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Identification, Appraisal and Evaluation of Agricultural Projects

SOME SPECIAL CHARACTERISTICS OF AGRICULTURAL DEVELOPMENT PROJECTS AND THEIR IMPLICATIONS FOR PROJECT FORMULATION AND EVALUATION

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An agricultural development project may be defined as an investment activity where resources are expended to create a producing asset from which we can expect to realise benefits over an extended period of time.[1] A project should be specific in terms of its duration, objectives and geographic location and lend itself to planning, financing and implementation as a unit. The World Bank includes under agricultural projects such widely varying activities as irrigation, land development, tree crops, livestock, agricultural machinery and agricultural education, research and extension. Agricultural development projects have many special characteristics which distinguish them from projects in other sectors. In this paper, we shall attempt to highlight some of these characteristics and discuss their implications for project formulation and evaluation with the help of concrete examples.

EXTERNALITIES

Most agricultural projects are characterized by the existence of externalities. An externality may be defined as an uncompensated spill-over or side effect. It has two properties: (1) interdependency—one person's behaviour creates a cost or benefit to other persons; and (2) lack of compensation—the one who creates the benefit is not completely rewarded for it, nor is the one who creates the cost made to pay for it.[2] An externality is revealed in terms of divergence between the private benefits and the social benefits or between the private costs and the social costs of a project. The concept of externality may be illustrated by utilizing the following production relationship:

Let : $Y_A = F(X_1, X_1 \ldots\ldots\ldots X_n)$ .....(1)

and $X_n = F(Y_B)$ .....(2)

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1. J. Price Gittinger: Economic Analysis of Agricultural Projects, The International Bank for Reconstruction and Development, Washington, D.C., U.S.A., The Johns Hopkins University Press, Baltimore, 1972, pp. 1-3 and 29.

2. Paul W. Barkley and David W. Seckler: Economic Growth and Environmental Decay: The Solution Becomes the Problem, Harcourt Brace Jovanovich, Inc., New York, 1972, pp. 101 and 128.

where :

Y_A = output of producer A;

Y_B = output of producer B; and

$X_1, X_2, \ldots\ldots\ldots\ldots X_n$ are inputs.

The existence of an externality is indicated by the term

$$\frac{\partial Y_A}{\partial X_n} = 0. \qquad \ldots\ldots\ldots(3)$$

This means that an externality arises wherever the value of a production function (or a consumption function) depends directly upon the activity of others—in our illustration X_n. An essential feature of the concept of an externality is that the effect produced is not a deliberate creation but an unintended or incidental by-product of some otherwise legitimate activity.

In agriculture, single purpose irrigation projects, multi-purpose river valley projects, soil and water conservation projects, land development projects, plantation of tree crops, establishment of pastures, etc., are all examples of the projects characterized by the existence of externalities. For an illustration, let us take an example of a soil conservation project in a hill area. The private benefits to a farmer from soil conservation include: (1) higher output from the land brought under conservation and (2) increased value of land. The social benefits include improved water quality, reduced sedimentation of water courses and reservoirs and the resultant decrease in floods, and increased water supply for irrigation and power generation purpose. The social benefits from soil conservation far exceed the private benefits and this means that there is an externality (positive) involved in this work. In order to realise the socially optimum state of soil conservation, the farmers should be provided subsidies on the soil conservation measures so that they are able to capture part of the social benefits resulting from their work. Or alternatively, the farmers who do not adopt the recommended soil conservation measures should be required to pay some tax so that they also bear part of the social costs which result from their not adopting the appropriate conservation measures.

In project formulation and evaluation the externality problem can be handled by extending the scope of benefits and costs to include all the direct, indirect and intangible benefits and costs associated with the project in question. It is possible only when a systems approach is adopted for project formulation and evaluation.

A realistic and more equitable solution to the externality problem could be achieved through a government agency receiving complaints from the affected citizens and transforming these inputs into regulatory intervention (taxes, subsidies, laws, or regulation) in the producer's affairs. In our example of a soil conservation project, the feed-back loop would be closed through the

path → affected citizens → Government → hill farmer who does not adopt the recommended soil conservation measures and a more nearly optimum state of conservation would be attained (Figure 1).

