Introduction to financial and economic analysis of agricultural projects

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INTRODUCTION TO FINANCIAL AND ECONOMIC ANALYSIS OF AGRICULTURAL PROJECTS

PRADEEP ITTY AND ALAIN BIDAUX

DECEMBER 1991

Before...

... and after

DEPARTMENT OF AGRICULTURAL ECONOMICS, ETH-ZENTRUM (SOL), CH-8092 ZURICH, SWITZERLAND.

CONTENTS:

1. GENERAL PRINCIPLES

1.1. The purpose of the present manual

This manual is to provide a basis to understand the terminology and methods of financial and economic analysis used by major development agencies. It should be easy enough for non-economists to follow but should also be useful to economists who have not been involved in project valuation. We do not intend to make any methodological breakthroughs or reproduce the vast literature on the subject but to present the methods in a simple form and orient the reader on the available literature to facilitate the practical use of these documents. The problems of project analysis are much too diverse to allow a single, mechanical procedure and therefore this manual does not provide a universal recipe but presents the broad principles and offers selected examples to give an idea of the problems and considerations which have to be accounted for.

1.2. The broader context of financial and economic analysis of projects

Governments usually define their general objectives for economic development in the form of **policy statements**. These specify the major goals to be achieved and the form of economic organization for resource ownership and management which are considered acceptable. Typical development priorities are faster growth of national output, reduction of poverty, improvement in the balance of payments, more efficient internal marketing, more stable prices for basic commodities and so on. A government's plan of action for moving economy and society further along the path towards the goals enunciated in policy statements represents a **strategy**. In most developing countries, general statements of economic policy and strategy are given a particular interpretation in the form of national development plans. (Drawn from FAO, 1986).

A **project** is formulated and takes place as an integral part of the more broadly focused and continuous process of development planning outlined above. It is defined in its narrow meaning as an **investment proposal**. In a broader sense it can be defined as a **set of activities which can be planned and carried out towards achieving a development objective**. Resources which could have been used to provide items for consumption now are instead diverted into activities for producing items for consumption later, the intention being to increase future consumption levels above what they otherwise would be or to achieve a qualitatively different pattern of consumption.

Various stages are generally distinguished in a project cycle:

a) **Identification**: A diagnostic analysis is carried out, development requirements and opportunities and provisional objectives are established and an outline of an investment concept is drawn.
b) **Preparation**: A feasibility study is conducted, detailed design and necessary inputs are specified.
c) **Appraisal**: Technical, managerial, institutional, financial and economic viability are closely examined together with the expected environmental and social effects.
d) **Implementation**: Capital investment takes place and operations start.
e) **Monitoring**: The project is monitored during implementation. It requires the collection, analysis and utilisation of information to ensure that work plans are being achieved and objectives obtained as planned or that adjustments are made.
f) **Evaluation**: This is a systematic examination of a completed (sometime on-going) project with the aim of determining its efficiency, effectiveness, impact, sustainability and developmental value. Lessons from all stages should be incorporated into similar investments in the future.

(Readers interested in the formulation of agricultural and rural investment projects (stages a) to c)) will find valuable information in FAO (1986), Gittinger (1982) and OECD (1988)).

THE CRITERIA TO JUDGE A PROJECT TO BE GENERALLY BENEFICIAL OR DETRIMENTAL SHOULD REFLECT NOT ONLY FINANCIAL AND ECONOMIC CONCERNS BUT ALSO TECHNICAL, MANAGERIAL, INSTITUTIONAL, ENVIRONMENTAL AND SOCIAL (INCL. GENDER) CONSIDERATIONS. SUCH ANALYSES SHOULD BE INTEGRAL TO ALL STAGES OF THE PROJECT CYCLE BECAUSE DECISIONS ARE TAKEN AT EVERY STAGE.

Analyses can therefore be of three types:

- **ex-ante** (before the project takes place) this occurs during the stage of project appraisal
- **simultaneous** (during the project implementation) this occurs during the stage of project monitoring
- **ex-post** (after the project has taken place) this occurs during the stage of project evaluation

Financial and economic analyses should be considered within the broader project framework and it should be clear that although the present manual is focusing on the above mentioned analytical methods, these do have limitations and incorporation of other criteria is necessary. (This issue will be discussed further ahead).

1.3. Characteristics of agricultural development projects

Certain characteristics which are far more frequent in agricultural development projects are listed hereafter (drawn from Jahnke, 1974):

- There are various possibilities to attain a given objective: eg. increased meat production can be achieved either by developing traditional pastoral systems or ranches.
- The possibilities offered have often fundamental differences in terms of requirements and effects: eg. ranches are more capital intensive and less labour intensive relative to traditional systems; development of traditional systems increases the income and labour opportunities of the local population.
- There are many project participants and therefore many different objectives: eg. the government, producers, consumers, extension services, traders etc.
- The linkages between the project, the agricultural administration and producers are very important.
- A project affects the whole rural system. Since this is complex it is difficult to foresee all the elements which can influence a project.
- Projects often concern regions which are heterogeneous in terms of infrastructure, natural, social or cultural environment etc.
- Agricultural projects often create public goods and services for which there is no clear market to value the output: a road is built to reach the project village and this could trigger additional effects.

For the reasons given above, it is particularly difficult to analyse an agricultural project. One can therefore make the following conclusions:

- It is very important to proceed systematically
- The complexity of data reduces the interest of estimating optimal solutions. It is recommended to compare between various projects.
- Project appraisal should be understood as an iterative process.

1.4. Financial and economic analysis

Private and social cost-benefit analyses are first to be distinguished. A **private analysis** looks at the issue from the point of view of an **individual entity** which participates in a project (producer, firm etc.) whereas a **social analysis** looks at the issue from the point of view of the **society** or the nation i.e. it aggregates the effects over many entities[1]. In the veterinary sector for example, this distinction can be illustrated by treatments delivered through government services. The livestock owner is charged for the drugs but not for the cost of the delivery system (the veterinary services). If the producer is the unit of reference, only the drugs should be accounted for; if the nation is the reference, both the drugs and veterinary services are to be valued.

The second point to define is financial versus economic analysis. A **financial analysis** identifies **the money profit** accruing to the project operating entity (Squire and van der Tak, 1975) but can also take into account non-cash receipts and payments (produce grown for home consumption, barter transactions etc.). This analysis is done using **market prices** which are the **actual prices** at which goods and services are traded in a generalized system of exchange. In contrast, **economic analysis** uses **shadow prices** (also referred to as accounting or efficiency prices). In effect, using shadow rather than market prices is one of the ways in which emphasis is given to social rather than private analysis, or to economic rather than purely financial calculations. Shadow prices basically **eliminate distortions** which appear in market prices. These are apparent in imperfect markets -where the laws of supply and demand do not function perfectly- such as those in most developing countries. When the market price is altered to make it more closely represent the opportunity cost -the value of a good or service or capital in its best alternative use- to the society, the new value assigned becomes the shadow price (Gittinger, 1982). An example would be: the consumer market price of pesticides is 0.5 US$/l and the state subsidises this input at the rate of 0.2 US$/l. The subsidies which are a transfer of funds from taxpayers to consumers represent a cost to the society. The shadow price of the pesticide is therefore 0.7 US$/l (0.5 US$/l born by consumers plus 0.2 US$/l born by taxpayers).

In project analysis costs and benefits are only meaningful in relation to the party whose point of view is considered and the objective(s) to be achieved. No formal analytical system for project analysis could possibly take into account all the various objectives of every participant in a project. Some selection will have to be made. In the analytical system here, we will take as formal criteria very

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[1] We use the word social as related to 'society'. Some authors (eg. Squire and van der Tak, 1975) use the word social when they include in their analysis an appreciation of distribution of income between the rich and the poor.

straightforward objectives of income maximisation and accommodate other objectives at other points in the process of project selection. The justification for this is that in most developing countries increased income is probably the single most important objective of individual economic effort, and increased national income is probably the most important objective of national economic policy (drawn from Gittinger, 1982). The question of the objectives, particularly of increased national income will be further discussed in chapter 3.6. "Limitations and criticism of cost-benefit analysis". For the moment we will follow the methodology developed on the basis of the above mentioned objectives.

Economic analysis is important in countries where market prices have been distorted by heavy reliance on protective trade policies. It is equally important in countries where people are kept unemployed because of minimum wage legislation and union pressure make the abundant labour too expensive and because subsidised interest rates, concessionary taxes on imported capital equipment and accelerated depreciation allowances make scarce capital too cheap. These policies also distort market prices, so that calculations of private profit do not reflect the profit or loss to the country as a whole. Shadow prices reflect the true value to the country of its resources.

If the project is not financially viable but has a positive net economic value, it implies that economic policy changes regarding exchange rate, subsidies, market prices (if price controls are imposed), taxes and/or tariffs will be required to make the project financially viable as well. Conversely, if it is financially viable but economically unacceptable, the project must be rejected, or redesigned if possible (Hansen, 1978). Differences between financial and economic analysis will be explained further through examples.

The procedures used in financial and economic cost-benefit analyses are identical once the prices have been differentiated (between market and shadow prices) since both are based on so-called discounted cash flow analysis. This procedure will be explained in the next chapter.

2. FINANCIAL ANALYSIS

2.1. Introduction

Farm investment analysis is somewhat similar to, and sometimes confused with, farm management analysis such as farm income analysis and funds flow analysis (Gittinger, 1982). It is therefore important to differentiate these three types of analyses which are all valid but used for different purposes. The various components of the analyses and techniques should be distinguished to avoid mistakes in applying the methods. Table 2.1 presents an overview of the characteristics of the three types of analyses which are explained in the following sections. The sections dealing with farm income analysis and funds flow analysis are drawn from Dillon and Hardaker (1984) and the one on farm investment analysis is based on Gittinger (1982).

TABLE 2.1 DIFFERENCES BETWEEN FARM INCOME ANALYSIS, FUNDS FLOW ANALYSIS AND FARM INVESTMENT ANALYSIS *(source: Gittinger, 1982).*

Item	*Farm income analysis*	*Funds flow analysis*[a]	*Farm investment analysis*[b]
General objective	Check current performance of farm	Check farmer's liquidity	Check attractiveness of additional investment
Period usually analyzed	Individual years	Loan repayment period	Useful life of investment
Prices used	Current prices	Current prices	Constant prices
Treatment of capital	Annual depreciation charge	Cash purchases and sales	Initial investment, residual value
Off-farm income	Excluded	Cash portion included	Cash and noncash included
Home-consumed farm production	Included	Excluded	Included
Performance criteria	Return to capital and labor engaged on farm	Cash available to farm family	Return to additional resources engaged
Time value	Undiscounted	Undiscounted	Discounted
Performance indicators	Profit as a percentage of net worth, family income	Cash surplus or deficit	Net present worth, internal rate of return, benefit-cost ratio, net benefit-investment ratio, net benefit increase

a. Also called sources-and-uses-of-funds analysis.
b. Benefit-cost analysis of on-farm investments.

2.2. Farm income analysis

The objective of this type of analysis is to check the current performance of the farm by calculating the net farm income. This is calculated over a single-period, usually a year, by the following procedure:

Net farm income = gross farm income - total farm expenses

The **gross farm income** is defined as the value of the total output of the farm for the accounting period, whether that output is sold or not. It is also referred to as gross output or gross return. It includes output:

- sold
- used for household consumption
- used on the farm (seed, livestock feed etc.)
- used for payments in kind
- in store at the end of the accounting period

The **total farm expenses** (or total farm costs) are defined as the value of all inputs used up or expended in farm production for the accounting period with the exclusion of family labour. Farm expenses include both cash and non-cash items (value of goods and services paid for in kind or advanced on credit). Farm produced inputs (such as seed and livestock feed) should also be included as farm expenses. Where capital inputs such as machinery are used, a depreciation allowance should be included so as to allow for the fall in value of the asset through use during the period being assessed. Interest on capital, whether owned by the farm family or borrowed, is not included.

The net farm income measures the reward to the farm family for their labour and management and the return on all capital invested in the farm, whether borrowed or not. It is therefore a measure of farm profitability that can be used to compare the performance of farms. Because interest is excluded, comparisons are not confounded by differences in level of indebtness.

By deducting the value of various components of the resources rewarded by the net farm income, the return to the remaining resources can be calculated as explained in the next paragraphs.

Probably the most useful measure for appraising small farm performance is **net farm earnings.** This is computed from net farm income by deducting any interest paid on borrowed capital. It measures the total income earned from the farm for family purposes and is the reward to all family-owned resources used in farm production. Combining net farm earnings with any other household income, such as wage income or payments in kind from off-farm work, gives **family earnings** (or total household net income). If assessments of poverty or of income distribution are needed for policy or planning purposes, these should usually be made in terms of family earnings.

In semi-commercial farming, returns on capital may be a relevant criterion of farm performance. **Return to total capital** is calculated by deducting the value of family labour from net farm income. (For this purpose family labour is valued at prevailing wage rates). The resulting margin is normally expressed as a percentage of **the total farm capital** (i.e. the total value of the farm assets). Alternatively if, in addition, interest paid on borrowed capital is deducted from net farm income, and if the family owned share of farm assets is only considered, **the return to farm equity capital** can be calculated.

The **return to family labour** can be computed as net farm earnings less an imputed interest charge on farm equity capital. This profit can be divided by the number of family members working on the farm expressed as adult equivalents. We thus will obtain an estimate of **return per adult** which can be compared with ruling farm and non-farm wage rates.

