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RAPPORTEUR'S REPORT

ON

BENEFIT-COST ANALYSIS OF AGRICULTURAL PROJECTS

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The broad outline on the subject indicated a very wide category of projects relating to agriculture which could be subjected to the methods of benefit-cost analysis. Besides analysis of specific projects, related methodological issues could also be examined.

In all 27 papers were received. Not unexpectedly, 15 of them relate to evaluation of benefits and costs of irrigation projects, mostly lift irrigation projects. However, other agricultural projects like rural electrification, cold storage, use of agricultural machinery are also examined in three papers. Two papers are devoted to benefit-cost of land development and soil conservation schemes. There is one paper on the benefit-cost of investment in certain long duration tree crops. Two papers examine the economics of the Small Farmers Development Agency and the I.A.D. Programme. And finally, there is one paper relating to the estimation of the contribution of agricultural research to agricultural production in India. There are two or three papers that are wholly or partly concerned with methodological issues relating to benefit-cost analysis. We shall summarise below the papers in the different sections.

Benefit-Cost of Irrigation

The largest number of papers related to irrigation, mostly tube-well irrigation. The papers take up specific irrigation projects for benefit-cost analysis. Such specific studies should normally prove of interest and use not only to scholars but also planners and administrators. However, the usefulness of many of the reported exercises is affected by the improper methods used in the analysis.

K. Sain and S. N. Kundu estimate the benefit-cost of shallow tube-wells in a district in West Bengal. In an otherwise carefully worked out exercise, they, however, fail to make one point clear, and use an erroneous formula to estimate present value of the stream of project costs. They study a few sample farms with tube-well irrigation for their purpose. But it is noted that only about half of the total irrigated area of these farms was under irrigation from the shallow tube-wells. It is, however, not made clear if the direct benefits arising out of irrigation estimated for these farms, relate only to the irrigation due to these shallow tube-wells, or related to the entire irrigated area. In case it is the latter, comparing the net benefits from all

sources of irrigation available to the sample farms with the project costs only for the shallow tube-wells would be improper. They use both the Benefit-Cost ratio as well as the Net Present Value method. In estimating the net present worth of the project, they discount the stream of benefits, but use an inappropriate formula to estimate the present value of the stream of costs. That explains why the ratio of discounted benefits to costs turns out to be 1.69 only while the B/C was put at 6.56.

T. V. Moorti and John W. Mellor, in their paper, based on an earlier publication by Moorti, compare the economics of private and State-run tube-wells in U.P. They come to the conclusion that the private tube-wells are more economic and should be preferred. For this purpose, they examine not only the cost structure of the two types of tube-wells, but also support their findings with data on intensity of irrigation and cropping. If the basic data are correct it is surprising that the State tube-wells were at all taken up. For, the capital costs (fixed as well as variable) on an annual basis were 7 to 10 times as much on the State tube-wells as in the private tube-wells, while the water discharge capacity of the former was only about double that of the latter. Therefore, even if the State tube-wells had been able to supply water to the farms with equal efficiency, the State tube-wells would have proved far less economic. Indeed, this casts reflection on the cost of construction and/or technical choice in the case of the State tube-wells.

Two other papers also relate to the benefit-cost of tube-well irrigation in U.P. Lakshman Singh and R. P. Singh estimate the benefit-cost of tube-well irrigation in Deoria district. On the basis of data from a sample of farms, in which irrigation was introduced at different times during the first four Plan periods, they estimate the net benefits per hectare due to irrigation at 1968-69 prices. But when it comes to estimating costs, they estimate these on the basis of the actual capital costs incurred at different times in the past! Consequently, when they estimate the benefit-cost ratios separately for the schemes undertaken in the first, second, third and fourth Five-Year Plan periods, they come up with declining ratios. It is necessary to remember that the benefit-cost exercise is meant to decide on investment projects, and therefore the prices at which costs and returns are to be estimated should be comparable. Failure to do so is sure to mar any analysis.

H. L. Srivastava's paper relating to tube-well irrigation in Kanpur is unclear about the cost-benefit figures presented at the end, and therefore it is not possible to judge the validity of the very low B/C ratio arrived at. The paper also does not make clear the year to which the costs and returns relate.

