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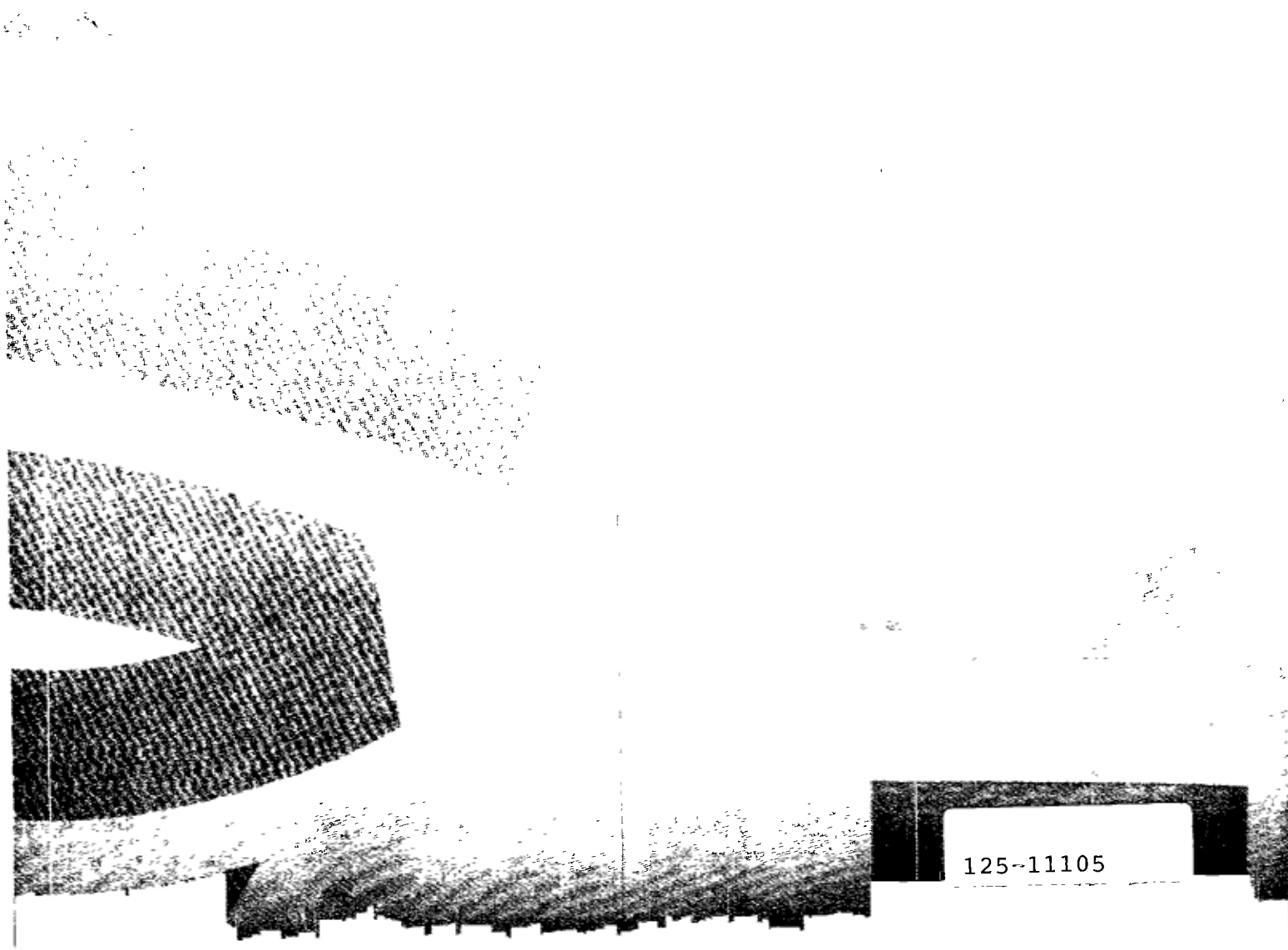

NEI Netherlands Economic Institute

Cost-Benefit Analysis

for Non-Economists

Michiel J.F. van Pelt
René A. Timmer

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Netherlands Economic Institute

P.O Box 4175
3006 AD Rotterdam
The Netherlands
K P van der Mandelelaan 11
3062 MB Rotterdam

Telephone. +31 10 453 88 00
Telefax +31 10 452 36 60
Telex 25490 NECIN NL

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Introduction

How to appraise development projects? Consider the following examples, which all are based on or inspired by projects financed with Dutch aid funds:

- support to a vaccine factory in Indonesia, aimed at upgrading quality control mechanisms and expansion of production levels;
- assistance to several embankment projects in Bangladesh, with the objective of reducing agricultural losses due to inundation;
- construction of one or more dams in a river in Yemen, aimed at expanding agricultural production;
- support to an Indian organization, focused at creating employment among women, as a part of a programme aimed at improving urban living conditions;
- assistance to an institutional development programme in Indonesia at the level of regions and cities, to contribute to an integrated approach toward urban infrastructure provision.

If you would be responsible for the decision to reject or to accept these projects, what types of issues should be addressed in your view? In other words, what would be the appraisal criteria? What would your approach be if these criteria appear to be of a conflicting nature?

Cost-benefit analysis (CBA) is a method frequently applied to investigate whether development projects and programmes are attractive from a *financial* and *economic* point of view. CBA studies are often conducted on behalf of ministries and other government agencies responsible for development aid programmes, both in developing ("recipient") and in developed ("donor") countries. Moreover, various United Nations multilateral agencies co-operate in projects and programmes. Increasingly, non-governmental organizations (NGO) and semi-NGO's, both in developing and developed countries, embark on studies that include a CBA-like approach.

Few aid agencies conduct CBA-studies themselves. Consultancy firms are often commissioned to perform such studies on their behalf. Many firms employ economists who specialize in this field, but it also happens that non-specialists are in charge. In some cases in-depth, thorough and theoretically sound studies result, which - moreover- meet the requirements of the principal. Sometimes, however, outputs carry surprisingly basic errors or fail to address the principal's questions satisfactorily. Hence, although external advisors generally conduct CBA studies, aid agencies have to play a very active role. They should be able to a) precisely tell consultants where a CBA should be focused on and how detailed it should be, and b) understand and interpret correctly the approach followed by a consultant in his or her CBA report. To take on this dual responsibility, decision-makers should be master of CBA principles. Organizations like the World Bank apart, the staff of most aid agencies largely consists of non-economists. They often lack the background to perform the two roles satisfactorily. Consequences may be severe. It may happen that a project officer gets a favourable impression of an aid activity because "the internal rate of return, at 2%, is positive". The conclusion, as will be explained in this syllabus, should have been that such an outcome generally is a decisive reason to reject it (and that the consultant should be blamed for his analysis). Others, unable to fully grasp what a 100-page CBA report exactly contains, may conclude that this approach is not that useful after all and that experience and intuition are better guides to decision-making.

presentations will be given of cost-effectiveness analysis (CEA) and multi-criteria analysis (MCA).

2. *Financial analysis*
   What is known as financial analysis comprises several issues that reflect a concern for designing financially sound development activities. A prerequisite for any project is that at all times it should have sufficient funds available to cover investments as well as recurrent costs. Investigations in this field are known as liquidity analysis. Especially in "social sectors", like drinking water supply, health services and education, the question of user charges and cost recovery are critical issues addressed in liquidity analysis. In sectors like industry, agriculture and so on, an additional analysis focuses on profitability. Assessing financial profitability is known as financial CBA, and a variant is financial CEA. Besides liquidity and profitability, financial analysis may include accounting, which is briefly explained.

3. *Economic CBA*
   Profitability may also be assessed from a national point of view. In economic CBA the focus is on the question of how attractive a project is considering its impact on real national income. Besides aggregated income in monetary terms, the outcome should reflect all resource use, including non-marketed environmental goods and services. Economic CBA starts from the outcomes of financial CBA, which are adjusted for price distortions, external effects and transfers.

The second part focuses on two themes relevant to all sectors, viz. environment and distribution.

4. *Environment, ecological sustainability and economic cost-benefit analysis*
   Incorporation of environmental effects and ecological sustainability appear to be key appraisal objectives in the 1990s. To what extent should and can such concerns be addressed in economic CBA? Possible problems associated with a) measurement and valuation, and b) discounting are discussed. The possible use of MCA as a supplementary tool to CBA is illustrated.

5. *The poor and woman: distributional analysis and project appraisal*
   Economic CBA is indifferent to the distribution of costs and benefits of development projects among the poor and the rich, or between women and men. In fact, distribution ranks high among the objectives of recipient and donor countries. After an elaboration on which types of distribution questions may arise in appraisal studies, the applicability of several appraisal methods is analyzed. This involves a third type of CBA, viz. social CBA, as well as MCA.

1 A BIRD'S-EYE VIEW OF COST-BENEFIT ANALYSIS

1.1 Introduction

This chapter contains an overview of the main CBA principles, including an outline of three classes of CBA and the purposes for which they might be used.

In 1.2, the objectives of the Netherlands aid programme are the starting point for an analysis of the type of criteria CBA can address. Whereas some objectives can be incorporated by CBA, others are beyond its scope.

