/cost ratio for the comparison of alternatives arises from the fact that the denominator includes project investment as well as the recurring annual costs. Consequently, when assessing comparable investment proposals having different degrees of current costs such as hydro-electric and thermal power projects, erroneous impressions are likely to be created by relying on the benefit/cost ratio alone.

2. *Total Net Project Benefits.* This parameter can be obtained directly only when the present worth method is used. The difference between the total present worth of project benefit and the total present worth of costs is the total net project benefit in present worth. The special significance of this parameter as a decision criterion lies in the fact that the criterion of maximization of economic efficiency or of increase of national income seeks to maximize a project's net contribution to the increase of national income which, in turn, is taken as the maximization of the total net project benefit. As stated earlier, all projects with a benefit/cost ratio greater than unity are economically justified for inclusion in a Government budget, and only that combination of compatible and complementary projects of largest net benefit is the combination which maximizes enhancement of national income.

In using this criterion for the comparison of alternatives, it should be noted that it does not take into account the absolute level of the costs involved in realizing the excess of benefits over costs indicated by it; i.e., two projects having equal surpluses of benefits over costs would appear to be equally desirable even though the capital costs of one may be several times that of the other. Therefore, this criterion is useful for comparison of alternatives only in circumstances where the projects or programmes compared are similar in character and in the scale of development. Referring to the comprehensive version of the benefit/cost ratio discussed earlier, when a specified alternative way of using the resources committed to a given project is considered as a yardstick, the real meaning of the total net project benefit is the excess of the increase of national income in the comparison of that project with the yardstick project.

When the total net project benefit is compared with the capital invested in a project, a ratio is obtained which serves as a useful criterion for comparison of certain types of alternatives. This criterion can be regarded as an index of the likely increase of national income contributed by a project per unit of scarce public capital invested in it, i.e., per Rs. 1,000 or Rs. million of investment, etc., when net benefits are compared with public costs under the second version of the economic efficiency criterion referred to earlier.

The ratio of total net project benefit to project investment is useful for the comparison of alternatives in cases where the benefit/cost ratio and the total net project benefit are liable to lead to inconclusive results such as when comparing the normal type of project having high investment costs and low annual current costs with one having high annual current costs in relation to total costs. In such instances, two alternatives could in all probability require the same capital outlay and produce identical benefits (total present worths of costs and benefits), so that they would then be identical both on the basis of benefit/cost ratio and total net project benefit. However, if the total net project benefit of each is compared with their respective capital investments, one of them may be found to have a definite advantage over the other. This is in effect a comparison of the rates of return on investment of the two alternatives.

3. *Rate of Return on Investment.* The rate of return on investment may be defined as the discount rate at which a project investment is 'repaid' by the revenues or savings accumulating over the lifetime of the project. Hence, it is the discount rate i, which makes the right-hand side of the equation expressing the concept of capital recovery with a return equal to zero. However, it is obvious that this part of the equation cannot be solved directly for the value of i and, consequently, a trial and error procedure using trial discount rates is necessary to obtain the rate of return which alone satisfies the above condition.

This equation can be reduced to the more familiar form used in the present worth method as follows, with the accumulated amount A replaced with the summation of the equivalent uniform annual cost c_a, which is equivalent to the present investment or to the amount A accumulated at the end of the period under consideration:

$$C = \sum_{t=1}^{n} \frac{(b-c)_t}{(1+i)^n} - \sum_{t=1}^{n} \frac{(c_a)_t}{(1+t)^n}$$

$$\text{or, } C = \sum_{t=1}^{n} \frac{b_t}{(1+i)^n} - \sum_{t=1}^{n} \frac{(c+c_a)_t}{(1+t)^n}$$

$$\text{or, } C = \sum_{t=1}^{n} \frac{(b-c-c_a)_t}{(1+i)^n}$$

Exact repayment of the present investment C with interest at the end of the n-year period at a particular interest rate r^1 means that the total net receipts should be just equal to the amount A accumulated by the same time and, consequently, the right-hand side of the equations should be equal to zero. Thus, the value of i which satisfies this condition is the rate of return on investment r^1.

The rate of return thus obtained is the so-called 'internal rate of return' meaning the rate of discount which makes the total present value of a project's benefit stream equal to the total present value of its cost stream or, in other words, the rate of discount which gives a benefit/cost ratio equal to unity or which reduces the total net project benefit to zero.

It should be noted that the project investment costs enter into the computation either in the form of the initial yearly capital costs actually expended during the project implementation period when the benefits and costs are discounted to zero date or date of commencement of the project, or as overall investment inclusive of interest during the implementation period when they are discounted to date of project completion, and not in the form of the equivalent uniform annual cost c_a.

Using the annual cost approach when the yearly benefits and costs are uniform the rate of return on investment (or the rate of capital recovery) is given by the percentage relationship between the annual project 'net' benefit and the project investment.

$$r = \frac{(b - c - c_a)}{C} = \frac{b - c}{C} - \frac{c_a}{A}$$

$$\text{or,} \quad r = \frac{b - c}{C} - \left\{\frac{i}{(1 + i)^n - 1}\right\}$$

since c_a/A is equal to the sinking fund factor as shown earlier. Since this amortization factor is very small in magnitude, particularly when the period of analysis of a project extends to as much as 50 years the rate of return can be very closely approximated by the percentage relationship of the project annual 'current net benefit' to the project investment. However, in order to obtain the rate of return more accurately, a trial and error computation is necessary because only one particular value of i will make the right-hand side of the equation equal to r. In other words, if r is the rate of return on investment, the conversion of the project investment into the equivalent uniform annual cost c_a, must also be done using r as the interest rate.

It will also be observed that the rate of return is a rate of return on investment and not on all costs. Hence, with a view to making the project benefits compatible with project investment, it is sometimes considered appropriate to include only the primary benefits in the computations.

When comparing mutually exclusive alternatives, the rate of return can be used in the same way that the benefit/cost ratio and the total net project benefit are used for the same purpose. It will also select the same 'best' project from among alternatives only if it is correctly applied: i.e., only if an incremental analysis is carried out instead of selecting the alternative which has the highest rate of return.

However, comparison of alternatives on the basis of rates of return corresponding to different economic lives cannot be meaningful because the nature of the investment opportunity for the return from the shorter-lives alternative determines whether capital should be allowed to remain committed to a longer-lived alternative.

4. *Minimum Cost Criterion* Like the benefit/cost ratio and the internal rate of return, this criterion is also based on the concept of economic efficiency maximization. In fact, this is the only criterion which can be used for the comparison of alternatives in instances where it is impracticable or even impossible to estimate project benefits or where the benefits are identical. Generally, this criterion is widely used in the selection of the best alternative arrangement or layout of a project, or even the best alternative construction method. Therefore, it is an important criterion which can be used even at the stage of project formulation.

Project benefits usually do not enter into the computations when this criterion is used for proportioning projects during their formulation because, considering a particular element or component of a project the functions of which have been clearly specified, it would be impracticable to assign a part of the total project benefits to that particular element or component since it is just one portion of a composite project. Common examples of this sort of situation are the proportioning of dams and spillways, tunnels and power waterways, etc., of a multi-purpose project.

However, in ultimately choosing the 'minimum cost' alternative, the employment of the minimum economic resources to construct a given part of a project is assured; i.e., it will mean the most efficient use of resources, although how effecient it may be is still unknown as the benefits attributable to that particular part are usually impracticable to determine and a benefit-cost comparison is consequently precluded.