J. S. Chawla, S. S. Gill and M. S. Dhariwal present interesting data on the promotion of tube-well irrigation by the Small Farmers Development Agency in Amritsar. They present interesting evidence, based on a sample study, of the pattern of utilization of loan by the farmers, the difficulties that

plagued the small farmers' effort at installing and running the pumps, etc. The paper presents data on benefits accruing to the farmers as a result of irrigation. But except for the data on utilization of loans no data on costs or their analysis are presented. Consequently, it is not possible to assess the benefit-cost ratio given at the end of the paper.

J. P. Bhati, R. N. Tewari and L. R. Singh in their paper raise certain methodological issues besides estimating the benefit-cost ratio of tube-well irrigation in U.P. But the methodological issue relates to estimation of the potential irrigable area under any source of irrigation. While this is interesting, it is not central to the problem of benefit-cost analysis. The absence of adequate information about the basic character of the data creates difficulty in assessing the final results. The data relate to five tube-well irrigated farms and four unirrigated farms in Badaun district, for the year 1969-70. While this suggests that the benefits of irrigation are estimated at 1969-70 prices, it is not clear that this is true for the costs of the lifts as well. Further, it appears to be taken for granted without any justification that on the irrigated farms the new cropping pattern comes into existence from the very first year after the completion of the lift arrangement. Finally, it is customary in benefit-cost analysis to calculate net benefits of irrigation without deducting the irrigation charges which are payments towards the capital, interest and operation costs of the irrigation source. Indeed, the authors appear to recognize this when they say that 'If the estimated value of benefits from the tube-well is found to be greater than cost, the tube-well will be judged to be economically viable.' Yet when they calculate the benefits they deduct the irrigation charges (which are the annual estimated cost of the irrigation schemes) from the farm receipts to obtain net benefits. It is this benefit which is compared with the project cost, *i.e.*, the irrigation cost.

V. P. Shukla's paper on well irrigation, its costs and benefits in Jabalpur, is mainly concerned with working out optimum cropping patterns for irrigated and unirrigated farmers further sub-divided into traditional and advanced, by using the linear programming technique. Attention is given mostly to how the existing farms can improve their income position by adopting a better cropping pattern. As a result of the exercise the author concludes that only the irrigated advanced farms might be expected to register some improvement (by producing no dwarf wheat). No attention is however given to the differences between the per acre net incomes of the four categories of farms, to get an indication of the existing difference in benefit due to irrigation. The cost of lift irrigation has been estimated in the paper, but no use appears to have been made of it in calculating the benefit-cost ratio or estimating the returns to investment in irrigation in any other way.

M. L. Singh and P. K. Prasad estimate the benefits and costs of lift irrigation in Palamau district of Bihar. They however take recourse to such different measures for different items that should make comparison

impossible. The project capital costs are valued at 1972 prices. The operating costs, on the other hand, are estimated for 10 years 1968-1977—actuals for the first 5 years and a linear trend estimate for the next 5. These are then capitalised to 1968 (not 1972). Benefits are also similarly estimated for 10 years and capitalised. Net benefits are arrived at by deducting the operating costs of the lifts from the benefits due to irrigation. And then this net benefit is juxtaposed against the capital costs! It is difficult to understand all these methods.

Two papers are devoted to discussing the benefits-costs of medium and large flow irrigation projects. M. K. Shingarey and D. K. Sohoni present a benefit-cost analysis of the Bor irrigation project in the Vidarbha region of Maharashtra. Though the project construction is said to have been completed by 1963-64, only 1,478 of the 13,355 hectares of irrigable land had actually come under irrigation by 1968-69. To estimate the benefits of irrigation, a sample of farms already irrigated (presumably by 1968-69, or later) and another sample of unirrigated farms were surveyed. These data provided the basis for estimation of net benefits of irrigation in 1968-69. These net benefits (adjusted for the loss of income from the submerged area) were compared with the costs of the irrigation project. The capital cost however was the cost actually incurred by 1963-64 when the project was completed. Comparing these costs with the benefits valued at 1968-69 prices would be improper. Further more, while the authors in the methodological section suggest the amortized annual value of the capital cost, this method is not followed in estimating the annual project costs. Finally, the fact of a large time-lag in the use of irrigation water made available is not taken into account in estimating the benefits and costs. It is said that the extent of irrigation and cropping pattern are likely to improve in years to come. But no efforts are made to estimate that. On the basis of the existing irrigation and following the methods of computation indicated, the benefit-cost ratio comes to 1.2. Had the benefits as well as the costs been estimated at comparable prices, the ratio would have been lower still.