In 1.3, the role of CBA in the analysis of the overall feasibility of development activities is described. Besides financial and economic aspects, feasibility studies elaborate on, for instance, technical, institutional and social aspects. The relations between these fields are explained, as well as their possible relative priority in decision-making. This section starts from principles for project appraisal agreed upon by all donors participating in the Organization for Economic Co-operation and Development (OECD, 1988).

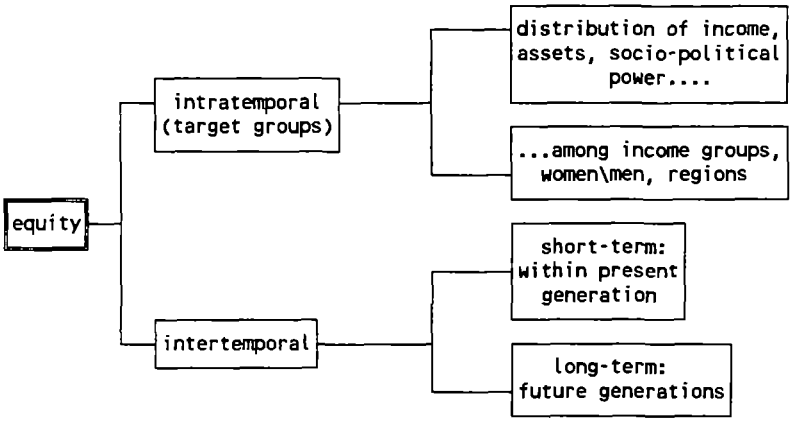
The next two sections explore CBA as a way of thinking (1.4) and CBA as a technique (1.5). This distinction is important: someone who is unfamiliar with the technical side of CBA, may very well benefit from applying the general principles that underlie the technique. Moreover, whereas the former interpretation of CBA draws attention to issues that aid organizations themselves need to take into account in the design of development policies, the latter deals with topics that may be analyzed by, for instance, consultants. In 1.5., key differences between financial, economic and social CBA, the three major classes of CBA, are summarized.

There are limits to the applicability of CBA. First, decision-makers may have objectives beyond the scope of CBA, like "improvement in basic freedoms". Second, it may be impossible to measure all effects in monetary terms; valuing human life is a classic example. Section 1.6 briefly explains two other methods that may be used in the appraisal of development projects and programmes, viz. CEA and MCA. CEA is recommendable when costs can be valued in terms of money, whereas benefits are known in physical terms only. Depending on which criteria apply and how much information is available about effects, MCA can be applied either instead of or in addition to CBA. In 1.7, preliminary conclusions are drawn regarding the use of CBA: under what circumstances is a CBA required? which type of CBA is most appropriate? what should be the scope of a CBA?

1.2 CBA and the objectives of the Netherlands aid programme

Understanding the potential relevance of CBA starts with an insight into the types of objectives or criteria it can (and cannot) address. We will use the objectives of the Netherlands development co-operation programme to illustrate CBA's applicability in this respect. The general objective is structural combat of poverty (DGIS, 1990). It has three dimensions, which can be considered the basic DGIS appraisal criteria: 1) *growth of production* (i.e. *income*), 2) a *fair distribution*, and 3) *ecological sustainability*.

Diagram 1.2 Equity attributes



With respect to *distribution among contemporaries* (intratemporal), economists tend to focus on the distribution of income. Similarly important are the questions of who has access to or owns production assets (for instance land), and of how (informal or formal) social and political power is divided. Policies may have different types of target groups. As most donors, DGIS aims at reducing poverty, which means that project benefits -in terms of income, assets or socio-political position- should particularly (or exclusively) accrue to low-income groups. A partly overlapping target group comprises women. Development aid has become "gender-specific", emphasizing the needs of and opportunities for women. A final option is to target development programmes at specific regions (usually but not necessarily the poorest in a country).

Policy-makers may have preferences regarding how welfare (and more particularly project costs and benefits) should be *distributed over time* (intertemporal). Objectives may be of a short-term nature, e.g. economic growth in the coming ten years, or take a long-run perspective. As we will explain below, the criterion of ecological sustainability is an operational form of views on a fair distribution of welfare over generations.

In theory, and to a limited extent only, CBA offers the opportunity to account for distribution objectives. To a limited extent, because it focuses on the distribution of *income* only. (It is not a tool for treating changes in ownership of assets or in socio-political power balances.) The adjustment of outcomes of economic CBA for income distribution objectives is known as social CBA. It may account for preferences of policy-makers regarding a) the distribution of income among target groups, and b) the use of income for either consumption or savings and hence investment (economic growth). Outcomes of social CBA hence give a simultaneous picture of efficiency and the desirability of the pattern of the distribution of income generated by a project. Despite this intriguing feature, social CBA is rarely applied by development agencies for reasons that will be elaborated below. Our discussion on social CBA will therefore be rather brief. In any case, if social CBA is not applied in the appraisal of a project, the desirability of the pattern of "winners" and "losers" should be addressed separately (see chapter 5).

Sustainability has become a key notion in the jargon of development agencies in recent years. Unfortunately, and rather confusingly, it is used in two very different meanings.

are of a very different nature, and their role varies between different programmes. They are all beyond the scope of any type of CBA.

1.3 CBA, feasibility studies and the project cycle

In 1988, the OECD published the "DAC principles for project appraisal". All donors participating in the DAC, including the Netherlands, have endorsed these principles. They will be used here to illustrate the scope of feasibility studies, and the role of CBA in such studies.

The DAC starts by emphasizing the need for a thorough understanding of the local context of projects. Without knowledge about the basic problems, bottlenecks and possible solutions in recipient countries and -at a lower level- regions and sectors, conceiving well-targeted development projects is practically impossible. Hence, before the stage of designing projects is embarked upon, macro-economic, regional, and sectoral studies should have been performed.

When projects or alternatives for projects have been identified on the basis of such preparatory studies, rational choices need to be made. In view of limited funds and other resources (for instance local management capacities), not all alternatives can be accepted. An appraisal should, according to the DAC, include the following items:

- technical appraisal;
- financial appraisal;
- economic appraisal;
- institutional assessment;
- social and distributional analysis;
- environmental assessment.

The *technical* feasibility focuses on the question whether the technical design of the project allows the project to meet its objectives, and on the appropriateness of technology and standards to the local circumstances. Without a technical assessment, no other form of appraisal can be conducted.

The *institutional* assessment is concerned with the implementing or operating agency's capacity to execute a project effectively, as well as with the institutional environment in which the project will operate. If the operating agency's existing capacities fall short of requirements, the project plan should include measures to overcome this gap, for instance through technical assistance.

The *social and distributional* analysis explores the extent to which intended target groups are affected by the project. Hence, key questions are who benefit from projects and who are harmed (see previous section). Moreover, the analysis should identify possible constraints to successful project implementation in the form of socio-cultural conditions, structures and traditions. Finally, the involvement of women in the planning and implementation of development projects should be investigated.

The *environmental assessment* focuses on the beneficial and adverse impacts of projects on the environment. It should be investigated whether harmful effects can be avoided by incorporating mitigating measures or changing the design of the project.

- sensitivity with respect to constraints and conditions.

c. *efficiency*, i.e.
   - degree to which means will actually contribute to achievement of intended results;
   - degree to which the costs of means used justify intended results (cost-benefit or cost-effectiveness analysis).

d. *controllability*, i.e.
   - extent to which implementation risks can be controlled at reasonable costs.

CBA and CEA are referred to under the heading "efficiency", which is logical in view of the previous sections. At the same time it is important to recognize that CBA cannot be conducted without information about, for example, "sensitivity with respect to constraints and conditions" (effectiveness) and "position of the project in the framework of plans and priorities in the country" (purposiveness). At the same time, "the impact on macro-economic conditions" is an example of an issue that has only an indirect association with CBA. These examples show the drawback of checklists that do not rank items in terms of the sequence in which they should be addressed or regarding their relative importance.

As CBA studies are not for free, their scope should depend on a) size of the project (total costs for feasibility studies should not exceed, say, 2-5% of investment costs), b) the appraisal phase ("back-of-the-envelope" calculations may be sufficient in the identification phase, whereas an in-depth and time-consuming study may be required in the final stage).

Recently DGIS introduced the "initial screening", whereby Netherlands embassies in recipient countries should apply three tests to project proposals, viz. the impacts on poverty, women and environment. This screening, which takes place in the identification phase, does not involve any formal type of CBA.

1.4 CBA as a way of thinking

CBA is the prime economist's tool to appraise a project. The underlying postulates, however, represent a way of thinking that anyone involved in policy-making may satisfactorily adopt and apply, while being ignorant of the CBA technique. People sometimes follow the opposite path, applying the CBA technique without understanding its logic. Misleading and, from a development perspective, dangerous CBA studies are the direct result.

