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FARM LEVEL BENEFITS AND COSTS OF AGRICULTURAL PRODUCTION PROJECTS*

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INTRODUCTION

It is the purpose of this paper to examine the practice and applicability of the techniques commonly used to appraise agricultural production projects[1] especially those which originate in the public sector. Some conceptual and methodological errors have been observed in the application of such techniques to national and international projects. The paper highlights these errors and tries to isolate factors which have caused such variability in approaches to appraising projects in agriculture. A suggestion has been made to suitably modify the current technique with a view to minimize errors and at the same time to make the appraisal technique more complete and meaningful from the standpoint of all the beneficiaries. The discussion mainly relates to identification, measurement, and importance of benefits and costs at farm level and their significance to the overall analysis of projects not only within agriculture but also projects in other sectors of the developing economies in Asia and the Far East.

The variability in approaches to appraisal of agricultural production projects poses a serious threat in allocating scarce resources between sectors and within the agriculture sector. Mistakes made in selection and ranking of projects in agriculture due to unrealistic techniques used in appraisal have more serious financial consequences. It is because in the experience of development financing institutions, such as the International Bank for Reconstruction and Development, the costs of appraisal in agriculture and education are 70-75 per cent higher than those of basic infra-structure projects. Consequently, reappraisal becomes very expensive. Also, the developing countries are relatively more deficient in both the quantity and quality of agricultural project analysts whose services are not easy to obtain. There is, therefore, a great need for refinement and as far as possible for standardization of methods that are being used in appraising agricultural production projects.

I

Both the financial and economic criteria have been commonly used by national and international organizations in the selection and ranking of

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1. Includes crops, livestock and fish culture.

agricultural projects, as with projects in other sectors. The economic analysis examines a project from the standpoint of its worth to the economy as a whole, while the financial analysis considers the profitability to individuals or groups who supply capital or have enterprise interest in the project. These individuals or groups could be private, public or government institutions. Consequently, a public sector project may be required to pass both the financial and economic tests while a private sector one may be only required to pass the financial test. Projects in public sector have usually two beneficiaries — the project authority and the national economy. The project level financial and economic analyses use benefit-cost ratio and internal rate of return techniques to compare expected return from a project with the opportunity cost of investment in the project. It is, however, a general practice to use benefit-cost ratio for economic and the internal rate of return for the financial analysis. The profitability of a project is judged by the size of the incremental net benefit which it is expected to generate throughout its life. The incremental net (project) benefit is the difference between net benefits 'with' and 'without' the project. This is the standard technique being applied to the appraisal of all production projects including those in agriculture.

There is little difficulty in applying this standard technique to most production projects outside agriculture. The analysis assumes that the resources used by the project authority are allocated according to their market prices and that each factor of production gets what it contributes to the project. Implicitly, capital is considered the most scarce resource and, therefore, the financial test aims at maximizing returns to equity capital alone. Conceptually in this analysis each factor shares a separate income. In most industrial production projects there is a clear distinction between labour, management and entrepreneurship. The entrepreneurship can buy labour and management in the 'open market.' The project benefits are also easily identified and valued at the market price. For economic analysis, the inputs and outputs are not valued at market prices if these prices do not reflect the true value of these items to the economy. The 'real' or 'true' prices are then estimated.

Application of this standard appraisal technique to agricultural production projects has led to many variations in identification and measurement of benefits and costs at farm level. The usual procedure followed for appraising agricultural production projects is to (1) calculate net production value (NPV) or net income for each farm enterprise, (2) aggregate NPV for all enterprises and to designate it as project benefit, (3) estimate project cost-investment, operation, and maintenance, *e.g.*, in the case of an irrigation dam, (4) estimate net benefit as the difference between project benefit and cost, (5) estimate incremental (project) net benefit using 'with' and 'without' project criterion, and (6) use benefit-cost ratio or internal rate of return to appraise profitability.