The minimum cost criterion has been found to be most appropriate for use in the appraisal of hydro-power projects because it is the minimum overall operating cost of the inter-connected power system into which the project is to be integrated that should be adopted as the economic criterion rather than the benefit/cost ratio or the internal rate of return of the hydro-power project. In other words, the criterion enables the comparison of overall system costs either with a given hydro-power plant or with an alternative theremal power plant connected to it, so that it will be possible to determine which alternative would result in the minimum system costs. The system operating costs, of course, include amortization of the capital investment of each alternative compared.

This criterion also assists in the decisions related to the best location of power plants when the system load is fairly evenly distributed over the areas to be served. Since the best location would be closest to the various load centroids, choosing one of several available hydro-power projects or deciding on the best location of a thermal power plant is greatly simplified when this criterion is used. The correct location of the power plant would lead to the minimum system costs because costs of transmission facilities would then be a minimum.

The Problem of Prices

The most crucial step in an economy study is the assignment of value to the predicted physical consequences of alternative courses of action. Hence, with regard to the assessment of the increase of welfare or national income contributed by a project and the resources consumed by it in common measurable terms,

a proper price system should be available which represents its true economic value. Market prices can be used if a pure competitive market exists and the market mechanism is in full operation. At the same time, if the market is perfectly competitive, it will automatically allocate resources so as to maximize national income. However, in centrally planned and mixed economies of the developing countries the market mechanism is far from perfect and the greatest difficulty in the assignment of economic value to project benefits and costs arises in the process of expressing them in monetary terms.

Moreover, the increase of national income criterion concerns only the magnitude of the increase and not the location or sector of economic activities from which the increase of national income would come. Therefore, if this criterion is to be strictly followed, it is obvious that the broad national point of view should be adopted in evaluating the benefits and costs of a project. It follows that an adequate investigation of the prevailing market conditions based on the principles of Price Theory has to be carried out before proceeding to appraise a project from the national economic viewpoint.

Price Theory provides the framework for the systematic study of the economic forces which together with governmental controls and subsidies policies, interact to determine prices in an imperfect market mechanism.

An analogy indicating how a public sector project should be designed to maximize benefits results from the study of how a business should be operated to maximize profits, and price theory provides the foundation for such studies in production theory. The study of price theory guides the decision on whether a particular market price is fair as a measure of true public worth for use in an economy study. It also provides the tools for generating shadow prices for use where the market price is not fair, or is distorted or where none has been established. It is price theory that provides the analytic framework for establishing the values of project costs and benefits.

Because the derivation of a proper framework of prices is a very complex process, attempts have been made in this country so far only to make some arbitrary allowance for the scarcity of foreign exchange resources and the abundance of unskilled labour. In regard to foreign exchange, it has been assumed that its shadow price is double the official exchange rate. Meanwhile, considering the level of unemployment among the unskilled work force, it has been considered reasonable to assume that labour drawn from the pool of unskilled labour will not reduce production elsewhere in the economy and, therefore, the opportunity cost of using unskilled labour is zero.

Incidentally, in the appraisal of the Industrial Co-operatives Project in Part II of this Appendix, a monthly wage rate had to be assumed for the blacksmiths employed in each smithy. It would be of interest to note that the shadow wage rate one would have to use in the national economic profitability method of evaluation could be substantially more than the Rs. 150/- per month assumed in this instance due to two reasons. Firstly, if the persons found employment already belong to the artisan or semi-skilled category of workers, the opportunity cost of employing such labour could be higher depending on the alternative employment opportunities available to them in the construction sector, even though this may not be on a permanent or assured basis.

The second reason arises from the relative importance almost always attached to savings vis-a-vis consumption, and this affects both skilled and unskilled labour in a manner which is usually not readily appreciated by all those concerned with the choice of techniques in planned economic development.

The usual situation to be expected in this country at the present time is that the propensity to save on the part of the majority of the population is very low compared to the propensity to consume. In fact, in connection with savings, investment and the financing of the Five Plan, it has been stated that —

> "Owing to their low incomes the ability to save of a large proportion of the population is limited. The low rate of saving is also a reflection of a society geared to a high consumption pattern relative to resources.....Ceylon can no longer continue on such a path where consumption and the style of living of the whole nation are geared to the aspirations and motivations of a bygone age fashioned by the needs and desires of a privileged group.....It is essential to generate as much savings as possible through an increased savings effort..... The savings effort pre-supposes the growth of income, and in turn, increase of income depends on saving and investment."

What happens in actual practice is that many of the under employed and unemployed persons are presently dependent on their parents or others, while some of them are commonly engaged in some form of productive activity, mainly in the agricultural sector, even if intermittently and for short periods. When these persons are found new employment, not only is there a likelihood that even the little money consequently saved by their benefactors will be diverted to consumption, but also that almost the entirety of the wages earned by the newly employed (which are paid out of accumulated national savings reserved for investment purposes) would simulataneously be spent on consumer goods.

Therefore, creation of new employment can increase even the very low opportunity cost of unskilled labour (it is really not zero) by an amount which reflects the social cost of the diversion of badly needed savings to consumption. At the same time, new employment creates additional demand for consumer goods and, as stated in the Five Year Plan, "where the shortage of foreign exchange compels stringent import restrictions, the pressure of demand on a limited volume of goods leads to an increase in prices, a rise in living costs and profiteers". Thus, this aspect of employment creation also introduces an additional element of social cost which is not easy to express in monetary terms, and the foregoing remarks will indicate the complex nature of any attempt at deriving accounting or shadow prices for assigning social values to project benefits and costs.

The Appropriate Discount Rate

The validity of the results obtained from the application of criteria based on the concept of maximization of economic efficiency hinges largely on the selection of the most appropriate discount rate. Meanwhile, goals other than economic efficiency can also be introduced to achieve desirable social objectives, and all such goals have various implications on discount rate selection.

An interest rate can be defined as an expression of the time value of capital, but a more precise definition is needed to distinguish between an interest rate and a discount rate, i.e., The basic resources (land, labour, capital, minerals, water, etc.,) can be used to produce consumer goods which are needed to satisfy immediate human needs. At the same time, they could also be used to produce capital goods or the intermediate goods used in the production of more goods. The production base necessary for a long-term improvement in human welfare is provided only by the formation of capital as more and more capital goods are produced.

An important question arising in connection with the planning of capital formation is – How much sacrifice in current consumption should be made to increase production of capital goods? The choice of the appropriate discount rate is closely linked with the answer to this question. The greater the sacrifice in consumption, the more basic resources could be devoted to produce capital goods and the faster capital will be formed.

A willingness to sacrifice directly influences the potential rate of economic development, and the discount rate for use in project evaluation is really a measure of such willingness to sacrifice. The value of sacrificed consumption then becomes the key to discount rate selection because this sacrifice comes closest to representing the marginal opportunity cost of additional capital formation.

When used in project evaluation, the discount rate expresses the time value of capital that should be adopted in calculations for comparing alternative courses of action. Since it is based on some compromise between present consumption and capital formation, it has to be essentially a value judgment from some particular viewpoint. However, when dealing with public works projects, the judgment has to be made from the viewpoint of society as a whole. The ideal discount rate would then achieve a rate of capital formation which maximizes total social welfare.