A first element in the CBA way of thinking concerns the definition of a ***project*** and the treatment of ***alternatives***. Frequently aid agencies wonder what the scope of a project should be. Project promotors often favour "comprehensive" or "integrated" projects instead of more modest schemes. A proposal for a rural development project may comprise activities such as: provision of seeds and fertilizer, agricultural extension services, construction of irrigation works, credit schemes, support to trade unions, and improvement of basic needs provision. Should all activities be included in a single project? Or should the activities be considered independent project possibilities? The answer to such questions directly affects the scope of the feasibility study, including CBA. In the first case, the impact of the total set of activities should be assessed, and

consultants give strongly differing estimates of the benefits of the project: respectively 4,000; 1,000 and 8,000 cars. Whatever the price used to value these benefits, the estimates vary from a 10 to 80% increase. In such circumstances, ask for a justification of estimates. Consider the following answers:

- consultant 1: "the benefit is 4,000 because that's the increase in daily traffic";
- consultant 2: "the benefit is 1,000, because if the road is not rehabilitated traffic would increase anyway, to 13,000, because of economic growth in the region and the fact that drivers do not care much for deteriorating conditions of the road";
- consultant 3: "the benefit is 8,000, because without the project the daily traffic would decline to a level of 6,000 because of further deterioration of the road's condition".

Consultant 1 sins against CBA principles. Like many other people are inclined to do, he focuses on the difference between the traffic "before" and "after" the project. The effect of the project, however, is defined as that part of the change in traffic that can be *attributed* to the project. And as can be concluded from the arguments of the two other consultants, there are numerous factors that affect the size of traffic. They correctly investigate the difference between the situation that is expected to occur if the project is implemented (the "*with-case*") and what would have happened in the absence of the project ("the *without-case*").

Whereas both consultant 2 and consultant 3 apply the with-without principle in a sound way, they have a dispute on traffic forecasting and consequently arrive at widely different estimates on the "without-case" and hence benefits. The two problems of application of CBA principles and forecasting, however, should clearly be distinguished. The discussion should from that moment be focused on how to improve the quality of these forecasts, for instance through surveys.

Extensions and expansions of *existing* projects may often be defended on the grounds that "already so much capital funds have been invested that without the additional project will be lost". Policy-makers who remember the with-without principle will not be impressed. Past outlays are a fact, whether or not a new project is started. These are "sunk costs", and economists say "bygones are bygones". Appraisal studies should focus on the question whether additional investments result in a better performance than if no extra activities are undertaken.

The combination of the micro-macro perspective and the with-without comparison explains the approach to ***valuation*** of effects, i.e. the types of prices used. For instance, what is the price of a piece of land? A factory planning to build a new plant there will base its calculations on market prices (micro-orientation). The value to society, however, might differ (macro-orientation). That value may be obtained by looking at the question of how much income that piece of land might generate in its next-best employment (without-case). Perhaps the land would be used for agriculture instead of industry. Using the land for industry implies giving up income from agriculture. The economic value of the land would hence be derived from the "benefits foregone", i.e. the value of the agricultural products (less inputs) that would be produced at that site without the project. Another example: what is the value of water used for irrigation? Possible answer: the value the water would have if used for drinking water.

The CBA approach to valuation also shows in the treatment of costs and benefits occurring at different moments in *time*. Suppose you have $100 available for investment. What would you prefer: a project that gives a return of $120 in year 1 and

- the valuation of effects.

In 1.3 it was argued that both financial and economic CBA are efficiency measures, but interpreted in different ways. The ***objective*** addressed by financial CBA is to maximize *private income or profitability*: does a project earn a financial profit justifying investments, as seen from the point of view of the owners of production assets, providers of financial resources, management, etc? Economic CBA assesses the *profitability for a country* as a whole: to what extent does a project contribute to real national income? "Real" here comprises income in monetary terms, as well as non-monetary welfare attributes, like health and basic needs provision.

Financial and economic CBA take different types of ***effects*** into account. To estimate financial profitability, a company will compare *receipts* for the products or the services (user charges) it sells, and all *outlays* for capital goods and recurrent costs (labour, raw and intermediate products, etc.). Financial CBA takes only these *direct* effects into account, which affect the project's financial position. All impacts the project may have on society, whether adverse or beneficial, which do not enter the financial accounts of a firm -called *indirect* or *external* effects- are beyond the scope of financial CBA.

Economic CBA considers all national increases in production of goods and services *benefits*, and all use of scarce factors in the country *costs*. All benefits and costs should be taken into account, irrespective of the question whether or not the project experiences a receipt, respectively an outlay. Consequently, some types of costs and benefits are irrelevant from a private point of view and hence to financial CBA, but do affect real national income and hence economic CBA. Similarly, some types of effects enter financial CBA but are not a part of economic CBA.

Transfers, such as direct taxes, subsidies and tariffs on trade, do affect private profitability and should hence be included in financial CBA. Any businessman or financial participant in a project is interested in the amount of taxes and tariffs payable and the subsidies it might enjoy. The former flows reduce profitability, the latter enhance it. But do such payments really matter for the country? As long as the question of who owns money in a country is irrelevant, an assumption in economic CBA, the answer is no. When a citizen of a country pays his income tax to the government, the country gets richer nor poorer. There is a change in ownership of money, but the availability of goods and services is not affected, nor are any scarce resources used. If a ministry assigns a subsidy to a firm the opposite occurs: money is exchanged between the company and the government without any changes in the "real" economy. Transfers should hence be ignored in economic CBA.

External effects constitute consequences of projects that, although not reflected in financial accounts, affect society's welfare. Hence, such effects are ignored in financial CBA but should be accounted for in economic CBA. Projects may, for instance, cause air or water pollution without having to pay for it. (If "the polluter pays", ecological costs are "internalized", and they should be included in financial CBA.) Elsewhere in society costs of pollution may appear. Pollution of rivers, for instance, may negatively affect agricultural productivity downstream. Cities may have to invest in purification installations. These are costs to the nation and should therefore be included in economic CBA. Chapter 4 devotes special attention to the question of how environmental concerns can be incorporated in economic CBA, and especially how environmental effects should be valued.

Another example of an external effect, a positive one, is provided by immunization schemes. The direct benefit of immunization is reduced illness and

price in financial CBA. Whether this wage is determined at a free, competitive labour market, or strongly influenced by trade unions, minimum wage regulations and so on does not matter in this stage. In many countries, however, market wage rates do not reflect the value of labour to society. Therefore, in economic CBA a shadow wage rate is often used. Its basis is the value of the production of labour if it would not be employed in the project (the without-case). For instance, the economic costs of employing somebody in a project who would otherwise (involuntarily) have been without a job are zero. Compared to the without-situation, there is no loss of production due to his participation in the project. The shadow wage rate in such a case would hence be zero. In fact, the shadow wage rate for unskilled labour will generally be somewhere between zero and the actual market wage rate.

Finally, the price of capital, i.e. the interest rate, is different in financial and economic CBA. In the former, the (borrowing or lending) market interest rate relevant to a firm is applied. Capital markets, however, are often distorted in developing countries due to strong government intervention. Therefore an economic interest rate is applied in economic CBA. The ARI may be derived from international capital markets, which are the alternative to domestic borrowing (without-case). Interest rates are particularly important because future costs and benefits are discounted in CBA (see next section).

The main differences between financial and economic CBA are gathered below.

Aspect	Financial CBA	Economic CBA
POINT OF VIEW	private, project	society, country
OBJECTIVE	maximize private income/profitability	maximize real national income
EFFECTS		
transfers	included	ignored
external effects	ignored	included
VALUATION		
general	domestic market prices	accounting prices/ opportunity costs
foreign currency	official exchange rate	shadow exchange rate/official exchange rate[4]
labour	market wage rate	shadow wage rate
rate of discount	market interest rate	economic interest rate

[4] There are two systems for economic CBA, one of which uses the official exchange rate, the other the shadow exchange rate. This will be explained in chapter 3.

All variants of CBA show a similar treatment of the temporal pattern of costs and benefits. The length of the period for which effects are estimated ("the time horizon") depends on the nature of the project. In principle all effects, whether short term or long term, should be included. In the case of the construction of a dam, the time horizon might be as long as 100 years, whereas it might be confined to just 10 years in the case of an industrial project in a market with rapid technological developments. Whatever the time horizon, some effects occur immediately (the investments, for instance), whereas others (like benefits at full capacity utilization) may show after several years. To make effects occurring now and in the future comparable, CBA usually involves the application of a technique known as *discounting*: "future costs and benefits are discounted to the present". Both in financial and economic CBA, an outlay of one dollar fifteen years after the start of a project is assigned a lower value than the payment of a similar amount now. The rationale behind discounting is provided by the notion of opportunity costs: a dollar now can be reinvested and thanks to accumulated interest or profits be worth much more after fifteen years (the without-case). Arithmetical discounting calculations are similar for financial and economic CBA, but the discount rate differs (market rate versus economic rate).

Through discounting an overall measure of profitability can be calculated. The most well-known *decision criteria* are net present value (NPV), internal rate of return (IRR) and benefit-cost ratio (BCR). Hence, for a particular project, both a financial and an economic NPV can be estimated. Similarly, a financial IRR and an economic IRR may be determined, as well as a financial BCR and an economic BCR.

