THE DOMINANCE OF THE INTERNAL RATE OF RETURN AS A PLANNING CRITERION AND THE TREATMENT OF O&M COSTS IN FEASIBILITY STUDIES

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1. INTRODUCTION

In 1986 I completed a study for the Overseas Development Administration. It reviewed the socio-economic and institutional problems reported in 50 recent evaluations of irrigation projects in developing countries, funded by various agencies. The objective was to make recommendations for improving the study of these matters during the preparation and planning phases. In five cases the original feasibility or appraisal documents were also examined. Staff of consultancy firms and of the FAO Investment Centre were consulted on the difficulties in taking proper account of socio-economic and institutional factors in scheme design, in these and other cases. During the study the current importance attached to a high Economic Internal Rate of Return (EIRR) as a deciding factor for project funding emerged as in practice a constraint on institutional and technical design, on the phasing of implementation, and on the lack of adequate consideration given to either farmer incomes or to the income and expenditure of the project authority or other operating organisation (Tiffen, 1986). The study is now being prepared for publication and we will notify members when it is ready.

It is not suggested in this study that economic criteria should be ignored, but rather, that there should be a different stress to that created by the EIRR. It is assumed that farmers should normally meet at least O&M costs, and where possible, a proportion of capital costs. If it is not possible for them to achieve a reasonable income after meeting O&M costs, this should be clearly stated in the feasibility study, so that a government can take a reasoned decision on whether it wants to subsidise both capital and O&M costs because of social conditions in the

area, and if so, whether the cost of the subsidy can be met from alternative sources of government revenue. It is argued that it is necessary not only to look at benefits to the national economy as a whole, but also to the costs and benefits created for the project beneficiaries and for the project administration.

2. DEFECTS OF THE INTERNAL RATE OF RETURN AS A DECISIVE PLANNING CRITERION

The EIRR is attractive as a summary indicator of a project's worth, giving a single figure which subsumes many factors, which can then be compared with unlike alternatives, and which appears easy to understand in its comparability to the interest received on capital. It is probably for these reasons it has acquired its dominating importance as a test of project acceptability and the suitability of the project's concept and components.

The major drawbacks against over-dependence on the EIRR in the selection of projects are the following:

a. The bias against durability, and the assumption that capital is the scarce factor

Since costs and benefits occurring in the more distant future are discounted highly, little account is taken of project sustainability after the first 10-15 years of the project's life. For example, there may be little difference in the EIRR of a rehabilitation project which is thereafter maintained, and one which is not maintained, and which disappears after 15 years (World Bank Tenth, 1985). Yet for a farmer, and also for the nation, it is important in practice that the scheme is maintained and endures for 50 or more years. Choosing projects on the basis of a high EIRR introduces a bias against those with a high initial capital cost even if they have low maintenance costs, because it assumes initial capital is the scarce factor.

b. Bias against slow start up

The EIRR often causes excessive stress to be placed on rapid implementation to secure early realization of full benefits, and indeed

this is stressed in the World Bank guidelines. On the Rahad scheme, the choice between use of pumps and the alternative of a longer gravity canal was based on the greater speed of implementation possible with the former. On the Rahad, charges to farmers do not meet operating costs, including pumping, whereas they do on all the large gravity schemes in Sudan (FAO Investment Centre, 1986).

Correctly used, the EIRR should not bias against projects in which parts of both costs and benefits are delayed, as demonstrated by a discussion in FAO 1986, Annex 2. However, in practice "if two projects, one with a lengthy and the other with a short take-off period, are to have the same internal rate of return then the long-term advantages of the first must be far higher than those of the second" (Bergmann and Boussard, 1976, p. 73). The bias against projects which are implemented in phases also derives from its inconvenience for the financial time horizons of the lending agency.

