Chapter - IV

THE ECONOMIC VIABILITY

4.0 The Economic Viability in simple terms means that an investment project is capable of fetching more returns than the amount invested. If a rupee invested in a project brings back more than a rupee, the project may be said to be economically viable. This makes an easy explanation to begin with. There are complexities in this. Evaluating the returns from a project is just a starting point towards the process of decision making. Firstly, a rupee invested today does not necessarily bring back the returns today. For instance, investment in an irrigation project would firstly bring returns after some years and secondly returns will continue to flow over number of years, till the life of project is over. Should one assign the same value to flow of returns spread over years while evaluating the project benefits to-day? There exists a practice which gives a rough and ready guidance about the flow of returns. If the investors are looking for a criterion which would tell them about the required time to recover the initial capital, pay back period criterion would come to their help.

Pay Back Period.

It is the period which will be required for earning enough to cover the initial costs. For instance, if a project has an initial investment of Rs.100 and if it generates a return flow at the rate of Rs.20 per year, the pay back period will be 5 years. The competing projects are thus ranked on basis of their respective pay back periods. The project which covers the cost fastest is selected.

What if gestation period is long?

If an irrigation project is ranked with projects in other sectors such as animal husbandry etc., the irrigation project may get rejected for all the times. Optimum returns from an irrigation project starts flowing only after 6 to 7 years of commissioning. The criterion takes into account a very short period which tells us about the duration required to cover initial costs. 'The basic weakness of the pay back criterion', according to Baumol, 'lies in the limited period of which it takes into account'.[1] The investment in a machine or a project may be capable of generating net returns even after it has covered its initial costs. Two projects may be having same pay back period but one project may be capable of generating returns even after paying back the original investment.

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1 William J. Baumol, 'Economic Theory and Operations Analysis' Fourth Edition, Prentice Hall of India, 1978.

If two irrigation projects of the same kind are ranked, one may get a rough and ready guidance about the superiority of one over the other but it may not be able to provide exact guidance. It is likely that the project with early pay back period may yield relatively low returns once the initial costs are covered whereas the other project may take little longer to cover initial costs but may guarantee a higher flow of return thereafter.

The Fundamental Weakness.

The pay back criterion suffers from one more fundamental weakness. It estimates the return of future flow as they appear today. As already stated a rupee generated two years hence has a different value than the rupee generated today. The criterion fails to account for time value of money. For irrigation projects, whose life (both technical and economical) is spread over a long period, the criterion fails to provide guidance.

Time value of money and discount rates.

Investment is nothing but the consumption which is forgone today in order to consume at a future date. One would expect that the consumption in future should give relatively more satisfaction since it is sacrificed today. It is, therefore, necessary to accommodate this aspect when project benefit flows are evaluated at the time of decision making. A hundred rupees return after three years should have less than 100 rupee value today. By what factor the future flow of returns should be discounted? We shall answer this question in subsequent discussion. Presently we only say that the future flow of returns should be discounted at some rate.

The Internal Rate of Return and Net Present Value Criteria.

These are criteria which help arriving investment decision by discounting the future flow of returns. The Internal Rate of Return (IRR) or marginal efficiency of an investment project is defined as that rate of interest or return which would render the discounted present value of its expected future marginal yields exactly equal to the investment cost of the project. The Net Present value criterian goes little ahead since it tells us that a project will be profitable if the discounted present value of its expected earnings is greater than its costs (including discounted future operation and maintenance costs). The rate of discount at which NPV turns out to be zero is the internal rate of return for the project. Of the two criteria NPV gives consistent results and hence is often preferred.[2]

In irrigation projects not only the flow of benefits spread over a time period but even the costs are spread over a period of time. Further, it is not only the operation and maintenance cost that are spread but also the capital costs.

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2 IRR at times gives inconsistent results. For details kindly refer W.J.Baumol, op.cit.

The time taken for completing the irrigation project mainly depends upon the size. For a small tank irrigation it may take anywhere between 3 to 10 years. While evaluating the worth of the project the capital costs, which will be incurred at regular intervals, will have to be discounted. Thus the NPV, which will indicate the worth of project net of costs (discounted) will provide for better comparability between two projects.

These two criteria will not only help the comparison between two projects from the same sector but with also help in comparison between inter-sectoral projects. Since NPV takes into account the costs and benefits all through the life of project a comparison between animal husbandry and irrigation project is possible.

How Certain and risk free is future?

Testing of economic viability* of project by using NPV criterion is based on the flow of costs and returns in future. This means that the costs and benefits which are calculated for future are based on the assumption that the conditions generating benefit this year will not alter significantly in the coming years disturbing the flows. In this sense the flow of returns are calculated assuming certainty and risk-free behaviour of the project in future. This is hardly a

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* The term 'Economic Viability' is used in loose sense, actually meaning 'financial viability'.

realistic assumption. One must, therefore, accommodate for risk and uncertainty while evaluating a project. An irrigation project (tank irrigation project) for instance, would definitely have an element of uncertainty in flow of benefits. The tank will be able to generate benefit only when it gets filled. The filling up of the tank will depend upon the rainfall in the catchment area. The rainfall in arid and/or ~~sanir~~ semi-arid zones has an element of uncertainty. This will ultimately lead to uncertainty in benefit flows. The quality and quantity of change in benefit flow will depend upon the type of risk and uncertainty in which the project runs into.

<u>What is Risk and Uncertainty?</u>

"Risk is defined as situations in which the outcome is not certain but where the range of possible outcomes is known and the probabilities attached with these outcomes are known or can be estimated with some accuracy. Uncertainty relates to those situations where either the range of outturns is known, but probabilities cannot be estimated accurately, or where even the range of possible outcomes is not known".[3]

In case of a tank irrigation project the uncertainty of rainfall may be worked out and some probabilities may be attached to the outcomes. In that situation the benefit flow may also be estimated with probabilities attached and hence this would

3.G. Corti, 'Risk Uncertainty and Cost-Benefit: Some Notes on Practical Difficulties for Project Appraisals', in J.N. Wolfe edited: <u>Cost Benefit and Cost Effectiveness:Studies and Analysis</u>. George Allen & Unwin Ltd.,London, 1973, p.75.

be a risk phenomana. The investor in irrigation has an access to this data and he should evaluate the project after accommodating for risk of the type that has been mentioned. Uncertainty however would mean priorly unknown and/or uncertain phenomena affecting the benefit flow.For instance, with the introduction of irrigation the crop may be attacked by some pests which may not be known to experts at all. The pest attack would definitely disturb the benefit flow. One can accommodate for such uncertainty only if some prior knowledge about that exists. Once the knowledge is obtained, it no longer remains uncertainty it then becomes risk.

Thus, the distinction betwen risk and uncertainty is distinct but fine. The uncertainty may turn into risk as soon as the possible outcomes can be estimated with probabilities. Many techniques have been developed to take into account the risk and uncertainty while project evaluation. The concept of economic viability, thus, is far from simple.

A Vital Dimension.

The most important dimension in estimating the economic viability is that of the 'subject' for whom the test is carried out.It is important to know whether the viability test is to be run for a private individual or a firm or a community or group of firms or the society as a whole. As the 'subject' changes, the concept of viability itself undergoes a change.

What is viable for an individual or a firm may not be viable for a community or group of firms. Similarly, what is viable for a community may not be viable for society or an individual.

Public investment in an irrigation project of the kind which is under study, viz., the tank irrigation involves more than one subject. Individual farmers in group form the clientele for whom the government decides to invest. The irrigation department and/or Jilla Panchayat is the agency /authority that plans and implements the project after obtaining sanctions. The agency or authority charges for water which it supplies. In this kind of a project, costs are borne by individuals, authority as well the society as a whole. Similarly, the benefits flow to individuals, authority and to the society. The viability test cannot be uniform for all. The former for instance, would only evaluate the returns and costs on the basis of his choice of crops and water rates charged. He may not avail the facilities if he finds that it is not a paying proposition for him. In this process he may not realize that by not availing the facility, which technically he can, he is causing losses to the authority or society. In most of the developing systems, under and nonutilization of irrigation facility is explained by this that the individual farmer do not necessarily find it viable to irrigate despite the availability of the facility. When the investment decisions for irrigation projects - especially the small irrigation projects, are made it is assumed by the decision influencing people (mostly politicians) that all farmers in the command area would avail the facility. To put them in Fritz Machlups classification, they all form type no.1. Machlup's identification of the connotation of the term 'benefit cost comparison' says, "Type No.1 is the implicit sentiment, sans analysis, in favour of the particular project... Everyone with a favorite project will, when asked assert that "of course" the benefit from it are greater than the costs... even if they have neither theoretical arguments nor empirical data to support such contentions."[4]

It is therefore, very important to deal with this dimension of 'subject' in viability analysis. In the present chapter we intend to analyse the economic viability of tank irrigation and before doing so we shall deal with at some length the viability aspect from the view point of individuals, agency/ authority and society.

4.1 User's View Point :

User in case of an irrigation project is a farmer who has acceess to the source of irrigation. For further simplification we may define our user in the following way: User is the farmer who has -

(a) his field in the command area of the project;

(b) none of his own indigenous irrigation source; and

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4 Quoted by Alan Williams in 'Cost-Benefit Analysis: Bastard Science? And/or Insidious poison in the Body Politick?' In J.N.Wolfe edited : Cost-Benefit and Cost Effectiveness - Studies and Analysis, George Allen & Unwin, London, 1976, p.31.

(c) willingness and capability to obtain other necessary inputs in the desired quantity at market prices.

The test of economic viability for him would be very simple. He would weigh the flow of additional returns into terms of increased agricultural output against the additional costs which he will have borne. If he gets net additional returns as positive he will continue to avail the irrigation facility. In the long run he may also tend to make some further capital investment on his plots and utilize the irrigation water more efficiently. He will also account for the increase in levy, land revenue and other related items that would appear on the cost side of his assessment.

In the long run, therefore, the text of economic viability will consist of following considerations :

Costs	Benefits
1. Irrigation charges	1. Private net returns at price where he disposes off his produce.
2. Additional Labour Cost	2. Reduction in yield risks
3. Additional Inputs Cost	3. Improved accessibility to other resources.
4. Interest on capital if he invests any	
5. Betterment Levy	
6. Irrigation and Cess	
7. Depreciation	

Uncertainty in Water Supply.

Farmers in the command area of a perennial source of irrigation have relatively more certainty about regular water supply against the farmers who are in the command area of a tank irrigation. Since tank irrigation is based heavily on the actual rainfall in the catchment area, the uncertainty of rains may lead to uncertainty in water supply to the farmers.