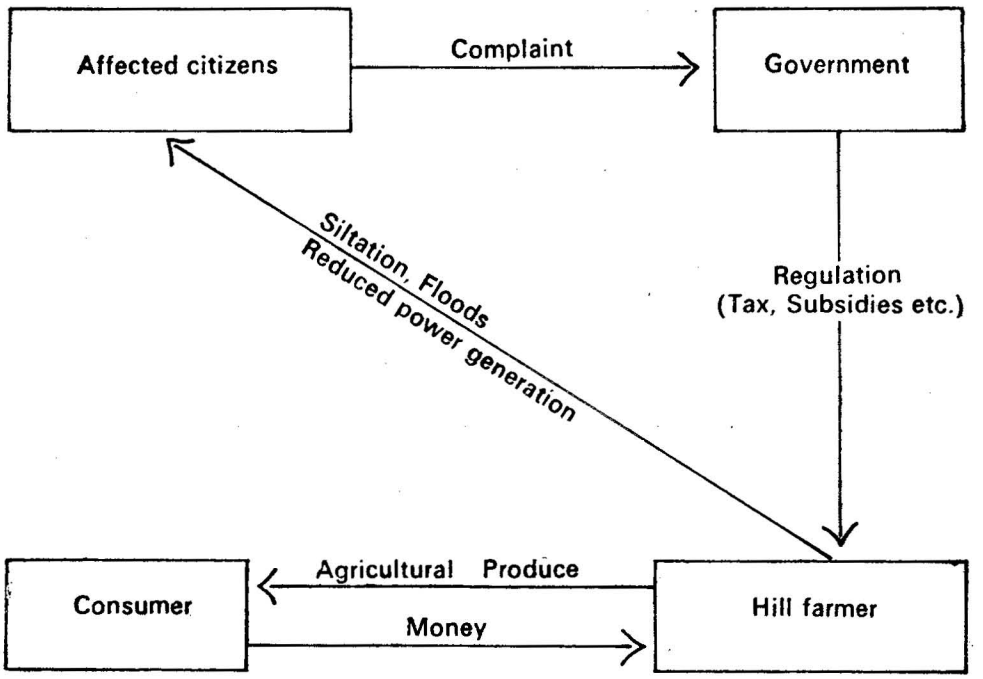

Figure 1—Externalities in Soil Conservation and Closing the Feed-back Loops

In view of the existence of externalities in most of the agricultural development projects, neither private individuals nor entrepreneurs undertake such projects and therefore most agricultural development projects are public sector undertakings. Government ownership is one of the most effective means of internalizing the externalities.

COLLECTIVE GOODS

The products of most of the agricultural projects are characterized as collective goods which are also called public goods. By a collective good we mean any good such that, if any person X_i in a group $X_1, X_2, \ldots\ldots X_i, \ldots\ldots X_n$ consumes it, it cannot feasibly be withheld from the others in that group.[3] Most of the collective goods can only be defined with respect to some specific group. In other words, those who do not purchase or pay for any of the collective goods cannot be excluded or kept from sharing in the consumption of the good, as they can where non-collective goods are concerned. Non-collective goods may be used by only one person at a time.

3. Mancur Olson: The Logic of Collective Action: Public Goods and the Theory of Groups, Harvard Economic Studies, Volume CXXIV, Harvard University Press, Cambridge, Mass., 1974, p. 14.

Their use is competitive. While public goods are used simultaneously by a large number of people, the supply of the goods is not diminishing. Many people can share them at no additional cost. So we say, the marginal cost of a collective good is zero.

In agriculture, the output of many development projects, *viz.*, single purpose irrigation projects, multi-purpose river valley projects, being a collective good, creates some problems in formulation, evaluation and financing the project. As the marginal cost of this output is zero, the optimum price is also zero. When an irrigation project has been completed or flood control measures have once been taken up through some project in a defined area, nobody living in that area could be excluded from sharing the benefits of the project. The individual beneficiaries cannot be identified, as the benefits are dispersed over the whole population of the area. In this case a general tax is warranted and should be levied.