Just as the market provides a convenient starting point for evaluating prices and assigning economic value to project benefits and costs, the interest rate established by the capital market provides a basis for discount rate selection. The capital market balances the supply and demand of capital to establish an equilibrium interest rate, thus, providing the discount rate best suited for evaluating alternatives. However, as with the price system in an imperfect market, the true significance of the market interest rate hinges on the consequences of market imperfections. The equilibrium point of the capital market is distorted by various factors, the chief among them being that the Government is both the participant in a big way and the regulator charged with keeping the interest rate in line with politically determined economic policy.

Many viewpoints have been expressed on what is the best discount rate from the public point of view. Some have advocated the approach of discounting with the market interest rate for risk-free investment such as the return on long-term Government bonds. Others have suggested discounting with the internal rate of return of the least productive project which can be financed without exhausting available investment funds. This is based on the axiom that the most rapid capital formation is achieved by making the most productive investment. According to this approach, if funds are first committed to the project yielding the highest return and then to subsequent projects in order of rate of return, the internal rate of return of the last project selected before funds are exhausted would be the marginal internal rate of return.

A third approach is to use the marginal internal rate of return for large firms in the private sector who are engaged on comparable activity. The basis for this approach is to preserve the merits of a discount rate based on productivity but avoid the weaknesses of one based on politically controlled budgetary constraints. A fourth approach is to tie the discount rate to the source of funds rather than productivity, which yields a discount rate equal to the interest paid on borrowed funds and, consequently, leads to complications in cases where both local and foreign borrowing has to be resorted to. A final approach which does not follow a market-based approach is to pick a discount rate on the grounds that the capital market is too badly distorted to have any normative significance.

The Ministry of Planning has suggested the use of two discount rates – 6 and 10 per cent per annum – although the basis for this suggestion has not been made clear. However, in making the value judgment necessary in discount rate selection, it is necessary to recognise the consequences of using too low a rate. A review of the possible consequences had pointed to the fact that a rate which is too low can have serious adverse consequences to national economic growth through excessive diversion of resources to the public sector prompted by the fact that the use of a low rate of discount is favourable to the construction of public works projects, with a tendency to depress the value of private sector investment which is often determined by using a higher discount rate.

Non-Economic Objectives

Project evaluation with the goal of economic efficiency can be adjusted to incorporate other social objectives such as progress towards a more stable economy, desirable income distribution, satisfying environment, etc. In this process of adjustment, progress towards one goal is often achieved at a sacrifice to other similar desirable goals. A reasonable compromise can only be reached through specific information quantifying the cost of achieving a particular goal, and two steps are usually required in the adjustment procedure.

Firstly, an acceptable measure of progress must be established which must indicate clearly the progress expected to be made towards each such goal as a result of the implementation and operation if a given project. Secondly, an acceptable procedure must be developed for weighing the relative desirability of the different goals.

Adjustment for the goal of desirable income distribution is appropriate for brief discussion here because one of the fundamental national objectives incorporated in the new Republican Constitution of Sri Lanka is "the distribution of the social product equitably among the citizens." A redistribution of income criterion is not generally familiar to most project evaluators because a practicable method of evaluation has not yet been developed which takes this into account in an adequate manner.

Nevertheless, redistribution of income directly from one group of individuals to another through Governmental taxation and subsidies policy is familiar enough to most people. On the other hand, the State has also been essentially implementing a redistribution of income policy indirectly through various investment programmes such as rural electrification, roads and highways, water supply and housing schemes etc. Moreover, the usually heavy subsidization of the capital costs of irrigation, flood control, drainage, power and public water supply projects is largely based on a redistribution of income policy rather than for any other reasons.

Meanwhile, some attempts have been made to apply this criterion to project evaluation on the basis of simplified sub-criteria such as:

(a) A given project must be located in a depressed area or must benefit depressed classes of citizens; and

(b) For a project located in a depressed area or which benefits depressed classes, the appropriate rate of return on investment from the point of view of redistribution of income may be fixed at a reasonably low level relative to the minimum appropriate rate of return governing investments under the criterion of maximization of economic efficiency.

Therefore, project evaluators could also sponsor marginal or even the slightly uneconomic projects for consideration of the higher-level decision-makers which appear to be justifiable on the basis of the redistribution of income objective. The final decision on such cases may be guided by policy decisions of the Government, while the appropriate trade-off on the acceptable rate of return on investment will usually be determined through the political process.

Criteria for Investment Decisions

Project evaluation as discussed so far basically involves the assignment of economic value to predicted physical consequences of alternative courses of action through the use of appropriate prices for the various project inputs and outputs. Because prices are analysed on the basis of individual participants in a market economy, project evaluation strictly involves a microeconomic approach. Study of the cumulative effects of all the numerous individual decisions on the national economy is a macroeconomic approach which is undertaken by the economic planners at a higher decision-making level. Investment criteria are generally applied at this higher-level decision-making stage for selecting and implementing the best available projects which can help to achieve the objectives of a national, development plan.

Nevertheless, a little understanding of these criteria will enable the project evaluater to play his role even more effectively by establishing some sort of linkage between central planning and lower level decision-making at the project evaluation stage. In fact, the following comment indicates that a lack of such co-ordination is not uncommon in many countries:

> "It is almost, if not quite unknown, to find a country where there is a logical connection between whatever form of central planning there is and lower level public investment decisions; that is, where the investment criteria which are necessarily implicit in all but the most rudimentary of economic plans are carried down consistently to investment decisions at all levels. Indeed, it is common to find inconsistency of criteria even within particular sub-sectors of the public sector, like transport or fuel and power, and even within sub-sectors again, between pricing and investment decisions."*

In the estimation of benefits under the second version of the economic efficiency criterion referred to earlier, the benefits are taken as the gross value of production less the private production costs. Here, the 'value added' closely approximates to these 'net' benefits when the costs of hired labour and other hired services are negligible. Otherwise, when the costs of hired services are deducted from value added, the resulting 'net value added' (or 'surplus') is a very close approximation of the benefits. Therefore, the cost accounting method of estimating project benefits from typical operating budgets presents data useful for determining a project's worth in relation to certain types of investment priorities.

For example, the value added will indicate the likely contribution made by a project to national income. The surplus will indicate what may be available for further investment and hence for future growth. The costing of the hired services provides data on new employment likely to be generated. In addition, if the costs in the operating budget can be split up into their foreign and local currency components, the net foreign exchange saving (where import substitution is made possible by a project) will be useful for drawing up the national foreign exchange budget in future years.

Meanwhile, investment criteria may be of different types, e.g., foreign exchange criterion, employment criterion, surplus criterion, value added criterion, etc.

*FOSTER, C. D., "Problems of Commercial and National Profitability", U.N. Centre for Industrial Development, No. CID/IPF/TW.7

For the application of such criteria, ratios of various items can be derived, such as ratios of —

net foreign exchange content of capital to total capital; net foreign exchange content of output to total output; employment to capital; surplus to capital; capital to output; value added to gross output; etc., etc.

From the point of view of choice among a large number of such investment criteria, a practical approach and starting point is generally to use the criterion of 'maximizing the rate of surplus', qualified by the desirability of maximizing employment and minimizing both the scarce resource of foreign exchange and the period of gestation of alternatives under consideration.