In real life it may be a distinct advantage to plan for phased implementation since this allows for the build up of experience amongst both farmers and scheme O&M staff, making it more likely that expansion or intensification of the original scheme will be handled efficiently. This was what happened, accidentally, in the case of Muda, Malaysia. The first phase provided field-to-field irrigation for two rice crops per year. A later phase provided for an improved water delivery system for diversified cropping. By the time the second phase was implemented farm incomes were much higher than previously; farmers were more capable of on-farm investment; higher O&M charges could be met if desired (the Government intentionally subsidised paddy farmers), and institutions and personnel were well established and capable of meeting more challenging O&M requirements.

c. Under-emphasis on risk of different outcomes

The comprehensiveness of the sole figure for the EIRR gives a false picture of the very real danger of different outcomes. Theoretically, this is met by sensitivity analysis. However, it is often difficult to predict either the crucial factors which may change or the extent of change. In any case, sensitivity analysis comes at the end of the

preparation period, and the results are seldom allowed to cause a fundamental reassessment of the scheme's components.

d. Bias against flexibility

It may happen that some of the solutions which are slightly sub-optimal from the point of view of maximization of the expected benefits, will have a much narrower range of possible outcomes, because of their increased flexibility, and will thus be safer (OECD 1985, pp. 57-59). This is important since one can safely predict that the outcome of an irrigation project will not be as predicted.

e. Ease with which cost-benefit analysis can be manipulated

All practitioners know how manipulation of key variables will increase the EIRR to the desired figure, and the abuse has been commented on in the literature (Carruthers 1985). Because of this manipulation, and genuine difficulties in predicting the outcome, the EIRR is in practice a very unreliable estimate. Fig 1 shows the difference between the EIRR as predicted at appraisal compared with that calculated at project completion, in the 37 cases out of the 50 where both figures were available. Table 1 shows the calculation made some years after completion, in the three cases where it was available. The completion figure is based on real costs, but on an estimate of the trend of future benefits. The latter may not materialise if maintenance is not carried out, or if farmers lose interest because of insufficient incentive.

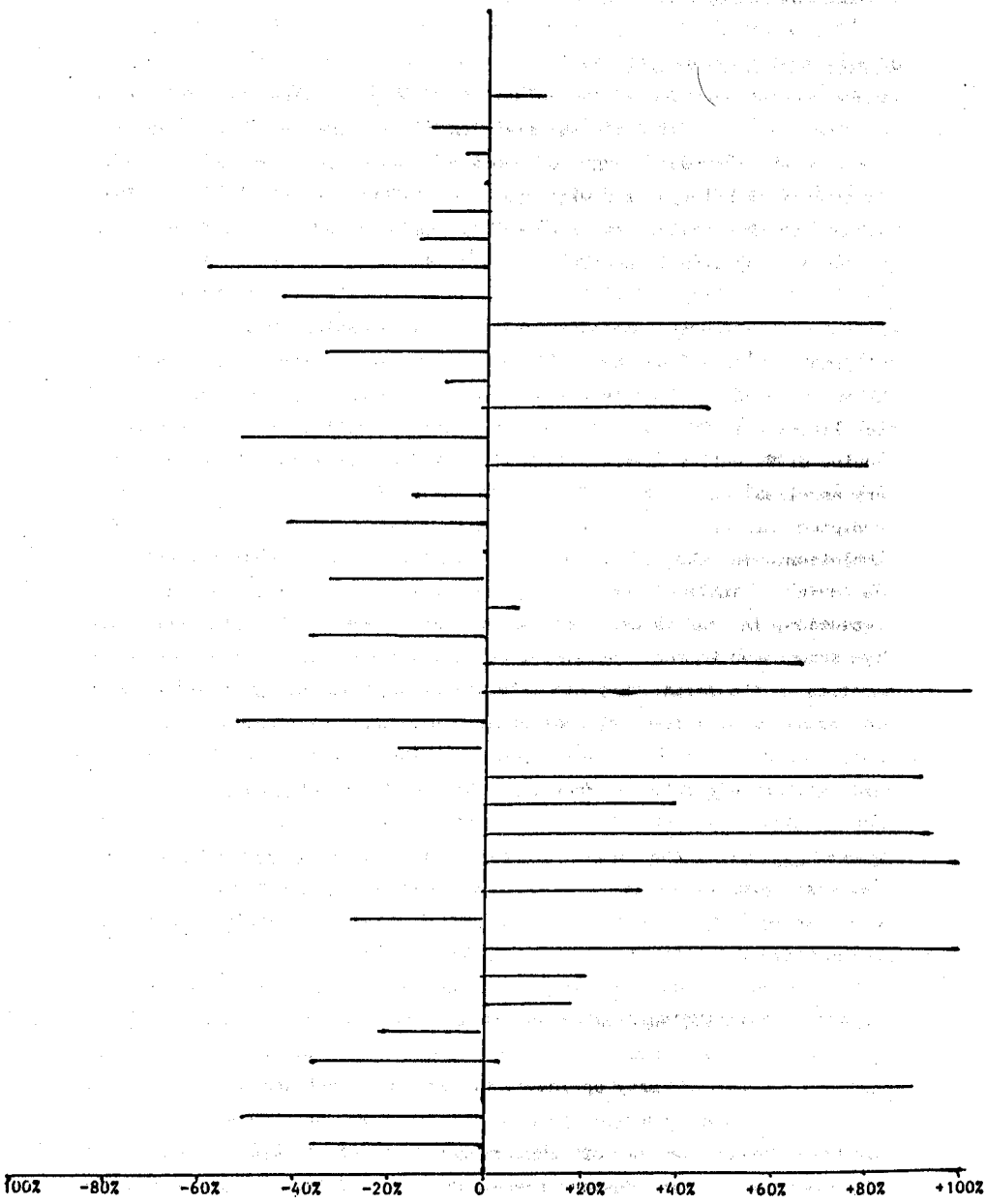
Table 1: Economic Internal Rate of Return at Three Points of Time