The CBA decision criteria are basically similar, and if applied correctly, make the same recommendations regarding approval and rejection. The decision rules can be summarized as follows:

criterion	decision rule	
	accept	reject
NPV	NPV > 0	NPV < 0
BCR	BCR > 1	BCR < 1
IRR	IRR > discount rate	IRR < discount rate

As the calculation methodology is similar, differences between financial and economic indicators should be explained by the figures that are used in the calculations:

- the occurrence of transfers (ignored in economic CBA) and external effects (ignored in financial CBA);
- the valuation of goods and services through market prices in financial CBA and accounting prices in economic CBA;
- the use of the market rate of interest in financial CBA and the economic rate of discount in economic CBA.

Financial and economic CBA may result in the same recommendation whether to reject or accept a project. Difficult problems may arise if the outcomes are contradictory: for

be devoted to the estimation of such critical items. Efforts might be made to adjust the design of the project through measures aimed at reducing risks.

1.6 Other methods: cost-effectiveness analysis and multi-criteria analysis

There are limits to the use of CBA, particularly in two fields:

- it may be impossible to assign a *monetary value* to the categories of costs and benefits that should be accounted for in CBA. For example, in theory all environmental damage should be incorporated in economic CBA, but in practice sufficient data may be lacking. Whether this problem arises in an appraisal study depends on various factors:
  . the types of effects (valuing a car is easier than valuing a watershed);
  . the timing of effects (predicting the price of oil next year is easier than for the year 2010);
  . the size of a project (multi-sector and integrated projects tend to involve more data problems than a simple, small-scale activity);
  . the quality of local statistical bases (gathering economic data is more time-consuming in Yemen than in India); and
  . time and means available for an appraisal study (compare a back-of-the-envelope calculation in the identification phase and a one-year study in the formulation phase).
- decision-makers have *criteria* beyond the scope of CBA. From 1.2 it can be understood that no type of CBA can cover an objective such as self-reliance. Moreover, despite the existence of social CBA, CBA has problems in accounting for distribution preferences. Hence, the lower the relative priority of efficiency according to policy-makers, the more modest the role of CBA.

These two problems should clearly be distinguished. In the first case, it is impossible to conduct a comprehensive CBA study, i.e. covering all efficiency-related effects. In such cases, CBA can at best give only a partial picture of the efficiency of a project. If only minor effects cannot be monetarized, CBA can still be applied. But obviously, CBA calculations become rather useless if the greatest part of efficiency-related effects cannot be expressed in terms of money.

The former (measurement) problem may be solved by, for instance, increasing time and means available for appraisal studies. There is no such solution for the latter (criteria) problem. CBA is just not a tool to treat any other criterion than efficiency (and to a limited extent equity). Hence, although available data allow a full-fledged CBA, the result will not carry much weight in decision-making if the major criteria are the socio-political position of women and improvement of human rights.

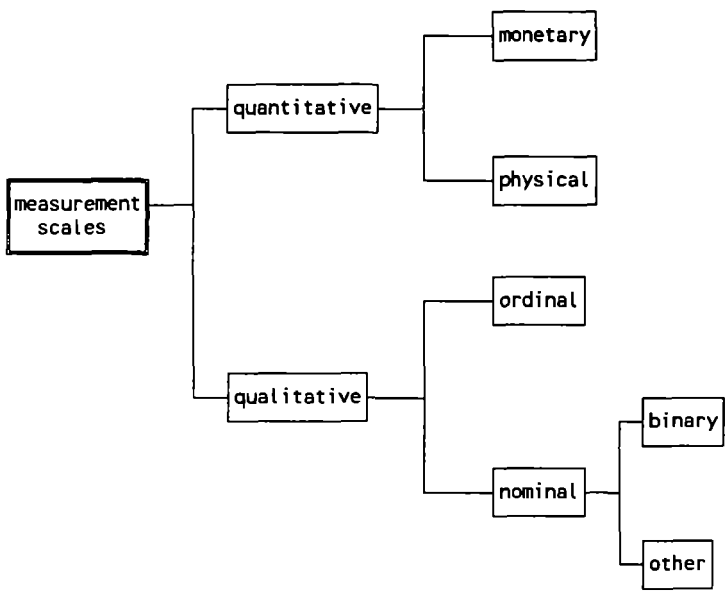
If these problems occur, we advocate the use of other methods in addition to or instead of CBA. In this syllabus occasionally reference will be made to two types of methods, viz. cost-effectiveness analysis (CEA, a limited version of CBA), and multi-criteria analysis (MCA). These methods will be outlined here.

CEA may be applied instead of CBA when insufficiently is known about *benefits*, in terms of quantities and/or prices. This often occurs in "social sectors", such as health,

MCA does not put any theoretical limitations to the nature of *criteria*. All criteria considered policy-relevant may be processed, including efficiency. This is a practical advantage of MCA over CBA when several policy goals apply that are beyond the scope of CBA. MCA's flexibility, however, also implies that more attention should be paid to the methodological soundness of criteria selection. There is a danger of arbitrary choices, leading to large numbers of criteria, double-counting and other problems.

With respect to *measurement of effects*, requirements differ between groups of MCA methods. Diagram 1.3 shows some measurement scales:

Diagram 1.3 Measurement scales



A quantitative scale allows measurement in monetary terms (guilders, rupiahs) or physical terms (kwh, litres of water, etc). A qualitative scale may be:

- ordinal. A ranking of alternatives according to the magnitude of scores. Possible formats of ordinal ranking are: "1, 2, 3, etc" or "+ + +, +, ..., 0 ..., -, --";
- nominal. Characteristics of alternatives are indicated. The criterion "colour" would have the following "scores": red, blue, white, etc. On such a scale ranking is impossible;
- binary. This is a special case of nominal scales, in which an alternative either has or does not have a certain characteristic. Possible formats of "scores" are: "0, 1" or "yes, no".

Quantitative information is often termed "hard", qualitative data "soft".

There are three groups of MCA methods:

- quantitative MCA methods can incorporate only quantitative effects;
- qualitative MCA methods can process only qualitative information;
- mixed information MCA methods can address quantitative and qualitative effects simultaneously.

be used to rank available alternatives, but also directly indicate whether or not projects are desirable. The rate of discount acts as a general rationing device at the level of countries (or sectors). MCA lacks such a mechanism, and consequently results in just a ranking of alternatives. This limitation especially applies if only one project proposal is considered, which should either be approved or rejected.

Another problem, which explains why policy-makers often hesitate to embark on MCA studies, is that a weighting mechanism is required. Instead of market or accounting prices (like CBA), MCA relies on explicit weights representing relative preferences of criteria according to policy makers. In the example of dams: how to weigh agricultural benefits and ecological costs? Either quantitative weights may be applied, or -less controversial- qualitative weights: "environmental costs are more important than agricultural benefits".

In view of these problems, in this syllabus we will only refer to MCA in cases with multiple criteria and measurement or valuation problems. In such cases, MCA's much greater practical flexibility becomes more important vis-a-vis CBA's stronger methodological basis. In this syllabus several examples will be presented of MCA applications, if possible using CBA outcomes as inputs.

1.7 The use of CBA

DGIS official guidelines say that all project proposals should be subjected to CBA, unless there are good reasons for not doing so. But what are suitable criteria for deciding whether or not to have a CBA conducted? And if a CBA is considered necessary, several other questions may arise, for instance regarding the most appropriate type of CBA and the scope of the CBA study. Such questions will be addressed throughout this study, to start with in this section. The most important principle in our view is that CBA should be used rationally and consistently. Instead of a direct basis for deciding on acceptance of a project, the outcome of a CBA study (like: IRR=18%) should be considered a starting point for a discussion on the pros and cons of a project, and on the assumptions and their justifications. It is a fact of life that figures used in CBA will involve varying degrees of uncertainty, but there is an important difference between explicitly indicating, and fogging uncertainty. CBA calculations are a matter of technique; the real issue is whether they make sense considering the features of the project and its social, institutional, technical and ecological environment. No CBA study often is preferable to a bad CBA study!

1. CBA: yes or no?

- *objectives and criteria*. CBA is an efficiency-tool. When only non-efficiency criteria (for instance human rights, cultural appropriateness, population policies) apply to a project, no CBA should be conducted. Efficiency, however, will in most cases be at least one of the criteria;
- *expected classes of costs and benefits (effects)*. CBA requires that all effects are expressed in monetary terms. If it is certain that (the most important) effects will not satisfy this condition, a comprehensive CBA cannot be applied;
- *phase in the project cycle*. The timing of a CBA study is of the utmost importance. Spending money on such studies does not make (economic) sense if a donor has already made commitments or if in general the decision to approve (or reject) a project has already been taken. CBA is most useful in early stages, particularly

2 Financial analysis

2.1 Introduction

Once the technical, institutional and environmental appraisals of project proposals have been completed the next step will be to carry out a financial appraisal. In this stage a financial analysis has to be carried out with the following objectives:

1. to assess the financial effects of the project on all parties participating in it. This comprises in the first place the project promoters who could be private or public, such as commercial institutions, development corporations, local or central government agencies etc. Furthermore, the impact on beneficiaries has to be assessed, like the consequences for farmers in agricultural projects, the recurrent costs for the users of new watersupply systems or energy costs for the beneficiaries of new electricity installations. The assessment is based on an analysis of each participant's current financial status and on a projection of his future financial performance as the project is implemented. The purpose is to ensure that financial resources will be available during the whole life of the project to meet all financial obligations. This type of financial analysis is called **liquidity analysis** and will be dealt with in section 2.2;
2. in the financial analysis also questions regarding the profitability of proposed investments are being addressed: are the expected profits enough to justify the costs as seen from the point of view of the promoters, which alternative has to be chosen in case there are different proposals, etc. This kind of financial analysis is called **profitability analysis** and will be dealt with in section 2.3;
3. an important objective of the financial analysis is also to work out a plan in which the amounts and sources of funds required for the various project participants and the project itself are analysed. The financial plan provides a basis for determining the amount and timing of investment by farmers and for setting repayment terms and conditions for the credit extended that has been extended. For the project as a whole the financial plan is the basis for determining the amount and timing of outside financing. This type of financial analysis is called **finance analysis** and will be dealt with in section 2.4.