This type of project could be evaluated through benefit-cost analysis using vertically-summed demand curves.[4] The output of the project could be allocated at zero price so that all the beneficiaries could exhaust the benefit at its fullest extent possible. The project could be financed by taxes imposed either on individual users or on everyone who benefits, directly or indirectly from the good.

INTANGIBLE BENEFITS

The agricultural development projects do not end up with providing those benefits which are marketable or which could be evaluated in monetary terms. There are some benefits such as the scenic effect as a result of building a reservoir, which cannot be quantified and others, although they can be quantified, cannot be valued in any market sense, as for example a reduction in lives lost due to flood control. We call such benefits which cannot be valued in monetary terms at least not at present as intangible benefits.

Better income distribution, reduction in lives lost, scenic effect, national integration, or just a better life for the rural people are some of the examples of intangible benefits which are the outcomes of most of the agricultural projects. Such benefits are real and reflect true values. It becomes difficult to use economic tools for dealing with intangible benefits in formulation and evaluation of the project. The best principle, as suggested by Gittinger,[5] "seems to be to acknowledge that intangible effects exist and are important but not to attempt to value them nor to include them in the economic analysis computations".

Ciriacy-Wantrup[6] argues that attempts to quantify such benefits should be encouraged. He also makes a strong case for the use of the term 'extra-market' rather than 'intangible' to describe those benefits that are

4. Barkley and Seckler: *op. cit.*
5. *op. cit.*
6. S. V. Ciriacy-Wantrup, "Benefit-Cost Analysis and Public Resource Development", in Stephen C. Smith and Emery N. Castle (Eds.): Economics and Public Policy in Water Resource Development, Iowa State University Press, Ames, Iowa, 1964, pp. 9-21.

not routinely valued in the market place. According to him, not necessarily those benefits be quantified in terms of money, there are numerous physical attributes that may be helpful in decision-making.

We agree that intangible benefits cannot be left aside, rather they should be handled appropriately in project formulation and evaluation. To deal with the intangible benefits, we can describe their nature as explicitly as possible and where feasible we can describe them in non-monetary, though quantitative, units. Such description would at least provide information on the importance of the impact even though its monetary value is still beyond measurement. In the case of flood control project, the marginal cost of saving an average citizen's life is zero, once the project is installed. But it is up to the decision-makers how much they were ready to pay to save a life and hence it could be used for valuing lives saved and thus the intangible benefits be quantified for taking it into consideration in the cost-benefit arithmetic.

Besides, some of the intangible benefits are not measured even by non-monetary terms. In that case, we cannot explicitly enter the benefit into the cost-benefit calculation, but we must try to establish an implicit value for it. For example, better life for the rural people as an intangible benefit of an agricultural development project cannot be quantified, but decision-makers must place an implict value on it in projecit formulation and evaluation.

RISK AND UNCERTAINTY

Agricultural projects are subject to greater risk and uncertainty than the projects in other sectors. This is mainly because of the biological nature of agricultural production and dependence of agriculture on climatic factors. There are several types of risks and uncertainties affecting agricultural projects of which weather, price, technological and institutional risks and uncertainties are important and should be taken into account in project formulation and evaluation. Risk and uncertainty can be handled in the following ways:

1. Sensitivity Analysis

Reworking an analysis to see what happens if the project benefits or costs or rate of discount or length of useful life of the project are changed, is called sensitivity analysis. Probably every agricultural investment proposal should be examined to see what happens to its profitability if the price assumptions prove wrong. For, alternative assumptions about future prices can be made and their effect on Net Present Value (NPV) or Internal Rate of Return (IRR) determined. Testing a project to see what will happen to the IRR when we assume different rates of discount is also a kind of sensitivity analysis. One may also wish to test a proposed project for its sensitivity to errors in yield estimates. There is a tendency in agricultural projects to be optimistic about potential yields especially when new technology is being proposed and the agronomic information is based mainly on experimental trials. A test to determine how sensitive the project's IRR is to lower yields may not only provide information useful in deciding whether to implement the project but

may also emphasize the need to assure extension services if the project is to yield a high rate of return. If the project pay-off turns out to be extremely sensitive to variations in a parameter, it will probably pay to make further studies of that parameter, the studies reducing the range of uncertainty. If the uncertainty cannot be resolved through further study, then the planner at least has the knowledge of the range of project performance that can be expected.