Scheme	Appraisal	Completion	Later Impact Evaluation
Gambia Agric Devt	30	22	negative
Lake Alaotra	11	22	negative
Mexico Third	11	21	17

3. FACTORS INFLUENCING PROJECT SUSTAINABILITY

The poor outcome of many agricultural projects, particularly irrigation ones, has been a source of concern for sometime, and the World Bank, in its Tenth Annual Review of the results of its project audits, has suggested that during design there should be much greater concern for

Figure 1: IRR estimated at PPAR as a percentage of IRR estimated at Appraisal



sustainability (World Bank Tenth, 1985). There has also been concern with the increased burden of recurrent costs on government budgets, and a number of writers have noted the need to give this issue greater attention during design appraisal (Carruthers 1985, Heller and Aghevli 1985). It has been suggested that one method of doing this would be to attach a higher shadow price to expenditures which make demands on limited government revenue when calculating the EIRR (Finney, 1984). While this method might have some attraction to governments which fund irrigation O&M costs out of general rather than specific revenue, there would still be the difficulty of deciding the correct shadow price (Heller and Aghevli 1985) and it would still be open to manipulation. It therefore seems doubtful if this suggestion is sufficiently radical. The EIRR has only been used as the dominating criterion for the choice of projects since the early 1970s. If it is an unreliable indicator of the outcome of projects, do we need to consider alternatives or complements to it, and can we decide if there are more important economic issues likely to affect a project's success?

The analysis of the socio-economic and institutional problems reported in 50 recent irrigation projects is shown in Table 2. While this shows the frequency of certain problems, it does not indicate their importance for the success or failure of the scheme. In general, it was found that problems in Group 1 were most likely to jeopardise a good outcome since they resulted in a lack of interest by the intended beneficiaries. The most important defects were found to be related to the prices and availability of inputs and outputs, which together affected the income a farmer could achieve from the scheme as compared with alternative activities that might be open to him. Thus, one conclusion of the study was that farm incomes were of central importance in deciding whether the constructed facilities would be fully exploited. In Group 3 it will be seen that cost recovery (I) was mentioned as a problem in a third of the cases. Problems connected with the provision of resources for O&M were reported under J and were frequently an underlying factor in the difficulties in securing that farmer organisations carried out the tasks expected of them, (H), which often included some maintenance activities.

There is an obvious linkage between farm incomes and farmer payments for O&M, particularly in low income countries where there is a danger that if

Table 2 Percentage of evaluations noting particular problems, by region

Group	Local Economics				Socio-Political				Institutional/Planning					Implementation		Unpredictable
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Asia	23	40	20	23	23	30	10	70	33	40	54	27	30	17	13	17
N Africa and Middle East	17	33	17	17	67	0	0	17	50	33	50	83	17	33	0	17
Sub Saharan Africa	48	83	17	50	58	33	50	25	33	50	33	58	33	16	8	33
Latin America	0	100	40	0	40	0	40	0	20	0	80	0	40	0	0	0
Total	25	49	21	26	38	26	23	43	34	38	49	34	30	17	9	19

Key on pages 11 and 12

Key to Table 2

Socio-economic and institutional problem areas in irrigation schemes.