Table 2.2 gives an example of farm income analysis.

TABLE 2.2 FARM INCOME ANALYSIS *(source: Dillon and Hardaker, 1984).*

Item	Cash	Kind	Inventory	Total
	($)	($)	($)	($)
Gross farm income				
Crops [a]	5 160	715		5 875
Cattle [b]	283	428	200	911
Total	5 443	1 143	200	6 786
Less variable expenses	1 020			1 020
Total gross margin	4 423	1 143	200	5 766
Overhead expenses:				
Rent and land tax	60			60
Permanent labour	1 800	750		2 550
Depreciation of improvements, buildings and machinery			241	241
Total	1 860	750	241	2 851
Net farm income	2 563	393	—41	2 915
Less interest paid	52			52
Net farm earnings	2 511	393	—41	2 863
Plus off-farm earnings	3 180	500		3 680
Family earnings	5 691	893	—41	6 543

[a] Net of share to land owner.
[b] Net of purchases

2.3. Funds flow analysis

When a change in farm organization or methods is being contemplated that will take some considerable time to implement, a budget covering several accounting periods is required. This procedure is used in funds flow and farm investment analysis. Long run planning is more difficult than short run planning because of the increased uncertainties about prices, costs and rates of performance in the more distant future. A detailed technical programme of what is to be produced and when is combined with forecasts of future prices for inputs and outputs to draw up **a cash flow budget**. The essential feature of cash flow budgeting is that receipts and payments are accounted for at the time they are expected to occur. It can be constructed on an annual, quarterly or even monthly basis.

Funds flow analysis is used to establish the amount of capital or credit needed and schedule of repayments and to check the farmer's liquidity. Only items in cash are therefore included: transactions in kind and items for home consumption are excluded. Off-farm cash receipts and payments are included as they influence the farmer's liquidity. It is necessary to take explicit account of **inflation**. For this the analyst has to predict the rate of inflation on the various items and draw up the cash flow budget in **current (nominal) money values**. These refer to values, most often prices, which include the effects of inflation: past values or prices as actually observed and future values or prices as expected to occur (Gittinger, 1982). If it can be assumed that inflation will affect more or less equally the various components of receipts and payments, it may be simpler to draw up the cash flow budget in **constant (real) money values** and then to divide the cash surpluses or deficits by an index of inflation to convert them to current values before the finance budget is drawn up. Constant or real money values refer to values from which the overall effect of a general price inflation has been removed; they reflect the physical quantities of goods or actual amount of services whenever they appear in a series (Gittinger, 1982).

Table 2.3 presents the cash flow budget for funds flow analysis.

TABLE 2.3 CASH FLOW BUDGET FOR FUNDS FLOW ANALYSIS

	Years	Pre-project	1	2	3	4	5	6	7
	Receipts:								
+	Farm sales	50	114	138	178	184	191	198	206
+	Off-farm receipts	16	32	38	48	50	51	53	55
	Total receipts	66	146	176	226	234	242	251	260
	Payments:								
-	Investment costs	0	-200	0	0	0	0	0	0
-	Operating costs	-30	-80	-83	-85	-88	-91	-94	-97
	Total costs	-30	-280	-83	-85	-88	-91	-94	-97
=	**Net Cash flow**	**36**	**-134**	**94**	**141**	**146**	**152**	**157**	**163**
-	Household payments	-25	-50	-51	-53	-54	-55	-57	-59
=	**Cash surplus**	**11**	**-184**	**42**	**88**	**92**	**96**	**100**	**105**
+	Loan advanced	0	220	0	0	0	0	0	0
-	Loan repayments *(principal + interest)*	0	-32	-42	-88	-92	-83	-11	-12
=	**Balance**	**11**	**4**	**0**	**0**	**0**	**13**	**89**	**93**

2.4. Farm investment analysis

2.4.1. Major principles and application

Farm investment analysis (or cost-benefit analysis of on-farm investments) is undertaken to determine the attractiveness of a proposed investment. It projects the effects on farm income of a particular investment and estimates the return to the capital engaged.

Market prices -prices actually paid or received- are used throughout but **non-marketed items are** also **included** and valued in market prices: the effects on **non-cash items, home consumption and the cost of family labour and land are for instance included**. The effects on **non-farm income** and **expenditure** are also accounted for. The rationale for inclusion of these various items is that we are concerned with all the effects of the investment which affect the project participant (the farm-household in our case).

Examples:

- Home consumption: The wheat produced as a consequence of the project is partly sold and partly retained for family consumption. All the wheat produced is to be valued at the farmgate producer price, regardless of whether it is actually sold or not.

- Family labour: The farmer's son works on the family farm. The opportunity cost of labour (the best alternative work available) would be to work as a labourer for the local landlord. By having the son work on the family farm, the remuneration which could be earned by working for the landlord is forgone and is therefore to be used as his labour cost.
- Land: In the case of a cattle production project, a farmer uses some of his land to graze cattle. The opportunity cost of this land to the farmer would be its best alternative use: the farmer could rent out the land for 100 Rupees/year. This is the cost of the land to be accounted for.

Inflation: Values are expressed in **constant terms** meaning that the effect of inflation is eliminated. This is justified on the grounds that one can assume that prices of inputs and outputs rise together and if all values are given in constant terms, only the real -physical or actual- quantities or amounts are being accounted for.

Residual value: In investment analysis we do not amortize capital investments to include these as costs for the period considered as in farm income analysis. The capital investment is a cost which has to be paid for in full when the purchase actually takes place (generally at the beginning of the project). If, at the end of the project period, we consider that the capital investment is still worth something, this residual value is entered as a benefit in the final year.

Example:

A tractor worth 100,000 Frs. is required for the project which lasts 5 years. The 100,000 Frs. outlay is put down as a cost in year 0 (the use of year 0 is explained further ahead under accounting convention). In year 5, the residual value of the tractor is estimated at 50,000 Frs. and this figure is put down as a benefit in that final year. This figure of 50,000 Frs. is the value of the tractor obtained by assuming that the tractor's depreciation is 10,000 Frs. per year.

Incremental values: One generally refers to the situation with and without project and the incremental values are obtained as the difference between these situations (see also Table 2.5). When carrying out an investment analysis the analyst is concerned **with the incremental costs and benefits** which arise from the investment. It is therefore only the return on that investment which is examined, not the profitability of the entire production system as such before or after the investment.

Example:

Even if it is profitable to use fertilizers to grow millet on marginal land (incremental revenues from fertilizer use > incremental costs of using fertilizers), it might not be profitable to grow millet on such land regardless of using fertilizers or not (costs of millet production without fertilizers > revenues from millet production without fertilizers and costs of millet production with fertilizers > revenues from millet production with fertilizers). To analyse the profitability of producing millet, we would have to consider millet production as the investment. In this case all the costs and the revenues from millet production would be considered as incremental and therefore accounted for. It might in fact be wise to add such an analysis of the production system before going ahead with an investment which seems promising.

Discounting: We saw under point 2.2 that it was possible to obtain an estimate of return on capital using farm income analysis. This gives a rough indication of return but lacks theoretical justification and can give misleading results because time is not adequately taken into consideration. The more rigorous method of investment analysis is based on the procedure of **discounting.** It is widely recognized that a monetary unit (say a Franc) paid out or received today is more valuable than the same sum paid or received in the future. This difference in value need have nothing to do with inflation. Instead, it reflects **the opportunity cost of capital** which is the forgone value of capital invested in its best alternative. Thus, 1 Fr. available today could be invested at the going interest rate of, say, 5%, so that in one year from now it would be worth (1 + 0.05) = 1.05 Frs. In n years, if left invested at the same rate of interest, it would have grown in value to $(1 + 0.05)^n$. This calculation is known as **compounding** and shows how a monetary unit available today can be converted to its equivalent value at some future time. In general, the value in year n, Cn, of some present sum P invested at an interest rate of i is given by $Cn = P \times (1+i)^n$. By simple algebra, this equation can be turned round to give the formula for discounting. That is, the value of a sum Cn paid or received in year n can be expressed in **present value** terms, when the interest rate is i, using the equation $P = Cn \times (1+i)^{-n}$. The merit of the discounting procedure is that it allows payments and receipts occurring at different times in the future to be converted to a common standard in terms of their present value. (Drawn from Dillon and Hardaker, 1984). **The principle of discounting is fundamental to investment analysis.**

The value of the opportunity cost of capital can be different according to the project participant we are considering. If looking from the point of view of an investor (bank, aid agency etc.) we will use the lending rate whereas the borrowing rate will be used in the case of the farmer who wants to finance an investment by taking a loan. In both cases, however, the discount rates will have to be net of any inflation effect since we are working in real terms. For example, if the nominal opportunity cost of capital per annum is judged to be 25% and the yearly inflation rate is expected to be 10%, the real annual interest rate to be used is 15%.

Determination of the appropriate discount rate can be at times difficult. As a rule of the thumb one considers the rate in real terms to be generally in the range between 8% and 15% per annum for agricultural projects in developing countries. Since most criteria require fixing the opportunity cost of capital (see point 2.4.2) in case of uncertainty, the value of the opportunity cost can also be varied through sensitivity analyses which are used to assess the effects of such changes.

Accounting convention: The discounting process used in discounted cash flow analysis implicitly assumes that every transaction falls at the end of the accounting period. Year 0 is generally used for capital goods which should be available at the moment the project starts. This could be the tractor required for cropping operations: in the cash flow table the tractor purchase will take place in year 0 (31st December) and incremental work and production can start in year 1. Increases in operating cost and incremental benefits will therefore fall in year 1.

Time adjusted phasing: If all transactions are considered to fall at the end of the accounting period, then we must allow for the availability of the needed operating expenditure at the beginning of the cropping season. This is accomplished by incorporating in the analysis an entry for incremental working capital at the end of the preceding year. The amount of the working capital needed is related to the farming system being analysed. If a single annual crop is produced, then nearly all the operating expenditure will be needed at the beginning of the crop year. But if two crops are to be produced in succession, only the operating expenditure of the first crop need be on hand at the beginning of the crop year, since there will be a harvest during the year which will provide proceeds to replace the input supplies needed before the second crop is harvested. Thus, only half the total annual operating expenditure need be on hand at the beginning of the year. The incremental working capital needed (either an increase or a decrease) at the beginning of the year, then, is entered at the end of the year preceding the year when it will be expected for production. In the final year, the incremental working capital is recovered. Under traditional accounting procedures, working capital requirements are often forgotten and cause liquidity problems in project financing. (Drawn from Schaeffer-Kehnert

1980). A set of recommended adjustments in incremental operating expenditure to obtain incremental working capital is given in Table 2.4.

TABLE 2.4 INCREMENTAL WORKING CAPITAL AS A PERCENTAGE OF INCREMENTAL OPERATING EXPENDITURE *(source: Schaefer-Kehnert, 1980).*

Item	*Percent*
Tree crops (slowly maturing, one harvest season)	100
Annual crops	
One season	80–100
Two seasons	40–60
Continuous cropping and continuously producing livestock enterprises	20–40

An example of time adjusted phasing using a 80% incremental working capital for one season annual crop production is provided in Table 2.5.

TABLE 2.5 CONVENTIONAL AND TIME ADJUSTED CASH FLOW COSTS FOR ONE SEASON ANNUAL CROP PRODUCTION

Item	**Without project**	**Project year 0**	**1**	**2**	**3**	**4**	**5**
Conventional phasing							
Operating costs	-200	-200	-500	-700	-700	-700	-700
Incremental operating costs		0	-300	-500	-500	-500	-500
Times adjusted phasing							
Costs:							
Operating costs	-200	-200	-500	-700	-700	-700	-700
Incremental operating costs		0	-300	-500	-500	-500	-500
Working Capital*		-240	-160	0	0	0	0
Benefits:							
Recovery of Working Capital **		0	0	0	0	0	400

* 80% of annual increments in operating costs projected for the following year (year 0: 80% x 300; year 1: 80% x 200)

** The outflow of working capital (240 + 160) is recovered in the final project year.

2.4.2. Measures of profitability

Four criteria can be used for measuring profitability in a cost-benefit analysis: the Net Present Value, the Internal Rate of Return, the Benefit-Cost Ratio and the Net Benefit-Investment Ratio. These are explained and discussed in relation to their use. Their calculation is tedious by hand but nowadays financial calculators and microcomputer spreadsheet programmes offer formulas which rapidly calculate these values. Since most analysts will be using such tools we refer the readers to their calculator and software programme manuals for practical utilisation of these instruments.

Table 2.6 offers an example of investment analysis and calculation of the profitability criteria which are developed below.

TABLE 2.6 EXAMPLE OF INVESTMENT ANALYSIS AND CALCULATION OF PROFITABILITY CRITERIA

Item		**Project year**						**Present Value**
		0	**1**	**2**	**3**	**4**	**5**	
Incremental values (after time adjusted phasing, with residual value)								
Incremental benefits			400	600	800	1000	1000	
Residual value of investments							300	
Recovery of working capital							400	
Total benefits			*400*	*600*	*800*	*1000*	*1700*	
Incremental costs		-800	-300	-500	-500	-500	-500	
Working capital		-240	-160					
Total costs		*-1040*	*-460*	*-500*	*-500*	*-500*	*-500*	
Incremental Cash flow		**-1040**	**-60**	**100**	**300**	**500**	**1200**	
Profitability criteria								
Net Present Value =	**300**							
Incremental Cash flow discounted at 10%		*-1040*	*-55*	*83*	*225*	*342*	*745*	*300*
Internal Rate of Return =	**17%**							
Benefit-Cost Ratio =	**1.10**	(3199/2899)						
Incremental benefits discounted at 10%		*0*	*364*	*496*	*601*	*683*	*1056*	*3199*
Incremental costs discounted at 10%		*1040*	*418*	*413*	*376*	*342*	*310*	*2899*
Net Benefit-Investment Ratio =	**1.27**	(1395/1095)						
Net benefit discounted at 10%		*0*	*0*	*83*	*225*	*342*	*745*	*1395*
Net Investment discounted at 10%		*1040*	*55*	*0*	*0*	*0*	*0*	*1095*

NET PRESENT VALUE (NPV)

This is the discounted value of the incremental cash flow and represents the value generated by the project in monetary units of today. To calculate the NPV (also referred to as Net Present Worth), the determination of the appropriate discount rate is required.