The errors observed in some appraisal studies relate to pricing of labour (family as well as hired), and inclusion of depreciation and interest on capital, taxes and subsidies in farm cost or benefit. The maximum variability in appraisal technique has been observed in pricing family, operator and the hired farm labour. In some studies the cost of labour has been left out completely while in others all the family, operator and hired labour have been included in farm cost structure. The zero cost of family and operator labour has been claimed to be justified on the ground that the opportunity cost of such labour is zero. A wealth of literature has developed for and against the concept of zero opportunity cost of labour in agriculture.[2] One point which has clearly emerged is that there is both labour surplus and shortage in peasant farming conditions. In cereal farming, particularly, which is the predominant type of farming in Asia and the Far East there is always a seasonal shortage of labour at the time of seeding, transplanting, and harvesting. It is, therefore, unrealistic to assume that the opportunity cost of labour is zero throughout an agricultural year. Dependable data showing the proportion of family and operator labour to total labour utilization on farms at the national or regional (sub-national) level are not readily available to show the overall importance of such labour to Asian agriculture. In the developing countries of Asia, however, a very high proportion of the total active population in agriculture, forestry and hunting is formed by self-employed farmers and their families. According to an International Labour Office estimate in 1971 it varied between 45 in Ceylon (now Sri Lanka) to 97 per cent in Thailand.[3] Pricing this labour at zero certainly improves the size of net project benefits and increases the chances of project selection. If cost of this labour is imputed and added to farm cost the reverse is likely to happen in relation to selection of the project. In appraising a project in India, S. N. Mishra and John Beyer estimated that if payment for labour (mostly own/family) was excluded from project costs, the financial rate of return was between 9 and 10 per cent, but dropped to between –3 and –4 per cent if labour was shadow priced.[4] On the other hand, in appraisal studies conducted by the World Bank the prevailing market wage rate has been used to price family labour in computing financial rate of return. In calculating the economic rate of return the labour was shadow priced keeping the seasonal fluctuations in demand for farm labour in mind. In a report submitted to the Asian Development Bank, a technical assistance mission priced both family and hired labour at zero. This valuation refers to financial analysis of the project.[5] In a feasibility study conducted by the U.S. Bureau of Reclamation in the Lower Mekong Basin, the costs of operator's and family labour were not included in net income estimates of individual farm enterprises. The hired or custom

2. For alternative ways of pricing farm labour refer to: J. Price Gittinger, Economic Analysis of Agricultural Projects, International Bank for Reconstruction and Development, Washington D. C., 1972, pp. 40-43.

3. International Labour Office, 1971-Year Book of Labour Statistics, Geneva, Table 2A.

4. S. N. Mishra and John Beyer: The Ratnagiri Fisheries Project: A Case Study in Social Cost-Benefit Analysis, Institute of Economic Growth, Delhi, 1972.

5. Asian Development Bank, Integrated Agricultural Development Programme for the Vientiane Plain, Laos, Code 4600, 1969.

labour was included at cost. These cost figures were used for estimating internal (financial) rate of return to the projects.[6] The widespread under/ unemployment of rural labour is a common feature of all developing countries in Asia. Realising that the labour is the most important cost item (if family and operator labour are priced) on peasant farms, such an extent of variability in the procedure used in identifying and pricing farm labour could introduce serious bias in the allocation of scarce resources within agriculture and between agriculture and other sectors of the economy. Such variability in measuring farm costs could also bias the financing of development projects by international bilateral and multilateral organizations in favour or against a particular country project.

It is a standard practice to exclude interest and depreciation from project costs if the appraisal aims at economic analysis. In the case of financial analysis, interest paid on borrowed capital is included as project cost but depreciation is excluded. To illustrate these points further, the financial rate of return is a measure of the earning capacity of equity capital invested in the project. In itself it is a kind of average rate of interest earned by the project overtime. Depreciation is not included as cost because in the framework of discounted cash flow analysis which is commonly used for project appraisal, it is assumed that the total capital is used up at the end of the project operation except for some salvage value which is treated as project benefit in the last project year. If the imputed cost of interest on equity capital and depreciation are included in estimating NPV at farm level, it leads to an error in double counting. In calculating financial rate of return in the case of Pa Mong Feasibility Report, the U.S. Bureau of Reclamation included depreciation as a cost element under 'farm improvement, equipment and tools' for estimating net income from crop enterprises.

Taxes and subsidies affect farm cost and benefit and are therefore a necessary component in calculating NPV. Such NPV should not be, however, treated as equivalent to project benefit if the appraisal test is undertaken from the standpoint of the economy. It is well known to project analysts that these are transfer items within the economy. To avoid the conceptual error, these items should be excluded from NPV if the same is used for purposes of economic analysis.

II

Most of the errors mentioned in previous section could have been avoided if the project analysts had realised that the standard tools of appraisal applied to projects must be adapted to special characteristics of the agricultural production projects. Even if an agricultural production project belongs to

6. U. S. Bureau of Reclamation, Pa Mong Stage I Feasibility Report, Appendix VI, 1970. (Prepared for the Committee for Co-ordination of Investigations of the Lower Mekong Basin and the Agency for International Development.)

the public sector it has a very large and an important segment in the private sector. The farmer is one of the major beneficiary of the public sector agricultural production projects. Most such projects embrace thousands of farm families which are scattered geographically over a vast agricultural area. Decisions made individually by these independent entrepreneurs regarding their participation in a project are of crucial significance to the success of a project. In fact, there are many examples in countries of Asia and the Far East of gross under-utilization of water at farm level in irrigation projects. This indicates that the tests used in appraising these projects were not adequate. While these projects might have passed the financial and economic tests from the standpoints of the project and the national economy, the appraisal framework failed to test these projects from the standpoint of participation of the farmer. If the interest of the farmer in the projects was properly watched and environment created to ensure his participation before the projects reached operational stage, these irrigation projects would not have been such a failure. The need for project appraisal from the standpoint of the farmer is obvious.