These situations are frequently encountered in the arid and semi-arid districts. The farmers view point of viability may therefore differ for these areas. All the farmers in the command area will not be actual users in all the seasons and all the years. We may introduce here terms 'potential users' and 'actual users'. By potential users we mean those farmers who may be willing to use water but may not be able to do so for all the seasons and all the years. The viability considerations for these potential users will be different. An actual user would consider all those factors which we have discussed earlier. There will, however, be some difference between the way a farmer would attach value to returns in a command of perennial irrigation source and the way in which a farmer in the command of seasonal source would. It is further assumed that farmers having seasonal source of irrigation are in the arid or semi-arid region.

In a normal rainfall year the viability considerations and value attachment may be same for both the farmer in a semi-arid area and the farmer in wet area. Ina bad year, the farmer in arid zone if aided with irrigation will evaluate his costs and benefits in a different way. Even with a limited water supply (controlled, since the tank may also receive less storage) the farmer will be able to get yields equivalent of a normal rainfed crop. The marginal cost (in terms of water charges) in such a case has a huge marginal return. This marginal benefit cost ratio may be so high that the entire operation of the season succeeds and the farmer becomes viable.

For potential users the water may not be available in a bad rainfall year. They may have to continue to incur losses in bad rainfall years. The project may alter their flow of returns for normal rainfall years in Kharif as well as Rabi seasons. These farmers may be reluctant to invest on capital items like tractors and other machines. Their assessment or benefit cost calculation will largely depend upon the availability of water in a particular season. Viability for them, therefore, will be restricted to the calculation of costs and benefits for the seasons for which they can avail the facility.

Flow Irrigation and Viability - Farmer's Angle.

Flow irrigation, based either on perennial source or seasonal (tanks), is a system where investment for creating the source is made by agency or authority external to users (we exclude co-operatives for the time being). In case of major irrigation projects the agency or authority also develops a comprehensive plan to lay the water courses leading to fields beyond the outlets of canal network. In case of tank irrigation projects the authority leaves the control and management of water beyond outlet with the farmers. Effectively, in both the systems farmers are left with choice of crops and various input combinations.

Farmer's viability with irrigation would imply that the differential output in agricultural production is more than the additional input costs along with water charges and other levies and cess. If the farmer who is in command area willing and able to pay the water charges charged by authority and if he is willing to pay the levies and cess, one can conclude that he is operating without losses. His willingness and ability to pay the charges and levies are taken to indicate viability from his angle because the water charges and levy rates are decided by the authority and are fixed for him. He can alter neither the water rates nor the levies. He would, therefore, be calculating his economics with these fixed costs. His willingness to pay would reflect that he has worked out his economics rationally. If it is not so he would not participate. This may partly explain the un- and underutilization of irrigation capacities created.

User of flow irrigation facility therefore is the one who has already worked out his viability and is participating. In most of the instances, farmers are not contributing to the capital cost of flow irrigation directly. Since they have to incur cost only in terms of payment of water charges it is comparatively a cheaper source of irrigation for them. This point has already been well established by various field studies. A very extensive study may be quoted here. A comparative study of the economics of minor sources of irrigation in Uttar Pradesh shows that canal is the cheapest source of irrigation. The comparison was attempted between canal, Government Tube wells, Private Tube wells, Masonary wells with persian wheels and ordinary Masonary wells. The Canals ranked first when various sources were ranked according to lowest cost of irrigation.[5] Various other comprehensive studies as well as case studies have shown that from the users' view point the economics of flow irrigation is favourable to other types of irrigation.[6] We have abstained ourselves from conducting field surveys because (a) it is already well established that farmer is not a loser with tank irrigation if he participates and (b) our main focus is not the viability of the project from the view point of users but the viability of the project from the view point of society.

4.2 Flow Irrigation and Viability - Authority's Angle :

Investment in majority of flow irrigation projects have been done by the government in India. It may either be the

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5 Dr. Shridhar Misra: A Comparative Study of Economics of Minor Sources of Irrigation in Uttar Pradesh. Oxford and IBH Publishing Co., 1968, p115, Table 82.

6 Some of the other studies are :
a) M.V.Nadkarni et al. Impact of Irrigation - Canal, well, tank. Himalaya Publishing House, October, 1979.
b) M.Von Oppen and K.V.Subba Rao: Tank Irrigation in Semi-Arid Tropical India, Part II: Technical Features and Economic Performance Progress Report 8 Economics Programme International Crop Research Institute for Semi-Arid Tropics, ICRI SAT, Mimeo (May, 1980).

state government or the local governments which have invested in flow irrigation projects. Government is not the same thing as a private firm or agency. The distinction here - between the governments considerations and society's consideration would not be of any significance. We do not have an authority like Tank Authority of India or Canal Authority of India. The concept has been introduced in the ICRISAT study.[7] This concept has been introduced probably to help visualising a situation ~~where a private agncy visualising a situation~~ where a private agency or firm is interested in investing its funds in a flow irrigation project.

Costs and Returns for a private authority/agency :

If a tank irrigation project is comprehensively planned the costs and returns would include the following items.

Costs	Returns
1. Cost of construction.	1. Irrigation charges (annual).
2. Cost of acquiring land.	2. Irrigation cess (once for all)
3. Fisheries development cost.	3. Betterment Levy(once for all)
4. Maintenance and Management cost.	4. Income from Fisheries(annual)
	5. Income from other leases. For instance, Brick-makiig in summer in the tank bed (annual)

The returns from the project will depend upon how thoroughly the project is constructed and managed. By listing cess and levy in returns we assume that the project authority is empowered

7. Ibid, p.17.

to impose it. This in real world setting may be true only for government. In case of private agency the returns will include only items 1, 4 and 5. Further if the site and the reservoir conditions do not suit the development of fisheries the private investor will have to rely on items 1 and 5. The income from lease for brick making will not be very significant and hence, the only significant source of returns will be irrigation charges. No doubt that the private investor may manage the project very efficiently with optimum use of water and he may also exercise some effective control on other inputs distribution, the irrigation rates that he charges should be commensurate with costs.

Canal is found to be cheapest source of irrigation because the irrigation charges or water rates are not decided on the basis of the cost of the project. If the private agency tries to fix its water rates considering the costs, one may end up with high cost per unit of land. The viability test for a private agency is simply the ratio of irrigation charges (sum of future flows discounted) over the cost per acre incurred in building the structure. In such a situation the private agency is not likely to recover the capital cost also.

An interesting study to this effect was conducted by ICRISAT. The study worked out benefit cost analysis from authority's view point for 32 tanks spread over 4 districts of Andhra Pradesh and 2 districts of Maharashtra. The remark on results says, "Its low average levels of about 0.03 (B:C Ratio) in all districts indicate the high degree of subsidization in tank irrigation; at the project authority level about 97% of the costs of tanks are being subsidised'.[8]

The B:C ratio of 0.03 is arrived at by assuming that in 22 years of tank life (tank life is taken to be as 22 years) the average revenue collection will be constant. To be more specific, it is assumed that the entire settled command area will be irrigated all the years. This is an optimists version of saying that things are not that bad. If one accommodates for the fluctuations in actual command area for each year the BC ratio may turn out to be less than 0.03.

The abovementioned exercise has neglected one aspect of revenue which is very important viz., Levy. Betterment levy is charged only once as a tax on the presumed increase in land value. If the betterment levy is charged in the beginning of the project, it may help in recovering the cost of the project over time. For charging betterment levy, the authority will have to ensure that it will be able to supply water to each acre of the Command area regularly. In real world situation, this is not likely to happen with tank irrigation. It is however likely that government is in a position to recover part of the costs in terms of levy. The irrigation charges are generally just enough to meet the operation and maintenance.

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8 op.cit. ,p.45 (B:C Ratio) is our addition.

Can Tanks be constructed and Managed Privately?

It is possible to imagine a hypothetical situation where a private individual or a firm or an agency is ready to invest in a tank project. It can construct the tank on a site taken on lease from Gram Panchayat and supply water to farmers by charging them appropriately. In real world situation this would not be possible for the following reasons :

a) The agency will only be able to lease in the tank site and not the catchment. Any development on catchment may affect the supply to its reservoir. The agency will not have any control over the catchment.

b) In an Arid or Semi-Arid zone (which is our area of study) the behaviour of rainfall itself will not ensure the supply of water from catchment every year.

c) The water rates commensurate with the costs will generally be so high that viability from the farmer's angle may be disturbed. The participation may then go down leading to loss of revenue.

d) It is difficult for the government to introduce cess and collect betterment levy. There are not only problems pertaining to management of project but there are political problems too. A private investor will hardly be in a position to impose levy or cess.

It is obvious, therefore, that private agency will not be in a position to build and manage the tank irrigation. Tank irrigation presently is built and managed by government. In these cases the difference between costs and returns must be treated as subsidy. Why has government continued to subsidise farmers in this fashion? This issue triggers off the age old debate of private profits and social benefits. It is said that an individual and a private agency would review the situation narrowly missing thereby some vital implication of a certain kind of investment (irrigation being one of them). We shall now look into the social view point.

4.3 Flow irrigation and viability - Society's Angle : Private Profit and Social Benefit.

In a laissez faire economy it is the profits which measure the gain derived by the society. Accepting this view, according to Little and Mirrless, "seems to permit capitalists to claim the moral plaudits of society as they line their pockets".[9] Measurement of gains, however is not the sole privilege of the capitalist society but is also a practice of the socialist society. The socialist society does not necessarily follow the signals sent out by the market forces. The allocation of resources, therefore, need not be on the basis of profits alone. This does not however, reduce the scope for measuring the gains generating out of an investment. The rejection of profit thesis is not because of their poor concern towards the returns from an investment but it is because of the

8 IMD Little and J.A.Mirrless in Project Appraisal and Planning for Developing Countries. Oxford and IBH Publishing Co.,1974, p.18.

contention that profits in the capitalist society are private and accrue to individuals who invest. The fundamental thesis which is rejected in the one which says that individual welfare leads to social welfare in a cumulative fashion. It is not the returns but the retainers of the returns who bother the socialists. The change in retainer also leads to change in concept of profit. Private gains are different from social gains. The actual receipts from the project do not necessarily measure the total gains to society. Similarly, actual expenditures do not measure the total social cost. Theoretically, with given social goals, if well defined and quantified social gains and costs are equal to actual receipts and expenditures, assessment of profits out of the project should become the sole criterion aiding the investment decision. The discrepancy between the two leads to differences in the viability from the view point of an agency and the society.

Major Differences :

When the viability is tested from the society's view point, some more costs and benefits are considered. These costs and benefits are not considered by the private agency. For instance, building a tank irrigation facility would also lead to increase in level of water tables in the wells of the surrounding area. These wells with improved yield will augment the area under irrigation. A private investor would not count it as gain since he would not be in a position to collect charges for it. Similarly, mosquetoes may bread in canals and cause health hazard. The society's health profile may deteriorate. This is a cost to society. A private investor would not account for it. The list of costs and returns from society's angle is larger than private agency.