The formal selection criterion is to accept all independent projects with a NPV > 0. For mutually exclusive projects, the one with the highest NPV will be accepted. (Independent projects are not mutually exclusive; mutually exclusive projects are of a kind that implementing one necessarily precludes implementing another).

The NPV is the preferred selection criterion for mutually exclusive projects.

An obvious problem of the NPV is that the selection criterion cannot be applied unless there is a relatively satisfactory estimate of the opportunity cost of capital.

No ranking of acceptable, alternative independent projects is possible because the NPV is an absolute, not relative, measure: it does not give any indication of the profit relative to the investment required. A small, highly attractive project for instance may have a smaller NPV than a large, marginally acceptable project.

INTERNAL RATE OF RETURN (IRR)

This is the discount rate which makes the NPV exactly zero and represents the rate of return to the capital invested in the project. It is the maximum interest rate that a project could pay for the resources used if the project is to recover its investment and operating costs and still break even.

The formal selection criterion is to accept all independent projects having a IRR > or = i, where i is the opportunity cost of capital.

An advantage is that the IRR is readily understood by people not familiar with financial or economic analyses since the IRR can simply be compared to the interest rate with which everybody is familiar.

Since the opportunity cost of capital might be tricky to estimate (what is the rate of return of the best investment alternative for a farmer in Bhutan ?), the IRR offers a solution as it is the only criterion for which one does not have to fix the opportunity cost of capital beforehand.

The World Bank has tended to use the IRR as its principal discounted measure because the IRR avoids making a close comparison of the opportunity cost of capital in the Bank's various member countries or setting a worldwide opportunity cost of capital. The IRR is also widely used by other major international agencies.

If the sign of the incremental cash flow changes once only (commonly from negative in the early years to positive later) there will be a unique IRR but if the sign changes more than once there may be more than one IRR (Figure 2.1 and 2.2). In such cases one cannot use the IRR criterion.

FIGURE 2.1 INCREMENTAL CASH FLOW OF A PROJECT WITH THREE SOLUTIONS FOR THE INTERNAL RATE OF RETURN

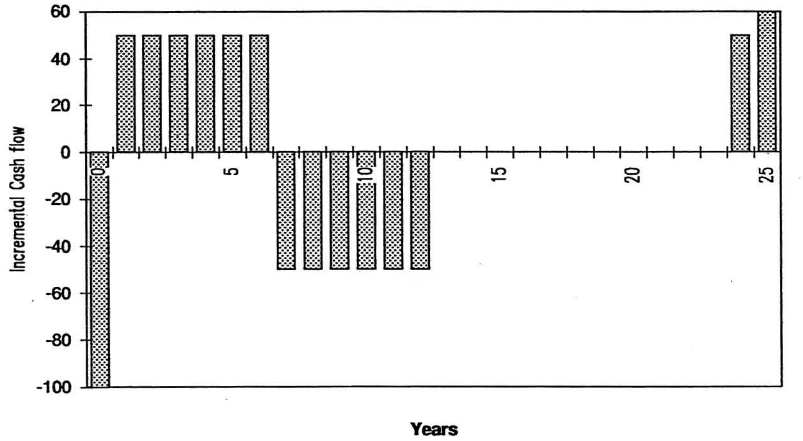
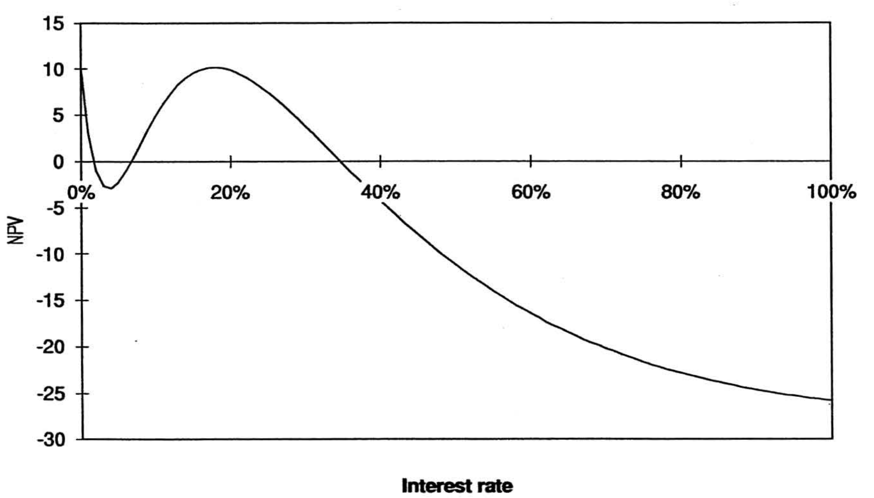


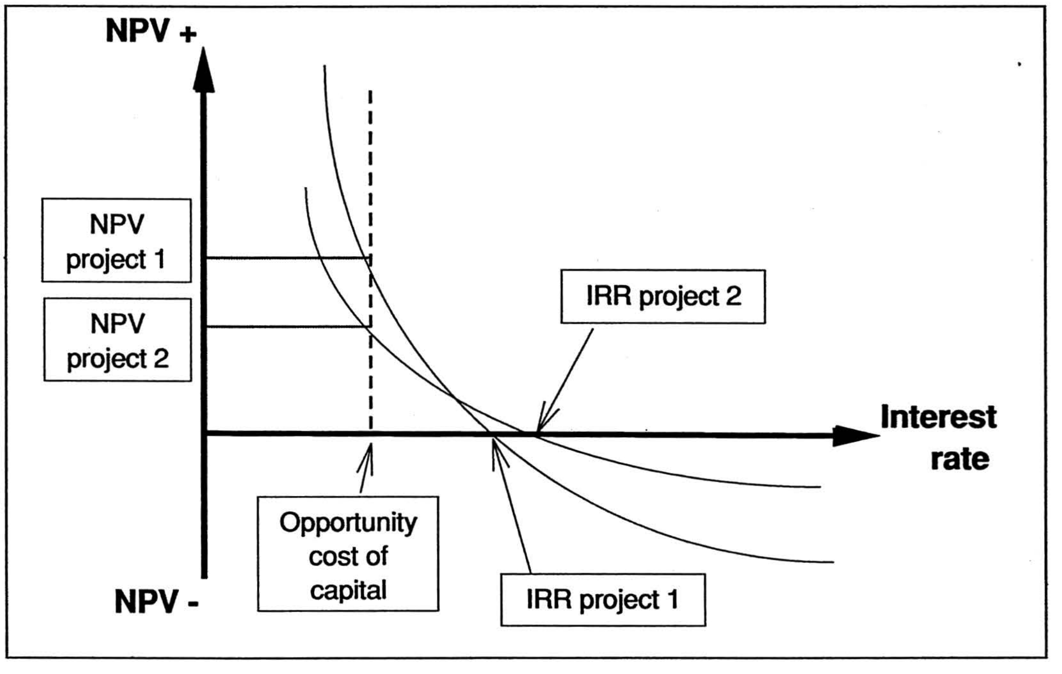
FIGURE 2.2 NET PRESENT VALUE AND INTERNAL RATE OF RETURN OF A PROJECT WITH THREE SOLUTIONS FOR THE INTERNAL RATE OF RETURN

IRR: 1.5%, 7% and 35% !



In the case of mutually exclusive projects, direct comparison of IRR can lead to an erroneous investment choice. This danger can be avoided by using the NPV. This is illustrated in Figure 2.3: project No2 has a higher IRR than project No1 but then if one uses the NPV criterion with the given opportunity cost of capital, the projects show the opposite ranking.

FIGURE 2.3 PROJECT RANKING FOR MUTUALLY EXCLUSIVE PROJECTS BASED ON NET PRESENT VALUE AND INTERNAL RATE OF RETURN CRITERIA



BENEFIT-COST RATIO (BCR)

This is the present value of the benefit stream divided by the present value of the cost stream.

The formal selection criterion is to accept all independent projects having a BCR > or = 1 which means that the present value of benefits is larger or equal to the present value of the costs.

The ratio will depend on the opportunity cost of capital which will have to be fixed beforehand: the higher the opportunity cost, the lower the ratio.

One convenience of the BCR is that it can be used directly to note how much the present value of costs could rise without making the project financially unattractive. For instance, if the BCR is valued at 1.48 this means that the present value of costs could increase by 48% before the BCR reaches 1. With a little manipulation we can tell that benefits could fall by 32% before driving the ratio down to 1 ([1-(1/1.48)] = 0.32).

The BCR is not commonly used in developing countries because the value of the ratio will change depending on where the netting out in the cost and benefit stream occurs. Netting out refers to the classification of various project components. Gittinger (1982) shows that the ratio (BCR) is different if, for instance, production costs are considered as costs (denominator) or are subtracted from the benefits (numerator).

In the case of mutually exclusive projects, direct comparison of BCR can lead to an erroneous investment choice. The BCR discriminates against projects with relatively high benefits and operating costs, even though it may be shown to have a greater wealth-generating capacity than that of alternatives with higher BCRs. This danger can again be avoided by using the NPV.

NET BENEFIT-INVESTMENT RATIO (NKR)

This is the present value of the net benefit divided by the present value of the net investment. The net benefit is taken as the NPV of the aggregate cash flow in those years after the stream has turned positive, and the net investment is taken as the NPV of the aggregate cash flow in those years of the project when the stream is negative.

The formal selection criterion is to accept all projects with a NKR > or = 1.

Fixing the adequate opportunity cost of capital is again required prior to the analysis.

Similar to the BCR, the NKR can be used to visualise immediately the proportion of discounted increased net investment costs (or discounted decreased net benefits) which can be sustained before a project reaches its break-even point.

We have seen that neither the NPV, IRR or BCR can be relied upon to rank independent projects: the formal selection rule for each is to accept all projects that meet the criterion. Yet in many instances it is convenient to have a reliable measure to rank projects to determine the order in this should be undertaken. This case arises when sufficient funds are not available to implement all projects. Selecting independent projects in the order of their NKR maximizes the return per unit of available investment. This in turn maximizes the NPV of the group of projects chosen, and thus maximizes the income stream that is the objective of the programme of project investment.

The NKR has been infrequently used in project analysis, perhaps because it is common practice to rank projects using the IRR or the BCR (although incorrect). As the limitations of these other measures for ranking projects become better appreciated it is probable that the NKR or some close variant will become more widely used.

In a nutshell, we recommend the use of the NPV in the case of mutually exclusive projects, the NKR to rank independent projects and the IRR for cases where determining the opportunity cost of capital is a problem.

Table 2.7 presents a summary of the four measures of project selection.

TABLE 2.7 COMPARISON OF DISCOUNTED MEASURES OF PROJECT WORTH (*source*: *Gittinger, 1982*).

Item	*Net present worth (NPW)*	*Internal rate of return (IRR)*	*Benefit-cost (B/C) ratio*	*Net benefit-investment (N/K) ratio*
Selection criterion	Accept all independent projects with NPW of zero or greater when discounted at opportunity cost of capital (see "Mutually exclusive alternatives," below)	Accept all independent projects with IRR equal to or greater than opportunity cost of capital	Accept all independent projects with B/C ratio of 1 or greater when discounted at opportunity cost of capital	Accept all independent projects with N/K ratio of 1 or greater when discounted at opportunity cost of capital in order of ratio value until available investment funds are exhausted
Ranking	Gives no ranking for order of implementation	May give incorrect ranking among independent projects	May give incorrect ranking among independent projects	May be used to rank independent projects
Mutually exclusive alternatives	Accept alternative with largest NPW when discounted at opportunity cost of capital (NPW is the preferred selection criterion for mutually exclusive alternatives)	Cannot be used directly; must discount differences between incremental net benefit flows of mutually exclusive alternative projects	Cannot be used directly	Cannot be used directly
Discount rate	Must determine a suitable discount rate, generally the opportunity cost of capital	Determined internally; must determine opportunity cost of capital to use as a cut-off rate	Must determine a suitable discount rate, generally the opportunity cost of capital	Must determine a suitable discount rate, generally the opportunity cost of capital

3. ECONOMIC ANALYSIS

3.1. The notion of cost-benefit analysis

Strictly speaking, the term cost-benefit analysis has to do with social or economic analyses only. The term was first used in 1936 in Section 1 of the Flood Control Act of the United States:

'It is hereby recognized that destructive floods upon the rivers of the United States, upsetting orderly processes and causing loss of life and property, including the erosion of lands, and impairing and obstructing navigation, highways, railroads, and other channels of commerce between the States, constitute a menace to national welfare; that it is the sense of Congress that flood control on navigable waters or their tributaries is a proper activity of the Federal Government in cooperation with the States, their political sub-divisions, and localities thereof; that investigations and improvements of rivers and other waterways, including watersheds thereof, for flood control purposes are in the interest of the general welfare; that the Federal Government should improve or participate in the improvement of navigable waters or their tributaries, including watersheds therefore, for flood control purposes if the benefits to whomsoever they may accrue are in excess of the estimated costs, and if the lives and social security of people are otherwise adversely affected.'