The surplus S, has to be calculated from cost accounting studies and it includes depreciation of buildings, equipment, etc., whereas 'profit' or 'savings' in the case of private sector enterprises is net of depreciation as well as amortization, interest and taxes. However, the surplus can be roughly calculated simply by deducting the annual wage bill from the annual value added. The proportion of this surplus to the total amount of capital invested, expressed in percentage terms, gives the rate of surplus.

This ratio can be adjusted to reflect the scarcity value of foreign exchange resources, if necessary, by applying an appropriate additional premium, p, to the foreign exchange contents of capital C and output O (F_c and F_o, respecively) so that preference could be given to those projects where the ratio of rupee content of output to import content of output is high, i.e.,

$$S' = \frac{S - p.F_o}{C + p.F_c} \times 100$$

The capital/output ratio is the ratio of total capital to gross output. This ratio would be appropriate for use in a formula for the rate of growth of GNP in terms of the rate of investment, this ratio and the annual rate of increase of population. However, in a formula for the annual growth of per capita income, the appropriate ratio to be used is the capital/value added ratio. Similarly, the rate of surplus might be used in a formula for rate of increase of capital accumulation, while the ratio of capital to net surplus would be used in a formula for the annual rate of growth of savings.

Conclusions

It was pointed out at the outset that every individual project prepared by technologists plays a vital role in planned economic development and also that project evaluation is an essential requirement for ensuring the efficient allocation and optimum utilization of public funds. The demonstration of a project's feasibility from the economic point of view implies that it has already been shown to be both technically and technologically feasible. While technical or engineering feasibility means that the project is capable of achieving the purpose for which it has been designed, technological feasibility may be considered as a requirement arising from the low priorities given to capital – and foreign exchange-intensive investments in the current Five Year Plan.

Nevertheless, there has been hardly any evidence so far to show that the requirement of economic feasibility has been insisted upon as a prerequisite to the approval of a project so that many technologists in this country may well have become accustomed to a belief that their role merely consists of preparing a project and demonstrating its engineering feasibility. For example, the utilization of the funds made available annually through lump sum provisions in the Government budget for medium-scale and minor development projects which do not require prior parliamentary sanction has rarely, if at all, been based on any rational considerations of economic feasibility. In fact, it would seem in some instances that although economic fesibility has as a rule been contingent on technical feasibility, political feasibility has not likewise been contingent on economic feasibility. At the same time, most major development projects have also been taken up for implementation in the past regardless of whether they had been economically justified on the basis of meaningful and adequate economic evaluation.

However, the latter has been chiefly because there has seldom been any other economic alternatives to choose from and not due to any lack of appreciation of the importance of economic feasibility. Furthermore, it appears that the lack of good projects proved to be a major handicap to the preparation of a development plan at the early stages of economic planning in 1966. It has been stated at that time that, rather than attempting to draw up a comprehensive development plan of the conventional type, the urgent need was to identify and finalise whatever projects were then thought to be available in the key sectors of the economy, which appeared to be suitable for early implementation.

Meanwhile, deficiencies in project formulation and evaluation become critical usually at times when desperate attempts have to be made for securing financing of urgently needed projects from foreign lending institutions. Indeed, it seems to be a valid conclusion that one of the reasons for the difficulties experienced by many developing countries in obtaining foreign aid has been the lack of 'good' projects.

The most urgent need at the present starting phase of planned economic development is for the identification, preparation and evaluation of the largest possible number of projects to enable the Government to choose the best among them for early implementation. Major projects requiring foreign borrowing must be adequately formulated and evaluated (including cost allocation in the case of projects serving more than one purpose, and also financial analysis, not discussed here) in order to avoid delays in securing the required foreign capital which might very well lead to unexpected repercussions on the progress expected to be made on a development plan. Project evaluation is therefore a major responsibility of the technologists in the current Five Year Plan.

The responsibility for the more complex tasks such as the generation of shadow prices and the choice of an appropriate discount rate rests on the economists at the central planning agency rather than with the technologists. Yet, until such work has been completed and the required information is made known, technologists could still attempt to make the best possible

contribution on their own part, provided they recognise that a part of their role also consists of acquiring a minimum understanding of the niceties of modern economic planning, project formulation and evaluation technologies.

Of course, the availability of the electronic computer now provides ample scope for further enhancing the technologist's role of project formulation and evaluation. For example, due to the uncertainties inherent in the estimation of prices and the appropriate discount rate, a very practical approach, would be to introduce what is known as 'sensitivity analysis' into the project evaluation procedure. This type of analysis consists of testing the response or outcome of a given project evaluation to variations in the magnitudes of the key parameters. It also involves the familiar statistical technique of using optimistic and pessimistic values which differ from the expected (mean) values by an amount proportional to the inherent degree of uncertainty in order that the analysis will be really meaningful.

The objective of this essay on project evaluation is not to suggest that any technologists confronted with the task of evaluating a project should immediately proceed to adopt all the sophisticated approaches discussed therein. Rather, it has been an attempt to provide some guidelines to finding answers to the multitude of questions that a technologist begins to ask when he cultivates a keen interest in the evaluation of the projects he formulates. Undoubtedly, it is possible that many of the aspects discussed in the essay may not be readily appreciated by those who have yet to undertake the interesting exercise of project evaluation.

The writer cannot claim to be an economist, but having been previously engaged on the evaluation of some major irrigation and multi-purpose water resource development projects, he became acquainted with the various economic principles and methodology associated with this task in the process of continuing to search for a method of applying the conventional economic efficiency criteria originally formulated for use in the developed countries to the complicated economic conditions prevailing in a developing country like Sri Lanka.

In the light of the writer's own limited experience, he holds the personal conviction that the commercial profitability approach illustrated in Part II of this Appendix, supported by the application of appropriate investment criteria, should be adequate for most of our purposes during the period of the present Five Year Plan, and until the information essential for adopting the national economic profitability method of comparing social benefits and scocial costs become available. Above all, the most important requirement should be the universal adoption of a uniform framework of prices, wages, discount rate, techniques and criteria for the evaluation of all projects proposed to be included in the Plan.

In conclusion, the writer hopes that the inclusion of this Appendix with his main comments would serve to encourage all technologists to cultivate a special interest in the methodology of economic planning and in the meaningful and objective evaluation of their projects in the context of specific development objectives, national priorities and investment strategies. This is quite an easy, task for them compared to the Herculean task faced by an economist, on the other hand, who attempts to acquire a minimum knowledge of the rapidly expanding engineering sciences.

As an aid to those who might wish to supplement their customary role of project formulation with the next sequential step of project evaluation, a list of the various economic parameters normally requiring careful, investigation before they are used in an economy study is appended below.

1. Capital (C)
   (a) Fixed Caputal (Cf)
   (b) Working Capital (Cw)
   (c) Ancillary Capital (Ca)
2. Foreign exchange (or import content) of C (Fc)
3. Value of annual output at full development (O)
4. Foreign exchange content of output O (Fo)
5. Domestic raw material content of output O (Md)
6. Annual depreciation, if any, (d)
7. Annual Value Added, VA = (O – Fo – Md – d)
8. Recurring employment at full development (Er)
9. Annual wage bill of Er (Wr)
10. Net value added or surplus (S) = (VA – Wr)
11. Period of gestation (G)
12. Employment during construction or implementation (Ec)
13. Annual wage bill of Ec (Wc)
14. Capital for special complementary investment (Cc)
15. Capital for special supplementary investment (Cs)

PART II - EVALUATION OF THE BLACKSMITHS' INDUSTRIAL CO-OPERATIVES PROJECT

The Project

An individual smithy will be run by an already established (senior) blacksmith who *employs* three currently under-employed blacksmiths. He will be supplied with all necesary tools and implements as well as a work-shed at Government expense. Each Industrial Co-operative is to consist of *about* 50 such smithies, and *ultimately* will be provided with a central heat treatment plant estimated to cost *about* Rs. 50,000/–, while each smithy will also be provided with its own power supply, both at Government expense.