2.2 Liquidity analysis

2.2.1 Cash flow accounting

As has been mentioned in the introduction liquidity analysis is an essential part of the financial analysis.

Liquidity analysis determines the impact of the project on the financial situation of all the participants. For instance, if we take as an example the set-up of an irrigation project it is important to know if the financial position of the farmers will improve by the project. Farmers will only participate if they can earn more income in the irrigation project than with their previous activities.

be shown by means of the **cumulative cash flow** which is shown below.

Year	1	2	3	4	5	6	7	8
Cumulative Cash flow	200	400	600	800	200	400	600	1100

The cash flow in the previous example does not yet give the information which is normally desired in project appraisal. Because, what is wanted there is the impact of the project on the liquidity position of the farmer, i.e. the change in his financial situation with the project as compared to the situation without the project. As we have seen in Chapter 1, project analysis always focuses on with-without. Thus, if the farmer's net income in the without case amounted to 80 annually, the change in the farmer's liquidity position would be as indicated in table 2.1 below:

Table 2.1 Determination of liquidity position

Year	1	2	3	4	5	6	7	8
Cumulative net cash flow with project	200	400	600	800	200	400	600	1100
Cumulative net cash flow without project	80	160	240	320	400	480	560	640
Change in liquidity position	120	240	360	480	-200	-80	40	460

This project has a clear positive effect on the liquidity position of the farmer. After eight years he ends up with 1100 as compared to 640 without the project. There will be little doubt, therefore, that from a financial point of view this farmer will be willing to cooperate with the project. In section 5.3 we will see that this is a fundamental question to be posed in considering the participation of the target group.

2.2.2 General scheme for liquidity analysis

This example was meant as an introduction to liquidity analysis. We have seen that the objective of this analysis is to determine the changes in the financial position of the participants of a project. Of course, this example has been very simple. We will now turn to a somewhat more complicated example to show how in general a liquidity analysis is set up.

We suppose that a small factory is set up for the production of farm implements. The local entrepreneur who is going to start with the factory has three sources of finance to meet the required investments in buildings, machinery, and working capital. First, he brings in his own capital which is called equity capital (E).

We will now work out with numbers the example of the factory for farm implements.

In the initial year, year 0[1], all investments will be realised. After this initial investment phase of one year, the factory will operate for five years. It is assumed that the factory will be sold in year 6. The initial investments in buildings, machines, working capital etc. are covered by the following sources of funds:

- the entrepreneur contributes \$5m to the project of his own funds (equity capital). Every year he expects \$1.5m in the form of dividends;
- the entrepreneur borrows \$25m from the bank. A 10% interest rate has to be paid on this loan (\$2.5m a year), while in year 6 the total loan has to be paid back;
- Furthermore, the entrepreneur receives a grant of \$2m.

The financial operations are summarized in table 2.3 below:

Table 2.3 Financial operations

Cash inflows		Cash outflows	
Equity (**E**)	\$ 5m	Dividends (**D**)	\$ 1.5m
Loan (**L**)	\$25m	Interest (**I**)	\$ 2.5m
Grant (**G**)	\$ 2m	Repayment (**R**)	\$25.0m

Sales amount to \$35m per year and total operating costs (raw materials, resources, labour, gas, water, electricity etc.) to \$20m per year. Every year \$5m has to be paid on taxes. The entrepreneur invests the total amount of funds of \$32m directly in year 0 in buildings, machinery and working capital. In year 6, after operating the factory for five years, he sells his company at \$5m.

Table 2.4 Non-financial operations

Cash inflows		Cash outflows	
Sales (**S**)	\$35m	Investments (**K**)	\$32m
Salvage value	\$ 5m	Operating costs (**C**)	\$20m
		Taxes (**T**)	\$ 5m

[1]In cost benefit analysis the starting year of a project is normally indicated with "year 0".

The following conclusion is therefore important to remeber:
1. Liquidity of a project is based on the total cash flow (financial and non-financial operations);
2. Profitability of a project is based on the cash flow for non-financial operations.

2.2.3 Financial sustainability

As has been mentioned in Chapter 1, there are different concepts of project sustainability: ecologically sustainability will be extensively dealt with in Chapter 4. Here, something will be said about sustainability in the financial context.

Liquidity analysis is important to judge whether a project will be financial sustainable after the donors have withdrawn their assistance. For projects in the water supply sector for example, the best safeguard for financial viability of a project is to impose user charges that are sufficiently high to ensure complete cost-recovery. Sometimes complete cost-recovery through user charges is not feasible or socially acceptable. In that case it is essential that realistic provisions are made for financing. If a project is not financially self-supporting, care must be taken that the subsidies required to maintain operations are ensured.

The degree of cost-recovery varies greatly among the sectors and with project circumstances. In some sectors, such as education or public health, recovery from the beneficiaries of the costs of providing services traditionally has not played a significant role. In other sectors and sub-sectors, such as power, telecommunications, ports, railways manufacturing industry and industrial and farm credit, cost-recovery should be based on the principal of marginal cost pricing, i.e. charging full costs to the beneficiaries. Water supply and sanitation projects normally also have difficulty in meeting the standard of full cost recovery. Generally, in most projects concerned with low-income target groups -such as slum upgrading, rural development, or village water supply- there is little scope for establishing systems that would permit full cost recovery. In these cases, charges imposed on beneficiaries will depend primarily on income distribution consideration. Chapter 5 will explain this aspect in more detail.

2.2.4 The treatment of inflation in liquidity analysis

Because liquidity analysis deals with the determination of the actual cash position in the future, it is important to take into account how receipts and expenditures will be influenced by changes in the price levels. Thus, estimates will have to be made on expected inflation rates over the life-time of the project. Economists say that the liquidity analysis has to be carried out in current prices. In section 2.3 we will see that the profitability analysis is normally based on constant prices, i.e. maintaining the same price levels as from the start of the project.

rehabilitation were estimated at 88,000 tons;
- a last group of experts said that it would be possible with all kind of small repairs to keep the factories running for quite some more years at the old production levels. Under this assumption the benefits of production amounted to 45,000 tons.

Although we have not yet discussed the different criteria by which the profitability of projects are measured, we can already understand that the outcome will differ enormously between the different assumptions. It is therefore very important to assess very carefully what will happen in the "without" case. Of course, the same holds for the "with" case.

Sunk costs is a concept which is often encountered in project studies. Sunk costs are costs which were made for the project in the past. In feasibility studies however future costs (and benefits) are the issue. The purpose is to determine the profitability of investments which are made at present. Costs made in the past play no role. These are "sunk costs" of which no account is taken in feasibility studies.

This means that the statement "already a hundred million is spend on the project" is irrelevant. The issue is if the investments proposed for the project will generate enough benefits to reach an acceptable rate of return for the promoters of the project.

In practice this means that rehabilitation or expansion projects often will show high rates of return, because most investment took place in the past. The extreme example is the machine which fails only one screw to let it operate. It may be clear that the profitability of the investment in this screw is extremely high.

In the previous example of the sugar industry in Tanzania there had been investments of different nature financed by DGIS over a period of more than twenty years of around $100m. Opinions on the desirability of new investments for the rehabilitation plan differed between the decision-makers. Some said that it would not make sense to invest more money in the industry as the previous investments had not resulted in well functioning factories. Others asserted that, because of all the investments realised in the past, it would be unacceptable to stop further aid. As we have seen above, the right argument should be to analyse the profitability of the required investments for rehabilitation. In this analysis previous investments are not taken into account.

2.3.2 Criteria for profitability

In the previous section often reference was made to the concept of profitability. How do we analyse whether a project is profitable? Logically this has to do whether the receipts over the life-time of the project surpass the outlays for investments and the stream of operating expenditures. There are different criteria to measure the profitability of a project. Most commonly used in project analyses are the **Net Present Value (NPV)**, the **Internal Rate of Return (IRR)** and the **Benefit-Cost Ratio (BCR)**. In these criteria the fact that receipts and expenditures which occur in the future are worth less than the same receipts or expenditures occurring at present is

If you have to choose between receiving hundred dollars today or within one year you surely will prefer to receive the money now, because this money could be put at the bank with interest. If the interest amounts 10%, the hundred dollars will have accrued after one year to 100 * (1+0.10) = 110 dollars.