The operative words are 'if the benefits to whomsoever they may accrue are in excess of the estimated costs,' and that standard soon was generalized to apply to a wide variety of public investment activities and led to a new branch of applied economics. The terms of 'benefits' and 'costs' are nowhere defined in the act and this induced number of discussions. Although economists have come closer to defining these terms and improving the methodology, discussions still go on and this demonstrates the inadequacy of a simple economic criterion for guiding political and social decisions (one could contend that non economic considerations are also contained in the act: 'if the lives and social security of people are otherwise adversely affected'). (Drawn from Dorfman, 1976).

3.2. The rationale of cost-benefit analysis

The basic economic problem facing all countries is that of allocating inherently limited resources (such as labour, capital, land, and other natural resources, as well as foreign exchange) to a variety of different uses (such as current production of consumer goods and public services as against investment in infrastructure, industry, agriculture, or other sectors of the economy) in such a way that the net benefit to society is as large as possible. (Squire and van der Tak, 1975). This is precisely the objective of cost-benefit analysis.

The most obvious justification or principle behind cost-benefit analysis is to regard the formula prescribed by the Flood Control Act as a non technical way of expressing what economists refer to as the Kaldor-Hicks (or potential Pareto improvement) criterion which greatly influenced welfare economics (Mishan, 1976). A Pareto improvement is a social change from which at least one person gains and nobody loses and a Kaldor-Hicks improvement is a change which would enable the gainers to compensate the losers while continuing to gain themselves. Since the compensation need only be hypothetical, a Kaldor-Hicks improvement offers only a potential Pareto improvement (Layard and Walters, 1987).

3.3. The methods used in cost-benefit analysis

There are two basic approaches to economic analysis in project formulation:

- the "shadow pricing" method and
- the "effects" method

They are both aimed at answering the same basic questions and are equally valid (FAO, 1986) but we will be concentrating on the shadow price method since it is by far the best documented and most widely applied.

3.4. The shadow price method

3.4.1. Principles

The essence of a cost-benefit analysis is that it does not accept that actual receipts adequately measure social benefits, and actual expenditures social costs. But it does accept that actual receipts and expenditures can be suitably adjusted so that the difference between them, which is therefore very closely analogous to ordinary profit, will properly reflect the social gain. (Little and Mirlees, 1974). The prices used, after such adjustments have been made, are called shadow prices.

Benefits are defined relative to their effect on the fundamental objectives of the society; costs are defined relative to their opportunity cost, which is the benefit forgone by not using these resources in the best of the available alternative investments that cannot be undertaken if the resources are used in the project. (Squire and van der Tak, 1975). Defining the objectives is therefore crucial since benefits will be set against this background. Where the project evaluation is not called upon to assess the benefit of the output, cost-benefit analysis becomes what is sometimes called 'cost-effectiveness' analysis.

Raising the present standard of living and to allocate investment to achieve higher growth rate of the economy and thus increase the future consumption is a fundamental strategic objective of the national development policy of any country; the national income is the only source for increasing both consumption and savings, it is a basic quantitative measure of the level and rate of increase in national welfare (UNIDO, 1986). (National income is basically defined in economics as consumption plus savings).

By defining our objectives for economic analysis in terms of change in national income, we are defining it in real terms. Real terms as opposed to money terms, refer to the physical, tangible characteristics of goods and services. We may say that in financial analysis our numeraire-the common measurement used as the unit of account-is the real income change of the entity being analysed valued in market prices and in general expressed in domestic currency. But in economic analysis since market prices do not always reflect scarcity values, our numeraire becomes the real, net national income valued in opportunity cost. (Drawn from Gittinger, 1982).

In a perfect market the shadow price for any resource would be its market price. In this ideal world, the price consumers are willing to pay for one more unit (its marginal value) would be exactly equal to the producer's cost of supplying it (the marginal cost[2]). If the resources were traded internationally, the market price would be equal the relevant border price (c.i.f. for importables; f.o.b. for exportables[3]). The price would not move higher, for consumers would import instead of paying more than the c.i.f. price to domestic producers; and it would not move lower, for producers would export rather than sell for less than the f.o.b. price on the domestic market (Hansen, 1978).

If a particular resource is very scarce (that is, many alternative uses are competing for that resource), then its shadow price, or opportunity cost (the

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2 Here and throughout the explanations on economic analysis, 'price', 'value' and 'cost' should be read to mean 'marginal price', 'marginal value' and 'marginal cost'. Unfortunately, in most cases, average rather than marginal prices for costs and values will have to be used because of a lack of information regarding elasticities of supply and demand at the margin. However, when such information is available, and where the impact of the project is significant in the total market for the input or output, the marginal price should certainly be used.

3 C.i.f. stands for cost, insurance and freight, it is the landed cost of an import on the dock or other entry point in the receiving country; f.o.b. stands for free on board, it is the price of an export loaded in the ship or other conveyance that will carry it to foreign buyers.

forgone benefit in the best alternative that must be sacrificed), will tend to be high. Market prices will often reflect this scarcity correctly, but there is good reason to believe that in less developed countries imperfect markets may cause a divergence between market and shadow prices. Such divergences are thought to be particularly severe in the markets for three important resources: labour, capital and foreign exchange. Resource availability, however, need not be the only constraints operating in the economy: political and social constraints may be equally binding (Squire and van der Tak, 1975).

Most notable publications on the subject include Mishan (1976) which contains much theoretical background, Little and Mirlees (1974) who first developed their methods for the Organization for Economic Cooperation and Development (OECD, 1969) and the United Nations Industrial Development Organization (UNIDO, 1972). Hansen (1978) presented a useful simplified version of the UNIDO method more oriented to practitioners. Although these books may differ in both emphasis and format, the general thrust of each is such that they may be regarded as a consistent body of literature on project of evaluation. (Squire and van der Tak, 1975). Squire and van der Tak (1975) favour the calculation of rates of return that take explicit account of the impact of the project on the distribution of income both between investment and consumption and between rich and poor and the authors therefore emphasize these aspects. These various analytical systems are far more complex than that prepared for the World Bank to evaluate agricultural projects (Gittinger, 1982). The latter does not have major conceptual differences up to the point the analysis is carried out (Gittinger, 1982); its strength lies in its practical approach, clarity and focus on agricultural problems.

3.4.2. Determining economic values (shadow prices)

The crux of economic analysis is the correction of financial prices into shadow prices. Determining these can indeed become quite complex. To quote Gittinger (1982), 'the analyst must therefore focus his attention on those adjustments that are likely to make a difference in the project investment decision. There is an important balance to be struck between analytical elegance and getting on with the job.' Hansen (1978) wrote similarly: 'It is easy to become so involved in the theoretical niceties of economic project appraisal that it is carried to the point where it produces only superfluous information instead of better investment decisions.'

As we have previously written, our aim is not to reproduce what others have developed and refined. We are therefore limiting ourselves to presenting in broad lines the principles and procedures to calculate shadow prices. This is hopefully enough to understand the principles of economic analyses of projects but is in no way sufficient to carry out such undertakings. To 'get on with the job', one has to have a good understanding and experience of the methods since a fair amount of judgement is required. As Hansen pointed out: 'However, a simple, uniform cut-off point for analytical detail cannot be established for all projects in all countries because needs vary too widely.' The methods cannot be applied as with a cookbook but solutions to specific problems can be found in the literature. Some of the details contained in the various reference books will be worth incorporating in the appraisal of some projects. Readers involved in the implementation of methods are therefore advised to consult these publications for full explanations.

Determining the premium for traded goods (foreign exchange premium)

We will express all economic values in domestic currency (the unit of reference or numeraire) and use a shadow price of foreign exchange to convert the price of items orginally expressed in foreign currency. The shadow exchange rate corrects the value of traded goods (goods actually imported or exported) to allow for the premium on foreign exchange arising from distorsions caused by import duties, taxes and tariffs, subsidies and other price distorsions to trade. (Drawn from Gittinger, 1982 and ODA, 1988). Such distorsions create macro-economic imbalances (balance of payment account, lower savings, higher imports, export disincentives etc.) which, for instance, structural adjustment programmes try to correct. In developing countries, there is often a shortage of foreign exchange, meaning that the demand for it exceeds the supply: the demand for foreign goods and services is greater than the supply of foreign currency needed to pay for them. Such excess demand arises when, on balance, the domestic price of foreign goods, and domestic goods which are or could be exported, are too low. It follows that foreign goods, and exportables, are on the average worth more to the economy than their domestic prices suggest: in other words they are undervalued relative to domestic resources. This is also often what is meant by saying that the exchange rate is overvalued. (Drawn from Little and Mirlees, 1974). By using a shadow exchange rate instead of the official exchange rate, international and domestic prices are made comparable. Distortions between these prices are corrected. To obtain the shadow exchange rate is, as Gittinger (1982) puts it, 'simple (and simplistic): ask the central planning agency'. Often however, the analyst will be forced to make his/her own estimate of the foreign exchange premium. This is also the premium on traded goods which people are willing to pay. By applying this premium, we are able to compare the values of traded and non-traded goods by the criterion of opportunity cost or willingness to pay (Gittinger, 1982). If this correction is not made, imported items would appear too cheap and domestic items too dear which would encourage overinvestment in projects that use imports.

The relation between the official exchange rate (OER), the foreign exchange premium (FX premium), the shadow exchange rate (SER) is perhaps easier to understand in equation form:

$$OER * (1 + FX\ premium) = SER$$

The prices of traded items expressed in foreign currency are then multiplied by the shadow exchange rate to obtain the corrected prices in domestic currency[4] (Drawn from Gittinger, 1982).

Although it is in general recommended that a different premium be calculated for each traded good, it is useful to have a figure giving a rough estimate for the various traded items. The foreign exchange premium is in simplified terms, the extent to which the domestic currency is overvalued towards the currency of the country which is the major trading partner.

Eg. In Ethiopia, in 1988, the domestic currency called the Ethiopian Birr (EB), was overvalued by about 40% towards the US$ (unofficial estimate by the World Bank). At the OER 1 US$ = 2.07 EB, at the SER 1 US$ = 2.9 EB (2.07 * 1.4).

Estimates of overvaluation can be obtained by using the differential inflation rate between domestic prices (approximated by the consumer price index) and foreign prices (based on the consumer price index of the major trading partner(s)-industrialized countries are often taken as a proxy for the major trading partner) or by discussing with economists working in the country considered. It should be noted that the parallel market rate (black market rate) is not necessarily a good estimate of the shadow exchange rate. Since foreign currency is most often not released on the market, it becomes scarcer than it really is; in addition, political uncertainty hikes up the cost of foreign currency since there is an increase in demand: people transfer their savings out of the country. In the case where only parallel and official rates are available, one could use as rule of thumb

4 If one wanted to convert the price of domestic items into foreign currency instead of the opposite as we do, one would multiply all domestic prices by the standard conversion factor (SCF) which is nothing else than SCF = OER / SER.

the average between the two rates to get a rough and ready estimate of the shadow exchange rate.

Determining the social discount rate

Probably the best discount rate to use is the opportunity cost of capital. It is the rate of return for public sector projects. Central authorities are increasingly attempting to establish a test discount rate or minimum rate of return and the advice of the national planning authority must be sought. Where there is no centrally determined discount rate, the analysis of recent project selection decisions may give an impression of what is regarded as acceptable. Jahnke (1976) writes that rates can reach in most developing countries 10% to 15%, Gittinger (1982) gives the range of 8% to 15% and ODA (1988) 8% to 12%. A second discount rate that might be chosen is the borrowing rate the nation must pay to finance the project. This is most commonly proposed when the country expects to borrow abroad for investment projects.

Adjusting financial price to economic values

This section draws extensively on Gittinger (1982). Major steps and decision trees for determining economic values are outlined in Figure 3. The explanations given hereafter refer to the decision trees.

The term intangibles (Figure 3, part A) refers to costs or benefits that, although having a value, cannot realistically be assessed in actual or approximate money terms. For the moment we will leave these aside to deal with the more straightforward tangible costs and benefits. Intangibles will be discussed under point 3.6.1 'Unquantifiable costs and benefits and externalities'.

The adjustments can be divided into three steps:

1) adjustment for direct transfer payments
2) adjustment for price distorsions in traded items
3) adjustment for price distorsions in non-traded items

STEP 1. ADJUSTMENT FOR TRANSFER PAYMENTS

The first step is to eliminate direct transfer payments (Figure 3, part B). These are payments that represent not the use of real resources but only the transfer of claims to real resources from one person in the society to another.