A. S. Charan makes a detailed study of the benefit-costs of the West Banas irrigation project in Rajasthan. The paper is based on very considerable field investigations designed to obtain detailed farm cost and return data from the command area. The analysis, however, appears to be handicapped by two basic shortcomings. In the first place, while the benefits as well as the associated costs of farming are estimated at 1968-69 prices, the capital cost of the project which was completed by 1962-63, is in actual pre-1963 values. Secondly, for the benefit-cost the author departs from the accepted practice of deducting the associated costs from the value of increased output due to irrigation in order to estimate net benefits. The author calculates net benefits gross of associated costs, and costs include both project costs and associated costs of farming. This is not justifiable. While correction for the latter would increase the B/C ratio, using comparable prices to

estimate the benefits as well as the costs would reduce it, possibly quite significantly. Besides these, there are a number of other points on which the analysis falls short of the methodological requirements.

The three papers by M. N. Upadhyay and K. Basu, P. K. Aiyasamy and S. Krishnamoorthy, and S. A. Radhakrishnan and R. Umakesan are general accounts of conventional benefit-cost techniques. Radhakrishnan and Umakesan also attempt an exercise with a 10-acre farm at estimating the benefit-cost ratio, internal rate of return and present net worth of irrigation through well digging and making land fit for flow irrigation. In the first place, it is not clear how the flow irrigation can be provided only with land improvement cost and no capital cost of the source of flow irrigation. Secondly, the irrigation costs appear to get netted as associated costs in order to estimate the net benefits. This is contrary to established practice.

Aiyasamy and Krishnamoorthy also make brief references to empirical estimates of B/C ratio for well irrigation in some areas of Madras and to the modernization of the Cauvery Delta. But it is not possible to examine them since the data base is not given.

G. R. Krishnan attempts an estimation of economic benefits due to irrigation projects in Tamil Nadu. But it is confined to estimating—in a manner that is not quite clear—the increase in yield of paddy due to irrigation.

A paper by T. V. Moorti, Banarsi Lal and K. K. Verma is concerned with finding out the number of irrigations that may be profitably given to a crop of wheat in Pantnagar. It is rather stretching the scope to call this benefit-cost analysis. Incidentally, the additional benefits of two extra irrigations, based on one year's experiment data, are so small at least in the case of one of the two rotations examined, that it would appear hasty to base extension advice on this finding.

Two papers, one by M. C. Agarwal and another by Arunendu Mukhopadhyay are concerned with essentially methodological issues relating to agricultural project evaluation. They will be referred to after the other papers relating to benefit-cost analysis in fields other than irrigation have been discussed.

Benefits of Land Development

Three papers relate to the economic benefits of land development projects. S. B. L. Gupta, Rajendra Prasad and R. K. Pandey attempt an economic evaluation of soil conservation measures in Varanasi district. A sample of 50 farmers from three villages in the tehsil where soil conservation work had been undertaken by the Government and another 50 farmers from

neighbouring area where such work had not been undertaken, were surveyed. Soil conservation measures are expected not only to improve the soil and water retentivity ability of the land, but improve the underground water level thereby making well irrigation more profitable. The paper estimates the net benefit flowing to the farmers from such a measure and compares it with the annual cost of the project. The B/C ratio is quite high, 4.6. Two questions arise in this connection. Firstly, the paper does not make clear whether associated investments made by the farmers, like sinking wells, putting up pumps, or any other development on land facilitated by the soil conservation measures have been taken into account in the 'associated costs.' Secondly, it is not clear if the project costs and returns are being valued at comparable prices. It would have been more appropriate to amortize the total project cost over the life-time of the project.

S. M. Patil reports on a similar soil conservation project in Poona district. The exercise, however, suffers from inadequate specification of relevant details. The study relates to a small area of about 70 hectares. But following soil conservation measures, wells were increased five-fold in number. Other associated investments might have been made by the farmers. It is not clear if these associated costs have been taken into account in estimating the benefits. The same problem of valuation of costs and benefits at comparable prices, raised earlier, arises in this case also. Finally, the associated costs and the project costs are pulled together to be compared with the gross benefits from soil conservation.