Although no specific time schedule seems to have been drawn up yet for implementing the overall project, the main objective appears to be the attainment of self-sufficiency in mammoties with the aid of 10 such Industrial Co-operatives. It is therefore assumed that, with the initial capital investment spread equally over two years, the useful economic life of the project would be the number of years of full production necessary to achieve the self-sufficiency objective, say, 10 years on a very conservative basis.

With regard to project output, the possible average value of production of Rs. 50/- per day given by the author of the Lecture was further verified, and it was ascertained that a day's production at any one smithy could be one of four alternatives, i.e., 4 mammoties, 12 pruning knives, 4 axes or 3 alavangoes. Also, consistently uniform production may be anticipated over 300 days per year every year. Although, according to the prices of these implements fixed by the Industrial Co-operatives, it would be most profitable to produce only the alavangoes, it is assumed that priority will be given to the production of mammoties only from the point of view of the import substitution possibilities. The gross value of production would then be Rs. 42/- per day for one smithy. However, the possible daily average value of Rs. 50/- used by the author of the Lecture will be adopted for this appraisal.

The project is being appraised from the point of view of the economy as a whole, using market prices for the inputs (implied in the author's figure of Rs. 25/- per day) as well as the apparently subsidized prices of the output of a smithy. No foreign exchange costs are expected to be included among the costs of the Government.

It is assumed that the estimated cost of inputs amounting to Rs. 25/- per day for each smithy would apply regardless of whether the production is limited to mammoties only or all four implements. It is further assumed that each senior blacksmith will manage the smithy under his charge and pay the wages of the three blacksmiths employed by him, as well as for the inputs and electric energy used by him. The cost of electric energy per month for each smithy is assumed to be Rs. 25/-, while a similar amount is expected to be spent each month for transport of materials, implements, etc., between each smithy and the central heat treatment plant and Industrial Co-ops. The monthly wage of each of the three blacksmiths employed at a smithy is assumed to be Rs. 150/- based on a daily wage rate of Rs. 5/-.

The costs of setting up the 10 Industrial Co-operatives their running expenses which should include payment for the electric energy used in the central heat treatment plants, etc., have been ignored although these costs might strictly be ancillary capital costs if they are met from Government funds. Therefore, the appraisal would appear to be made from the viewpoint of the Department charged with setting up the Industrial Co-operatives rather than from the broad national viewpoint. Finally, according to the assumptions made with regard to project implementation, full development of production will be at the end of two years so that the period of gestation will be the same. Although production can build-up in two equal steps commencing from the 2nd year of investment, this build-up is ignored in the appraisal.

Investment Data

The investment data should include the project capital costs as well as special complementary and supplementary investment that may be needed. The capital costs of a project are split up into three categories – direct costs (fixed capital), annual operation, maintenance and replacement costs (working capital) and associated costs (ancillary capital). Taking an irrigation project as an example, ancillary capital investment would be required for meeting the associated costs of land development and land settlement. Showing these cost items separately enables the components of total capital costs of one project to be compared with the corresponding components of another.

Again, taking an irrigation project for an example, complementary capital investments such as those required for supplying fertilizers and agro-chemicals, agricultural credit and extension services, storage and marketing facilities, etc., are those which will normally be paid for by the beneficiaries under the project, but which will have to be specifically provided for it. Supplementary capital investment represents any additional investment that may be required for provision of services such as rice milling, cotton ginning, sugar processing, fruit and vegetable canning plant, etc. Taking note of these costs separately is useful from the point of view of overall allocation of capital resources in a development plan.

The investment data for the Industrial Co-operatives Project as identifiable from the available information are listed below:

	Rs.
1. Fixed capital:	
Heat treatment plants – 50,000 x 10	500,000
2. Working capital:	
Recurrent costs of maintenance, operation, repairs, etc., of heat treatment plant and electric power supplies – not taken into account	—
3. Ancillary capital:	
Tools, implements and shed – 3500 × 50 × 10	1,750,000
Electric power supplies – 1500 × 50 × 10	750,000
Any other – not anticipated yet	—
Total project capital costs	3,000,000
4. Complementary investment:	
Special investment for supplying coke, oil, scrap iron, credit, marketing facilities, setting up and running the Industrial Co-operatives, etc., – considered unnecessary	—
5. Supplementary investment:	
No additional investment necessary for any processing of project output which is already in the form of finished goods	—

Output Data

The values of constant annual output over the period of 10 years of the project life are estimated from a typical operating budget drawn up for one smithy. This is illustrated in Table 1, where complete details of income and expenditure relating to a smithy are listed in an orderly and functional manner. The values of the project benefits and costs used in the benefit-cost computations are obtained from this operating budget.

Project Benefits	Rs.
Gross value of annual production	7,500,000
Annual production costs	6,750,000
Therefore, annual 'net' benefits	Rs. 750,000

Note: Annual net value added is also Rs. 750,000 because depreciation of work-shed, implements, etc., was neglected.

Project Costs

The capital costs of the project have been estimated assuming that the island-wide project consists of 10 Industrial Co-operatives, each made up of 50 smithies. However, to the project analyst, project costs, as distinct from the estimated capital costs, usually constitute a series of annual investments. This is because the capital costs of a project are almost always phased out in yearly instalments over a definite implementation period on the basis of a rational construction or implementation schedule, or even with the aid of a critical path network, once the most economically advantageous sequence of project implementation among all possible technically feasible alternative sequences has been established.

In fact, this is one of the initial tasks to be carried out in the course of evaluating a project and, as has been done in the case of the Mahaweli Ganga Development Programme, an absolutely essential requirement as far as very large projects or programmes are concerned. In this instance, it is conveniently assumed that the total project capital costs are divided equally between the two years assumed to be necessary for implementing this project.

Period of Analysis

The useful economic life of the project is assumed to be 10 years. The period of analysis, which would also terminate at the end of this 10 years, could be taken to begin either at the date of completion of the project, when it would be the same as the useful economic life, or to commence at zero date or date of commencement of the project when it would extend over 12 years. However, when large investments and substantial implementation periods are involved, it has been found most appropriate to adopt the date of project completion as the starting point of the period of economic analysis.

Interest During Construction (IDC)

When the period of analysis commences at the date of project completion, there is usually a substantial time lag between the date when the first expenditures are incurred and the date when the returns of benefits begin to accrue. This means in effect that the project investment costs are tied up to a given project during its implementation period without there being any prospect of obtaining the additional return that could have been earned by lending the money over the implementation period, for instance. Therefore, the interest that could have been accumulated, but is foregone, has to be added to the estimated capital costs of the project when the period of analysis is taken to commence at date of project completion.