Group 1: The Local Economy and Farm Level Economics

A. Existing, non-project activities of intended beneficiaries

B. Agricultural marketing factors (prices and price policy; risk in purchasing inputs or main staple food; crop patterns at variance with market requirements; availability or quality of inputs including repair services and credit; poor communications infrastructure).

C. Natural resource use and conflicts (ground-water management conflicts; water-use outside project area; conflicting hydro electric power requirements; conflict with livestock owners over land use)

D. Labour (peak labour shortages, appropriate farm size, employment effects)

Group 2: Social and Political Factors

E. Land tenure, consolidation, compensation, resettlement.

F. Equity issues (income, power and wealth distribution and conflicts; disadvantages for women)

G. Conflicts between state and farmer aims and other political constraints (excepting price policy issues considered in B)

H. Farmer organisations, conflicts between farmers affecting institutional arrangements, conflicts between farmers and farmer groups and other local institutions (eg local governments etc)

Group 3: Institutions, organisation and management, resources for operation and maintenance

I. Cost recovery, water charges

J. Allocation of responsibility and provision of resources for maintenance and on farm development; efficiency and equity of water delivery service

K. Project concept and development assumptions; suitable technology, faulty planning mechanisms (eg. inadequate preparatory studies, unrealistic timetable)

L. Staff: incentives, quality, quantity

M. Relationships of main and other national agencies involved in project

Group 4: Implementational problems not deriving from feasibility study

N. Procurement and contract mechanisms

O. Lending agency role and supervision; lending agency and national government conflict; consultancy and government department conflicts.

Group 5: General

P. Unpredictable external events (unexpected inflation, extraordinary drought, civil conflicts, etc)

farmers pay the full costs of irrigation, they may be left with unacceptably low incomes (Carruthers and Clark 1981, Sagardoy et al, 1982). In this case, the risk is that any structures built will not be fully utilised. However, in such countries, it is also likely that general government revenues are low. The challenge, therefore, is to design appropriate structures for an area that will yield adequate incomes to farmers, including the payments they make for running costs. Whether they should also pay a proportion of the capital cost is an issue the government should decide in advance of the feasibility study, as this will affect the design.

4. TREATMENT OF RECURRENT COSTS AND FARM INCOMES IN FEASIBILITY STUDY GUIDELINES

When one examines the guidelines for the preparation of irrigation feasibility studies issued by various agencies one is struck by the different importance given to financial viability at farm and project level by those drawn up mainly on the basis of developed country experience and those drawn up for use mainly in developing countries receiving loans from aid agencies.

This is not to say that the World Bank has been unconcerned with farmer payments for water. On the contrary, particularly in the 1960s and early 1970s, the Bank was most insistent as a condition of loan that there should be a water charge to recover costs. However, this was more because such changes were felt to be indicative of good economic management and national ability to repay the loan, than because of specific concern with revenues for maintenance. The Bank was not necessarily concerned to see that water payments went to the project authority, or were ear-marked in any way.

The Bank-approved Guidelines for Irrigation and Drainage Projects were first published in 1970 and reissued in substantially revised form in 1983 (FAO Investment Centre 1983). Revised guidelines for Agricultural Investment Projects were published in 1985 (FAO Investment Centre 1985). Both recommended substantially the same 10 or 11 chapters, in slightly different order. In the Irrigation one, a description of the Project

Area precedes the central chapters V. Project Design Considerations and VI. The Project. However, it is not shown how consideration of the local economy and institutions should influence design, and no mention is made of O&M costs as a design factor, although they are required to be estimated in the chapter on The Project. The main design consideration amplified in the guidelines is concerned with water supply and technical factors. In Chapter IX, Markets, Prices and Financial Results, one main concern is to show that the extra production can be marketed. It is also required to be demonstrated that the project gives attractive incomes to the farmers, although low objectives are set for this - the projected net cash income should not be lower in any year than it was before the project. It is noted that "incremental cash income may be less than the incremental value of production" and that this should be taken into account in estimating repayment capacity, and in the design of the project. This is not amplified. An examination of the government's cost recovery policy is required, and "Note should be made of the extent to which recoveries meet operating and maintenance costs".

