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The Appraisal of Rural Water Supplies

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Summary. — *Rural water supplies in developing countries often fall rapidly into misuse* and disrepair through inadequate operation and maintenance. Clearly this problem would be reduced by selecting techniques that do not involve high recurrent costs. But simply to modify the appraisal methodology by not discounting costs would be both logically incorrect and practically inadequate. Technology choice is intimately connected to numerous other decisions and a more holistic approach is required. In practice, a high degree of uncertainty surrounds most projects and a pragmatic approach to project appraisal is required. A useful tool is here suggested for choosing between two alternative designs for which the likelihood of prospective benefits being realized differs (as is the case with rural water supplies).

1. INTRODUCTION

Numerous evaluation studies, especially in recent years, have shown that rural water supplies in developing countries very frequently fall into misuse and disrepair within only a few months of completion. In many cases the technology chosen is inappropriate given the capacity to operate and maintain the supplies. This is a very serious problem, and one to which increased attention is now being paid.

In a recent paper in *World Development*, this point was well made (Baldwin, 1983). But the remedy suggested was, unfortunately, not satisfactory. In this paper, I shall begin by pointing out the shortcomings of the method recommended by Baldwin, and shall then propose an alternative approach that would be more suitable, although still only a "second best" solution. Next, I shall suggest how aid donors might contribute to improving on this "second best" situation. Finally, I shall explore some wider applications of the methodology proposed.

The theme of Baldwin's paper, "Why Present Value Calculations Should Not be Used in Choosing Rural Water Supply Technology," is evident from its title. In summary, he "questions the validity of this methodology for investments that will generate recurrent costs whose provision cannot be assured by user charges and must therefore be covered from government budgets" (p. 1075). "It is wrong," he claims "to use a methodology that (a) puts such future costs at a discount and (b) which converts capital and recurrent costs into an abstract, undifferentiated concept of 'total resource costs' expressed in a single number, the Present Value (PV)" (p. 1075). Let me begin by explaining why I believe this argument to be faulty.

After quite rightly drawing attention to the problems caused by inappropriate choice of technology, and the difficulties of securing adequate funds for recurrent expenditure, Baldwin identifies the "defects of discounting." "In 'collapsing' all costs into a single figure (the Present Value)," he argues, "the distinction between capital and recurrent costs is removed and all costs over the life of the project are treated 'as if' they were capital costs. This does not seem a particularly useful thing to do if a primary basis for choice is to avoid high recurrent costs" (p. 1075).

A misunderstanding of the concept of discounting is apparent here. The fact that the capital and recurrent costs are collapsed into a *single* sum is not what matters. All costs could equally well be translated into an annual equivalent sum. But this would not imply that recurrent costs were more important. What is significant is that the two types of cost cease to be differentiated, not that they are treated "as if" they were capital costs.

Having developed his argument further, Baldwin suggests alternative aproaches. "One might argue that PV calculations could be made using, e.g., a 10% discount rate for capital costs and a 3% (or zero) discount rate for recurrent costs" (p. 1080).

But how could such a procedure be justified? Surely there is a confusion here between time-discounting and placing a premium on recurrent as opposed to capital costs? Whatever discount rate is used for recurrent costs the figure selected would have to be justified somehow (even zero is not in any sense neutral). A formulation more consistent with the argument would be to apply a rate of time discount on all costs, together with shadow rate for recurrent costs.

In fairness to Baldwin, I must add that he continues: "My strong preference is not to go this route but to carry out separate, undiscounted comparisons of recurrent and capital costs on the technological 'short list' and then to base decisions on qualitative discussions of whatever trade-offs may exist" (p. 1080). But this seems inadequate. The present value methodology is half abandoned while no rigorous alternative is provided.

There is some merit in Baldwin's suggestion that recurrent funds should, if anything, be regarded as more scarce than capital funds, but the implications of a shortage of recurrent funds are far more complex than his analysis suggests. For it is project benefits that are most seriously affected, and it is necessary to develop a methodology that looks at the benefit as well as the cost side.

Let us examine how two alternative technologies (a diesel pumped scheme and a piped gravity scheme) would compare if we take account of benefits as well as costs. For the capital and recurrent costs of the two alternatives I have assumed figures rather similar to those of Baldwin's Table 2. But in addition to these costs, I have added some further figures to elaborate my own argument (see Table 1). First, I assume project benefits, equal for each of the two alternatives. Clearly, I have no idea what they might be in practice, but what matters is that they are equal for the two technologies, and at least of the same order as project costs.

Secondly, I have added a variant, II', to the diesel pumped scheme. This is the same technology, but assumes that actual recurrent expenditure will be barely half of what is considered necessary. This affects both project costs and project benefits. Total project costs fall because actual recurrent expenditure is less than forecast. Total project benefits (I have assumed) fall even more markedly, because maintenance and operation are inadequate owing to lack of recurrent funds, and the supply rapidly deteriorates. (Alternative I is unaffected since the recurrent funds needed for this technology are much less.)