The computation of the interest foregone in this manner could be a little confusing at times because interest costs from the point of view of a financial analysis are different from the interest costs used in an economy study. The allocation of public funds for development projects is invariably done through the provision of funds in consecutive annual budgets once a project has been authorized for implementation. In actual practice, these annual provisions are used up throughout each year, with items such as wages occurring fairly uniformly, and it is clear that the required funds must be made available at the commencement of the year. It would then seem as if each year's capital investment in a project becomes 'committed' at the beginning of that year.

However, under the 'end of year' convention convenient for the equivalence calculations in an economy study, the costs as well as the benefits which really occur throughout the year are treated as though they take place at year end. This is implied in the cash flow tables and in the calculations of present worth, annual cost and rate of return. Hence, interest during implementation should also be computed accordance with the same convention, i.e., on the basis that any year's investment becomes committed only at the end of that year.

When this convention is followed, the overall investment costs inclusive of interest during implementation which are either converted into equivalent uniform annual costs under the annual cost method or merely added to the present worth of the project's annual current costs under the present worth method, are actually the 'present value' of the investment costs as at the date of project completion. In this instance, the overall investment cost amounts to Rs. 3.15 million as follows, if the appropriate discount rate is taken as 10 per cent per annum.

Year	*Compound Interest Factor*	*Yearly Investments as phased*	*No. of years of interest*	*Cost including interest during implementation*
1	1.100	Rs. 1,500,000	1	1,650,000
2	—	1,500,000	–	1,500,000
Total		3,000,000	–	3,150,000

If the period of implementation had been three years instead, the first year's investment would earn 2 years interest and the second year's investment 1 year of interest. On the other hand, if the period of analysis is taken to commence at zero date and the present worth method is used, the problem of interest during the implementation period is automatically adjusted when the benefit and cost streams are made equivalent as at that date.

Benefit-Cost Comparison

The appropriate discount rate is taken as 10 per cent per annum. Equivalence calculations are made for both interpretations of the economic efficiency criterion discussed in Part 1 of the Appendix, i.e., maximization of the contribution made by the project to the growth of the economy as a whole as measured by the GNP, or per unit of scarce public capital. These two versions are referred to as follows:

Case I – (Gross Benefits vs All Costs)

Case II – ('Net' Benefits vs Public Costs)

All three conventional techniques of benefit-cost comparison are illustrated for each of these two cases.

(a) Present Worth Method. The benefit and cost streams are shown in the cash flow table below in units of Rs. million and the present worths of benefits and costs are discounted both to zero date and date of project completion in separate computation tables.

Year	*Int. factor*	*Case 1* Benefits	Costs	B – C	*Case 2* Benifits	Costs	B – C
1	0.0991	—	1.500	–1.50	—	1.500	–1.50
2	0.8264	—	1.500	–1.50	—	1.500	–1.50
3–12	5.0780	7.500	6.750	0.75	0.750	—	0.75
Total PW		38.085	36.979		3.809	2.603	
Total PW of (B-C)		1.206			1.206		
B/C Ratio		1.035			1.463		
(Present worths as at date of completion)							
3–12	6.1440	7.500	6.750	0.75	0.750	—	0.75
Total PW		46.080	41.470		4.608	—	
Investment Cost		—	3.150		—	3.150	
Total		46.080	44.620		4.608	3.150	
Total PW of (B–C)		1.460			1.458		
B/C Ratio		1.035			1.463		

(b) Annual Cost Method Under this method, the period of analysis is 10 years commencing from date of project completion. The overall investment cost inclusive of interest during implementation is multiplied by the capital recovery factor for 10 per cent discount rate and period 10 years to obtain the equivalent uniform annual cost. It is assumed that even the capital assets like the heat treatment plants of this project will not have any salvage value at the end of the period of analysis.

i.e. Equiv. uniform annual cost –

Rs. 3.150 × 0.16275 = Rs. 512,660

For Case I, when the annual private production costs of Rs. 6.75 million is added, the annual cost to be compared with the annual benefit of Rs. 7.50 million becomes Rs. 7.263 million. In Case II, the annual 'net' benefit is Rs. 7.50 – 6.75 = Rs. 0.75 million, and the annual cost is Rs. 0.513 million.

Period of Analysis	*Case 1* Benefits	Costs	B – C	*Case 2* Benefits	Costs	B – C
10 years	7.500	7.263	0.237	0.750	0.513	0.237
B/C Ratio	1.035			1.463		

(c) Prospective Rate of Return Although the benefit/cost ratio for Case I is different from that for Case II, like the total net project benefit or the annual net benefit, the rate of return on investment is the same for both cases. Using the discounted cash flow technique/ first, the trial and error computation is carried out using trial discount rates of 15 and 20 per cent per annum. The positive and negative net cash flows, are discounted to zero date under separate columns, and the differences between the totals of each column are ascertained.

The differences between the column totals for the two trial discount rates clearly indicates that this difference will be zero for a discount rate very close to 20 per cent, which is the internal rate of return required.

The exact value of the internal rate of return can be obtained by linear interpolation between the two trial discount rates and, in this case, it is found to be 19 per cent.

Year	Net Cash Flow	Present worth of positive and negative net cash flows discounted to zero date			
		15 per cent		20 per cent	
		Positive	Negative	Positive	Negative
1	-1.500	—	1.304	—	1.250
2	-1.500	—	1.134	—	1.042
3-12	0.750	2.845	—	2.185	—
Total PW		2.845	2.438	2.185	2.292
		2.438			2.185
Difference		+ 0.407			-0.107

A second, but more tedious aproach when using the present worth method is to compute benefit/cost ratios corresponding to several trial discount rates by discounting both the benefits and the costs instead of the net cash flows. The internal rate of return is the discount rate which gives a benefit/cost ratio equal to unity. While this computation could be regarded as an extension of the earlier computation for benefit/cost ratio under the present worth method, it is a practical approach when electronic computation facilities are made use of, especially when a computer programme is prepared in a comprehensive economy study to incorporate a sensitivity analysis as well.

Nevertheless, this method is also made use of in this instance for illustrative purposes and also to ascertain the benefit/cost ratios corresponding to a discount rate of 6 per cent per annum. The computation details are shown below for Case I only, while the second row of benefit/cost ratios are those obtained similarly for Case II. Linear interpolation for a benefit/cost ratio of 1.00 gives the internal rate of return as 18.75 per cent for Case I and 18.92 per cent for Case II. Smooth curves drawn through plots of benefit/cost ratio vs discount rate indicate a value of 18.80 per cent for both Case I and II. With the very little computations that are involved in this instance, use of calculated interest factors yielded the correct value of the rate of return as 18.75 per cent.

Present worth of benefits and costs discounted to zero date for 4 trial discount rates (Case I)

Year	6 per cent		10 per cent		15 per cent		20 per cent	
	Benefits	Costs	Benefits	Costs	Benefits	Costs	Benefits	Costs
1	—	1.415	—	1.364	—	1.304	—	1.250
2	—	1.335	—	1.239	—	1.134	—	1.040
3-12	49.133	44.219	38.085	34.876	28.500	25.600	21.850	19.650
	49.133	46.969	38.085	36.879	28.500	28.038	21.850	21.940
B/C (I)	1.046		1.035		1.018		0.994	
B/C/ (II)	1.787		1.463		1.167		0.954	

The annual cost method is also used for the computation of the internal rate of return for purposes of illustration. Following the same procedure adopted for computing the benefit/cost ratio by this method, the overall investment cost inclusive of interest during implementation is first calculated and then converted to equivalent uniform annual costs using trial discount rates. The rate of return is the discount rate which gives an equivalent uniform annual cost equal to the Rs. 0.750 million annual benefit of Case II, or which gives an annual cost equal to the annual benefit of Rs. 7.500 million of Case I after addition of the Rs. 6.750 million annual private production costs in Case I. Linear interpolation indicates that the equivalent uniform annual cost will become Rs. 0.750 million for a discount rate of 18.72 per cent.