Thus, receiving 100 dollars today is worth the same as receiving 110 dollars in one year from now. Or the reverse, 110 dollars in year 1 have the same value as 110/(1+0.10) = 100 dollars today. The factor 1/(1+0.10) = 0.9091 is called the **discount factor.**

In the same way, if hundred dollars are put at the bank for two years at an interest rate of 10%, the hundred dollars will have accrued to 100 * $(1+0.10)^2$ = 121 dollars. Or the reverse, 121 dollars received over two years have the same value as 121/(1-+0.10) = 100 dollars today. The discount factor in this case is 0.8264.

As an amount is received further away in the future and as the interest rate is higher, the value discounted to the present diminishes. The discount factors for different interest rates and number of years in the future are presented in Table 1 of the Appendix (section 2.8).

Suppose a project with investments in the initial year of $100, $110 in year 1 and $121 in year 2 as is shown below.

Year 0	Year 1	Year 2
-100	110	121

What would be the value today of the sum of these cash flows if the discount rate amounts to 10%?

$100 invested in year 0 has a value of	-$100
$110 received after one year is worth today	$100
$121 received after two years is worth today	$100

Thus, the total value today of the three cash flows amounts to $100. This is called the **Net Present Value**. In the next section this concept will be explained in more detail.

If in a number of subsequent years the same amount of net receipts is generated each year, it is easier to use Table 2 in the Appendix (section 2.8) in order to determine the Net Present Value.

a. Net Present Value

The Net Present Value (NPV) of a project is defined as the sum of the discounted net receipts over the lifespan of a project. Net receipts are discounted with a predetermined interest rate.

This discount rate can be determined in various ways:

Table 2.7 Determination of NPV

Year	Costs	Benefits	Net Benefits	Discounting factor at a discount rate of 10%	Discounted net benefits
0	-5.0	0.0	-5.0	1.000	-5.00
1	-5.0	0.0	-5.0	0.9041	-4.55
2	-0.5	1.0	0.5	0.8264	0.41
3	-0.5	3.0	2.5	0.7512	1.88
4	-0.5	5.0	4.5	0.6830	3.07
5	-0.5	7.0	6.5	0.6209	4.04
6	-0.5	7.0	6.5	0.5645	3.67
					NPV= +3.52

The NPV of this project is positive which means that investing in the new cotton field is profitable. In other words, the cotton sales will generate sufficiently to pay back the loan against a 10% interest rate.

Another example is the factory for farm implements of section 2.2.2. As we remember, the overall profitability of a project is determined by the cash flow for non-financial operations. This cash flow is determined on the basis of the cash inflows and cash outflows for table 2.5.

Table 2.8 Factory for farm implements Determination of profitability

Year	0	1	2	3	4	5	6
Non-financial operations							
Investments	-32						5
Sales revenues		35	35	35	35	35	
Operating costs		-20	-20	-20	-20	-20	
Taxes		- 5	- 5	- 5	- 5	- 5	
Cash flow for non-financial operations	-32	10	10	10	10	10	5

At a discount rate of 10% the NPV of the factory amounts to 8.7. The conclusion is that this project can be accepted. As we have seen before, the liquidity positions of the factory is also satisfactory in every year of its operational life.

BCR >1. Again the determination of the discount rate follows the same reasoning as in the case of the NPV and the IRR.

The example of the cotton field may again illustrate this. The discount factors at a discount rate of 10% can be found in Annex 1.

Table 2.9 Determination of BCR

Year	Benefits	Discounted Benefits	Costs	Discounted Costs
0	0.0	0.00	5.0	5.00
1	0.0	0.00	5.0	4.52
2	1.0	0.83	0.5	0.41
3	3.0	2.25	0.5	0.38
4	5.0	3.42	0.5	0.34
5	7.0	4.35	0.5	0.31
6	7.0	3.95	0.5	0.28
		14.80		11.24

The BCR of this project amounts $\frac{14.80}{11.24}$ = 1.32. This exceeds 1.0 and therefore the project can be accepted.

2.3.3 Use of NPV, IRR and BCR

The advantage of using more refined criteria as NPV, IRR and BCR above a criterion as the pay-back period is that more attention is paid to the time-aspects of cash inflows and outflows. A cash inflow or outflow incurred five years after the start of the project is worth less than the same inflow or outflow occurring at present. This difference is accounted for by means of discounting.

NPV, IRR and BCR can in principle be exchanged for one another. In practice, they normally lead to the same conclusion, i.e. the acceptance or rejection of a project proposal.

In order to accept a project it is required that:

NPV >0
or IRR >cut-off rate
or BCR >1.0

2.3.5 Inflation

The financial analysis of a project has, as has been observed at the beginning of this chapter, three main elements: liquidity analysis, profitability analysis and finance analysis.

In liquidity analysis inflation should be taken into account. In profitability analysis, however, inflation is mostly not taken into consideration. One can say that profitability analysis is executed using 'constant' prices, i.e. prices of inputs and outputs are assumed to remain equal to those in the base year. For the determination of the profitability of a project (expressed in NPV, IRR or BCR) is does not matter if inflation is incorporated or not, if prices of inputs and increase at the same rate. Only in the situation of important differences between price increases of certain inputs or outputs inflation should be taken into account.

2.3.6 Sensitivity analysis

Profitability analysis is based on projections of receipts and expenditures in the future. Project analysts will of course do their utmost to estimate as carefully as possible these future values but some uncertainty will always remain. For this reason, it will be useful to know what would occur to the NPV, IRR or BCR of the project if the estimates of some of the important inputs or outputs of the project would be different. This analysis is called **'sensitivity analysis'**. For example:

- how will the NPV, IRR or BCR change if the investment outlays prove to be 10% higher than expected?
- what will be the effect on NPV, IRR or BCR if the expected sales are 10% lower than estimated?

In this way we get an idea about the sensitivity of the estimated results of the project for changes in certain conditions. If this sensitivity results to be very high - for instance if 5% less sales than expected makes the project completely unfeasible- decision-makers should be very careful to accept the project.

It will be clear that in principle many variations at the receipts or expenditure side could be analysed. However, more than two or three variations is mostly not useful.

In addition the so-called **'switching values'** can be determined. These are the values of the main inputs or outputs for which NPV, IRR or BCR reach their critical value, i.e. NPV = 0, IRR = cut-off rate, or BCR = 1. If at only a small decrease in, for example, prices of sales the criteria of profitability reach their critical value the project is to risky to undertake.

As an example of the exploitation of the new cotton field is considered again. It is assumed that, as a result of general overproduction of cotton, cotton prices and thus benefits are 10% below the estimated values. The NPV of the project is calculated below in table 2.7

In this financing plan, both the total amount of finance is determined and the sources of finance are identified. In agricultural projects, for example, one or more of the following are the typically the main sources of finance:

1. government budget allocations (i.e. grants administered through ministries or parastatals);
2. government loans (e.g. to independent statutory bodies or cooperative societies);
3. international loans from multilateral or bilateral aid agencies or foreign commercial banks;
4. domestic loans (e.g. from national banks) to local institutions;
5. equity investments by individuals (farmers, other project beneficiaries).

An example of a financing plan for an irrigation project in India can be found in tables H8 and H9 of section 2.7.

2.4.2 Contingencies

Specialists will work on the estimated costs of buildings, land clearing, equipment etc. However, since it is impossible to anticipate exactly all the costs, it is standard professional practice to add on 'physical contingencies' to cover abnormal requirements (e.g. deeper than planned building foundations because of unexpectedly soft bedrock). Furthermore, 'price contingencies' should be added.

Thus, normally, two types of contingencies are encountered when planning an investment project: physical contingencies and price contingencies. **Physical contingencies** typically apply to capital costs as land, buildings and infrastructural facilities. The base costs are the best judgement of the quantities and prices of these items. However, due to possible changes in quantities and methods of implementation increases in total costs can sometimes be expected. In that case a certain percentage of the base costs can be added. In the example of the Kerala project (section 2.7, table H5) physical contingencies of 3% of baseline costs were assumed.

Price contingencies refer to the price increases that could occur during the investment phase of the project. It will, of course, be very difficult to project the inflation for the different types of capital outlays. Inflation has to be taken into account, however, because the financing plan has to cover the total expenditures during the investment phase. The impact of inflation is especially strong in the case of projects with implementation periods extending over several years. This can be seen in the Kerala project where price contingencies amounted to 21% of the baseline costs.

2.5 Elements in Terms of Reference

Precise Terms of Reference are, of course, essential to receive afterwards a clear report from the mission that had the task to study the feasibility of a proposed project. It has already been explained in section 1.3. that such a report should comprise many aspects of a project. The financial analysis is only one element in the whole appraisal study. Some indications are given below about possible

1. a first check could be to analyse whether the financial analysis consists of a liquidity analysis (in agricultural projects: both for the farmers, the project itself, the local government etc.), a profitability analysis and a finance analysis. In many reports, much attention is given to the profitability of the proposed project and much less to liquidity aspects and sources of finance;

2. has there been an active search for alternatives? It is nice to know that the proposed project can be accepted because of its high IRR. But is there no alternative which is even better?