FIGURE 3, PART A. DECISION TREE FOR DETERMINING ECONOMIC VALUE: MAJOR STEPS

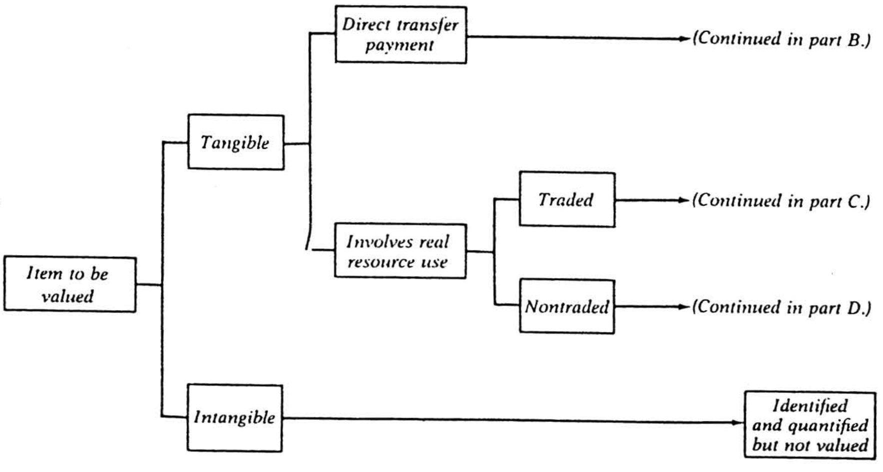


FIGURE 3, PART B. DECISION TREE FOR DETERMINING ECONOMIC VALUE: DIRECT TRANSFER PAYEMENTS

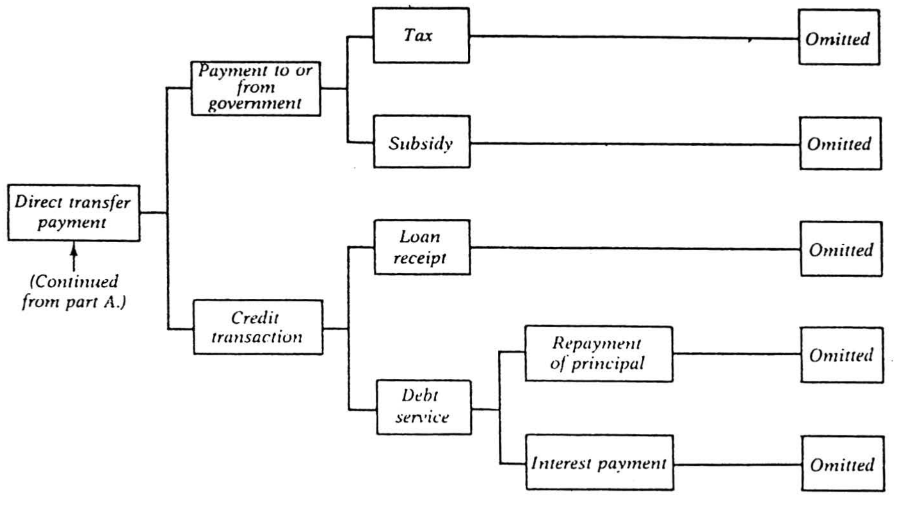


FIGURE 3, PART C. DECISION TREE FOR DETERMINING ECONOMIC VALUE: TRADED ITEMS

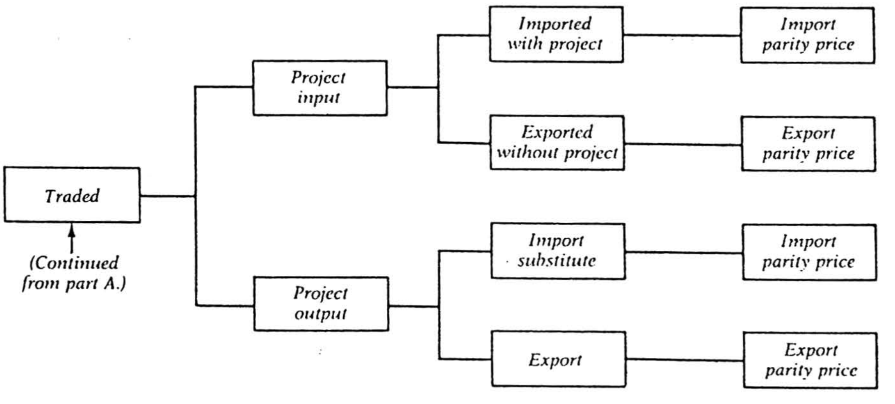
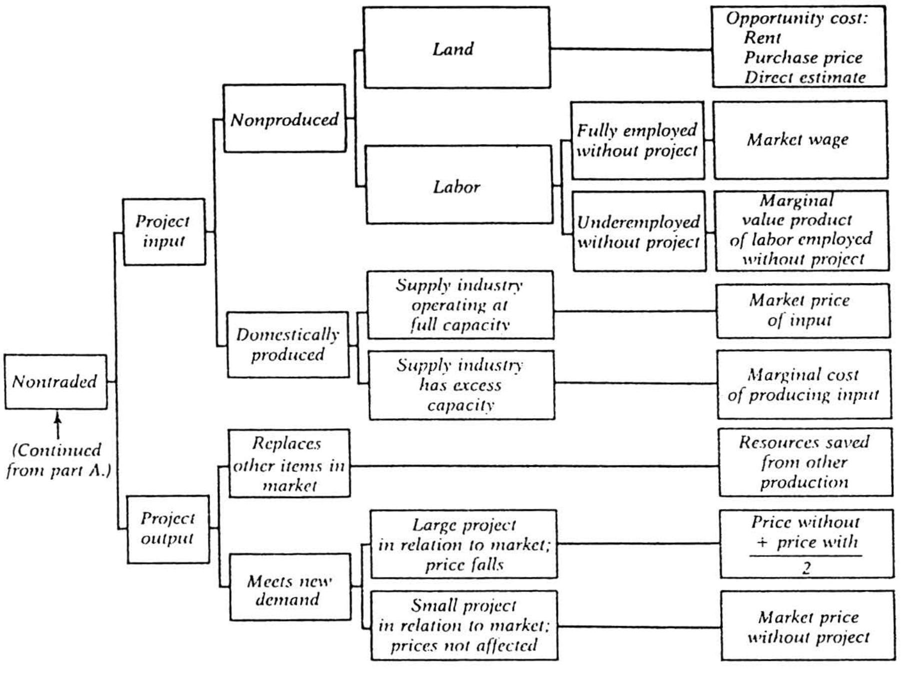


FIGURE 3, PART D. DECISION TREE FOR DETERMINING ECONOMIC VALUE: NONTRADED ITEMS



In agricultural projects, the most common direct transfer payments are taxes, subsidies, and credit transactions that include loans, receipts, repayment of principal, and interest payments. Two credit transactions that might escape notice are accounts payable and accounts receivable. All these entries should be taken out before the financial accounts are adjusted to reflect economic values.

Many important subsidies and taxes in agriculture operate not by means of direct payments but through mechanisms that change market prices. When adjusting the financial price of an item to its economic value these transfer payments should also be ommited before moving to the procedures outlined below for traded items (step 2) and non-traded items (step 3).

STEP 2. ADJUSTMENT FOR PRICE DISTORSIONS IN TRADED ITEMS

The second step in adjusting financial prices to economic values is the adjustment for distorsions in market prices of traded items (Figure 3, part C).

Traded items are those for which, if exports,

f.o.b. price > domestic cost of production,

or the items may be exported through government intervention by use of export subsidies and the like, and , if imports,

domestic cost of production > c.i.f. price

Conceptually -and usually in practice too- prices for traded items in project analysis are more easily dealt with than those for non-traded items. We begin the valuation by determining the border price. For imports, this normally will be the c.i.f. price and, for exports, normally the f.o.b. price. The border price is then adjusted to allow for domestic transport and marketing costs between the point of import or export and the project site (often the farmgate). This is the so-called import or export parity value. Algebraically, the import parity price at the farm gate is:

$$Pb = Pw + Tw + Td - Cd$$

and the export parity price is:

$$Pb = Pw - Tw - Td - Cd$$

<u>where:</u>

Pb is the border equivalent producer price (import or export parity price)

Pw is the world market price

Tw represents ocean freight and insurance charges

Td represents handling, transport and marketing charges from port to domestic market

Cd represents transport, processing and marketing charges from farmgate to domestic market

Many items that are locally produced incorporate a significant proportion of imported components and may be considered indirectly imported items. To determine either parity values or values for indirectly traded items involves valuing separately not only the traded component but the non-traded component as well.

If the proposed project produces something that can be used in place of imported goods-that is, if it produces an 'import substitute'-the value to the society is the foreign exchange saved by using the domestic product valued at the border price, in this case the c.i.f. price. But if the project uses items that might otherwise have been exported-that is, if it uses 'diverted exports'-then the opportunity cost to the society of these items is the foreign exchange lost on the exports forgone valued at the border price, this time the f.o.b. price.

If using the shadow exchange rate to allow for the foreign exchange premium, the economic value of a traded item will be obtained by converting the foreign exchange price to its domestic currency equivalent using the shadow exchange rate.

STEP 3. ADJUSTMENT FOR PRICE DISTORSIONS IN NON-TRADED ITEMS

The third step in adjusting financial prices to economic values is the adjustment for distorsions in market prices of non-traded items (Figure 3, part D).

Non-traded items are those for which

$$\text{c.i.f. price} > \text{domestic cost of production} > \text{f.o.b. price}$$

or the items are non-traded because of government intervention by means of import bans, quotas, and the like.

Often, non-traded items will be bulky goods such as straw or bricks, which by their very nature tend to be cheaper to produce domestically than to import but for which the export price is lower than the domestic cost of production. In other instances, non-traded items are highly perishable goods such as fresh vegetables and items for which domestic transport costs are very high such as commodities produced far inland (this is particularly relevant in countries with poor transport infrastructure such as in Africa).

If the market price of a non-traded item is a good estimate of the opportunity cost, or willingness to pay is the criterion, we will accept the market price directly as our economic value. Otherwise, we will adjust the market price to eliminate distorsions by the methods outlined in this section and then use the estimate of the opportunity cost we obtain as the shadow price to be entered in the economic accounts.

As pointed out earlier, prices for traded items are more easily adjusted to economic values than are prices for non-traded items. The following subsections treat some of the difficulties encountered.

- MARKET PRICES AS ESTIMATES OF ECONOMIC VALUE. In a perfectly competitive market, the opportunity cost of an item would be its price, and this price would also be equal to the marginal value product of the item. If a non-traded item is bought and sold in a relatively competitive market, the market price is the measure of the willingness to pay and is generally the best estimate of an opportunity cost. Most agricultural projects are expected to meet a growing demand for food or fibre and are small relative to the total agricultural production of the nation. If that is the case, in general we can accept the market price directly as our estimate of the economic value of a non-traded item. Also, if we are valuing a domestically produced project input that is produced by a supply industry operating near full capacity, we can generally accept the market price of the input as its economic value.

  In some instances more common in industrial and transport projects than in agricultural, the output of the project is large relative to the market. The output from the project may therefore cause the price to fall. But the economic value of the new production, despite the fall in price, is not lower to the old users of the product; to them, it is still worth what the price was without the project. Yet to new users, the project output is not worth what the old price was; otherwise, the price would not have fallen. Under these circumstances, the economic value of the new output is neither the old price nor the new; rather, it is estimated by some weighted average of the old and the new values. As a result most economists, when dealing with a project whose output is large relative to the market adopt a simplifying rule of thumb and take the new estimate of the average value in use or opportunity cost -hence, of economic value- to be the average of the price without the project and the lower price with the project.

Sometimes a project will be proposed that does not meet new demand but replaces other goods or services in the market. Again, this is more common in industrial and transport projects than in agricultural. In such situations, if the project accounts are cast on a with-and without basis, the economic value of the incremental net benefit stream would reflect only the saving from the new project compared with the old. This is because one of the costs of the new project would be the benefit forgone from the old production no longer realized and because one of the benefits would be the cost avoided for the old production. Such a case might arise, for instance, if an inefficient food processing plant were to be replaced by a more modern and efficient one. The analyst has to charge as a cost to the project the benefit forgone from the production of the old plant that is to be displaced.

Note that some non-traded items may involve using significant amounts of imported raw materials. These will be considered as indirectly traded items. Such items might include machinery assembled domestically from imported components or electricity that is generally non-traded but that may require imported generating equipment and traded fuels for production.

One non-traded item that can sometimes lead to confusion is insurance. At first glance, insurance might look like a transfer payment and thus would not be included in the economic accounts of the project but, to the extent an insurance cost represents sharing of risk, it represents a proportionate sharing of real economic cost and should be included in the economic accounts. The insurance rate is usually based on the probability of a real loss and the value of the item insured.

- VALUING LAND. The opportunity cost of land-the value of land in its best alternative use-should be taken as its economic value. One solution is to make a direct estimate of the productive capability of the land in its best alternative use. A straightforward approach is to take the gross value of the land's output at market prices and deduct from that all the costs of production-including allowances for hired and family labour and for interest on the capital engaged, again all at market prices. The analyst can assign the residual as the contribution of the land to the production of the output and take that as the opportunity cost of the land in financial terms. This set of computations can then be converted to economic terms by using economic values for each of the input and output entries. For those familiar with the technique, estimating a production function would provide a much more accurate estimate of the contribution of the land to the value of the output than the direct method described here and thus is a preferable approach. The economic value of land could be the purchase price but in many countries agricultural land is not sold at all, and, when it is, considerations of investment security and prestige may push its price well above what the land could reasonably be expected to contribute to agricultural production. In these instances, we will not want to accept the market purchase price as a good estimate of the economic opportunity cost of the land and must search for an alternative. This could be the rental value of land. A renter is not likely to pay any premium for prestige or investment security and thus will not pay a rent higher than the contribution the land can make to the crop he proposes to grow. The economic rental value can then be entered year by year as a cost.