2. The second difference is that that society may not necessarily value the costs and returns at the market prices. A private investor values his costs and returns at market prices. When viability is viewed from society's angle the prices applied are different. In case of tank irrigation, for instance, a private investor will account for labour cost on the basis of prevailing wage rates which he offers. When the society views this cost it will adjust the wage rates depending upon its labour supply situation. In a labour surplus economy such as ours, the opportunity cost of labour may not be as high as the market wage rate.

Time Value of Money :

Future for an individual is relatively less certain and more risky. His life and expectations are short and quick relative to society. Society survives longer than individuals. It may be expected, therefore, that an individual will be discounting rather heavily on future expectations. Society can afford a little more luxury in this regard. How does or how should society discount for future? Will market rate of interest act as a rate for discounting social returns? These are some of the basic issues which have generated lot of discussion both in academic as well as bureaucratic circles. It is this magic rate of discount, applied to all kinds of social benefits and costs, that gives birth to a new and now extremely popular technique of social cost Benefit Analysis (CBA). This magic rate is given by the political body in a society which is supposed to be concerned with welfare of the society. It is this rate which is decided by subjective considerations and passed on to economists and other social scientists who in turn are supposed to use this rate objectively to discount the streams of costs and benefits of a project.

It is because of this technique that there is change in the connotation of the term 'economic viability'. '<u>Economic Viability</u>' is now used to indicate the profitability of a project to the society and not necessarily to an individual or an agency. The profitability of a project to an individual and/or an agency is termed as '<u>financial viability</u>'. In the earlier sections, therefore, we were taking all the time about financial viability of project for a farmer or for an authority. Economic viability in general means social viability.

<u>What is CBA ?</u>

CBA is a technique to arrive at the magic ratio of social benefits to social costs after discounting the future streams of benefits and costs at social rate of time preference to help assist the decision making for those projects which may or may not be financially viable. This needs a little elaboration. The social benefits and social costs refer to all those benefits and costs which may or may not be stemming from the project directly.

'The practical use of cost-benefit analysis, say little and Mirrless, began with water resource development in United States in 1930s. Despite its intimate theoretical connections with parts of traditional economics, it was originated by engineers'.[9] The need for such an analysis was probably felt because of the increasing responsibility of the corps of engineers and its policy commitment towards flood control activities. Robert Haveman records it thus. "From the very inception of Corps activity in both the development of navigation facilities and flood control measures, some emphasis has been placed on the degree of economic efficiency of the projects to be constructed. The first tangible evidence of such concern is presented in the act which created the Board of Engineers for Rivers and Harbours in 1902. The act stipulated that in reviewing the economic merits of a proposed navigation project, the Board shall have in view the amount and character of commerce existing or reasonably prospective which will be benefitted by the improvements..... and the relation of ultimate cost of such work both as to cost of construction and maintenance and to the public commercials involved.... With the adoption of flood control activity in 1936, the Congress further

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9 op.cit., p.27.

reaffirmed and clarified this position by requiring that, for such projects to be authorised, benefits must exceed cost, 'to whomsoever they may accrue'. Since that time then, all water resource projects have been evaluated by a method of economic analysis called benefit-cost analysis".[10]

The CBA since then has become an increasingly sophisticated analysis and its need has been felt in all types of economies. The scope for CBA in developing economies like ours seems to be there in sectors where the developed economies at the stage do not require the CBA. In little and Mirrless words, "why should one start with the presupposition that actual prices are very much worse reflectors of social cost and benefit than is the case in advanced economies?"[11] There are numerous other seasons which have been recounted by authors. According to them, any of the factors from among inflation, currency overvaluation, wage rates and unemployment, Imperfect Capital Market, Large Projects, Inelasticity of demand for exports, Protection, Deficiency of saving and Government expenditure, Distribution of wealth and external effects, may necessitate a cost-Benefit analysis for the projects in public sector.

Social Benefits and Social Costs :

Benefits and costs must be measured with respect to goal. It is the social objective of the planner in the context of the given circumstances of the economy, that calls for CBA. Benefits

10 Robert H.Howeman. Water Resource Investment and the Public Interest. Vanderbilt Univ.Press, 1965, pp.21-22.

11.IMD Little and J.A.Mirrless, op.cit., p.29.

should, therefore, measure the effectiveness of action in achieving the goal. The resources committed once cannot be used anywhere else and hence, the cost should measure the effectiveness of the forgone opportunity in achieving the goal. Goal setting is an important starting point for the CBA. The degree of clarity and extent of unambiguity go a long way in helping a smooth and meaningful CBA.

Since the market prices lose their significance in CBA and since the investor also considers the factors not indicated by market forces, the benefits and costs stem from different kind of effects. This calls for a systematic procedure to ensure the consideration and evaluation of each of such effects. All relevant issues on this count have not been resolved satisfactorily. The literature has a bundle of categories which can potentially be considered as benefits and costs. Douglas James and Robert Lee have quoted Tillu Kuhn on this issue who says,[12] "a jungle of .... categories :pecuniary and nonpecuniary, internal and external, private and social, nontransfer and transfer, on site and off site, direct and indirect, market and extramarket, economic and non-economic, measurable, monetary and non-monetary, tangible and intangible, direct and spill over, individual and collective, primary and secondary".

Is this Method Full-Proof?

One may have great reservations about it. The moment

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12. C.Douglas James and Robert R.Lee. Economics of Water Resources Planning. McGraw-Hill Series, 1971, p.164-65.

normative side of the project is considered, the entry for biases is ensured. It is possible to corrupt the analysis. The critics point out areas where the decision makers, - usually the governments, can attach excess weights to the benefits and tone down the costs so as to prove the worth of investment. It is also likely that investment decision is already made and the B:C ratio is worked out to provide justification. It is generally pointed out that the social goals are achieved at the cost of economic efficiency. This, however, is streching the argument too far. The CBA has a limited role to play. To put it in Alan Williams Words, "I take the objective of CBA to be to assist choice (not to make choice, nor to justify past choice, not yet to delay matters so that some previously chosen course of action has a greater chance of adoption, although I recognize that each of these purposes may also be served by skillful employment of CBA)".[13]

The need for CBA is still there and growing in developing countries because:

a) a properly carried out CBA may help to restrain the abuse of economic argument in the political process where different areas may be competing for limited funds, and

b) the quantification attempts of the benefits and costs while carrying out CBA helps understanding the entire system and its physical, social and economic problems in the development of a certain resource.

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13 Alan Williams, op.cit., p.32.

Social Benefits and Social Costs in Tank Irrigation Project.

The economic viability of a tank irrigation project from society's view point will be established if the social benefits weigh over the social cost. The social present value (SPV) should atleast be zero in order to make favourable investment decisions. If we assume presently for convenience that all types of social costs and social benefits are measurable, the major cost and benefits items to be considered will be as follows :

Costs	Benefits
1. Social cost of construction by irrigation department.	1. Net addition in agricultural produce with irrigation (at average national prices) net of water charges.
2. Social cost of investment done by agriculture and allied departments.	2. Reduction in yield variations.
3. Social cost of land acquired and/or loss of forests.	3. Reduction in soil erosion.
4. Social cost of operation and Maintenance by Government.	4. Increase in water tables of the surrounding wells.
5. Social cost arising out of health hazards due to Mosquito Breeding etc.	5. Increased drinking water facility and water for domestic use.
	6. Income to government through water charges.
	7. Net addition through income in Fisheries.

Has the irrigation department in Panchmahals district considered all these aspects while evaluating tank irrigation projects? What is the type of analysis which has been carried out? What of viability do they reflect? These are some of the questions which will be analysed in subsequent sections. It is also examined that if all the social benefits and social costs are accounted for, will the tank project be economically viable or not.

4.4 Viability - Ex ante.

Before we examine the ex ante viability of a tank project in semi-arid zone such as Panchmahals district, we shall review the existing practice and procedure of project evaluation and identify the gaps.

Current Practices.

The project formulating authority currently carries out the Benefit Cost analysis for every tank irrigation project. A typical exercise may be reproduced here. Two tables are prepared in order to find out the BC ratio for a proposed project. First table records the information on cropping pattern and values both before and after irrigation (Refer Table 4.1). The second table is prepared listing the detailed cost of construction and cost of operation and maintenance. With the help of costs and benefits the BC Ratio is worked out (Refer Table 4.2).

We have presented a case of a Kharif tank namely Demli Minor Irrigation Tank (MI Tank) ShK8). The tank has a command of 564 acres and was built with a cost of about Rs.9.03 lakhs. The construction consists of head works, earthen dam, Waste weire, canal and an approach road. These are the major items considered under cost. The Benefit Cost ratio exercise is then reduced to annual basis. Annual costs comprise of interest on capital (10% per annum), Depreciation (2% per annum) and operation and Maintenance cost per annum on prorata basis. Annual benefits are worked out by estimating product differentials before and after irrigation. Some rough and ready estimate of cost of production is also estimated and deducted from the gross benefits. The net benefit thus estimated in weighed against cost. The most interesting part of the project evaluation is that investment decisions have been made even if the B:C ratio thus calculated is less than 1. It appears that for the MI division the calculation is a part of routine and has no relevance for decision making. Table 4.3 lists the departmentally calculated BC Ratios for some of the tanks for which it has been possible to gather data. For rest of the tanks the ratios are either not calculated by the department or the tanks are so old that project files are not traceable.

The M I division at district level prepares the project proposals on the basis of guidelines issued by the state and/or Central government. Till recently the minor irrigation projects were sanctioned on the criterion of cost per acre. The benefit cost ratio calculation was deemed essential as recently as 1975. The Rural development Department, Ministry of Agriculture, Government of India issued 'guidelines for judging the economic feasibility of irrigation projects under DPAP'. DPAP refers to Drought Prone Areas Programme. The guideline says, "It has been

Table 4.1

Cropping Pattern and Value   Tank Code ShK7

Season & Name of the crop	Before MI Tank					After MI Tank				
	Land in Acre	Average yield per acre in quintals	Total yield in quntls.	Price per Qntl. Rs.	Total Value in Rs.	Land in Acre	Average yield per acre(Qntl.)	Total yield in quntls.	Price per Qntl. Rs.	Total value Rs.
1	2	3	4	5	6	7	8	9	10	11
Kharif										
1. Maize	150	5	750	75	56,250	254	9	2286	75	1,71,450
2. Paddy	90	5	450	90	40,500	150	8	1200	90	1,08,000
3. Millet	90	4	360	80	28,800	Nil	-	-	-	-
4. Groundnut	139	3	417	100	41,700	160	5	800	100	80,000
5. Jowar ~~Pegion-Pea~~	95	3	285	80	22,800	Nil	-	-	-	-
Total	564	-	2262	-	1,90,050	564	-	4286	-	3,59,450
Rabi		Nil						Nil		

Note: The prices are based on market yard quotations.