What do we find? If we discount all costs at a rate of 10% per year, and compare only alternatives I and II, then II is found to be cheaper. But if we discount at a rate of 0% then I (the piped gravity scheme) is found to be cheaper.

Baldwin would presumably argue that technology I, the gravity flow scheme, is the more appropriate choice, and that this is an argument against using the Present Value methodology. I would disagree. Certainly, alternative I is more appropriate, but the argument is not on the basis of costs as presented here. The problem with alternative II is that because the *required* recurrent expenditure is high (and higher than actual recurrent expenditure) the benefits are far less than they should be. It is in this respect that project costs matter — because of their effect on project benefits.

One could even argue that Baldwin's approach

Table 1. *Comparison of alternative rural water supply technologies (illustrative figures)*

	I Piped gravity flow scheme		II Diesel pumped scheme		II' Diesel pumped scheme (limited recurrent expenditure)	
Year	Costs	Benefits	Costs	Benefits	Costs	Benefits
1	12,000	—	6,000	—	6,000	—
2	250	1,800	1,100	1,800	400	1,800
3	250	1,800	1,100	1,800	400	1,000
4	250	1,800	1,100	1,800	400	500
5	250	1,800	1,100	1,800	400	500
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
10	250	1,800	1,100	1,800	400	500
Total (undiscounted)	14,250	16,200	15,900	16,200	9,600	6,300
Present value (discounted at 10% pa)	13,440	10,366	12,335	10,366	8,304	4,474

would yield a perverse result. For, on the basis of the figures given in Table 1, and comparing total present values of costs, we find that alternative II* appears the cheapest of all, at a discount rate of 10% per year or zero. Clearly, looking at costs alone is not enough. This is my major criticism of Baldwin's article. Despite agreeing with much that he says about rural water supplies, I cannot accept the approach he recommends for coping with these problems.

2. AN ALTERNATIVE APPROACH

In a recently completed manual on the appraisal of rural water supplies commissioned by the Overseas Development Administration (NcNeill, 1985) I have argued that the choice of design of rural water supplies in developing countries is a very complex matter involving a basic nine interconnected decisions e.g., choice of source, degree of community involvement, method of charging (if any). I suggest that what matters is not simply the prospective benefits (and costs) assuming that the supply is well operated, maintained and used. Equally, if not more important, is the likelihood of this situation coming about. In that manual, I argue that the design of a rural water supply may be viewed as the selection of a route through a "decision maze" involving nine related steps. The optimal design must take account of the influence of each of these nine decisions, and no single decision (such as choice of source) should be taken independently of the others. Among the other factors to be taken into account, problems of recurrent finance are of major significance. Indeed, maintenance and operation are probably the most important concerns. Minor tinkering with the established method of project appraisal is, however, not enough. The problem is more basic than this. But even if we do seek to resolve the problem by modifying the present value methodology, I suggest that there is a better way of doing it.

This alternative methodology becomes readily apparent when we look again at Table 1. We need to take account, in our appraisal, of likely benefits as well as costs. The purist would argue that we require a probability distribution indicating alternative recurrent expenditure streams, and their associated benefits, together with the probability of each alternative being realized.

Unfortunately, as practitioners are well aware, this is not possible. All is not lost, however, provided we are prepared to accept a rather rough-and-ready approach. Let us suppose that, as in the case under consideration, the two alternative technologies are relatively similar in terms of total cost. Then we can ignore cost and concentrate on benefits, or rather on the likelihood of benefits being realized (for we are assuming that potential benefits are the same under either technology). To be more specific, given two alternative designs that would, if all went well, yield the same benefits and that are (within reasonable margins) of similar cost, we should select the design for which the likelihood of potential benefits being realized is greater.

This, I suggest, is what practitioners often do, though perhaps not explicitly. For a design alternative to merit serious consideration it is likely that its total costs (capital and recurrent) will be of a similar order of magnitude to other alternatives under study. And experience with rural water supplies shows that by far the widest margin of error is between actual and forecast benefits, not between the total costs of alternative schemes, however these are compared. Thus, there is a good case for adopting this procedure, as opposed to the methodology that Baldwin proposes.

3. THE IMPLICATION FOR AID DONORS

The approach here proposed for dealing with projects in the rural water supply sector is based on the assumption that nothing can be done to improve the recurrent expenditure situation, and is therefore a second best solution to the problem. If it is the case that actual benefits are likely to be far less than potential benefits because of improper operation and maintenance of the supply, then this should be recognized and the appraisal methodology adapted accordingly, perhaps along the lines I have suggested.