2. *Mathematical Expectation*

In the presence of risk and uncertainties, project benefits and costs are not known for sure but can be thought of as following some probability distribution. For example, net benefits, from a tubewell in the tenth year B_{10} cannot be pinned down to one number like Rs. 5,000 but these benefits may range from Rs. 3,000 to Rs. 8,000 depending upon a host of factors such as crop pattern, yield rates, price of farm commodities, price of inputs, etc. The best representation of our knowledge of B_{10} might be an explicit probability distribution of a pay-off involving risk as follows:

Value of B_{10} (Rs.)	Probability of occurrence
3,000	0·1
4,500	0·2
5,500	0·3
7,000	0·3
8,000	0·1

This probability distribution can be entered into the calculation of NPV by replacing B_{10} by its expected value, $E(B_{10})$ which is just a weighted average:

$$E(B_{10}) = 0.1 \times 3000 + 0.2 \times 4500 + 0.3 \times 5500 + 0.3 \times 7000 + 0.1 \times 8000 = \text{Rs. } 5{,}750.$$

Similarly, other uncertain parameters in a criterion equation can be replaced by their expected values.

3. *Shortening the Period of Analysis*

It is generally agreed that the longer the economic life of a project, the more risky it will be because of greater complications in estimating the future benefits and costs of the project. Shortening the period of analysis, say from 100 to 50 years, would reduce the riskiness of a project but it can also lead to systematic misplanning in the formulation of projects, *e.g.*, a resorvoir without a dead storage capacity. However, specification of an upper limit is necessary for making benefit-cost ratios of different projects comparable. A rule of thumb in this context is to put a limit of 50 years on the lives of the projects.

4. Adjustment in the Discount Rate

An alternative to the limit on the period of analysis is the introduction of a risk premium into the interest rate. A risk premium of the order of 1-2 per cent may be added to the basic interest rate used for evaluating a riskless project. All projects whether their life is longer or shorter than some arbitrary limit will be subject to the adjustment, yet the increasing risk of long lives is reflected.

5. Safety Allowances

Another alternative for handling the problem of risk and uncertainty is the safety allowance—a flat percentage reduction of benefits or increase of costs. The extent of the safety margin would naturally vary with the riskiness of the project(s) under consideration.

CONCLUSION

The special characteristics, such as externalities, collective goods, intangible benefits and risk and uncertainty which distinguish agricultural projects from the projects in other sectors, should be given due consideration in the formulation and evaluation of agricultural development projects. The problem of externalities could be tackled by the Government either by undertaking the management of the project or by means of taxes, subsidies, regulation, etc. Collective goods produced by agricultural projects create problems in project formulation and evaluation and even in financing the project. By imposing tax in the project area, the problem of financing could be tackled. Similarly, intangible benefits produced by the project should be given due weightage, either explicitly or implicitly. The agricultural projects are subject to greater risk and uncertainty due to biological nature of production. The risk and uncertainty problems could be handled by sensitivity analysis, mathematical expectation, shortening the period of analysis, adjustment in the rate of interest and safety allowance.

FORMULATION OF MINOR IRRIGATION SCHEMES— DATA REQUIREMENTS AND PROBLEMS

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The concept of project formulation for regional development is gaining importance inasmuch as the planned approach in executing development activities pays greater dividends. By project approach the development activities envisaged could be supervised more closely by technical personnel and problems encountered during execution can be solved then and there. After the formation of Agricultural Refinance and Development Corporation

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