The small farm sector generally is less profitable as compared to the industrial manufacturing sector in the developing economies. The standard appraisal technique as applied to industrial projects assumes that most inputs used in production and output produced have a readily available market. In agricultural production there are difficult-to-market or even non-cash items of expenditure and income.[7] To bring these items into the appraisal framework, the technique requires appropriate modification so as to reflect these special features and at the same time to keep the overall technique unbiased when used to compare profitability of investment in other sectors or within the sector.

It is not so difficult to isolate each factor of production including management in most industrial projects. It is, therefore, customary in financial analysis to estimate return to capital only. This individual input approach is difficult to apply to farm projects. The peasant farmer usually performs three functions : worker, manager and entrepreneur. It is, therefore, unrealistic in agricultural projects to estimate the rate of return to capital alone and ignore his other two functions. Any artificial separation of these functions is impracticable. The approach, therefore, should be 'multi-input.' In other words, the appraisal from the standpoint of the farmer should be undertaken and it should estimate the return to the combined three functions of the farmer. This approach to appraisal is suggested for the interim period till peasant farming becomes a commercial undertaking and directly comparable to industrial production projects.

Much of the confusion in identification and measurement of benefit and cost at farm level arises due to use of NPV data for economic analysis

7. This excludes items of cost and benefit which are equally relevant to both agricultural and industrial projects, *e.g.*, cost of pollution, benefit of improvement in health.

while the data are originally compiled, generally, to meet requirements of the financial analysis only. Some project analysts only undertake financial analysis of public sector agricultural production projects. They leave the economic analysis out of the appraisal framework.[8] As was pointed out earlier, each public sector project must be appraised from the economic criterion so as to permit objective allocation of national resources to most profitable uses.

III

This section presents a set of tools which can be used for appraising agricultural production projects. These tools will meet to a large extent the expectations of each of the three direct beneficiaries, *i.e.*, farmer, project authority and the national economy. At the same time this procedure will lead to standardization of the appraisal technique and make within sector, between sectors and inter-regional comparisons meaningful by reducing personal bias of the appraiser. These tools while emphasizing the 'multi-input' approach for permitting inter-farm comparisons also strengthen the commonly practised 'single-input' approach which is necessary for making inter-sectoral and inter-regional comparisons of projects. Although a crop husbandry project differs from a livestock project in technical, technological and management aspects, yet both the projects can be appraised on the basis of a standard technique. It is quite likely that the tools suggested will be further refined as more field experience is gained by agricultural economists and other technologists in formulating and appraising agricultural projects.

The following set of appraisal tools is suggested for financial and economic appraisal :

(*i*) *Net Farm Income, Undiscounted* [*NFI* (*U*)]

If farm income is measured in the usual language of an accountant, *i.e.*, by pricing each input and output, this will result in negative profits on most peasant farms due to the under-developed nature of farming in Asia and the Far East. A farmer in evaluating his farm business, however, thinks in terms of net returns to his labour (L_o), family labour (L_f), management (M), and equity capital (K_e), *i.e.*, return to combined or 'multi-input.' The undiscounted net farm income is a tool which measures return to the 'multi-input.' It is a financial measure. The gross farm return is calculated by adding the value of gross production (R) at farm price to the value of farm privileges (P) such as farm dwelling. The items of cost, *e.g.*, loan amortization (A), interest on borrowed capital (I_b), wages paid to hired labour (L_h), costs of inputs used in production, *e.g.*, seed, fertilizer, insecticide, irrigation water, hire of farm machinery, etc. (S), land revenue or tax paid for cultivating (own) land, and depreciation (D) on capital assets. The prices used are prevailing or predicted market prices of outputs and inputs. The residual,

8. U. S. Bureau of Reclamation and Asian Development Bank : *op. cit.*

difference between gross farm return and farm costs, is the net return to the 'multi-input' : L_o, L_f, M and K_e. The NFI (U) can be computed for the full development project year and the 'without' project year. The difference will show the incremental net farm income at full development stage. This measure will be useful for inter-farm comparisons of projects based on major farm characteristics, *e.g.*, size, type, mode of irrigation, extent of mechanization, etc. The project authority can use NFI (U) to assess views of the potential settlers or the farmers living in the project regarding their acceptance of the project on the basis of incremental net farm benefit. The farmer will accept to participate in the project if his net farm income is likely to increase significantly.