In the short term, this is the best procedure. But aid donors should make strenuous efforts to remedy this unsatisfactory state of affairs. As Baldwin rightly points out: "It is often easier for poor countries to acquire the *initial* capital (through aid programmes or liberal financing terms) than to find the recurrent resources needed to keep a scheme in operation." Surely this situation should be rectified. One obvious proposal is for aid donors to finance recurrent expenditure. The Development Assistance Committee of the OECD has been recommending this for years, and some donors are moving in this direction.

But merely shifting funds from the capital to the recurrent budget may not be enough. Often the problem of maintenance and operation is not simply one of the lack of funds. There may be a shortage of skilled manpower, of difficulties in importing spare parts, or an overcentralized system for maintaining the supplies. Before an aid donor provides capital funds for new construction it should always assess the capacity of the sector to ensure that operation and maintenance of new supplies will be adequate, and that the supplies will be well used. If this is not the case, the donor should offer a different kind of aid. If the amounts being offered are small, it may even be better not to intervene at all. But, if possible, a sectoral approach should be adopted, leading to one or more programs, which might include, for example, training, assistance in water supply maintenance, and health education. It may indeed be appropriate to spend more on recurrent expenditure, and less on capital, but this decision should be based on an informed review of the sector as a whole.

4. WIDER IMPLICATIONS OF THE PROPOSED METHODOLOGY

The common-sense approach set out in Section 2 has radical implications for the textbook method of project appraisal, and the economic purist. Faced with two alternatives that seem finely balanced, many economists are inclined to seek more and more data to "prove" that one is in fact the better. My own, perhaps heretical, view is precisely the reverse. If you cannot discriminate readily between alternatives, it is a waste of *time to* try. This *near* truism *might* be raised to the status of a law, along the following lines:

> If, on the basis of cost-benefit analysis, the choice between two alternatives is found to be sensitive to the value of a certain variable, and if the probability distribution of values of this variable is judged to be such that the likelihood of each alternative proving better is approximately equal, then the decision should be based on other, non-quantifiable factors.

From this law, and the procedure proposed in Section 2, we may derive a technique for appraising projects somewhat akin to cost-effectiveness analysis, and which may be applied not only to the rural water supply sector. In the case of cost-effectiveness, the choice is between two alternatives that yield the same benefits but differ with respect to cost. In many situations, however, the choice is between two alternatives that yield the same benefits at roughly the same cost, but offer very different prospects of their benefits being realized. In such a situation, the preferred alternative is simply the one with the greater prospect of realizing its benefits.

This technique could be extended further to allow comparison between alternatives that differ markedly in terms of cost. This would involve "normalizing" the alternatives, i.e., varying their scale to bring their costs into equality. Clearly, however, the benefits would also then be affected, and the analysis would become more complex and liable to error.

A second, and perhaps more important, conclusion for methodology is that the emphasis in project appraisal should be shifted more towards sensitivity analysis. Margins of error in appraisal are often so wide that estimates of costs and, to an even greater extent, benefits, are little more than informed guesses. In such a situation, it is not particularly helpful to carry out detailed calculations based on the "most likely" forecasts, with their spurious appearance of accuracy. Rather, a range of alternative projects and project designs should be considered, each with a range of alternative forecast costs and benefits; and the major effort should be devoted to carrying out a sensitivity analysis to select the best project and the best design. If the same alternative emerges as best under a wide range of different assumptions, then this should clearly be selected. If, however, two alternatives are found to be well matched, then the choice between them should be made on cruder, pragmatic grounds, or even on the toss of a coin.

This article is not intended to present the case for abandoning project appraisal altogether, but I do believe that cost-benefit analysis has proven unworkable. What is required, therefore, is a set of rigorous but practical techniques, such as have been discussed here, which genuinely guide practitioners, instead of forcing them to ignore or deliberately distort the results of a supposedly scientific methodology in which they do not believe.

REFERENCES

Baldwin, G. B. "Why present value calculations should not be used in choosing rural water supply technology," *World Development*, Vol. 11, No. 12 (1983), pp. 1075–1081.

McNeill, D. J., *Manual for the Appraisal of Rural Water Supplies*. (London: HMSO, for the Overseas Development Administration, 1985).

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Reply

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I seem not to have communicated very effectively to Mr McNeill, and perhaps not to others, in my article questioning the usefulness of Present Value (PV) methodology in the appraisal of rural water supply (RWS) projects. My objective was to persuade engineers and economists that, for RWS projects, the use of this conventional technique for helping decide choice-of-technology questions obfuscates instead of illuminates the technology-choice issue and ought therefore to be abandoned.