Source: Correspondence file, MI Division, Godhra.

Table 4.2

The B C Ratio Calculation

Tank Code ShK7

Name of the Tank	Taluka	District
Demli	Shehera	Panchmahals

	Rs.
Total Cost of the Scheme.	9,03,189
Say Approximately	9,03,200
1. Interest charge at 10% of capital cost	90,320.00
2. Depreciation charges at 2%	18,064.00
3. Maintenance charges at the rate of Rs.4.5 per acre	2,538.00
Total	1,10,922.00

Gross Benefit = Column 11 - Column6 (Table 4.1)

= 3,59,450 - 1,90,050

= 1,69,400

Assuming 50% as cost of Labour

Net Benefit = 84,700

Benefit cost ratio $= \frac{84,700}{1,10,922}$

= 0.76

Source: Correspondence File, MI Division, Godhra.

Table 4.3

Departmental B:C Ratio for Selected MI Tanks in Panchmahals

Sr. No.	Tank Code	Proposed Command Area in Acres	Cost per Acre in Rs.	Departmental B:C Ratio
1	2	3	4	5
1.	ZK16	225	1253	0.86
2.	ZK17	501	3050	0.30
3.	ShK7	564	1410	0.76
4.	ShK8	621	459	0.74
5.	DBK13	338	1170	0.94
6.	DBK14	305	1118	1.19
7.	LK9	413	1142	1.40
8.	LuK4	408	2059	1.34
9.	ZT24	950	726	1.92
10.	ZT27	540	959	1.20
11.	ZT28	470	959	1.41
12.	ZT29	250	575	1.38
13.	DBT13	1000	910	1.11
14.	DBT14	498	847	1.93
15.	DBT15	1608	813	1.17
16.	LuT5	320	2250	1.42
17.	LuT7	335	760	1.90
18.	LuT8	638	836	1.44
19.	ST16	1445	839	1.29
20.	ST17	793	578	2.40
21.	ST18	850	560	1.50
22.	ST19	670	1631	0.80
23.	ST20	355	694	1.70
24.	ST21	265	2943	0.52
25.	DT31	830	592	1.59
26.	DT32	270	789	1.30
27.	DT83	530	1200	0.98
28.	JT11	625	561	2.50

Source: Compiled from Master Plan M I Division, Godhra.

observed that the application of the criterion of cost per acre does not permit a proper economic appraisal of the irrigation schemes, as it gives only one side of the picture, i.e. cost and does not take into account the type of crop grown and thus the actual benefit accruing to the project command in monetary terms is not reflected by this criterion ..... It is, therefore, felt the criterion of benefit cost ratio analysis, which is more realistic, should be taken as the guiding factor for testing the economic feasibility of minor irrigation projects in DPAP also to be in line with general policy of Govt. of India."[17]

In case of Gujarat State, it appears that the B:C ratio calculation was a practice even before the circular of the Government of India was circulated. This is reflected in case of some projects which have been formulated and implemented before the circular was issued.

From Table 4.3 it can be observed that 8 out of 28 tanks listed have B:C ratio less than 1 and have been implemented. Of these two tanks also cross the limit of Rs.2000 per acre cost which is the upper limit prescribed by the government. Rest of the 20 tanks have B:C ratio greater than 1 within a range of 1.11 to 2.50. If we assume for a moment that same kind of proportionate relationship holds for all the 56 class I MI Tanks in the district, we may say that 16 tanks have B:C ratio less than 1 and 40 have more than 1.

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14 No.28(22)/75 DPAP/13-11-75 Rural Development Department Ministry of Agriculture, Government of India.

Of these 28 tanks for which the B:C ratios are known, 13 were not operational at the time of this investigation. The problems are technical such as leakages from head works etc. Of these 13 only 2 tanks have B:C ratio less than 1. For rest of them the B:C ratio is very impressive (Refer Table 4.3 with Table 3.4).

Are These Ratioes Representative?

This question crops up in the context of the social viability of a tank project in semi-arid district of Panchmahals. One will have to analyse in detail about (a) the relation of exercise vis-a-vis the social goal for constructing a minor irrigation tank, and (b) the assumptions, methodology and procedures involved in the B:C calculations.

The Social goals.

The way in which the body politick argues for an irrigation tank in Panchmahals is interesting. We have already observed in Chapter 2 that the annual rainfall is the district is relatively low and has a significant variation. As per the DPAP report every third year has been a drought year characterised by below average rainfall and variations in precipitation. People's representatives put forth strong case for constructing irrigation tanks in a big way. Their contention is that construction of irrigation will not only provide on the spot employment to the farmers and agricultural labourers in the nearby area (of the site) but would help protecting the

Kharif Crops in a bad year. They also argue that with tank the area under irrigation both in Kharif and in Rabi would be enhanced. This they say would improve the otherwise backward agriculture. This has been by far the major consideration for constructing class I and Class II minor irrigation tanks in the district.

If we define the above contention in terms of social goals, they will be the following.

1. To increase the employment opportunities in the drought prone backward areas,
2. To help protect or to provide insurance to the Kharif crops in relatively bad years.
3. To augment the area under irrigation and thereby modernise agriculture.

Economic viability and project evaluation will depend upon the sequence in which these social goals are considered. If the sanctioning authority attaches importance to these goals in the order in which they have been mentioned, it may land in serious trouble. We assume that constructing a minor irrigation tank is treated as a return bearing investment by the society and not a dole. If it is a dole there is hardly any need for justification. If it is not then the order would be different.The second and third goal are of paramount importance if the project has to generate returns to the society. The direct return to the society will be in terms of net added agricultural produce with irrigation.

Providing temporary relief employment to the drought hit population is a necessity but this may be accomplished by some other project. If the project authorities have enough technical grounds to show that the second and third objectives will not be accomplished, it should be cautious before making an investment decision. There are effective alternatives such as road laying project which have better employment potential. In an irrigation tank of the total cost 70 to 75 % is needed for constructing head works which is mostly 'brick and mortar'. Employment potential in an irrigation tank is, therefore, limited. The society has a better alternative in roads to accomplish the first goal.

Protection to Kharif Crops - A Case for a bad year :

It is true that in a bad rainfall year farmers are put into difficulty. A bad year may have any or some of the following characteristics.

a) Rainfall in not enough for the crop to grow.

b) Rain fails at the crucial watering times in the beginning or in the middle or towards the end.

c) The rains fail in the beginning beyond the normal sowing period.

An irrigation tank can potentially help meet the first two situations. If the rains fail or in other words if rains delay in the beginning, the tank also would not receive any storage. It is unlikely that the last years storage will be there and in enough quantity to supply to the farmers in the command. The second goal of providing protection in Kharif should also be taken with a pinch of salt.

The actual storage in the tank towards the end of monsoon season will depend upon the 'dependable rainfall'[15] estimated for the tank. We have already discussed this aspect in detail in section 3.4 of chapter 3. In a tank project where beneficiary is well defined, will it be possible to cover all the farmers of the proposed command area in a bad year? The answer in the light of understanding of the conceptual issues is no. It will be only a few farmers, operating their land towards the head of the canal, who would get benefit of irrigation in a bad year (assuming that some water is there in the tank). In such an instance would the social goal be justified? There is scope for reservations. One must then necessarily relate the benefits with costs.

To achieve the third social goal one will have to necessarily assess the economics. We therefore shift our attention on the economics of tank irrigation.

<u>Assumptions in Calculating Departmental B:C Ratio</u>:

Table 4.1 and 4.2 illustrate the standard pattern adopted by the department in calculating the social benefit cost ratio. In the process some assumptions are implicit which deserves attention. These assumptions are as follows :

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15 The term has already been introduced in Chapter 3, Section 3.4. Refer page.

1. The potential command area and actual command area does not undergo any change throughout the project life. This means that in each year the actual area irrigated will be equal to the potential command that is created.
2. The cropping pattern in the command area is the one which is proposed by the agriculture department and it remains same every year through out the project life.
3. The Gross benefits from the project remain constant every year from the first year to the last year of the project life (a corollary to 1 and 2).
4. The cost of the project remains the same even if there are delays in implementation.
5. The farmers in the command area would manage efficiently the supply of water beyond outlet without any kind of problems.

All these assumptions hold true if a tank has to be constructed in an ideal hypothetical situation. In real world setting none of the five assumptions hold true. The very first assumption about the potential command and actual command is not true because of number of valid reasons. We have already discussed in previous chapter that both supply and demand for water will vary depending upon the exogenous variables such as rainfall etc. It is likely that in some years the actual command and potential command be same (favourable exogenous variables) provided there is an efficient management. Otherwise the discrepancy between the actual and the potential will exist. The degree of discrepancy will affect the extent of viability. Even for a set of trained farmers with modern attitude, the demand for water will depend upon the physical conditions of their farms, their ability to combine other factors of production and above all their rational calculations.

The second assumption cannot be realistic, but one has to make it in order to test the economic viability of a project. However, instead of making assumption about the actual areas under each crop (current practice), one may assume about share of individual crops to the total proposed command area. Further, to be more realistic the project formulating authority should obtain three to four probable cropping patterns and test the economic viability for each of the cropping pattern separately. In reality it is likely that farmers in the command area would continue to grow the same crops in similar propositions with irrigation which they grew without irrigation. They may alter their cropping pattern once they are sure of the water supply. In future they may also respond to market signals for crop selection. Assuming only a single cropping pattern would imply a limited approach to the exercise of testing economic viability.

When the first and second assumptions are disturbed, the third assumption cannot hold true. Change in the either of the assumption will lead to a distortion in the flow of gross benefits. This has serious implication on the method which is used to calculate B:C ratio for the project.

The fourth assumption is made by almost all the project formulating authorities in public sector. It is usually assumed that costs would not alter till the project is complete and commissioned. We do not get into reasons why this assumption is very often made but we only say that this assumption is also unrealistic. Scope for increase in costs have two basis. Firstly, delays in project implementation lead to increase in total cost of the project (It is not the same thing as cost escalation due to inflation). If the implementation is not planned properly, it may lead to bad coordination. This may lead to actual rise in costs. Secondly, from society's point of view delay should itself cost to the society. The cost of delay in simply ignored both by the project formulating authorities as well as project appraising authorities. This issue calls for little more details.