J. S. Sisodia estimates the benefits and costs of land development programme in Tawa pilot project area in M. P. This development is undertaken on farm land brought under command of an irrigation project. Yet the project costs estimated do not take irrigation project costs into account, while the benefits include those. Besides, other relevant details about the data base of the calculations are not made clear.

B. S. Murdia's paper on the benefit-cost of rural electrification projects is largely a statement of the formal analytical method. Even in this the method of estimating the benefits to the farmers who use electricity is not fully explained. He gives an illustrative example of such a project in Rajasthan. But the basis of the relevant data, particularly relating to the benefits, appear to be the observations of the author during his tours. The discount or interest rate used is only $5\frac{1}{4}$ per cent which can be hardly justified in any benefit-cost estimation for the economy. The benefit-cost ratio is estimated assuming that the pattern of benefits observed 5 years after the project was started would be the pattern in future (although it is noted that this is not a valid assumption). The author does not discount the cost and benefit stream or use the amortization formula, for calculating the benefit-cost ratio.

Two papers are concerned with the benefit-costs of a cold storage plant and of use of machinery in agricultural operations. R. I. Singh, Y. S. Chauhan and D. S. Shukla examine the benefit and costs of a cold storage plant. The benefits of the plant are the revenue from the storage charge paid by the cultivators who store their produce in this plant. But here the paper appears to suffer from two shortcomings. Firstly, the net benefits are calculated net of the costs of the cold storage plant, and then expressed as a ratio of the plant cost. This is contrary to the accepted measure of benefit-cost. Secondly, the benefits appear to be based on one year's charges collected by the plant. It would have been necessary to take into account the fluctuations in the capacity utilization of the plant from year to year while estimating the benefits. The costs are the construction, repair and maintenance costs of the plant. But there is no attempt at discounting the costs to their present value or to amortize the costs. It is not clear if the capital costs of the storage plant and building have been valued at the same year's (or years') price as the benefits. It is not clear why the interest, at some current rate, on the estimated value of potato stored by the producers, is included among the project costs. A second measure of benefit-cost is also given in which the gross benefits constitute the sale proceeds of the stored potato at different stages, net of cost of shrinkage and loss during storage. Net returns or benefits should have been this gross return minus the purchase or pre-storage price of the potato stored. This, however is not done; instead the purchase price and the storage costs are deducted to find the net benefit, which then is expressed as a ratio of the project costs plus the purchase price. This does not appear to be meaningful.

H. S. Aulakh and P. S. Rekhy present a cost-benefit analysis of investment in farm machinery in a region in Amritsar district of the Punjab. They examine the data from sample farmers in regard to the benefits of tractors, tube-wells and diesel pumps. While the cost is estimated in a conventional style (without discounting or amortizing), the benefits remain unclear. The benefits are said to be the net increase in production, plus the returns from hiring out the machine's services. But it is not stated what these net benefits include and what they exclude. A clear statement about these is needed to show that double counting has been avoided.

Economic Returns from Plantations

M. V. George and P. T. Joseph in an interesting exercise estimate the benefits and costs of a plantation crop like oil palm and compare it with coconut and rubber plantations to examine their relative economic merits. They follow the well-established methods of estimating benefit-cost and come up with a finding that oil palm has the greatest return over cost, in Kerala. It is also an interesting exercise in so far as it exemplifies the way in which the economics of forest plantations may be examined. What possibly deserved greater attention than has been given in the paper, relates

to relative prices of oilseeds, which are expected to decline the world over in years to come.

Benefit-Cost of Agricultural Extension Service

Two papers—one by M. S. Bhatia and Bipin Behari, and the other by R. K. Pandey relate to an evaluation of the benefit-cost of special administrative devices for agricultural development. Bhatia and Bipin Behari examine the Small Farmers Development Agency in a district in U. P. The costs relate to the administrative costs of SFDA, and the subsidies provided by them, considered as direct costs, and the loans taken by the farmers from institutions and other expenditures on production, as indirect costs. The two are combined to estimate the costs for benefit-cost analysis. The benefits are largely guess works, inasmuch as certain net increase in agricultural production has been assumed. Consequently, the estimated benefit-cost ratio loses much of its significance.