	Trial Discount Rate	
	15 per cent	20 per cent
Overall investment cost inclusive of interest costs	3.225	3.300
Equivalent uniform annual figure for a 10 year period	0.643	0.787

Alternatively, since the ratio of a uniform annual series of payments over a given period to its equivalent present investment represents a capital recovery factor, this ratio can be compared with the actual capital recovery factors for trial discount rates and the same repayment period. The internal rate of return is obtained by linear interpolation as the discount rate for which there is no difference between the computed and actual values of the capital recovery factors, i.e., 18.73 per cent.

Overall investment cost	3.225	3.300
Ratio of annual net benefits to investment	0.23256	0.22727
Actual capital recovery factor from published Tables	0.19925	0.23852
	+ 0.03331	− 0.11250

A third method would be to substitute trial values of i in the expression for the sinking fund factor as assumed values of the rate of return r, and to calculate the values of r as given by the equation for the rate of return based on annual benefits and current costs. Comparison of the assumed values with the computed values of r leads to the same result as before.

Overall investment cost C	3.225	3.300
(b − c)/C (c is zero)	0.23256	0.22727
Sinking fund factor from Tables	0.04925	0.03852
Hence, r computed from equation	0.18331	0.18875
Assumed r (trial discount rate)	0.15000	0.20000
Difference	+ 0.03331	− 0.01125

Comments on the Techniques

The employment of several different techniques for the computation of the benefit/cost ratio, rate of return, etc., was to illustrate their application with sufficient clarity so that even the novice in project evaluation could recognise the advantages of any one of these methods under particular circumstances. Of course, in actual practice, much larger and more complicated streams of benefits and costs are often encountered, and the present worth method will usually be best suited for the computation of benefit-cost parameters as well as the internal rate of return.

With regard to errors introduced by resorting to linear interpolation for the internal rate of return, a plot of benefit/cost ratios or total net project benefit in present worth against the trial discount rates will at once indicate that linear interpolation is only an approximation because the actual relationships are always curvilinear, the degree of curvature being dependent on the nature of the benefit and cost streams. The error in linear interpolation will be greatest when the internal rate of return happens to lie midway between two trial discount rates and if the latter were separated by as much as 5 per cent as in this case. However, linear interpolation is adequate for most practical purposes.

The time required for the trial and error computation for the internal rate of return can be minimized if the first trial discount rate is fairly close to the internal rate of return. A close enough value can be guessed after inspection of the cash flow table and substituting a roughly equivalent uniform annual series for the net cash flows in place of the usually irregular streams. The ratio of the assumed uniform annual net benefit to the investment cost can be compared with capital recovery factors in published Tables to pick the first trial discount rate.

This turns out to be a simple matter in this instance because the annual net benefit is the same throughout the useful economic life of the project. The ratio of annual net benefit to overall investment cost is 0.75/3.15 = 0.23809, which suggests that the first trial discount rate should be 20 per cent, for which the capital recovery factor for a 10 year repayment period is 0.23852. The result obtained using the 20 per cent discount rate showed that the next trial discount rate should be less, thus, it being necessary to carry out the computations using only two trial discount rates.

Investment Criteria

The values of several ratios relevant to investment priorities worked out from the information given in the annual operating budget of Table 1 are given below together with their meanings:

		Rs. cts.
1.	Capital/Output – Capital investment required for obtaining Re. 1/– worth of production ..	0.46
2.	Capital/Value Added – capital investment required to obtain Re. 1/– additional income ..	0.96
3.	Value Added/Output – additional income from Re. 1/– worth of production ..	0.48
4.	Surplus/Capital – surplus generated by each Re. 1/– of capital investment ..	0.22
5.	Net Surplus/Capital – savings generated for each Re. 1/– of investment ..	None
6.	Foreign exchange content of output/gross output – net foreign exchange saving in each Re. 1/– worth of production ..	0.38
7.	Capital/Employment – capital investment necessary for finding employment for one person .. (Rate of surplus is 22 per cent)	Rs. 2310/–

Review of the Results

Considering, first, the indicators of economic efficiency, it is seen that the project would yield a return on the investment which is substantially greater than the frequently quoted value of 10 per cent believed to be representing the marginal opportunity cost of capital to the economy. The cumulative present worth of the

excess of benefits over costs, amounting to Rs. 1,206,000, provides an indication of the contribution likely to be made by this project to the growth of the economy over the period of analysis. If this contribution is measured in terms of the gross national product, the benefit/cost ratio is only 1.03, and a consideration of the benefit/cost ratio alone might give one a first impression that the project is only marginally economic. On the other hand, if the project's contribution is viewed in the light of increase of national income per unit of scarce public capital (value added/capital concept), the benefit/cost ratio is somewhat higher, i.e., 1.46.

Considering next the indices worked out for assisting the investment decision, the most beneficial aspects of the project from the point of view of current national priorities are found to be:

1. A sum of Rs. 2,812,500 will become available each year as a net foreign exchange saving.
2. A total of 1500 persons will be found employment at a cost to the State of Rs. 2310/- per person.

The annual import contents of the inputs in the operating budget are only 'guesstimates', included merely for illustrative purposes, although when the total import content of production costs at one smithy is expressed as a percentage of the total production costs, a reasonable value of 20 per cent is obtained.

Considering the various ratios which provide a guide for decision-making in the light of investment priorities, the capital/output ratio for an individual smithy not very significant really is 0.33. When the invesment on the heat treatment plant is also taken into account, the capital/output ratio becomes 0.46. However, this is really not comparable with the overall capital output ratio used for planning purposes, this value of 3.25 being a sort of weighted average covering both small and very large investments. Meanwhile, it is found that the project requires the investment of almost Re. 1/- of scarce capital resources to obtain Re. 1/- additional income, while it may be expected that each Re. 1/- worth of production under the project would generate 48 cents additional income.

Finally, remembering that that the investment in the project has to be met from the very limited savings reserved for development work, it is found that this project would not help to generate any savings which might be channelled to further investment in the future. This is because the senior blacksmith managing a smithy has nothing left as a profit or saving when his own cash living expenses are deducted from the net income for an individual smithy, and also because it is hardly likely that even the three blacksmiths employed by him will be able to save anything out of their monthly wage of Rs. 150/- each.

Incidentally, the 'mark-up' of 15 per cent in prices by the Industrial Co-operatives is expected to be largely a saving as stated by the author in his Lecture. While this really is tantamount to a jacking up of the prices to the consumer, the surplus available from this action would be about two-thirds of this only if the balance one-third was sufficient to cover the overheads, wages, interest, taxes, etc., of the Industrial Co-operatives.