Suppose it is estimated that a particular tank project would take 2 years to complete. And suppose it actually takes 3 years and there is a delay of one year. We further assume that the head works have been completed but the canal works delayed. The project cannot be commissioned until the canals are complete. So for the investment which has already been made in headworks would not fetch result for a year for which the returns were calculated while working out the viability. The society loses the social interest for one year. This is a cost. Hence, the actual cost of project would be cost of head works plus the interest which has been forgone and the cost of canals.

This cost may become very crucial in case of those projects which may have got qualified by being at Margin. If a social benefit cost ratio of a project is 1, a delay of even 6 months may render the project non-viable. We shall come back to this once again a little later.

The fifth assumption is often made for small tank projects which is the subject of our study. We feel that it is sufficient to state that the problems of water management beyond outlets not only exist for small irrigation structures such as tanks but they also exist for medium and major irrigation projects. Inter--personal problems and power politics operate in water management. Such problems are extremely actute particularly in bad monsoon years. A farmer with his own irrigation facility (say having well) may not allow the water course to pass through field enabling the other farmer to avail flow irrigation facility. Such a hostility may arise out of pure jealousy or envy or out of frustration in case he was selling water to that farmer before canal was laid. This problem is as much true for bigger projects. Such problems do lead to un/under-utilization or even wastage of canal water.

Working out the social benefit-cost ratio is, thus, not a simple exercise. The department carried out these exercises with assumptions that are not very realistic.

The Method of Calculating the B:C Ratio :

Table 4.2 illustrates the standard practice. The method is to compare annual costs with annual returns. On the cost side annual cost is worked out by deriving interest on Capital, annual depreciation and annual operation and maintenance cost. We shall dwell upon each item one by one.

The Interest Rate : The department takes 10% of the capital as interest to arive at the annual cost. What does this rate reflect? Is this the social rate of discount or is this social opportunity cost of capital? It is very important to determine this. Social rate of discount or social time preference rate is likely to be low in developing economics. This would be so because society as a whole will have lower preference to present because much of the prosperity of the system depends on how future is shaped. This is more acute in the economies where population is growing faster and the development is not able to keep pace with it. Such a system would be ready to sacrifice more today in order to have better tomorrow. This alternatively means that with a limited available capital in the system the pay-off has to be high. The social opportunity cost of capital, therefore, will be higher than the social time preference rate.

If we apply the social time preference rate, we are implicitly assuming that the capital has been generated by sacrificing consumption. The society as a whole decides to forgo consumption today and is willing to consume at a later date. This it would do by discounting the future consumption. The rate at which it discounts is the social time preference.

If we apply the social opportunity cost of capital we shall have to check whether the decision to make investment in public sector displaces the private investment. If all the public investment displaces the total private investment then the rate of return generated out of this investment will be the social rate of return.

It is not necessary that all the public investment comes through either from cut in consumption or displacing the private investment. In reality it comes partly by displacing private investment and partly by a cut in current consumption. In such a case an average of the both the rate are to be found out.[16] For educational investments in India Mark Blaug and others concluded: 'that half of all educational investment may displace private investment, and, if we assume that the STP rate is 5 per cent, we can deduce the relevant alternative rate for educational investment as 12.5 per cent.[17] The authors had assumed that the rate of return in private investment was around 20%. Why should one assume that the STP is 5%? There is in fact no definite answer about it. It may be true that the STP rate will be lower than the social rate of return on private capital but by how much it has to be less remains an unanswered question.

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16 This has been illustrated by Mark Blaug et al by following Marglin's rule. See for details Mark Blaug et al: The Causes of Graduate Unemployment in India. Allen Lane, The Penguin Press, 1969, pp.23 to 28.

17 Ibid, p.25.

Which rate should be appropriate for an irrigation project? Should we say that STP rate should be applied or should we say that social rate of return should be applied? One more exercise done to calculate the B:C ratio for rural electrification adopted the Mark Blaug's method. The Report shows that assumptions about the public investment displacing private investment and cutting current consumption have been different. It is assumed that three-fourth of capital has come from displacing private capital and one-fourth has come from cut in current consumption.[18]

It is very difficult to decide a rate which can be taken as interest rate for calculating the interest on the capital invested in irrigation project. It is, however, possible to say something about the nature of the investment in minor irrigation. We have already stated in Chapters II and III that minor irrigation is a state subject and it is the Jilla Panchayats who take investment in the district for a year is a given sum. The amount is decided by the state government. For a district an amount passed on is an investment. It has no choice between consumption and investment. Its choice basically is between the alternative opportunities either within the sector and/or outside the sector. There are two reasons for not discounting the future flow of returns from irrigation tank project with STP.

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18 For details kindly see, V.N.Kothari and M.M.Dadi : Economic Benefits of Rural Electrification in Gujarat. Department of Economics, Faculty of Arts, M.S.University of Baroda, 1977, pp.157-158.

The first reason is that as far as district is concerned nothing is being cut from the consumption. Secondly, the district being prone to drought and backward economically is paid special attention (in the form of allocative biases). It should be expected that the district's income should grow at a relatively faster rate compared with other non-backward districts. This is based on the assumption that backward districts have otherwise vast potentials which have not been exploited for one reason or the other and that if substantial amount of investment is done in these areas it will fetch better marginal returns.

One should, however, be clear with regard to weightages attached to investment and returns in the backward districts. Could it be argued that a unit of return generating out of a project in backward district should be socially higher than the similar kind of return generated from the same project elsewhere. It would be being enthusiastic with absurdity.* This type of argument wins favour of those who feel that a cake distributed more evenly increases the total welfare. But we should bear in mind that the very allocation pattern of investment does take care of the distribution aspect.

For the district, therefore, the social opportunity cost will be on the higher side. The social time preference may be low. What rate should be applied for discounting the future

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* These kind of arguments are forwarded often in the Zilla Panchayat meetings when a group of politicians want to stress the need for project.

benefits then? It should be the social opportunity cost of capital which should be taken as the rate. The central government guideline does indicate in this direction. It says, "As per the prevailing practice, the state government indicate the benefit-cost ratio by taking into account two basis of interest, viz., 5% and 10%, while the actual feasibility is judged on the basis of 10% interest on capital".[19] Since there is no further revision of this rate we take it that the state practice is endorsed by the Centre. It seems that 5% rate is taken as the STP for the investment and 10% is taken as the social opportunity cost. We take this as the society's decision without going for further arguments. As a matter of fact the social opportunity cost may be higher than what is stipulated.

The Depreciation : The standard practice is to take 2% of the capital as depreciation per annum. The depreciation is calculated on the maximum life of the project, which is assumed as 100 years for medium projects and 50 years for minor irrigation project. The authorities are not making any distinction between the project life that is technically feasible and project life that is economically viable. The benefit-cost analysis considers the benefits and costs are expected to get generated till the point to which it is economic to run the project. The project life therefore is not strictly a technical phenomena. It is likely that a tank project is faced with severe silting problem after 35 to 40 years leading to a substantial loss in storage.

19 Central Government: Guideline, op.cit.

In case of minor irrigation project it is better to calculate more strictly the project life. This would apparently increase the depreciation rate.

Depreciation is not based only on project life. The authorities assume that 2% per annum set aside would cover the total capital at the end of 50 years which is the project life. There is a serious limitation in accounting for depreciation in this way. The first point is that this kind of calculation assumes that there is no scrap value at the end. This may be realistic. The important point is that the amount which is kept aside as capital recovery amount also has a capacity to grow cumulatively. Depending upon the social rate of interest the amount will compound itself till the project life. This implies that the amount, which is set aside considering only the project life, will be far greater than the amount which would by compounding itself at the social rate would become equivalent of the capital amount by the end of project life. The benefit cost exercise run on annual basis does provide an evidence that the depreciation or more appropriately 'replacement allowance' also depends on the rate of discount.[20] This is shown in the Appendix-1 of this chapter.

Once we accept that replacement amount depends on the rate of discount also, we can say that the rate of depreciation normally based on project life alone is an overestimate. To this extent the cost of the project will be reduced.

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20 This concept has been developed by Dr. Ravindra H.Dholakia in, Social Benefit-Cost Ratio - A Case for Improvement in Computations. District Project Planning Cell Panchmahals,Godhra(Mimeo) July,1980.

Operation and Maintenance :

The standard practice is to account for Rs.10 per acre for operation and maintenance. While calculating the social cost one may tend to argue that since a social asset has to be operated and maintained, the pecuniary costs incurred need not be the social costs. The social cost may be less than the pecuniary cost. The rate which is fixed for most of works in the district is not really sufficient to meet the operational cost let alone the maintenance. In class I irrigationtank a watchmen (known as Pagi) and an Irrigation clerk are the personnel who operate the tank. The cost of these two functionaries is itself higher than the amount kept aside for every acre of irrigation. Further the cost of hiring a Watchmen and an Irrigation clerk is not a divisible cost. The functionaries will have to be paid whether one farmer demands water or all the farmers demand. Secondly, since the structure is permanent for at least 50 years the functionaries cannot be laid off in off seasons. These two aspects would lead to a fixed cost of operation and maintenance.

The project authority also collects water charges from farmers. Part of this amount or whole (depending upon the tank size) may be used to meet the cost of operation and maintenance. A liberal assumption could be that the operational & maintenance cost is met with the amount set aside per acre and the water charges per acre. Since both the amount set aside and water rate are fixed on social considerations they may be treated as social costs and social returns respectively. This would imply that the society will not earn anything net by charging for water. On benefit side, therefore, one may substract the earnings from water charges.

To summarise the discussion on costs we can conclude that following are the main features:

a) The social opportunity cost of capital taken as 10% may be an underestimate and to that extent the annual cost as worked out by department will increase.

b) Depreciation is overestimated. The actual rate will be lower than 2% per annum and to the extent to which it is low the annual costs will be reduced.

c) The operation and maintenance cost are under-estimated and to that extent the annual cost will be depressed.

It can, therefore, be said that the costs are under-estimated.

Calculation of Benefits :

The department calculates the benefits by arriving at the net value of benefits after irrigation. The difference between 'before and after irrigation' agricultural production is obtained and termed as gross benefits. Of this 50% is taken as the net benefits. The remaining 50% is accounted for labour costs. There are serious limitations in such an approach.

Before and After V/S with and Without :

In working out benefits if before and after type of approach is used, it leads to an overestimate of benefits. The underlying assumption in before and after approach is that there will not be any change in productivity in the proposed command area if irrigation is not introduced. Hence, whatever change in productivity is foreseen will be realised only after irrigation. This is an unrealistic assumption. The productivity undergoes a change in agriculture not merely because water is made available. Other technological innovations leading to change in input combinations may also lead to change in productivity. Dry farming research has yielded some favourable results in rainfed areas.* The yield statistics for the district for three major crops provides evidence.