(ii) Net Farm Income (NFI)

It is calculated by adding investment cost (K) to and subtracting depreciation (D) from NFI (U) for each year of the project life. These annual cash flows are then discounted using an appropriate discount factor such that the sum of the discounted cash flows approximates zero. This discounting rate is the internal rate of return (IRR) to 'multi-input,' *i.e.*, L_o, L_f, M and K_e, at farm level. This IRR is a good indicator of the profitability of a project to the farmer because the farmer can compare this IRR with return in other projects. It provides the basis for ranking projects in a more realistic way because it measures return to the 'multi-input' on the farm, the language which the farmer generally understands. Table I at the end gives the details of computation.

(iii) Net Production Value [NPV (F)]

The first two tools are best suited for intra-sectoral comparison of projects. Projects in most non-agricultural sectors are, however, appraised on the principle of return to 'single' input which is usually the equity capital provided by the project authority. To make agricultural production projects comparable with projects in other sectors in the use of standard appraisal techniques, two farm level measures, net production value for financial analysis [NPV (F)] and net production value for economic analysis [NPV (E)], are suggested.

The NPV (F) is a discounted financial measure of return to the farmer's capital invested in the farm. It is calculated by subtracting imputed cost of L_f, L_o, and M from NFI. The NPV (F), when aggregated over all farms, is equated to project benefits and used for calculating the internal financial rate of return. This permits inter-sectoral comparison. An entrepreneur will be able to compare expected return from an agricultural project with that of projects in other sectors. This tool can also be used for selecting and ranking projects within the agricultural sector from the standpoint of a project authority or a financing institution. Table I at the end gives the details of computation.

(iv) Net Production Value [NPV (E)]

The NPV (E) is a discounted economic measure of worth of a project to the economy as a whole, at the individual farm level. It can be calculated by leaving out subsidies and taxes from net farm income calculations and by pricing the farm outputs and inputs at 'true' prices, *i.e.*, the prices which would prevail if there was perfect market economy. It is computed by subtracting imputed costs of L_o, L_f, and M from NFI. For ease of calculation and with a view to standardise the appraisal technique, it is useful to shadow price agricultural labour keeping seasonal variation in demand in mind. After effecting the above-mentioned accounting changes, the NPV(E) can be aggregated over all farms. This is then treated as project benefit and used for estimating the internal economic rate of return. By applying an economic (social) rate of discount, the project benefit and cost can be brought to their present worth to permit calculation of the benefit-cost ratio which is commonly applied to test economic (social) worth of a project. The details for computing NPV (E) are given in Table I at the end.

An *ad hoc* farm survey must be considered an integral part in preparation and appraisal of agricultural production projects. The farm survey data provides a sound basis for planning agricultural projects in various sub-sectors, and even other sectors of the economy. The inadequacy and unreliability of farm level data in developing countries is well known to the project analysts. The farm survey data will fulfil the gap which is caused by lack or non-availability of reliable information so necessary for planning agricultural projects. These data are required for farm budgeting which is a necessary intermediary step in calculating NFI(U), NFI, NPV(F) or NPV(E).

Table I presents a systematic technique for computing farm level appraisal tools as suggested in this paper.

TABLE I—TECHNIQUE FOR COMPUTING SUGGESTED TOOLS OF APPRAISAL

Serial No.	Appraisal tool	Computation
(1)	NFI (U)	= R+P—A—I_b—L_h—S—T—D
(2)	NFI	= R+P—I_b—L_h—S—K—T
(3)	NPV (F)	= R+P—I_b—L_h—L_f—L_o—M—S—K—T
(4)	NPV (E)*+	= R+P—L_h—L_f—L_o—M—S—K
(5)	Net (project) benefit	= NPV—Cost (investment + maintenance + operation)
(6)	Incremental (project) benefit.	= Net benefit 'with' project *minus* net benefit 'without' project.

Notation:

R =Value of gross production at farm price.
P =Value of farm privileges, *e.g.*, imputed rent for farm house.
A =(Annual) loan amortization. I_b=Interest on borrowed capital.
L_h=Wages paid to hired labour, L_o=operator, L_f=family.
S =Cost of operating inputs, *e.g.*, seed, fertilizer, water.
T =Land revenue/tax. D=Annual capital depreciation.
K =Investment: equity capital (K_e); borrowed capital (K_b). M=Charges for management.
* =Net of subsidies and taxes, if any.
+=Labour to be priced at the opportunity cost which is higher in the peak and lower or zero in the slack season.