It is noticeable that Chapter X, Benefits and Environmental Impact, contains some implied criticism of the Internal Rate of Return, because it may not include all social benefits of the project. This is not a valid criticism since all social benefits will depend on increased agricultural production and sustained O&M, so they must be regarded as secondary objectives. The EIRR is not faulted for leading to under-valuation of the importance of financial viability at farm and project level, or because it is difficult to estimate accurately in the real world of changing conditions. It is clear that the EIRR is still regarded as the main justification of the project, and that much of the earlier financial analyses are required simply to provide data for its calculation.

The Guidelines for the Preparation of Agricultural Investment Projects are in several respects better than the Irrigation ones. Under Design Considerations, it lists more items that need justification, including appropriate scale, the range of components, choice of technology and farming systems, appropriate time frame and phasing, etc. The chapter on consideration of the Project area is given 8 pages instead of the 2 in the irrigation document, and shows greater realisation of the need to see

the project matches the locality in more than technical respects. The calculation of the cost of maintaining services at levels necessary to achieve project objectives is required, and it is noted "it may be desirable to comment on the government's capacity to meet the implied financial commitments". In the following chapter on Organisation and Management it is noted that "In some cases it may be necessary to consider reductions in project scope to conform with institutional capacities", indicating one way in which institutional considerations might affect project design. In the chapter on Markets, Prices and Financial Results, it is stated that it has first to be shown that the project will be sufficiently attractive financially to encourage the participation of the farmers, and secondly, that it is acceptable from the wider economic point of view. However, the same rather low objectives for farm incomes are set as in the Irrigation document. It does require careful attention to the impact on the Government budget. The final chapter on Benefits and Justification again concentrates on the EIRR.

In summary one could say of both these Guidelines that they deal with farm incomes and O&M costs, but do not give them central importance as factors to influence design. The revisions show some doubt about the EIRR, but retain it as the main test of project acceptability. Of the two, the Agricultural Project Guidelines go further in showing how local economic and institutional considerations might affect the scope and components of the project. However, both begin with the necessity to maximise benefits and minimise costs. As the recurrent cost element in costs will be discounted heavily in the EIRR calculation, recurrent costs are not shown as necessarily affecting decisions on the project's size, scope and components.

The emphasis on maximising production for national benefit and the lack of centrality for farming incomes and project O&M costs stands in marked contrast to older guidelines developed in the United States and Europe. The USBR manual of 1951 defines irrigable land as that which can:

> meet all production expenses, including irrigation operation and maintenance costs, and provide a reasonable return on the farm investment;

provide a reasonable repayment contribution toward the cost of project facilities;

provide a satisfactory standard of living for the farm family.

This summary is taken from Guidelines: Land Evaluation for Irrigated Agriculture (FAO Soils Bulletin 55, 1985) which basically endorses the USBR approach, and which suggests that at the reconnaissance study stage, one looks at potential yields, but that at the final stage of eliminating unsuitable marginal lands, the Net Incremental Irrigation Benefit be calculated, taking into account:

i. farm investment and operating costs, and returns ordinarily accruing from the agricultural use of land

ii. all project investment, operating and maintenance costs.

The Guide to the Economic Evaluation of Irrigation Projects (Bergmann and Boussard, 1976) was published in 1976 after testing in 14 irrigated areas, mainly in southern Europe. However, it was intended to be useful everywhere. The 5 chapter headings in the illustrative feasibility study indicate the greater importance given to farm profitability and O&M costs than in the World Bank model. The central chapter C, The Targets, covers the technical description of the project, the agricultural development envisaged with irrigation and the operating and maintenance costs. Chapter D is entirely devoted to profitability at farm level. The final chapter, E, looks at profitability from the standpoint of the national economy. The authors state it is essential to deal with private profitability before making the profitability calculation from the national standpoint. They suggest farmers will look for 2 or 3 times their present cash income if they are to be induced to make the necessary complementary investments and to utilise fully the water provided. In their discussions on national economic benefit, the main authors, Bergmann and Boussard, favour the use of the internal rate of return while noting it is difficult for long-term agricultural projects to show a higher rate than 16 - 17%. They include the calculation of the financial viability of the operating organisation where this is an independent legal entity, as it often is in Europe.