Table 4.4

Yield of Crops (Paddy, Maize and Groundnut) in Panchmahals (yield Kgs. per hectare)

Reference year	District Avg.Rainfall(mm)	Yield of Paddy	Yield of Maize	Yield of Groundnut
1	2	3	4	5
1962-63	967	931	783	735
1963-64	948	985	778	805
1971-72	694	893	1639	752
1972-73	609	157	980	376
1973-74	1561	912	762	967
1974-75	472	17	626	415
1975-76	1208	1007	1756	1021
1976-77	1796	1234	868	702
1977-78	1358	971	387	670
1978-79	1216	778	643	637

Source: Directorate, Agriculture, Govt. of Gujarat.

* The introduction of HYV Variety of Maize has shown improved yield in one of the rainfed areas of Panchmahals. Observed at Maize Research Centre near Godhra.

2. District Statistical Abstract. (Source)

The data sources do not give separate yield figures for the crops considered for dry and irrigated. But if we look at the area under irrigation under these crops for corresponding years we may come to know about the share of irrigated output to total output.

Table 4.5

Proportion of Area Under Irrigation under Paddy, Maize and Groundnut in Panchmahals

(As percentage to respective toals)

Reference year	Paddy	Maize	Groundnut
1	2	3	4
1962-63	0.07	0.003	0.00
1963-64	0.58	0.040	0.00
1971-72	3.31	0.720	0.00
1972-73	5.03	0.310	0.004
1973-74	4.98	0.590	0.00
1974-75	5.89	0.670	0.00

Source: Estimated from District Statistical Abstracts, 1963-64, 1963-64, 1971-72, 1977-78.

The area under irrigation is insignificant. If this is accepted then we may observe that there is an increase in yield in some years. There are fluctuations which are distinct but in good rainfall years there is higher yield. It is lack of data which does not permit us to observe the average yields in past 4 or 5 decades. But one may certainly say that average yield even in rainfed situation have potentials to improve.

This improvement is not reflected if 'Before and After' approach is adopted.

'With and Without' approach offers this scope. By definition yield without irrigation has to be a value which takes care of the possible improvements over a period time (project life in this case) and also considers the possible fluctuations. Similarly, the yield with irrigation is the value which has to be arrived at by considering the possible fluctuations in future. It will be the difference between the average yield with irrigation and without irrigation which will be the addition to output. If we substract the net additional input cost from this difference, we shall arrive at the net benefit from the project.

How to arrive at With and Without Irrigation Yields?

Firstly, it will depend upon the season. For Kharif or monsoon crops the without irrigation yield may be arrived at by observing the trend of the past. Based on this trend one may extrapolate an average yield without irrigation. With irrigation yield levels may be extrapolated considering assured irrigation in case of failure. Secondly, it will depend upon the possible input combinations permitted by the level of technology with and without irrigation. The average yield for a particular crop with and without irrigation may then be extrapolated for final use.

The current practice of calculating benefits before and after irrigation may generally lead to an overestimate of the benefits.

The Method :

Till now we analysed the way in which the benefits and costs are accounted for and the limitations therein. We shall now examine the method which is adopted for B:C ratio calculations. The exercise is performed on annual basis. That is the ratio of benefits to costs are calculated for one year and it is assumed that the ratio will hold true for the entire project life. Once again there are limitations in this approach especially when the underlying assumptions prove to be unrealistic. Running B:C exercise on annual basis assumes :

(a) the gross benefits from the project remain constant every year;

(b) the rate of discount remains constant every year; and

(c) the operation and maintenance costs remain constant every year. We can also say that the net benefits from project remains constant and thus combine first and third assumption.[21]

With these assumptions the net benefits are compared with cost and the ratio is worked out.

In the real world setting the first assumption proves to be unrealistic. The second and third assumption may hold true.

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21 For details kindly refer Ravindra H.Dholakia, op.cit., pp.1-2.

Both the latter assumptions are exogenously determined and hence may not be affected by the project performance. The first assumption is disturbed significantly. Recalling our discussion on conceptual issues in utilization we can summarise by saying that the gross benefits flowing each year may be different. The reasons are following.

1. The actual rainfall may be different than the dependable rainfall.
2. There may be more water losses than anticipated.
3. The distribution may be adversly affected due to management.
4. Changein cropping pattern may lead to change in water utilization
5. Farmers may take time initially to feel convinced about the supply and hence may delay the command area development.

Any single or a set of reasons from among these may lead to under-utilization of the facility. Over-utilization is ruled out because the upper limit of the storage capacity is technically determined and fixed. The annual constant return method adopted by department will thus be inconsistant with actual returns with irrigation.

What will be the probable benefit flow?

The trend of utilization and consequently the trend of gross benefits from the project will depend upon :

(a) behaviour of the rainfall during the project life;

(b) time taken by formers to change their attitudes in favour of irrigation and improve practices;

(c) technical factors leading to decrease in available water supply (silting etc.); and

(d) the efficiency with which the project is managed and operated.

In a semi-arid zone such as Panchmahals the irregularity of rainfall is known. If we take that every third year will be a drought year* (insufficient rainfall) then 12 out of 50 years may be drought years in the district. If we assume that in all cases, the actual rainfall is less than dependable rainfall, the available storage commensurate with rainfall will be less than the optimum storage. If we assume that the bad years appears every third year and continues in that sequence, every third year the gross benefits will be less than the optimum. If no other factor is acting against the benefits, every third year the gross benefits will be lowered by some proportion depending on the actual rainfall.

Secondly, the farmers in the command do take somtime in adjusting themselves to the new situation. The initial years of commissioned project may be marked with, uncertainty feeling, interpersonal fights, looking for soures for other inputs etc. This will definitely have dampening effect on the actual

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* The Drought Prone Area Programme, Panchmahals, Godhra, 1974-75. Report gives this figure.

utilization. For 5 to 7 years not all the farmers in the command area will be demanding water for all the acreage that they bring under cultivation. Initial years, therefore, will show less gross benefits.*

Thirdly, towards the later half of the project life and especially last few years, the technical factors may come in way of full utilization. Silting is the most common phenomenon which is normally noticed. The gross benefits from the project will therefore, be affected and will be lowered towards the end of the project.

These three factors have very low chance of being controlled even with a superior Management. If we accept this then we may say that the benefits from the project will be relatively lower in the beginning, it will reach to some peak optimum level in the middle of project life and it will once again start falling towards the end.**

If we now bring in risk and uncertainty of the kind not considered so far (such as non-availability or shortage of fertilizers, Pest breaking out etc.), we may say that gross benefit will have a tendency to be different every year from the first year to the last year of the project. In as far as the gross benefits differ, the annual basis exercise becomes meaningless. A better way is to work out the gross and net benefit flow for each year and then discount it to the present.

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* The T & V Extension System Experts opine that it may take **about** 5 years for the command farmers to get tuned with the irrigation facility and management.

** One should note that benefits forgone in earlier years of the project are more valuable ~~and beneficial~~ than the fuller gains that may be realised in the later part of the project life.

This discounted present value should be compared with the cost.

Associated Costs and Indirect Benefits.

The current practices never incorporate the associated costs and indirect benefits. It is likely that such costs and benefits are too insignificant to get attention. But this needs to be examined. Building an irrigation tank in a village has definitely lot of other implications which may not be necessarily related to use of water by farmers for the cultivation. At the same time there will be certain costs in the form of giving up things such as lush forest patches or good grazing land.

The Cost Side :

A decision for investment in irrigation by a public body entails much more commitments than merely constructing a structure and maintaining it. There exist variety of other costs which the present authorities do not consider at all. It is a practice to ignore the cost arising due to submergence of some land. If the submerged land is private then compensation is given to the farmers and the amount is treated as a cost. If it is forest or a government land no cost is accounted for. From the social point of view, this is a cost. The society as a whole looses the production due to the forest or to the government land. Even if the land is not put to use by government, some value must be imputed. This may not be cost from authority's point of view (transferred from one use to another) but it is a cost from social point of view. The total cost of the project will therefore go up to the extent to which the losses in forest produce and/or imputed cost for land is accounted for. The other associated costs are in terms of the cost of laying field channels, water courses and drainage. This we shall discuss in management aspects.

Indirect Benefits :

A tank built on a site where there was no structure previously would generate some indirect benefits. If a village tank is converted into an irrigation tank the indirect benefits may be lower. A new structure would imply that along with irrigation, facilities would increase for drinking water and water for other domestic uses. The cattle population will also be benefitted by the tank. The village with a tank will improve its green fodder position.These benefits may or may not be substantial depending upon before tank conditions.

There is one more indirect benefit. The construction of a tank would lead to an improvement in the ground water position. It is technically established fact that a reservoir increases the water table in the nearby areas. The farmers having well may realize that the yield of the well has gone up after the tank was constructed. This would certainly add to the agricultural production. It is also likely that farmers owning well and other sources of irrigation may shift to canal irrigation. This substitution is obvious because canal is a cheaper source of irrigation. If all the farmers in the command area owning wells-energised or otherwise, shift to canal irrigation, society as a whole will benefit by spending less on irrigation thus saving the national resources. Such a substitution will however depend upon the faith of the farmer over the public source of supply. It is at times observed in the field that farmers continue to depend on their own indigenous source because they do not have complete centainty about the supply from public source.* In such an event the real net indirect benefit would be reduced. The author witnessed one more case where a farmer continued to rely on well irrigation for his wheat crop in Rabi because he felt that the Canal water was too cold for his crop. He said that well water was lukewarm and it had an added effect to wheat output.**

In general, however, the farmers have tendency to substitute canal water for well. Though it is technically well established that a surface reservoir has a capacity to increase ground water potential in the nearby wells, the extent to which it would increase is still a moot point. It verymuch depends on the type of soil strata that is found around the reservoir. If the geological formation is consolidated and

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* This was observed by the author in village Morva of Godhra taluka, Panchmahals district when he visited a pilot project on Water Management at Morva Under Panam Medium Irrigation Project sponsored by World Bank in April,1982.

** Command Area of Zinzri Class I irrigation Tank Devadh Baria taluka of Panchmahals district.

unconsolidated type, there may not be enough flow from reservoir to the nearby wells. The Panchmahals district has more or less this type of formation. The expert's opinion is that the extent of increase in water table can be ascertained only after each tank site and its command is studied technically. In our study we assume that there is no significant increase in the ground water levels. The indirect benefits are therefore extremely limited. These indirect benefits will not alter the B:C ratios in any significant way unless they are attached with extra-ordinary weights. We have seen that the social goals do not mention indirect benefits. Within the framework of given social goals indirect benefits do not get any added priority. As they stand they do not filt the balances.