- VALUING LABOUR. In most instances, skilled labour in developing countries is considered to be in rather short supply and would most likely be fully employed even without the project being considered. Hence, the wages paid to such workers are in general assumed to represent the true marginal value product of these workers, and the wages are entered at their market values in the economic accounts.

  The price of labour in a perfectly competitive market, like other prices in that impossible place, would be determined by its marginal value product. That is, the wage would be equal to the value of the additional product that one additional labourer could produce. It would pay a farmer to hire an additional labourer-for harvesting, for example-so long as that extra worker increased total output by a value more than the wage the farmer has to pay him. Market wage rates for unskilled labour in many developing countries may not accurately reflect the opportunity cost of shifting labour from its without-project occupation to its with-project use. For social reasons minimum market wage rates are set, unskilled government employees receive wages higher than their marginal value product or than what they would earn if working for a private entrepreneur etc.

  In many populated countries the labour opportunities are very restricted. If we take away a labourer from a farm community where he is producing very little or nothing and put him to work productively in an agricultural project that produces something of value, the society does not have to forgo very much to use this labour. We can therefore consider the cost of the labourer to be very low-some economists would say even zero. In such a situation, it is likely that

the rate of return on a labour intensive project will look very favourably in comparison to a capital intensive project which uses labour-saving machinery.
Even in labour abundant societies, there are probably peak seasons at planting and harvesting when most rural workers can find employment. At those seasons, the market wage paid for rural labour is probably a pretty good estimate of its opportunity cost and its marginal value product. On a year-round basis, one would have to weight the earning possibilities. E.g. most rural labourers find employment during the 25 working days of the two month harvest season at a wage of 10 Indian Rupees per working day. During the ten remaining months, these labourers find virtually no employment either on their own farm or otherwise and their contribution to the national income is therefore marginal (say 100 Rs). The opportunity cost of labour diverted to a new project would be 10 Rs per day if work is required during the harvest time but would be 600 Rs per annum if required all year through ((10 Rs * 50 working days during harvest) + 100 Rs for the work in the remaining months).
Similarly, the opportunity costs for a given professional category are likely to be different between regions, between regional and the national figures, between rural and urban location etc.
Opportunity costs of labour should also consider off-farm employment possibilities (including non-agricultural sectors) and account for remuneration in both cash and kind.

- EXCESS CAPACITY. In some projects, a domestically produced input may come from a plant that is not operating at full capacity. The opportunity cost of using the input in a new project is only the marginal variable cost of producing the input, and no allowance need to be made for the fixed capital cost of the plant itself. If the national cement industry is operating at less than its full capacity and it is proposed to line the project irrigation canals with cement, then the cost of the cement for the canals would be only the marginal variable cost of producing the cement. This would be less than the average cost of cement production, which would include some allowance for fixed costs of production.

- TRADABLE BUT NON-TRADED ITEMS. In the system of project analysis presented here, the project will be carried out within a framework of economic policies set by the government. The project analyst must make the best judgment about what those policies are and will be, not just what they ought to be, and work the economic analysis accordingly. This can lead to difficult choices when the analyst must evaluate the real effects on resources of a project that involves items that could be traded but probably will not be because of government regulation. These items, which are 'tradable but non-traded ' across national boundaries, are valued as non-traded.

Such items would usually be imported/exported were it not for an import/export quota or an outright ban that is enforced against them. For importables, their value may well rise above the prevailing price on the world market. The import restriction might be enforced to protect domestic industries, even though the imported item may be preferred by consumers. Import of foreign engines for tubewells, for example, may be forbidden so that domestic manufacture might be encouraged. Yet, the domestic equivalent may not be as efficient or as durable as the imported engine and may cost more to produce. The domestic engine clearly could not compete on the world market, and it would therefore be a non-traded item. For those few imported engines allowed to enter the country, the price may rise quite high. This indicates that to some buyer the imported item is worth more than its domestic equivalent. If our project will use one of these engines, the economic value is not a price based on the world market as if the engines could be relatively freely traded. Rather, it is the higher domestic market price of the imported engine, which indicates its high opportunity cost.

Similarly, export bans may drive the price of a product below what the price would be if the product were traded. Several years ago, Pakistani egg producers developed a brisk trade with the Persian Gulf states. The price of eggs rose, reflecting the world market price. To protect lower income urban consumers, the government imposed an export ban on eggs and the price fell well below the export price since domestic consumers were willing to purchase the additional eggs only if the prices were quite attractive. If we had been contemplating an egg production project at that time, and we judged that the government regulation forbidding export would continue in force, then the value of eggs taken for our analysis would have been the low domestic market price arising from the willingness to pay, not some price derived as if the eggs were traded.

By valuing tradable but non-traded goods as non-traded, our system incorporates less of a free trade bias than if we assumed that all tradable items could and should be traded. Policies forbidding export or import of tradable items, however, will lead to a less than optimal allocation of resources in the economy, at least in the short run and, thus to economic inefficiencies. In the cases mentioned above, protection of domestic engine production and of the urban poor was given priority over economic efficiency.

In the cases illustrated above, we assumed that the project analyst has very little influence on trade policies, for this is true in the agriculture sector in most countries. Questions often arise, however, about the effects on a proposed project if trade policies were to change, and about whether changes in trade policies should be recommended. If the purpose of the analysis of the tubewell irrigation project is to value a proposal aimed at saving the country's resources under conditions of trade liberalisation, then one would value the tubewell engines as traded items. If it is expensive to produce tubewell engines domestically, this is an indication that engine production uses a large amount of scarce domestic resources relative to the resources necessary to produce some other product that could be exported to earn the foreign exchange needed to import the engines from a foreign supplier. If the quota or prohibitive tariff against the input were removed, then the project investment would look quite different. A change in trade policy, however, will have implications ranging far beyond the boundary of the project itself, implications for both efficiencies in the economy and for non-economic objectives. A change in trade policy may bring a wide range of changes in other prices in the economy as well as the price of engines used on non project farms, and to be valid an investment analysis would have to be run with the new price relations and include non project farms. Project analysis therefore provides only a signal, not a criterion for decision in trade policy; much, much more must go into a reevaluation of trade policy than the analysis of one project. "The aggregate level of government investment is strongly influenced by considerations of economic policy for which cost-benefit analysis is not well adapted. In other words, benefit-cost analysis excludes the macro-economic externalities of investments, that is the possible effects on inflation, foreign exchange balance and other macro-economic conditions." (Dorfman, 1976).

3.5. The effects method

This method has been elaborated in France and is used in several developing countries where French cooperation is most active. There is no major advantage or disadvantage in applying this method rather than the shadow price method but since the majority of international multilateral and bilateral development agencies use the latter, we will only provide a brief outline of the effects method based on the description given in FAO (1986). Readers wanting more information should consult Fabre and Yung (1985) for instance.

This method is based on the same fundamental principles of economic analysis e.g. comparison of defined with-project and without-project situations to measure project impact, breakdown of values into their domestic and imported components and the separating out of transfer payments. The same profitability criteria (e.g. IRR) can be applied.

Economic growth is measured by increases in the national income, i.e. gross domestic product (GDP) or gross national product (GNP). GDP (or GNP) is the sum of the value added by all economic agents within the country's borders (or by agents who are nationals of the country, regardless of their location). The value-added (VA) of an activity is the difference between the market price of the goods and services produced (P) and the cost of the intermediate consumption (IC) required to produce them (i.e. "inputs", the goods and services used up during the production process).

$$VA = P - IC$$

Value-added measures the wealth created by the agent controlling the production process and represents the value which the agent adds to the initial value of the inputs consumed in producing the new output.

Value added is also the sum of incomes accruing to workers (wages, W), to credit institutions (financing costs, i.e. payment of interest, F), to government (taxes, T) and to the enterprise - i.e. the agent itself - (gross operating benefit, B, which includes depreciation of capital):

$$VA = W + F + T + B$$

The aggregation of incremental values-added of all the agents directly or indirectly participating in the project measures the effects of the project on economic growth in terms of addition to GDP or GNP. Furthermore, the breaking down of the incremental value-added into its components -W, F, T, B- shows how the income generated will be distributed. It is also useful to show which agents are creating positive value-added and which are associated with negative value-added (and who will thus need some form of subsidy) to understand the dynamics of the project.

An IRR can finally be calculated taking the incremental value-added as project benefits and total investment expenditure as project costs.

3.6. Limitations of cost-benefit analysis

3.6.1. Unquantifiable costs and benefits and externalities

In principle all effects should be identified, valued and taken into account in project analysis. Yet unquantifiable costs and benefits (Gittinger (1982) uses the term intangibles) and externalities may not actually or obviously be covered by analysis of the direct, visible resource and output dimensions of the project. The term 'unquantifiable' refers both 1) to effects that are known to arise but which cannot be measured in physical terms and 2) to effects which cannot be valued. Difficulties in quantification and valuation will often go together. (Drawn from ODA, 1988). An externality is an effect of the project felt outside the project. These two categories of effects do overlap to a certain extent.

Quantifiable externalities (technical and pecuniary) should be taken into account and, as far as possible, valued. E.g. country Y is considering a project to expand dramatically its area planted with cocoa. This increase in supply will result in a drop of the world market prices for this commodity and will also affect neighbouring country X which derives a large share of export earnings through the sale of cocoa. Political and economic relations between the two neighbouring countries might suffer from as a consequence of this project.

Unquantifiable factors comprise a whole range of considerations-economic considerations such as income distribution, number of jobs created or regional development; national considerations such as national integration or national security; environmental considerations that can be both ecological and aesthetic, such as preservation of productive ecosystems, recreation benefits, or spots of scenic beauty. Many development projects are undertaken primarily to secure unquantifiable benefits-education, domestic water supply, environmental and health projects are a few common ones. When considering projects with such effects the least the project analyst can do is to identify them. Very often, the analyst can also quantify them: number of lives saved, number of jobs created, number of students enrolled etc. Even this can be of substantial help in making an investment decision. Economists have tried repeatedly to find means to value unquantifiables and thus bring them within the compass of their valuation system. An example is: health and sanitation benefits valued in the number of hours of lost work avoided by decreasing the incidence of the disease. (Drawn from Gittinger, 1982). Gittinger (1982) writes that "few applied project analyses in developing countries currently attempt to use approaches to valuing intangible costs and benefits. For one thing, such efforts generally greatly underestimate the value of the intangibles. (...) Good health is a blessing far in excess of merely being able to work more hours. (...) Moreover, the methodological approaches used to value intangibles turn out to be unreliable and open to serious question." For Dorfman (1976), one should recognize the limitations of cost-benefit analysis since it is impractical in such applications as environmental protection, public education, and public investments in health services, all of which are nowadays highly significant aspects of governmental activity. It is likely that ad hoc decisions are the most sensible solution, that is adopting trade-offs among objectives that are widely at variance from each other on different occasions.

On the other hand, ODA (1988) adopts a different stand and writes that non-quantified effects must not be ignored. There is always a risk that effects which can be quantified will seem more important than non-quantified effects but this can lead to serious mistakes. The economist should be ready to show how effects, once recognised, can be calculated and valued in terms comparable to the value units of the rest of the economic analysis, units of the efficiency analysis numeraire. The authors proceed to suggest solutions in the field of environmental effects. Chemical discharge into rivers may reduce fishery production downstream or in the sea; this loss in fish catch can be estimated and counted-in shadow prices-as a cost to the project; it could also be valued at the cost of replacing in the sea and rivers the fish lost or at the cost of prevention (recycling the chemicals etc.). Air and water pollution could be valued through effects on lower productivity and increased medical expenses. House price differences between polluted and non-polluted locations could be compared.

A technique more widely used is the cost-effectiveness analysis. In its environmental application, this approach can involve setting goals or targets for maximum tolerable levels of environmental damage, and then finding the most cost-effective way of meeting them. This implies that goals are agreed upon and that these are identically fulfilled by the alternative projects.

Admittedly, Gittinger and Dorfman's remarks still apply to the measures proposed by ODA. Limitations of cost-benefit analysis are real and these should be clear to analysts and decision makers. Environmental considerations might well be better handled through specific methodologies which are being developed and refined nowadays. The methods outlined by ODA could help quantify certain aspects of unquantifiables but it should be well kept in mind that such quantifications are underestimates. Providing a straightforward monetary valuation of environmental consequences might however be sufficient to demonstrate the superiority of a project over others. This therefore indicates that such methods can be useful and should not be neglected.

3.6.2. Distributional aspects

Another issue of central importance concerns distributional aspects. Bromley (1990) writes that the work of people such as Hicks (1939), Kaldor (1939) and Robbins (1932) tended to reinforce the idea that economics was not about increasing satisfaction of the citizenry directly, but rather about increasing the production of goods and services which-when consumed-gave satisfaction. Furthermore, the distribution of income which determines one's ability to acquire commodities, and so the relative welfare of members of society from those commodities-or from other sources-may be of concern to the political scientist and the sociologist, but the objective economist has nothing to contribute here. Kaldor was thus able to argue that scientific welfare economics was possible, this being one which analysed situations with a view to establishing whether or not it was possible to make everyone better off. This left the issue of distribution to be settled outside economics, for, he argued, it was "quite impossible to decide on economic grounds what particular pattern of income distribution maximizes social welfare." (Backhouse, 1985 quoted in Bromley, 1990).