The validity of the above conclusions, of course, depends on the accuracy of the cost estimates of the capital investment needed for the project as well as on the various assumptions made in the preparation of the annual operating budget for a smithy. If, for example, wither the wages of the blacksmiths or the costs of electric electric energy or transport have been under-estimated, the islandwide project may well turn out to be unsatisfactory from the purley economic point of view.

Conclusions

All the profitability indicators and investment criteria which have been worked out above will have maximum value only when they are actually used for comparing all available alternative means of achieving the desired objective., thus enabling the selection of the most profitable and advantageous alternative for eventual implementation. In this instance, if the objective is taken to be the timely supply of mammoties so as to fully satisfy the current demand, two other possible alternative ways of achieving the objective are, certainly, importing them, or expanding the present production capacity of the State Hardware Corporation.

Assuming that these are the only possible alternatives to the Industrial Co-operatives Project that are available for consideration and evaluation and also that the costs and benefits of each of them have been carefully identified and estimated, each alternative could have been evaluated to determine the various indicators of relative merit in the first instance. If, for instance, importing the mammoties was found to be the most economically efficient alternative, there is every possibility that the higher-level decision-makers would have still shown a preference for the next-best alternative on the basis of the foreign exchange criterion.

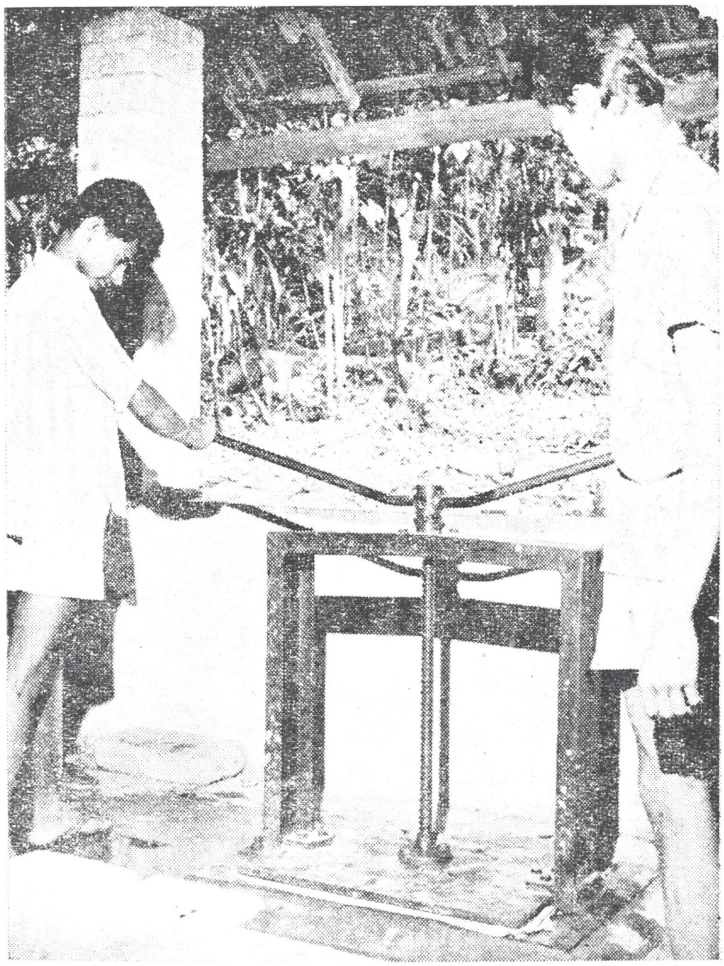
If, on the other hand, the next-best alternative on the basis of economic efficiency turned out to be the expansion of production capacity of the State Hardware Corporation, this too might have been discarded in favour of the last available alternative, the Industrial Co-operatives Project, chiefly on the basis of the employment criterion and partly due to the need for importing some additional machinery for the purpose. At the same time, the first two alternatives would also have been unsatisfactory in relation to the non-economic objectives not mentioned earlier, such as the revival of the village blacksmith throughout the country, development of indigenous technology, becoming self-reliant, etc.

Meanwhile, it may well happen that the Industrial Co-operatives Project would be selected on the basis of the non-economic goals alone despite the fact that it had a benefit/cost ratio less than unity. At the same time, it may be argued that this project could have been selected through some logical reasoning such as above without having to spend some time and effort in carrying out an economy study. However, it is clear

that none can dispute the fact that, if an economic evaluation is carried out as a matter of routine, it would provide the information to recognise what would have to be sacrificed in economic terms in order to achieve the non-economic objectives.

Finally, if this project had been selected on the basis of its benefit/cost ratio of 1.46 (Case II), it would prove worthwhile to undertake further studies prior to its implementation on the economies of scale, i.e., to investigate whether the addition of a few more Industrial Co-operatives to the island-wide project would result in a further increase in net project benefit while the benefit/cost ratio still remains above 1.0. Alternatively, the present scale of development could have been checked to determine whether a slightly reduced scale of development would be more advantageous. Such additional studies would have been eliminated if the method of incremental benefit-cost analysis had been adopted at the very start, commencing with one or two Industrial Co-operatives as the basic project and adding one such unit at a time until the best scale of development indicated by an incremental benefit/cost ratio of unity was reached.

Nonetheless, it would be of great interest to ascertain how the investment decision on this project was made and also whether any other comparable alternative investment opportunities were available for consideration before priority was given to this particular project.



A Locally manufactured paper press.

TABLE 1

HYPOTHETICAL ANNUAL OPERATING BUDGET FOR ONE SMITHY

INCOME

		Rs.
ash receipts		
1. Gross value of production (50/– x 300)	.. .. ..	15,000
2. Cash receipts from any non-project activity	.. .. ..	None
3. Total cash receipts	.. .. ..	15,000
on-cash income		
4. Value of co-operative privileges	.. .. ..	Ignore
5. Rental value of work-shed	.. .. ..	Ignore
6. Total non-cash income	.. .. ..	None
7. Hence, total annual income	.. .. ..	15,000

EXPEDITURE

ash expenses	*Imported*	*Local*	*Total*
(a) Other industry inputs			
Charcoal ..	—	1200	1,200
Scrap metal ..	—	3000	3,000
Oil ..	1800	300	2,100
Grinding wheels, files, etc., ..	900	300	1,200
Electric energy ..	—	300	300
8. Total other industry inputs ..	2700	5100	7,800
(b) Other cash expenses:			
Hired blacksmiths ..	—	5400	5,400
Hired unskilled labour (?)			None
Hired transport ..	75	225	300
9. Total cost of hires services ..	75	5625	5,700
10. Taxes, interest, insurance, etc., ..	—	—	None
11. Total annual cash expenses ..	2675	10725	13,500
12. Depreciation of work-shed, equipment, etc. ..			Ignore
13. Total expenses including depreciation ..			13,500
14. Value added – (7 – 8 – 12)			7,200
15. Net value added (or surplus) – (14 – 9)			1,500
16. Net income from one smithy – (15 – 10) or (7 – 13)			1,500
17. Annual cash living expenses of senior blacksmith			1,500
18. Profits or savings (net surplus) – (16 – 17)			None
10 Industrial Co-operatives each consisting of 50 smithies:			
Total annual cash expenses			6,750,000
Gross value of production			7,500,000
Annual value added			3,600,000
Annual net value added			750,000
Foreign exchange content of output			1,387,500
Equivalent foreign exchange cost of production			4,200,000
Net foreign exchange saving through import substitution			2,812,500