3. is it sufficiently clear what would happen in the "without case"? Especially in projects for project rehabilitation it is very important to check very carefully on the consultants' assumptions;

4. are the estimates on the proposed investments correct? Remember that one of the main reasons for failure of projects (resulting in a recalculated IRR after termination of the project much lower than presented in the original report) is that investment costs were underestimated. Has working capital been foreseen as part of the investment? Are physical and price contingencies included? Inflation during the construction period is important to be included to know the required finance of the project;

5. what has been assumed about the length of the investment period? Is it realistic to suppose that the construction of the factory will take only one year? Or that it will take only two years to bring the whole area under irrigation with farmers that are not used to apply irrigation techniques?

6. in general, it is very important to analyse the time-period that has been foreseen for the project to arrive at its full capacity (and for factories: what is the estimated utilization of installed capacity?). Remember that it can make much difference for the values of NPV or IRR if full benefits of the project will be received after two years or after five years because of the discounting procedure;

7. one of the crucial things to check on are the quantities and prices of the products that will be sold. Are the yields of the rice, cotton etc. realistic in the light of what is actually being produced in the project area? Will it be possible to sell the products at the proposed price levels? Here, the marketing aspects of the project should be carefully analysed;

8. have reinvestments of equipment, vehicles etc. been taken into account during the operational period of the project? Repair and maintenance has been foreseen?

9. in the profitability analysis we have to check on the discount rate assumed for the calculation of the NPV or (what is the same) the cut-off rate for the IRR. What is the source for the value that is used?

10. finally, we should check whether a sensitivity analysis has been carried out by the consultants and to what conclusions they arrive on the basis of that analysis.

control and supervision of infrastructure works and monitoring and evaluation after commissioning of the schemes.

Farmers will be involved in the planning and preparation process right from the beginning. They will also have to contribute to the cost of capital investment. In principle, the bore well is given to the Farmers Association free of charge, but all other cost related to the distribution network are to be borne by the farmers themselves. To enable the farmers to finance these investments, loans can be contracted with NABARD and the Kerala State Cooperative Bank. The loans in turn can be subsidized by 25 to 50%, depending on the size of the landholding.

2.7.2 Farm income analysis

Approach

Incremental farm incomes which would result from the project have been calculated on the basis of crop models and farm models. Two farm models have been developed; one for a farm with a holding size of 0.2 ha and one for a farm of 0.04 ha. These farm models are regarded to be representative for the holding sizes in Trichur district, because 77% of the actual land holdings are in groupsize 0.02-0.5 ha. It has also been considered to design a farm model for a farm size of 0.4 ha, but since the outcome of this model would in essence be the same as two times the farm model of 0.2 ha and since the actual distribution of the land holding sizes within the group 0.02-0.5 ha is unknown, it has been decided not to develop such a model.

It should be noted that the landholdings presented here are net holdings. Double cropping and inter cropping occur on a large scale in Kerala and the calculation of the cropping intensity in India is based on these cropping patterns together without making a distinction between the two. Due to the intensive agricultural practises in Kerala, the cropping intensity of the farm models developed for this project is 2.08. This implies that the net areas should be multiplied by two to arrive at the gross area cultivated.

All farm models are based on crop models. For each crop model two tables have been prepared; one showing the yields and inputs (and thus the quantities produced and used) and one showing a financial budget.

For each crop model a distinction has been made between existing technology and new technology. Under the existing technology it is assumed that farmers would apply some fertilizer, but would not have irrigation water available during the dry season. This implies that some yield increases under the existing technology (in terms of coconuts) are expected, but not to the same extent as under the new technology when farmers do have irrigation water available and also apply more fertilizer and other crop inputs. The rationale for this approach is to ensure that the calculated incremental yields (and inputs used) would stem solely from increased availability of irrigation water (accompanied by more use of agricultural inputs to make optimal use of the irrigation water).

The crop models which have been constructed reflect the complexity and intensity of the existing farming systems in Kerala. For example, a crop model (based on a surface

Table H.1 Financial and Economic Prices Applied in Crop Models and Farm Models

Item	Unit	Financial Price	Economic Price
Outputs			
Coconut	no	2.40	0.80[a]
by products			
leaves	no	0.50	0.40[c]
dried spathes etc.	value	1.00	0.80[c]
tree	no	200.00	160.00[c]
Arecanut	no	0.14	0.11[c]
by product: tree	no	30.00	24.00[c]
Pepper	dry kg	32.25	27.70[b]
Banana: table variety	kg	3.50	2.80[c]
nendran	kg	4.50	3.60[c]
sucker	no	1.50	1.20[c]
Tapioca	kg	1.00	0.80[c]
Ginger: dried	kg	20.00	16.00[c]
green	kg	6.00	4.80[c]
Jack fruit	kg	2.00	1.60[c]
Mango	kg	3.00	2.40[c]
Colocasia	kg	2.50	2.00[c]
Yam Dioscorea	kg	4.00	3.20[c]
Amorphophalus	kg	4.00	3.20[c]
Inputs			
Arecanut	seedling	3.00	2.40[c]
Pepper	vine	0.50	0.40[c]
Ginger seed	kg	15.00	12.00[c]
Banana sucker	no	1.50	1.20[c]
Prep.& digging pit	value	1.00	0.40[d]
Plant mat	no	2.00	1.60[c]
Fertilizer			
mixture 10:5:20	kg	1.87	3.77[e]
urea	kg	2.41	5.00[a]
muss. phosph.	kg	0.80	2.40[a]
mur. potash	kg	1.33	3.50[a]
Liming	kg	2.00	1.60[c]
Organic matter banana	8 kg/plant	4.00	3.20[c]
Organic matter coconut & arecanut	kg	0.50	0.40[c]
Manure	kg	0.75	0.60[c]
Organic manure	ton	250.00	200.00[c]
Crop protection coconut	tree	1.00	0.80[c]
Crop protection arecanut	tree	2.00	1.60[c]
Crop protection pepper	value	1.00	0.80[c]
Crop protection banana	value	1.00	0.80[c]
Bunch support	no	7.00	5.60[c]
Labour			
male	day	35.00	14.00[d]
female	day	21.00	8.40[d]
harvesting (hired, coconut	no of climbing	1.25	0.50[d]
harvesting (hired, arecan	100 bunch	60.00	24.00[d]
harvesting (hired, pepper	dry kg	10.00	4.00[d]
harvesting (hired)	bunch	0.50	0.20[d]

a) import parity price
b) export parity price
c) Standard Conversion Factor = 0.8
d) Shadow Wage Rate = 0.4 x market wage rate
e) weighted average of urea, muss. of phosphate and muriate of potash

The cost of the bore well (Rs. 100,000) will be financed by the project and thus Rs. 295,000 (or Rs. 73,750 per ha or Rs. 14,750 per farm of 0.2 ha) must be borne by the farmers themselves. Of this Rs 14,750, the farmer will have to contribute 10% through own funds and for the remainder it is assumed that he/she is eligible for a loan and will receive a subsidy of 33.3% (Rs. 4,425) of the loan amount.

Table A.5 also reveals that the return per family day of labour decreases from Rs. 205 in year 1 of the 'without project' situation to Rs. 141 in year 1 of the with project situation. At full development, however, the return per family day of labour is expected to reach Rs. 631/day. The reason for the initial decline in return per family day of labour (with initially a stagnating farm income) is that the amount of family labour required increases (see table H.2). It is also worth to note that in both the 'without project' and the 'with project' situation the return per family day of labour exceeds the prevailing daily wage rate (Rs. 35/day) for male labour. On the other hand, table H.2 also shows that the amount of family labour required for the farming activities is much less than what is available at the farm. This implies that the farm families, after fulfilling their own labour requirements on the farm, will have some surplus labour which can be made available elsewhere (provided that regular opportunities exist) to generate off-farm income. Since there are no reliable data on off-farm income, this aspect has not been taken into account in the farm income analysis. That fact the return per family day of labour is higher than the daily wage rate indicates that a farmer will give priority to farming activities on his/her own land.

Table H.2 Family Labour Available and Required[a)]

Farm size	Labour required (person/days/yr)		Labour available (person/days/yr)		Surplus	
	without project	with project	without project	with project	without project	with project
0.2 ha	33	48	430	430	397	382
0.04 ha	18	21	430	430	412	409

a) Average family size 6 persons (3 female and 3 male), of which 0.5 female and 1.4 male economically active. Women are assumed to have 4 hours/days available for agricultural activities. Year supposed to consist of 260 working days of 8 hours each. Men supposed to have 260 days per year available.

Table A.6 (for a farm of 0.04 ha) shows that the farm income after financing increases from Rs. 2,174 in year 1 of the project to Rs. 7,597 at full development. The returns per family day of labour for these farm models are also much higher than the prevailing daily wage rates.

Financial internal rate of return (FIRR). To measure the feasibility of the various farm models the FIRR has been calculated on the *incremental* farm income *before* financing. Moreover, since the above-presented farm models are assumed to be operating in an irrigation scheme of 4ha net, two variants have been calculated. One based on an irrigation scheme of 2.25 ha net and one based on 6 ha net. The reason for this is that investment costs (and thus the operation and maintenance costs) increase with a declining size of an irrigation scheme. Elsewhere in the report cost data are presented for these three different irrigation schemes (not shown here). These data have been

The official exchange rate applied is Dfl. 1,- = Rs. 10.25.