5. IMPLICATIONS FOR PROJECT DESIGN

Irrigation must offer farmers a substantial improvement over alternative and perhaps less demanding types of work. It also requires a constant flow of resources for operation and maintenance, without which schemes will decay. The financial outcome at farm level and the resource flows at project level must therefore be the two primary tests for project sustainability. This suggests a return to an older method of preparing irrigation projects, followed for example by the investors in the original Gezira scheme. Even in the case of the old government schemes in India in the nineteenth century there was generally a concern to see that the costs could be met out of expected increases in government land revenue.

There are many ways in which a greater concern from farm incomes and for resources for O&M would influence design. It might affect, for example, the size of the service area and the length of the main canal. It could affect the choice of technology according to local availability and skills for repair. On the institutional side it might indicate a greater role for farmer groups in maintenance, which normally has to be compensated for by giving them also a greater role in design choices and agricultural management at least at the tertiary level, and taking into account as far as possible existing tenure boundaries and social and administrative boundaries in designing block layout. It could affect the phasing of development, with provision for simple structures initially that could be up-graded as funds accumulated. It could indicate in certain circumstances that heavier and stronger gates are provided initially, rather than cheaper ones that need more frequent repair or replacement. It might indicate the advisability of accepting a higher than normal risk that the optimum water supply was unavailable for the second or third crop.

It is not suggested that the EIRR be totally abandoned. There are two ways of using financial and economic criteria: to try to optimise, and to see whether a test is passed. Currently, most projects have tried to optimise the EIRR, and them test at farm income level. It is suggested it would be better to optimise at farm income level (in practice, it is difficult to prevent farmers from doing this) and to test, firstly by

seeing there will be adequate resources for the amount of O&M that will be necessary to sustain the project and secondly, that the EIRR is 8% or better. Given the uncertainties attached to the calculation of EIRR anything less than 8% should be ruled out as within the margin of error that could include a negative outcome and a waste of national resources; given the same margin error it is not important if the EIRR is 16% or 24%.

REFERENCES

Bergmann, H and Boussard, J M. 1976. Guide to the Economic Evaluation of Irrigation Projects (revised version) OECD, Paris.

Carruthers, I D. 1985. 'Factors influencing agricultural recurrent budget problems in developing countries' in John Howell (ed) Recurrent Costs and Agricultural Development, ODI, London.

Carruthers, Ian and Clark, Colin. 1981. The Economics of Irrigation. Liverpool University Press, Liverpool.

FAO Investment Centre. 1986. 'Irrigation in Africa South of the Sahara', Technical Paper 5, Rome.

FAO. 1985. 'Guidelines for the preparation of agricultural investment projects: revised version' Investment Centre, FAO, Rome.

FAO. 1985. 'Guidelines: land evaluation for irrigated agriculture' FAO Soils Bulletin 55, Rome.

FAO. 1983. 'Guidelines for the preparation of irrigation and drainage projects: revised version' FAO Investment Centre, Rome.

Finney, C. 1984. 'Least-cost analysis and the O&M problem' Water Resources Development 2(1).

Heller, P S and Aghevli, J C. 1985. 'The recurrent cost problem: an international overview' in John Howell (ed) Recurrent Costs and Agricultural Development ODI, London.

OECD. 1985. Management of Water Projects: Decision Making and Investment Appraisal. OECD, Paris.

Sagardoy, J A et al. 1982. 'Organisation, Operation and Maintenance of Irrigation Schemes', FAO Irrigation and Drainage Paper 40, FAO, Rome.

Tiffen, M. 1986. 'Improving the Socio-Economic and Institutional Content of Irrigation Feasibility Studies', ODA, London.

World Bank. 1985. 'World Bank Tenth Annual Review of Project Performance Audit Results, 1984', World Bank, Washington.

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