The main reason for urging abandonment of PV analysis to help decide what technology to use was the central importance of performing and paying for the operating and maintenance tasks which are almost always the central problem in a system's ability to function — to deliver benefits. I pointed out that the question which PV methodology answers is not the one we ought to be asking when assessing rural water supply technology — or any other technology where the key question is "How can we ensure that the necessary operation and maintenance (O&M) tasks will get done, and how can we raise the money to pay for them?" PV methodology converts all project costs, capital and recurrent, into a single class of undifferentiated lifetime costs and shows which technology will have the lowest total cost in present-value (i.e. discounted) terms. That question, I argued — and still believe — is a red herring that we ought not to drag across the path of RWS appraisals. It tempts us to follow a false scent. I suggested other ways of approaching the problem, relying primarily on straightforward comparisons of (undiscounted) O&M costs under competing technologies, and judgmental assessment of the trade-offs between differing capital and recurrent costs and between technologies with differing lives.

Mr McNeill complains about the method I recommended (in Section 5 of my article) but nowhere does he summarize my method nor show that he has understood it. He misreads me by saying that I seem to be "half abandoning" PV methodology (not so: I suggested *total* abandonment) and then complains that "no rigorous alternative is provided." Mr McNeill then says we ought to pay more attention to the benefit side of water-supply technologies and should try to assign probabilities to the likelihood that different technologies would in fact deliver their intended benefits. Alas, he says, "this is not possible. All is not lost, however, provided we are prepared to accept a rather rough and ready approach." So much for a rigorous alternative.

Mr McNeill seems to want to play around with estimating the probabilities of benefit realization promised by different technologies — a theme he returns to in the very paragraph following the one in which he has explained that "this is not possible." One reason for wanting to do this, apparently, is his conviction that "For a design alternative to merit serious consideration it is likely that its total costs (capital and recurrent) will be of a similar order of magnitude to other alternatives under study." (Such an assertion does not square at all with my experience. And does Mr McNeill favor the use of discounting to arrive at his undifferentiated "total costs"?) Apparently Mr McNeill wants to assume that the (discounted?) costs of competing technologies are roughly equal and then to concentrate analysis on the differing probabilities of benefit delivery; this contrasts with my preference for taking *targeted* benefits as given and concentrating on differences in recurrent costs as the main factor underlying benefit probabilities. Perhaps McNeill and I would agree on this last statement — but would disagree on how to take it into account. (I am forced to use such conditional words as "seems," "apparently," and "perhaps" in characterizing McNeill's argument because I have some difficulty understanding just what it is he is saying. One hopes his recently published ODA *Manual* is less elliptical.)

Without using that language, I suggested we take account of "benefit probabilities" by focusing attention on the O&M problem and its funding when comparing RWS technologies and that this end would be served much better by using undiscounted recurrent cost comparisons than by using conventional PV analysis, which I regard as mischievous and misleading. My advice would be. "Having developed a 'short list' of candidate project designs, take the one with the lowest recurrent costs, since this implies the highest probability the system will be able to deliver its designed benefits." I am not sure what advice Mr McNeill is offering; perhaps it is to be found in the rather general statement that when "two alternatives are capable of yielding the same benefits, at roughly the same cost . . . [then] in such a situation the preferred alternative is simply the one which has the greater prospect of realising its benefits." He never mentions the recurrent cost problem as the key determinant of benefit realization.

In closing, let me make clear something I failed to state in my December 1983 article: the view I put forward was a personal one, not one officially approved by the World Bank. The Bank does not have a set of officially approved views that must govern staff when expressing their personal views; it requires only that individual views be identified as such. It is fair to note, however, that among World Bank staff who deal with RWS problems there has been far more agreement than disagreement with the views I have expressed.

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Rejoinder

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I am surprised at the combative tone of Mr. Baldwin's "reply" since it appears that we do not differ with regard to two of the three major points of concern. We agree that, in rural water supply projects, failure of operations and maintenance is often the most serious problem and that conventional cost–benefit analysis does not provide the answer. Where we differ is in how to resolve the difficulty. Since space does not allow me to deal with each point in detail, I will confine myself to two short comments.

On the theoretical side, I still feel he has missed the point. Costs which arise at different times are as unlike as apples and pears. A discount rate is an attempt to put them on a comparable basis; but one would have to justify whatever discount rate is selected — even zero. If it is the case that capital funds are less scarce than recurrent funds, then by all means place a premium on the latter. This has a similar effect to reducing the discount rate, but is not, strictly, the same thing.

On the practical side, Mr Baldwin's advice is "having developed a 'short list' of candidate project designs, take the one with the lowest recurrent costs, since this implies the highest probability the system will be able to deliver its designed benefits." We certainly agree that the most important objective is to maximize the likelihood of prospective benefits being realized; but I cannot accept that this is achieved simply by choosing the design with the lowest recurrent costs; too many other factors must also be taken into account.