Construction, Operation and Maintenance - Management Issues :

If a good plan, feasible location and sound appraisal are necessary conditions, efficient management in construction and operation are sufficient conditions for the success of a minor irrigation tank. Delays in construction and completion of the project lead to increased social costs. This may not be necessarily due to inflation.

The ex-ante viability calculation implies that benefits and costs are evaluated on constant prices. Delay in commission would add to the costs in terms of earning opportunities for-

* Private Communication. Geologist in-charge Geo-hydrological Survey Sub-Division, Godhra.

gone on that part of capital which has already been turned into an asset. Suppose, our tank in question was to be ready for commissioning in 5 years as per schedule and it actually commissioning in 7 years as per schedule and it actually commissions at the end of 7th year and suppose that by the end of 5th year head works are completed then the earning due to capital invested in head works will be lost for next two year till the canals are completed. If delays are the facts of the present day construction management (which it is), the society must account for this loss.

Similar is the case for operation and maintenance. Any lags and leaks in the system would reduce the actual flow of benefits. This phenomenon is once again very often observed in the real life situation - especially in public undertakings. Administrative delays and public service personnel's lethargy are the facts of the present day functioning of the system. No project appraising authority can ignore this. The efficient operation and management of an irrigation tank assumes among other things a sound network of field channels and drainage system in the command area. It is the practice of the department not to undertake the field channels in minor irrigation tank projects. The argument putforth is that field channels would increase the cost of the project. The associated costs of this kind are neither incurred nor accounted for. The field channels in flow irrigation form the backbone of the structure. It has been observed that laying of field channels leads to change in cropping pattern, cropping intensity, enlargement of irrigated area etc. A study of this kind has found that mean levels of inputs and output obtained were different for villages with and without field channels. The villages with field channels scored over the villages without field channels.[22] Dr. Kumar's study shows that the B:C ratio with field channel is 16.50:1 from the farmers view point. At a nominal cost of Rs.25 to 30 per acre the net income realised was Rs.269.92 (Net of cost 'c').[23] This indicates the importance of field channels and efficient water management.

How Viable an Irrigation Tank is?

Considering the already discussed factors leading to distortions in the flow of costs and benefits, we may say that ex-ante viability of a tank should be more objectively assessed in the light of the facts and circumstances that exist in the area where the test is conducted. We shall recount certain facts before making a final comment on the economic viability.

Area Characteristics :

1. The general productivity status is relatively low (Chapters II, p.5). The southern talukas have relatively better productivity status but have less of irrigation tanks.

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22 P.Kumar, Economics of Water Management, Hontage Publishers, New Delhi, 1977.

23 Ibid, p.48, Table 9(b).

2. The topography of the area suggests that most of the area have atleast an elevation of 75 meters and above going upto 300 meters. The flow with gravity in command may therefore, be questioned.

3. 40% and more of the soil has heavy or light texture coupled with relatively inferior NPK status. Water alone, therefore, would not lead to spectacular change in output.

Departmental Characteristics

1. The identification of the tank sites are not always based on technical considerations.

2. The structures are not always technically perfect. (Chapter III Discussion on Problem tanks).

3. There is an average delay of 2 to 3 years in completing the works.

4. Evaluation and monitoring remain on low key. The main emphasis is on spending money on construction (The confidential Report (CR) is written on the basis of expenditure performance).

5. The department does not and is not likely to line the Canals and lay a network of field channels.

Farmers' Characteristics:[24]

1. Attitude, behaviour and cultivation practices differ from command to command.

24 For details on this kindly Refer: Sudarshan Iyengar, "Issues in Agricultural Development in a Tribal Area - A Study of Panchmahals District," in SSRD Conference Papers, Tribal Area Development (Mimeo) Society for Studies in Regional Disparities, New Delhi, October,1981.

2. Invariably the farmers have tendency to wait longer before registering demand for in Kharif. The department cannot plan out its supply because of this.
3. Chemical fertilizers, pesticides and other necessary inputs are sparsely used.

In the context of the above framework, the viability of a tank can rightly be questioned. We have already seen that even with crude calculations (departmental B:C Ratios, Table 4.3) about 30 per cent of the tanks are not viable. From among the viable ones, the highest B:C Ratio is 2.5:1 which means that the project can generate two and half times of benefit for everry unit of cost. We have by now seen that there are serious gaps in estimating the costs and benefits. The benefits are generally overestimated and costs are under-estimated. A reestimate of the ratioes may explain where the viability stands.

Economic Viability - An Attempt to reestimate: suppose the departmental B:C Ratio for a hypothetical minor irrigation class I tank is 1:1. And we also suppose that benefits and costs can be reduced on annual basis after incorporating every reduction and rise in benefits and costs which we have discussed. The Revised costs and benefits will be as follows :

Revised Costs : The addition to the project cost over and above the cost accounted for by the project authorities would be :

1. Imputed value of land submerged net of compensation paid for private land acquisition. Technically maximum allowable area under submergence is 25% of the total gross command area. In case of Panchmahals district all tanks do not have submergence equivalent to 25% of command. Our population of 56 tanks has an average cost of Rs.5.25 lakhs and has an average command area of 244 hectares. If we take 10% of this as equivalent of the area submerged, the average submerged area is 24.4 hectares. 10% is generally the lower limit for small tanks. If we take 25% of the command to be equivalent of the submerged area (the maximum allowable limit), the area submerged will be 61 hectares. Assuming no private acquisition the social price of 24.4 and 61 hectares of land will give us the lower and upper limit of the cost to be added to the project cost. Assuming market price of Rs.2000 per hectare (Prevailing at the time of study) and half of it as the social price the lower and upper limit of the cost would be Rs. 24,400 and Rs.61,000. These would be 5% and 12% of the average cost of the project which is Rs.5.25 lakhs. We take the average of the two and assume that additional cost to be added is 7.5% of the project cost. Therefore, the revised project cost would now be 1.075 instead of 1.

2. Cost of Delays.

We have seen how delays add to cost. There is an average 2 years delay*. We also take that 80% of the capital is

* For the tanks for which the correspondence files were available difference between proposed date of commissioning and actual date was obtained.

invested (since the delay is only in laying canals). If the social rate of return is 10% (departmental assumption), the earnings lost would be 0.1806 on the capital already invested.* The revised cost of the project will further move up to 1.2556.

3. Operation and Maintenance Cost. We have already stated that this cost is underestimated. On prorata basis Rs.10 per acre is a low cost compared to the work involved. Assuming Rs.10 per acre gives us 1.2% of the average project cost of Rs.5.25 lakhs and with an average command of 244 hectares (610 acres). If we add the average water charge per acre (based on our argument earlier), the average operation and maintenance cost will be around Rs.30 per acre (Rs.20 will be the water charge). This would then become 3.5% of the average project cost. Being conservative we may take 20% as net addition to the cost due to operation and maintenance. The revised project cost will be 1.0965.

The total project cost can now be expressed in terms of increased costs due to evaluation of submergence (1.075) plus increased operation and maintenance cost (0.0215) plus the cost of delays (0.1806). The revised total cost will be 1.2771, say 1.30 . We have kept the depreciation as it is in the present analysis. If we recalculate the depreciation, the total cost of the project would be reduced to some extent.

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* If the project cost is 1.075 then the lost earnings will be :

$$1.075 \times 0.8 \times 0.21 = 0.1806$$

Revised Benefits :

The benefit which is taken as 1 to start with will get reduced in the following way :

(a) If we continue to hold that department has the practice of arriving at potential command without considering the storage, the effective command area will be reduced by 29% (Chapter III gaps in formulation). To be on conservative side we assume that fall in effective command area is 20%.

(b) The subsequent and direct reduction in command will be due to non-existence of field channels. Assuming that Dr. Kumar's estimates are representative estimates the reduction in command will be 13 per cent.[25]

(c) Since the storage is dependent on the 'dependable rainfall' (Chapter 3 - Conceptual issues) and since every third year is a drought year (actual rainfall being less than dependable rainfall) the actual acreage under command will shrink. Further in normal year there will be less demand in Kharif and the actual demand by the end of Rabi will not be equal to the difference in Kharif potential and actual plus the Rabi potential because there will be evaporation losses between Kharif and Rabi. It is difficult to have exact estimates with all these features. We assume that the average annual loss in command area will be around 25% of the potential command (Utilization Statistics hints at this).

25 P.Kumar, op.cit., p.37.

(d) For all other factors such as time taken in developing command area, in efficient water supply, seapage, water logging, lag in farmers response, over flooding, waste the average annual loss in command area may be assumed to be 5% of the potential command. The total reduction in actual command are will be :

Potential Command area (Based on storage) less loss in area due to non-existence of field channels,
Less Rainfall irregularities and subsequent change in supply and demand,
Less other contingencies.

If the benefit is taken as 1 and if it is assumed that there is 1 to 1 correspondence between area irrigated and benefits derived then actual benefits will be :

$$0.8 - (0.104 + 0.20 + 0.04) = 0.456.$$

The revised Benefit: Cost ratio will be : $\frac{0.456}{1.30}$

$$= 0.35$$

Now if we assume the B:C ratio of 2.5:1 the revised B:C ratio will be $\frac{1.14}{1.30} = 0.87$.

This is only an indication towards the fact that tank irrigation is not a desirable proposition from the view point of society. We have not as yet accounted for the actual cropping pattern, the technical faults that crop up which reduce the flow of benefits substantially.

One cannot categorically state that any tank proposition is the district is economically non-viable but with the given facts one can difinitely say that tank irrigation in general would not fetch the society enough returns to compensate the costs.

We once again bring the social goals into picture. If the society has a priority for creating employment during off season in agriculture and if by creating a tank, the society intends to create a drinking water facility and facility of water for domestic use etc. It may very well do it by constructing a simple tank without head-works and canals. An irrigation tank becomes all brick and mortar and less of labour employment once the head works are planned. It is basically this marginal cost* on material structures which fail to generate enough returns.

Is Management the only problem?

Of late the irrigation administration is becoming management conscious due to expert intrventions of bodies such as the World Bank and others. This has led to a general belief that irrigation projects are not paying propositions just because the management is inefficient. With lined canals, field channel net work and drainage, the project performance would improve substantially. There is some truth in this. But we have seen that there are facts which are much more relevant for the non-

* This does not include the cost to the society by way of developing the command area, broadening the extension network etc.

-viability. The management aspect is only at margin. To quote Dr. Dhwaan (while arguing a case for Tubewell irrigation), "In fact, one can argue that deep tubewell irrigation is inherently more reliable than surface irrigation backed by storage reservoirs which too are vulnerable to drought in their catchment areas, the vulnerability varying with the severity of the drought and the reliability with which the storage is planned to cope with bad years".[26]

The arguments will be incomplete if we do not analyse the actual irrigation that has taken place with our population of 56 class I tanks in the district. We shall examine this aspect in the next section.