A somewhat different approach has been followed by R. K. Pandey in estimating the benefit-cost of Intensive Agricultural District Programme in Aligarh. In order to do this, Pandey shows that during 1961-68 when the IADP was in operation, the growth of agricultural output in Aligarh was higher (over 1954-61) than in the neighbouring districts as well as for the State as a whole. This, he assumes was due to the IADP in Aligarh. This is a very difficult assumption to accept; it would attribute all inter-district variations in growth rates of production in a State to IADP except for the fact that all districts were not IADP districts! The estimation of costs include the administrative costs of IADP plus the additional costs incurred by the farmers. All of these costs are not presumed to be induced by the IADP but a large part of it. It is assumed that the rate of growth in farm inputs could not have been more than that of farm outputs, and the increase in inputs induced by the IADP was somewhat less. These are also difficult assumptions to accept. The data for different districts would show different rates of growth in agricultural output and inputs, as will be seen from the data presented by Robert E. Evenson and Dayanatha Jha in their paper (to be noted subsequently). Given the methods of discounting followed in benefit-cost analysis, the merit of Pandey's analysis appears to be based on the above doubtful assumptions.

Issues for Discussion

Before turning to the paper by Evenson and Jha, we may sum up certain observations about the benefit-cost analysis presented in the papers presented for discussion.

(*a*) The actual merit of this method of project analysis depends significantly on the character of the empirical data used. Many papers, while purporting to present specifically empirical studies, do not seem to be careful about this aspect.

(*b*) Some papers were not clear about the meaning of costs and returns in this form of analysis and also about the nature of the ratio of benefits to costs.

(*c*) The concept of discounting the stream of benefits and costs in future, so central to the whole problem of project analysis, does not seem to have been fully appreciated. A. Mukhopadhyay in his paper illustrates the various ways of using this basic concept to bring out the relative characters of the net present value measure, the benefit-cost ratio and the internal rate of return—a point often made in the literature on the subject.

(*d*) Care is often not taken to see that the relative prices of costs and benefits are not changed except when expected to do so. Using the actual project construction costs in some past period and valuing the flow of benefits in current prices often results in this very error.

(*e*) Distinction is usually drawn between the financial and economic estimates of benefits and costs. In this the basic distinction lies in valuing certain inputs differently for the individual than for the economy as a whole. The two most important examples of it are valuation of labour in agriculture and the rate of interest or discount. In the literature on benefit-cost these have been frequently discussed. M. C. Agarwal in his paper concerned with methodological issues, draws attention to these. None of the papers, however, appear to discuss this in the empirical exercises presented.

(*f*) The relative importance of financial and economic analyses of benefit-cost, in the context of developing economies faced with the problem of financing development, would appear of interest. This question has not drawn any attention.

(*g*) Since project analysis is concerned with the estimation of costs and returns into the future, the physical outputs and relative prices have to be estimated with as much reliability as possible. Fluctuations, uncertainties are the constant features of these estimates. In most of the papers there is no indication of this problem, much less an effort to discuss it empirically.

We may take up these issues, among other things, for discussion in the context of the papers submitted.

Effect of Research on Agricultural Production

The paper by Evenson and Jha is not a paper on the now conventional field of benefit-cost (or project) analysis. However, it deals with the effect of research and extension on agricultural production in India. It uses the technique of production function analysis to measure the marginal productivity of expenditure on agricultural research and extension on agricultural production. The paper tries to measure the contribution agricultural re-

search (in a State as well as a region), agricultural extension, as well as literacy, and research publications have made to increasing agricultural productivity in India which is measured by deducting from the growth rate in agricultural production the rate of growth of agricultural inputs valued at market prices. It is widely recognized that the conventional valuation does not fully incorporate the changes in 'quality' of the product. These authors while theoretically admitting the possibility of doing so, doubt its practicability. They instead try to explain the differential between growth, in measured outputs and inputs with the help of the factors like research, extension, etc., which after all lend quality changes in inputs (as well as outputs). They use cumulative expenditure data on research as well as extension as variables to explain the net productivity growth rates, and come out with significant results. It is interesting that while research and extension show greater contribution, irrigation has a negative relation. The so-called green revolution variable—the impact of the development of new seed in the North-west region on the rest of the country—, also appears minimal; it persists even for the pre-green revolution years. Therefore, while it is quite interesting to see the significant relation between regional and local research expenditures and agricultural productivity, one is left with the question: what did this research contribute to Indian agriculture, that was not so significantly related either to irrigation or to the so-called green revolution. Thus while the paper gives some interesting explanations, it also raises some intriguing questions, and invites a serious discussion.