Bromley (1990) argues on the other hand that welfare theorists have long known that the economist cannot separate the way in which income is distributed from the efficiency implications via the potential Pareto improvement test. Little and Mirlees (1974) write that profitability measure treats a dollar's worth of consumption as equally beneficial no matter who gets it; it is therefore a good measure of the net social benefit (i.e. the social profit) of a project only if, in the case under consideration, neglect of income distribution can be justified. The reason being that a dollar's worth of consumption by a rich person, and a poor person cannot be both reckoned as a benefit of $1 to society. Squire and van der Tak (1975) argue similarly that the operational assumption that all units of income make the same contribution to growth may be untenable. For example, in an economy in which the level of national investment is below what is required to secure the desired level of growth, investment may be considered more valuable than consumption. It was then a short step to the realization that the separation of the growth and equity objectives may not be justified. On this basis it was concluded that project analysts should investigate the impact of projects on the distribution of income between consumption and investment but also on the distribution of income between the rich and the poor[5]. Only by this mean will it be possible to allow in project decisions for the tradeoff between raising consumption levels of the poor and accelerating overall economic growth. Resource availability need not be the only constraints operating in the economy: political and social constraints may be equally binding. If the tools of general economic policy-that is, fiscal and monetary policy-cannot break these constraint, project analysis should take account of them by means of appropriate adjustments in shadow prices which is why authors such as Little and Mirlees (1974) and particularly Squire and van der Tak (1975) propose a system which weights the economic effects

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5 The basis of the argument is that income is equal to consumption plus savings (used for investment) and that saving increases along with the level of income. Consumption and saving functions show that saving is negative at low income levels and positive at higher income levels (Dornbusch and Fisher, 1987).

depending on the social groups affected by a project. (Squire and van der Tak (1975) use the term of efficiency analysis for cost-benefit analysis using shadow prices and social analysis for analysis which additionally weights the distributional impact).

Following arguments have been put forward against this approach. "The incorporation of different aspects into a single aggregate is possible only by assigning numerical weights (directly reflecting political value judgements) to these partial considerations; nominal unit of future consumption as compared with a unit of present consumption; nominal unit of present or future consumption of the rich as compared with the poor; nominal unit of present or future income of wage earners and profit earners compared with a unit of income of the government; nominal unit of income earned by a backward region as compared with that in a more developed region. This approach requires highly reliable justification of the distribution of the net benefits generated by a project between present consumption and savings (for future consumption); of the marginal propensities of different social groups to save and consume; of the marginal rate of return on investment; of the marginal rate of savings; of the shadow price of investment etc." (UNIDO, 1986)

A single value that might summarize all the impacts by using some weighting scheme would be of little use, for such a value would cover up the project's impact on each of these areas. The process of weighting is extremely delicate and the single value result, although easy to use, is not transparent and paradoxically too easy. Project assessment is most often not easy or straightforward but involves discussions and a dialectic process which involves ranking of objectives and examining the contribution of alternative projects towards fulfilling these. In 1988, in their preface to the sixth printing of their book, Squire and van der Tak (1975) write: "The reluctance of country economists to quantify their judgments with respect to a government's concern with equity, coupled with the difficulty of estimating the distribution of future benefits at the project level, has meant in practice that social analysis has tended to be neglected."

Another aspect which is actively discussed is the concept of sustainability. The two main paradigms underlying the concept are those of ecology and economics. The following discussion is based on Norgaard (1991) who examines the paradigmatic challenge faced by economists. Sustainability can easily be understood as an issue of intergenerational equity, as a redistribution of rights or a transfer of assets to future generations which redefines the efficient allocation of resources. Problems arise for instance when it comes to discounting the benefits to be received and the costs to be borne by future generations. With lower discount rates, it appears that more investment in renewable resources and a larger stock of renewables would be justified. Similarly, it appears on preliminary analysis that lower rates of discount favour using stock resources more slowly. Thus many see a strong link between the rate of discount, the conservation of resources, and hence the sustainability of development. Norgaard goes on to argue that the benefits that accrue to future generations from investments undertaken to assure their rights cannot be measured by current preferences nor should they be discounted. The optimal portfolio of investments (and disinvestments) to meet the rights of future generations is determined according to the cost-effectiveness of alternative combinations of ways of sustaining their rights over time. This framing resolves some of the key, long-standing ethical dilemmas of usury. The author finally calls for conceptual pluralism and a move away from neoclassical positivism (scientific objectivity) and its mechanistical view of the world as he sees development as social system and ecological system coevolution. (Interestingly enough, several economists are, according to Norgaard (1991), arguing that questions of sustainability lie beyond economics). Concepts are being developed but analytical systems are yet to find solid foundations.

In view of the above mentioned points, we advocate, instead of weighting various elements, the inclusion of a comprehensive qualitative discussion on effects of alternative projects on various distributional aspects, on the environment etc. in addition to the presentation of economic selection criteria.

3.6.3. Welfare economics and underlying assumptions

There is increasing recognition that economic growth will not necessarily nor automatically lead to an improvement in human welfare, in the obtainment of justice, or in the protection of the environment. Also, the neoclassical measure of gross national production as a monetized proxy for human welfare is rejected.

The following paragraphs are drawn from Bromley (1990): "(...) it is a value judgment for the economist to claim that economic efficiency ought to be the decision rule for collective action. In Dorfman's (1976) terminology, benefit-cost analysis has evolved as an effort to impose an economic approach onto a political problem. "(...) "benefit-cost analysis" has come to mean a directed search for a decision rule by which good decisions might be demarcated from bad ones." "To analyse something is not to reduce all of its components to dollar estimates of surplus, or to changes in net national income. While these measures may clearly be one part of a complete benefit-cost analysis, to analyse a proposed policy is to attempt to understand who the gainers and losers are, how they regard their new situation in their own terms, and what this means for the dull array of beneficial and harmful effects."

"There can be no better contemporary (late 1989) illustration of this issue than the controversy surrounding the use of bovine somatotropin (BST) injections to induce greater milk yields. Economists appeal to efficiency gains in the dairy industry, drug manufacturers appeal to evidence from the Food and Drug Administration that BST is a naturally occurring compound in milk and hence there is no health risk, and scientists in general (and Deans of Agriculture) appeal to the need to continue technological innovation (including genetic engineering) so as to remain 'competitive.' Consumers meanwhile, remain unimpressed. A number of food processors and dairies have announced that they will not accept milk from cows that have been injected with BST. While economists and dairy scientists condemn the rise of neo-Luddism, consumers-seemingly-could care less. How this particular issue will be resolved is not clear. But it is clear that economists are not viewing the 'benefits' and 'costs' of BST in a manner that is consistent with perceptions by consumers 'in their own terms.' As long as this dissonance continues, the general population will simply ignore the 'economic' analysis of BST."

Bromley (1990) writes that the evaluative stance advocated by some authors would see the role of the economist as centrally concerned to assist the decision maker in selecting choices that are consistent with the latter's objectives. It is however not always easy to maintain a sharp distinction between policy objectives and policy instruments and therefore the economist as policy analyst will continue to face a difficult task.

The purpose of including this critical perspective is not to denigrate cost-benefit analysis but to make the reader aware of its limitations and to explicit some of the underlying assumptions to avoid abuses of the technique. We remain convinced that cost-benefit analysis is a valid instrument to provide answers within the limits set by the potential Pareto improvement criterion. We have seen that other criteria need to be included in analysing projects, that economic efficiency might not even be important at all since the analysis is subject to the objective function of the decision makers. This is consistent with the broader project framework described in the first chapter "General principles".

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ANNEX: COMPARISON OF FINANCIAL AND ECONOMIC ANALYSIS

The example is based on investigations which are part of a study on the 'economics of village cattle production in tsetse affected areas of Africa' (Itty, 1991). A cattle herd of 88 animals was investigated in Boundiali, northern Côte d'Ivoire. The aim was to estimate the profitability of this herd of local cattle breed to a) the cattle owners and b) to society. To perform the financial and economic analyses we used biological herd productity data and financial and economic data. The biological data were recorded on a monthly basis from 1986 to 1989 (liveweights, calving rate, milk yield etc.) and the averages were calculated. The financial and economic data were collectd in October 1988 (input quantities and input and output prices). These data were entered in a herd simulation model (von Kaufman et al, 1990) which accounts for the dynamics of cattle production and values inputs required and outputs produced in a cost-benefit analysis framework. The model makes projections over ten years. We are hereafter presenting and explaining the market prices used in the financial analysis and the shadow prices used in the economic analysis as well as the profitability results obtained. We will skip the simulation model procedures and the data on biological performance since these are not part of our present concern.

Financial (private) analysis

The **discount rate** used (opportunity cost of capital) was 10%. It was estimated that this would more or less be the interest rate farmers would receive if they invested their savings in the best alternative (hoarding of goods, investment in crop inputs, in small ruminant production etc.). For decision makers and readers having a different opinion on the opportunity cost of capital, we included the Internal Rate of Return criterion to allow for the comparison with any estimate.

The **official exchange rate** for the local currency the Franc de la Communauté Financière Africaine (FCFA) was in October 1988 300 FCFA = 1 US$.

The market price of the local breeds of **cattle sold for further breeding or for slaughter** reached on average 300 FCFA/kg liveweight. In the analysis we simulated the purchase of the herd (at its breeding value) in year 0 and the sale of the herd in year 10, at the end of the exercise. This explains 'cattle acquisition' and 'final herd value' in Table 2, 3 and 4. The final herd value accounts for the increase in herd size over the ten years as computed by the model.

The average market **price of milk** was 112.5 FCFA/l.

The **remuneration of the herdsman** was in cash and kind. This cattle owner gave 252,000 FCFA per annum cash and left the herder to extract all the milk which the latter wanted. (Lactation offtake was 192 l/year).

The cost of **milking the cows and marketing milk** had to be deducted from the gross revenues of milk sales (total milk offtake times the producer price) since considerable labour was required (the herdsman had to milk and market the milk which was his property). These were accounted for on the basis of the opportunity cost of labour from the cattle owner's view which is the opportunity cost of labour he and his family would have to provide to extract and market the milk. The opportunity cost of milking was estimated at 37,500 FCFA per year (opportunity cost: 25,000 FCFA per month * 12 months / 8 since we assume that the herder needs 1 hour and half to milk the cows in a total working day of 12 hours (12/1.5=8)), that of marketing by women at 30,000 FCFA per year (opportunity cost: 7,500 per month * 12 months / 3 since it is assumed that the women spend 4 hours per 12 hour day sitting in the market to sell the milk (12/4=3)).

Veterinary services were not accounted for since farmers did not pay for these.

Veterinary treatments: acaricides and anthelmintics had a 30% subsidy; other drugs were only paid at the value c.i.f. Abidjan which means they also contained subsidies since transport and marketing costs to Boundiali were not included. The vaccine against rinderpest and pleripneumonia (Bisec) was given free of charge.

The cost of construction of the **crush and paddock** was subsidised by the government at the rate of 78% for the former and the barbed wire needed for the latter was subsidised at 50%. The investment and recurrent costs are given for each year in Table 1.

Feed supplements: **cotton seed** was subsidised at 63%.

Cotton seed store construction was also subsidised at the rate of 63%.

Minerals were susbsidised at 65%.

Economic (social) analysis

The **discount rate** used (opportunity cost of capital) was 10%. We assumed that the state would be able to place money at the same rate which private farmer investor would obtain. Again since we provide the Internal Rate of Return criterion readers can compare this with their own estimates.

The World Bank estimated the FCFA as being overvalued by 30% (Huband, 1990); this estimate was taken as the **foreign exchange premium** and was used to convert the price of goods traded on the world market. The shadow exchange rate is obtained by multiplying the official exchange rate (300 FCFA = 1 US$) by one plus the shadow exchange premium. The shadow rate was thus 390 FCFA = 1 US$.

Table 1: Financial and economic data, Boundiali, Cote d'Ivoire

	Unit	Financial analysis	Economic analysis
Discount rate	%	10	10
Foreign exchange premium	%	0	30
Breeding cattle	FCFA/kg LW	300	300
Beef	FCFA/kg LW	300	550
Milk	FCFA/kg LME	113	302
Milking and marketing	FCFA/year	67500	0
Herder remuneration	FCFA/year	252000	120000
	% milk/yr	100	0
Annual veterinary services	FCFA/cattle	0	593
Veterinary treatments (per dosis)			
Berenil	FCFA/kg LW	167	184
Trypamidium	FCFA/kg LW	150	165
Terramycin L.A.	FCFA/kg LW	800	880
Exhelm II (anthemintic)	FCFA/kg LW	80	114
Ektafos (acaricide)	FCFA/cattle	5	7
Bisec vaccine	FCFA/cattle	0	21
Pasteurellosis vaccine	FCFA/cattle	50	55
Blackleg vaccine	FCFA/cattle	50	55
Knapsack sprayer			
purchase in yr 0 & 5	FCFA	20000	33800
maintenance each yr	FCFA/yr	2000	3380
Crush			
construction in yr 0, 4, 7	FCFA/yr	30000	140000
Paddock			
construction in yr 0 & 5	FCFA/yr	24000	48000
maintenance each yr	FCFA/yr	2400	4800
Cotton seed	FCFA/kg	19	30
Cotton seed store			
construction in yr 0 & 5	FCFA/yr	150000	350000
Minerals	FCFA/kg	80	172

LW: Liveweight / LME: Liquid Milk Equivalent / yr: year

Breeding cattle was a domestically produced non-traded project input (Figure 3, part D, pathway 4). Its shadow price was therefore valued by the market price of 300 FCFA/kg liveweight.