4.5 Viability Ex-Post :

We do not intend to recalculate the benefit-cost ratio for all the tanks in this section. We shall be highlighting the actual utilization which has already been analysed in Chapter III, section 3.5.

Of 56 Class I irrigation tanks, only 28 are completely operational. The other half may or may not become operational. All the tanks however are adding to their age and are moving towards end. As we have seen that the tanks built in 70s have relatively more and serious problems. The investment in most of 28 non-operational tanks is thus sunk. If tanks in general have

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26 B.D.Dhawan, Development of Tubewell Irrigation in India, Agricole Publishing Academy, New Delhi, 1982, p.7.

to become economically viable, the operational tanks should show a B:C ratio of 10:1. This is physically impossible. The best utilised tank, viz., Vardhari tank in Lunawada taluka (LUK3) with a command of 2000 acres has an average utilization of 68 per cent during last 10 years. Another big tank in Zalod taluka ZT22 has an average utilization of 53 per cent. (Table 3.8, Chapter III). These two big size tanks help improving the overall average performance of 28 operational tanks. The overall average utilization for last 10 years is 40.11 per cent of the total potential. The two big size tanks, whose potential command area is 23 per cent of the total command, irrigate 35 per centof the total actual command that got irrigated on an average every year.

With 40.11 per cent average annual utilization of the command hardly any tank would prove to be economically viable even by departmental calculations. The utilization pattern holds some clue to our doubts which we have raised regarding the flow of benefits. Table 3.6 contains information for last 10 years by tank (In some tanks the available information is not for 10 years and some tanks are new). 1974-75 which was the worst drought with an average rainfall of 15.15 inches over the district, shows that actual storage in the tanks came down substantially. As a matter of fact some of the tanks did not receive any storage (Tank GK1, GT3, GK2, ZT22, ZT23, LuT4, LuT6, etc.) There have been other years where the storage has gone down considerably. The constant benefit with full utilization is therefore ruled out on factual basis.

. Would efficient management change the situation in favour? One may express serious doubts about this. The 0 to 500 acres tank size group shows an average actual irrigated command is 33.3 per cent using 65.91 per cent of the actual storage. The next size group of 501 to 1000 shows that 47.92 per cent of potential command was on an average irrigated annually using 74 per cent of the actual storage. The 1001 and above size group of tanks irrigated 79 per cent of the potential command annually using 88 per cent of the actual storage. Without field channels and lined canals wastage of water is bound to take place. With field channels and lining of Canals the cost of the project will go up substantially. One will have to calculate the B:C ratio for this marginal investment. Dr. Kumar's estimates on this are from the view point of farmers. He assumes that technical assistance is freely available to the farmer.[26] This is however, cost to the society. It is doubtful whether the social cost of providing lining and field channels at this stage, will be so low against the social benefits so as to ccompensate for the losses made earlier.

Since the utilization suggests intensive use of water, we should also examine the cropping pattern. Is it that farmers in the command area have taken up more remunerative cropping pattern which is water intensive and high yielding? If so, then one may argue that the value of benefits really accrued may be higher than the values anticipated on ex-ante basis.

26 P.Kumar, op.cit., p.13.

Table 3.10 (Chapter III) gives abstract, data on the crops for which water was demanded and supplied. Examining the lead tanks LuK3 and ZT22, we find that these two tanks are representatives of their respective areas which differ in characteristics. LuK3 represents non-tribal area with farmers modernising and ZT22 of Zalod represent a tribal area where farmers are still relatively traditional. In Lunawada taluka and specially in Vardhari Command (LuK3), cultivators demanded water for Paddy alone in Kharif. In 1976-77 2.3% of the area irrigated by tank grew cotton. In Rabi wheat was grown in 80 to 90% of the actually irrigated area. In the command of ZT22, Kharif registered no demand from 1974-75 to 1977-78. In 1978-79 about 28 acres were irrigated in Kharif which grew paddy. In Rabi atmost 100 percent area irrigated grew wheat, gram and a joint crop of wheat--gram. This explains the general trend in cropping pattern.

The abstract of 30 tanks given in Table 3.10 does list a large number of crops in all the three seasons. The major crops, however, are Paddy, Maize, Wheat, Gram, Wheat/gram, Cotton and Tobacco. The share of Cotton, Tobacco and other cash crops are very insignificant. The actual irrigation mainly goes for food crops. Food crops are not high duty crops. Except Paddy rest of the crops require light watering. The intensive water use therefore, is not explained by cropping pattern.

The prices of food crops are in no way very attractive. In fact Maize, Gram and Paddy are staple diet items of the area.

The marketable surplus is the ought to be relatively low for these crops. The relative prices for this crop do not have any advantage. The entire agriculture is still on the whole traditional. The very fact that some farmers have tried to irrigated crops like cotton and tobacco, shows that they want to go in favour of them but there must be some factors impeding that. One may be assured water supply.

With this kind of utilization and cropping pattern, we cannot comment on the values of the benefits that have actually accrued. We may only say that the trends in utilization are not very encouraging and strengthen our case which argues that in general viability of a tank is doubtful.

Before we close the discussion on the viability issue we shall discuss briefly the issues of illegal irrigation and distribution aspects.

It is sometimes believed that underutilization of flow irrigation is explained to some extent by the illegal use of water. Illegal use of water refers to the use of water by breaching canal or the branches or irrigating field without registering a demand for it. Those who are caught are fined and charged by the department. Rest of them get away. Whether they are caught or not, some would argue that society as a whole would benefit since the production will increase (ethics apart).We agree that it is utilization. But in Panchmahals such cases seem to be rare.

The departmental figures for illegal irrigation (those brought to books) constitute hardly 1% of the actual area irrigated.* We may say that another 5% of the area was illegally irrigated which did not get reported. This in total is not a very significant utilization. In case of Panchmahals the theft of water would not explain the underutilization.

The other issue of distribution has two dimensions. While discussing the conceptual issues we have already stated that inequality in water distribution at head, middle and tail end does exist and it grows in a bad year. This can be corrected with better management. The performance of tank that distributes water efficiently to head, middle and tail ends is definitely superior qualitatively to the one which supplies with a bias to head.

The other dimension is the users status. If there are more small and marginal farmers in the command area then the resource allocation with a bias will lead to better income distribution reducing the income inequalities. This is taking the logic too far. We have seen that district as a whole gets special allocations on the basis of its backwardness. This does ensure reduction in regional disparities provided the special allocations generate better returns. The personal income distribution will

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* Computed from the Utilization Abstract MI Division, Godhra.

depend upon the type of projects that are selected. Irrigation projects do not necessarily guarantee a reduction in personal income inequalities. The fundamental technical factor determining the trend of income generation in command area is the canal alignment. This factor is of immense significance but hardly given more than technical attention. It is generally assumed that for the benefits from the project the technically best aligned canal holds the key. Technically best aligned canal does not necessarily mean that small and marginal farmers will get the benefit. It is likely that two alignments are technically feasible one benefiting small and marginal farmers the other benefiting large farmers. It is further likely that the alignment benefitting the large farmers costs significantly less than the alignment benefitting small and marginal farmers. Society may favour the costlier alignment. However, one must be cautious that the B:C ratio from either alignment is atleast 1:1. The choice cannot be between a non-viable and a viable proposition. The effective choice has to be between a project having higher B:C ratio (with minimum B:C ratio of 1:1) and a project having lower B:C ratio (not less than 1). The distribution considerations can enter only after the basic economic viability is achieved.

We may say, therefore, that these issues do not disturb our original argument. The tank irrigation in general may turn out to be a non-viable proposition from the view point of society.

By promoting tank irrigation in districts like Panchmahals society may achieve its social goals partially and that too after paying an immense cost. Is it not desirable that one should look at the alternative investment opportunities? Our next attention is towards the possible alternative opportunities.

APPENDIX - I

The net benefit from the project on annual basis will be :

$$B = \sum_{t=1}^{n} \frac{(R-M)}{(1+r)^t}$$

where -

R = Gross benefit, r = constant rate of discount and

M = annual operation and maintenance cost.

$$B = \frac{(R-M)}{1+r} \left[\frac{1-\left(\frac{1}{1+r}\right)^n}{1-\frac{(1)}{(1+r)}} \right]$$

$$= \frac{(R-M)}{r} \left[\frac{(1+r)^n - 1}{(1+r)^n} \right]$$

Now, the present discounted value of all the net benefits should be compared with the costs (say C). i.e.,

$$B \longleftrightarrow C$$

$$\therefore \quad \frac{(R-M)}{r} \left[\frac{(1+r)^n - 1}{(1+r)^n} \right] \longleftrightarrow C$$

$$(R-M) \longleftrightarrow r\ c \left[\frac{(1-r)^n}{(1+r)^n - 1} \right]$$

$$(R-M) \longleftrightarrow r\ c \left[1 + \frac{1}{(1+r)^n - 1} \right]$$

$$(R-M) \longleftrightarrow r\ c + \frac{r\ c}{(1+r)^n - 1}$$

This puts everything on annual basis. R and M are respectively the gross benefit and operational and management coston annual basis. r c represents the annual interest on the total capital cost of the project. We have to interprete only the expression $\frac{rc}{(1+r)^{n}-1}$ let us say;

$$\frac{rc}{(1+r)^{n}-1} = D$$

$$C = \frac{D}{r}\left[(1+r)^{n}-1\right]$$

$$C = \frac{D(1+r)^{n}}{r}\left[1-\frac{1}{(1+r)^{n}}\right]$$

$$C = D(1+r)^{n-1}\left[\frac{1-(\frac{1}{1+r})^{n}}{1-\frac{1}{1+r}}\right]$$

$$C = D(1+r)^{n-1}\sum_{t=o}^{n-1}\frac{1}{(1+r)^{t}}$$

$$C = \sum_{t=o}^{n-1} D(1+r)^{t}$$

This implies that D is the amount we have to put aside every year in order to obtain the exact C after n years with the rateof return 'r'. Thus the amount D which equals the operation $\frac{rC}{(1+r)^{n}-1}$ can be interpreted as some kind of depreciation allowance. The annual depreciation or replacement amount, therefore, can alternatively express as some rate at which capital should be charged. Thus, let D = iC i here has same dimension as r but denotes rate of replacement allowance. We know that ;

$$D = \frac{rC}{(1+r)^{n} - 1}$$

$$\therefore \quad iC = \frac{rC}{(1+r)^{n} - 1}$$

$$\therefore \quad i = \frac{r}{(1+r)^{n} - 1}$$

The rate of replacement will thus depend upon the life of the project (n) and the rate of interest at which capital is discounted (r). The actual depreciation may be worked out with the help of standard table with values relating to rate of discount and project life.