The shadow price of **beef** was obtained by taking the import parity price since this commodity was a traded imported output (Figure 3, part C, pathway 3). The formula to calculate the import parity price is: Pb = Pw + Tw + Td - Cd. The world market price of beef (Pw) reached in 1988 1.4 US$/kg carcass weight (FAO, 1989), the freight and transport costs (Tw) 0.781 US$/kg carcass weight (T. Williams, ILCA, Niamey, Niger, Unpublished data used in Williams, 1990), and the domestic transport costs (Td - Cd) amounted to 257 FCFA/kg carcass weight (T. Williams, ILCA, Niamey, Niger, Unpublished data). The prices in US$ were converted using the shadow exchange rate. This resulted in a high import parity price of 550 FCFA/kg liveweight. (Carcass weight = liveweight/2). This shadow price was high because of the important transport costs to Boundiali located far inland and because a premium on traded goods was used when converting costs in foreign exchange into local currency.

The shadow market price of **milk** was calculated by the same method as for beef since milk was also a traded output. In 1988, the world market price (Pw) was relatively high at .217 US$/kg liquid milk equivalent (FAO, 1989). The freight and transport costs (Tw) reached 0.1561 US$/kg liquid milk equivalent (T. Williams, ILCA, Niamey, Niger, Unpublished data) and the domestic transport costs ((Td - Cd) amounted to 54.9 FCFA/kg liquid milk equivalent (T. Williams, ILCA, Niamey, Niger, Unpublished data). After accounting for the undervaluation of traded items, the import parity price obtained was 302 FCFA/kg liquid milk equivalent.

Herding costs. All herdsmen were Peul patoralists. The herding costs were calculated on the basis of the opportunity cost of labour of these men. This was low, at 120,000 FCFA per annum and per herdsman) because the Peuls were unskilled, except in the field of animal husbandry, and were reluctant to take up any other activity. As a social consequence of their changing way of life, many Peuls, particularly young men, spent most of their time idling in the town of Boundiali. These observations are similar to those made by Jahnke (1974) in Uganda: 'The oppportunity cost of labour in the pastoral areas are probably very low; lower than in the agricultural and urban areas due to the lower standards of education and the pastoralist's contempt for work other than cattle work'.

The cost of **milking the cows** did not have to be deducted since this is included in the herding costs (milking is performed by the herder). The costs of **marketing the milk** is accounted for in the import parity price of milk since the transport, processing and marketing charges from farmgate to domestic market (Cd) were deducted from the calculated price.

Veterinary services were accounted for since these costs were borne by the society. Taken as a whole, the veterinary services can be considered as a partially traded item which has to be broken down into various components. The costs of traded goods (transport: vehicles and fuel) were corrected by using the foreign exchange premium. Salaries were corrected by taking the shadow wage rate for unskilled labour whenever applicable. Buildings were considered as non-traded domestically produced project inputs and the market price was used. The resulting average annual cost per cattle was 593 FCFA.

Veterinary treatments, minerals, crush, paddock, cotton seed and store were all valued by omitting the share of subsidies contained in the market prices. All the prices are given in Table 1.

Comparison of financial and economic profitability

Financial (private) returns to capital were far lower than the economic (social) returns. Two main reasons explain this: the market price of labour for herding was far higher than the shadow cost and market prices of outputs (milk and meat) were much lower than the shadow prices which reduced the revenues by half. Although many inputs were subsidised, meaning that their market prices were lower than their shadow prices, this had a only a mild overall effect in reducing total financial costs: 85% of the costs were due to herding and cattle acquisition which were not subsidised.

Differences in financial and economic costs of herding can possibly be explained by examining the share contract system between the cattle owner (crop farmer) and herdsman. The cattle owner did not primarily keep cattle for milk and meat production but rather as a savings deposit (and as a source of traction power) where profits from other activities (crop farming, off-farm earnings etc.) could be invested. The cattle owner presumably wanted an average return on investment comparable to the opportunity cost of capital. Share contract is a response to uncertainty and asymmetrics in information. Assymetrics of information does occur since herding is performed by experienced pastoralists for cattle owners who are traditionally better acquainted with crops. One may also view the share contract as a response to different types of market failure, in labour, insurance, credit and capital markets. Under a pure wage contract, the cattle owner bears all the risks and the herdsman has no incentive. Wage contracts provide no incentives for effort. Share contract is the preferred risk-sharing arrangement, as it also provides uniform incentives - albeit imperfect ones - for effort. One could assume that true labour input (effort) of herders is not observable by the cattle owners or if it is, only at a cost (managerial and supervisory input are required). If the herd owner is imperfectly informed concerning the abilities of potential herders, he may use the terms of the contract to help them sort out (screen) more productive from less productive workers. In particular, herders who are willing to accept a larger share are likely to be more productive.

Table 2: Financial costs and benefits in Boundiali, Cote d'Ivoire
(includes allowance for working capital in year 0), unit: FCFA.

Year	0	1	2	3	4	5	6	7	8	9	10
COSTS											
Cattle acquisition	4679670	0	0	0	0	0	0	0	0	0	0
Remuneration of herder (computed by model)	75600	855200	805710	787140	830730	845910	850760	868360	885880	900000	840220
Veterinary services	0	0	0	0	0	0	0	0	0	0	0
Veterinary treatments (computed by model)	54910	116360	116370	119130	121660	143680	126550	129770	132880	136110	104600
Crush and paddock	54720	2400	2400	2400	32400	24000	2400	32400	2400	2400	1680
Cotton seed	14250	47500	48310	49090	49760	50470	51600	52830	54070	55390	42520
Cotton store	150000	0	0	0	0	150000	0	0	0	0	0
Minerals (computed by model)	11590	38650	39280	39810	40370	41280	42270	43260	44320	45410	46530
TOTAL	5040740	1060110	1012070	997570	1074920	1255340	1073580	1126620	1119550	1139310	1035550
BENEFITS (computed by model)											
Cattle offtake (sales and slaughter)	0	1241660	1258300	1247090	1257640	1254610	1278040	1311410	1340440	1371670	1406180
Final herd value	0	0	0	0	0	0	0	0	0	0	5730600
Milk offtake	0	535700	486210	467640	511230	526410	531260	548860	566380	580500	596320
TOTAL	0	1777360	1744510	1714730	1768870	1781020	1809300	1860270	1906820	1952170	7733100

Table 3: Economic costs and benefits in Boundiali, Cote d'Ivoire
(includes allowance for working capital in year 0), unit: FCFA.

Year	0	1	2	3	4	5	6	7	8	9	10
COSTS											
Cattle acquisition	4679670	0	0	0	0	0	0	0	0	0	0
Remuneration of herder (computed by model)	36000	120000	120000	120000	120000	120000	120000	120000	120000	120000	84000
Veterinary services	16830	54130	54550	54610	55780	57250	58530	59910	61420	62940	64480
Veterinary treatments (computed by model)	77700	172340	172320	176240	180040	209090	187320	192070	196690	201470	154780
Crush and paddock	189440	4800	4800	4800	144800	48000	4800	144800	4800	4800	3360
Cotton seed	22500	75000	76280	77520	78570	79690	81470	83420	85380	87470	67130
Cotton store	350000	0	0	0	0	350000	0	0	0	0	0
Minerals (computed by model)	24870	82900	84250	85390	86600	88550	90660	92790	95060	97410	99810
TOTAL	5397010	509170	512200	518560	665790	952580	542780	692990	563350	574090	473560
BENEFITS (computed by model)											
Cattle offtake (sales and slaughter)	0	2275970	2306460	2285920	2305260	2299700	2342650	2403810	2457030	2514280	2577530
Final herd value	0	0	0	0	0	0	0	0	0	0	5730600
Milk offtake	0	1619260	1486410	1436560	1553580	1594310	1607330	1654580	1701620	1739520	1781980
TOTAL	0	3895230	3792870	3722480	3858840	3894010	3949980	4058390	4158650	4253800	10090110

Table 4: Results of financial (private) and economic (social) analysis off cattle production in Boundiali, Cote d'Ivoire

Item	Unit	Financial analysis	Economic analysis
Costs			
Discounted costs/cattle	FCFA	119950	93040
Share of discounted costs due to:			
Herding costs	%	44.9	8.4
Cattle acquisition	%	40.0	51.6
Veterinary treatments	%	7.0	13.3
Feed supplements	%	4.8	5.6
Minerals	%	2.3	6.3
Crush & paddock	%	1.0	4.5
Veterinary services	%	0.0	4.1
Revenues			
Discounted revenues/cattle	FCFA	136800	271570
Share of discounted revenues due to:			
Cattle offtake	%	59.1	54.6
Milk offtake	%	24.3	37.0
Final herd value	%	16.6	8.3
Cost-benefit analysis			
Net Benefit Investment Ratio		1.33	4.22
Internal Rate of Return	%	15.0	61.2

The shadow price of beef (import parity price) was calculated on the basis of world market prices of Argentinian beef adjusted for transport and marketing costs. This world market reference was taken because Côte d'Ivoire could no longer depend on Sahelian countries for regular supply of beef and therefore imported beef from countries such as Argentina. World market prices of both beef and milk were high compared to domestic market prices in Boundiali, in addition to which high transport costs increased the import parity prices. (High transport costs are a common feature in much of Africa and this induces large differences between domestic and import or export parity prices for many agricultural commodities).

Risk and uncertainty

One should always account for risk and uncertainty because farmers are risk averse and they do not only consider the average yields which is what analysts often use. Other sources of uncertainty are the technical and economic parameters used in the analysis which might be subject to changes and/or debate. Such cases can be accounted for by performing **sensitivity analyses**. To do this one has to change the value of a parameter which is subject to uncertainty and one can then examine if the returns change significantly.

In our original study, we carried out a certain number of sensitivity analyses; two of which are explained below.

SUBSIDIES: In the reference analysis, we used the market price of inputs as recorded in 1988. These contained a fair amount of subsidies since the government of Côte d'Ivoire wanted to encourage the uptake of inputs. This was however being phased out and it was therefore important to see how removal of subsidies affected financial returns. The costs of inputs were recalculated and reentered in the model which produced the following results: Net Benefit Investment Ratio: 1.09 and Internal Rate of Return: 11.4%. This shows that financial results were fragile because a removal of subsidies would reduce the returns near to the opportunity cost of capital.

BEEF IMPORT PARITY PRICE: In the economic analysis it could be argued that in Boundiali local beef production might be sufficient to cover the local needs. This implies that the economic value of beef treated as a non-traded commodity would be equal to its market price (Pathway 8 of Figure 3, part D). To categorically state that beef is non-traded is debatable since it is estimated that 53% of the cattle in the region are transhumant livestock. These animals belong to Peul pastoralists and are often moved across the borders making it most uneasy to classify beef as traded or non-traded. If the beef in Boundiali were to be considered as traded and imported from the Sahel it would be very difficult to calculate a precise figure for the import parity price. It is, however, safe to assume that the import parity price of beef coming from Mali would be somewhere between the producer price in Mali and the import parity price of beef coming from Argentina. The average producer price in Mali was 394 FCFA/kg liveweight which is close to the price in Boundiali (300 FCFA/kg LW). Based on these considerations, we performed sensitivity analyses using various estimates of import parity prices of beef from Mali (450 FCFA/kg LW to 350 FCFA/kg LW) which would imply that beef was imported from Mali, and also using the market price of beef in Boundiali (300 FCFA/kg LW) which would imply that beef was non-traded. The results show that even with the low price of 300 FCA/kg LW the economic rate of return remained over 40% which underlines the high social profitability of the production system under a whole range of assumptions of the shadow price of beef.

Incorporation of other criteria

In our study, the financial and economic analyses of a range of herds (which included the herd described above) were part of a more global approach in which we provided qualitative information on the national objectives of cattle production in Côte d'Ivoire, on the objectives of cattle owners, on intensification of farming systems (crop-livestock interaction which includes animal traction and manure which in our case were unquantifiables), on the various constraints to improved cattle production (technical, social etc.), on environmental considerations of farming development in tsetse affected areas and in comparing tsetse and trypanosomiasis control techniques etc. This information was collected by conducting group interviews of farmers (men and women) with and without cattle, by discussing with livestock extension services, traders, blacksmiths etc. and by literature review. Our final conclusions incroporated these various elements and were not only based on figures assessing profitabilities.

Conclusion of the case study

To pursue our case study to the end, we are reproducing some of the conclusions which were reached (based on the full range of herds examined).

> 'The social profitability of cattle production in Boundiali was extremely high and very robust to a wide range of effects simulated in the sensitivity analyses. These results would suggest that it is socially worth enhancing cattle production. Private returns present a different picture since these were just above the opportunity cost of capital. Private rates of return were sensitive to a phasing out of subsidies and to increased herding costs indicating that the system is financially fragile.
>
> With the limited private returns achieved in Boundiali, great care must be taken as not to over-burden the producers with costs. This means that the level of inputs should not be increased without being certain of the revenues. The local extension services are stressing the move towards improved production systems necessitating more production inputs. Such technological changes have to be free of risk considering that, traditionally, cattle production was for the crop farmers a means of investment with low inputs. The private returns to capital invested were fairly low. This could explain the reluctance of a great number of farmers to increase their use of inputs (only a minority used regularly drugs). Adoption of the recommended practices were not always met by success once subsidies were phased out. Socio-economic considerations (farming systems approach, cost-benefit analyses of interventions, assertion of

risk etc.) should therefore be given appropriate attention when attempting to increase productivity' (Itty, 1991).

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