Total project costs (see table H.5) are Rs. 144.477 million (Dfl. 14.095 million), of which baseline costs (thus excluding physical and price contingencies) are Rs. 117.176 million (Dfl. 11.432 million). Physical contingencies amount to Rs. 2.943 million (Dfl. 0.287 million), or 3% of the baseline costs. Price contingencies are Rs. 24.358 million (Dfl. 2.376 million), or 21% of the baseline costs.

Table H.5 India, Community Irrigation Pilot Project, Project Cost Summary

	Rupee			Dutch Gld.			% Total	
	Local	Foreign	Total	Local	Foreign	Total	% Foreign Exchange	Base Costs
A. Groundwater Development	37490	14760	52250	3658	1440	5098	28	45
B. Land & Water Management	22467	2152	24620	2192	210	2402	9	21
C. Extension and Training	5528	18450	23978	539	1800	2339	77	20
D. Women in Development	1275	0	1275	124	0	124	0	1
E. Monitoring and Evaluation	1533	10147	11681	150	990	1140	87	10
F. CIPAK	1322	2050	3372	129	200	329	61	3
Total BASELINE COSTS	69616	47560	117176	6792	4640	11432	41	100
Physical Contingencies	2840	103	2943	277	10	287	4	3
Price Contingencies	18696	5662	24358	1824	552	2376	23	21
Total PROJECTS COSTS	91152	53325	144477	8893	5202	14095	37	123

Values Scaled by 1000.0 - 3/7/1991 11:52

Table H.6 shows the costs of the project by project component (i.e. the major *objectives* of the project) by the summary accounts (i.e. the means to *achieve* the objectives, such as equipment, vehicles, local staff, technical assistance, and operation and maintenance). With regard to the summary accounts, a distinction has been made between investment costs and recurrent costs. The table indicates that the total amount of taxes is Rs. 3.933 million (3% of the total project costs) and that the foreign exchange costs amount to Rs. 53.325 million (37% of the total project costs). By far the major part of the foreign exchange costs is related to the technical assistance.

Table H.7. India, Community Irrigation Pilot Project, Rupee, Summary accounts by year

	Base Costs						Foreign Exchange	
	01	02	03	04	05	Total	%	Amount
I. INVESTMENT COSTS								
A. Equipment	15316	7272	9144	9718	900	42350	2	1030
B. Vehicles	5228	0	0	0	0	5228	0	0
Total INVESTMENT COSTS	20544	7272	9144	9718	900	47578	2	1030
II. RECURRENT COSTS								
C. Local staff	2883	2956	2956	2956	2883	14635	0	0
D. Technical assistance	6985	12027	13770	8917	5227	46928	99	46530
E. Operation & maintenance	1604	1609	1609	1609	1604	8035	0	0
Total RECURRENT COSTS	11473	16593	18335	13483	9715	69598	67	46530
Total BASELINE COSTS	32017	23865	27479	23201	10615	117176	41	47560
Physical Contingencies	469	642	808	858	166	2943	4	103
Price Contingencies	3684	3765	6028	7221	3660	24358	23	5662
Total PROJECT COSTS	36169	28272	34315	31281	14440	144477	37	53325
Taxes	1526	598	753	840	215	3933	0	0
Foreign Exchange	8192	13040	15442	10367	6284	53325	100	53325

Values Scaled by 1000.0 3/7/1991 11:52

Total project costs are to be financed by GON, GOI/GOK and the beneficiaries themselves. GOI/GOK will finance the salaries of the local staff as well as the taxes on equipment and vehicles (see table H.8, which shows the financing plan by disbursement category). The beneficiaries will finance (through own savings or long term loans) the pumps, pumphouses, electric connections and the distribution system of each CIP. The latter amounts to Dfl. 2.46 million (or 17% of the project costs), see table H.8 which expresses the contributions to the project by the various partners in Dutch guilders. The contribution by GOI/GOK to the project will be Dfl. 3.06 million (22% of the total project costs). The contribution by GON (Dfl. 8.57 million) covers expenditures on equipment, vehicles, technical assistance and operation and maintenance.

Table H.8 India, Community Irrigation Pilot Project, Financing plan by disbursement category, Dutch Gld.

	Gov. of the Netherlands		Beneficiaries		Gov. of India/Kerala		Total		For. Exch.	Local (Excl. Taxes)	Duties & Tax.
	Amount	%	Amount	%	Amount	%	Amount	%			
A. Equipment	1823	94	0	0	121	6	1944	14	116	1707	121
B. Vehicles	549	95	0	0	29	5	578	4	0	549	29
C. Local staff	0	0	0	0	1855	100	1855	13	0	1852	4
D. Technical assistance	5131	100	0	0	0	0	5131	36	5086	45	0
E. Oper. & maintenance	1067	100	0	0	0	0	1067	8	0	1003	64
F. Investm. costs CIPs	0	0	2464	70	1056	30	3520	25	0	3354	166
Total Disbursement	8570	61	2464	17	3061	22	14095	100	5202	8509	384

Values Scaled by 1000.0 3/11/1991 10:24

2.7.4. Annex to CIPP case study

Table A.1 Crop model for perennials; Yields and inputs (per ha)

		Existing technology (with fertilizer, without irrigation)				New technology (with fertilizer, with irrigation)						
	Unit	1	5	10	14-25	1	2	3	4	5	10	14-25
Yield												
Coconut tree												
main product	nuts	4,900	5250	6425	6700	4,900	4,900	4,550	4,900	6,300	9,610	10,800
by product												
leaves	leaves	1,400	1,400	1,400	1,400	2100	2100	2100	2100	2100	2100	2100
dried spathes etc.	value	350	350	350	350	525	525	525	525	525	525	525
trees	no			4	4						4	4
Arecanut tree												
main product	nuts	137,500	137,500	137,500	137,500	134,750	132,000	141,000	230,000	290,000	922,000	922,000
by product tree	no	5	5	5	5	5	5	5	5	5	5	5
Peppervines on areca	dry kg	100	100	100	100	220	330	345	380	425	685	685
Operating												
Coconuts												
Inputs												
fertilizer												
mixture 10:5:20	kg	350	350	350	350							
urea	kg					175	175	175	175	175	175	175
muss. phosph.	kg					300	300	300	300	300	300	300
mur. potash	kg					350	350	350	350	350	350	350
liming	kg					175	0	0	175	0	175	60
organic matter	kg					4,375	4,375	4,375	4,375	4,375	4,375	4,375
crop protection	value	80	80	80	80	525	525	525	525	525	525	525
Labour												
male	days	50	50	50	50	60	60	60	60	60	60	60
female	days	25	25	25	25	10	10	10	10	10	10	10
harvesting (hired)	no. of climbings	1,575	1,575	1,575	1,575	1,575	1,575	1,575	1,575	1,575	1,575	1,575
Areca												
Inputs												
fertilizer												
mixture 10:5:20	kg	125	125	125	125							
urea	kg					100	100	100	100	100	100	100
muss. phosph.	kg					100	100	100	100	100	100	100
mur. potash	kg					125	125	125	125	125	125	125
liming	kg					100	100	100	100	100	100	100
organic matter	kg					7,500	7,500	7,500	7,500	7,500	7,500	7,500
crop protection	tree	50	50	50	50	100	100	100	100	100	100	100
Labour												
male	days	20	20	20	20	20	20	20	20	20	20	20
female	days	5	5	5	5	15	15	15	15	15	15	15
harvesting (hired)	100 bunch	10	10	10	10	10	16	22	28	34	40	40
Pepper												
Inputs												
fertilizer												
urea	kg					100	100	100	100	100	100	100
muss. phosph.	kg					100	100	100	100	100	100	100
mur. potash	kg					125	125	125	125	125	125	125
crop protection	value					12,500	12,500	12,500	12,500	12,500	12,500	12,500
Labour												
male	days	10	10	10	10	20	20	20	20	20	20	20
female	days	10	10	10	10	20	20	20	20	20	20	20
harvesting (hired)	dry kg	100	100	100	100	100	230	360	490	620	750	750

Table A.2 (continued)

	unit price	Existing technology (with fertilizer, without irrigation) 1	5	10	14-25	New technology (with fertilizer, with irrigation) 1	2	3	4	5	10	14-25
Income (before labour costs)		30,878	31,718	35,338	35,998	14,062	15,915	15,158	27,577	39,478	143,077	146,163
Labour												
Male		2,450	2,450	2,450	2,450	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Female		630	630	630	630	945	945	945	945	945	945	945
Total		3,080	3,080	3,080	3,080	4,445	4,445	4,445	4,445	4,445	4,445	4,445
Income (after labour costs)		27,798	28,638	32,258	32,918	9,617	11,470	10,713	23,132	35,033	138,632	141,718

Table A.4 Crop model (0.04 ha) Financial budget Cropping Year

	unit	Unit Price	Existing technology (with fertilizer, without irrigation) 1 to 25	New technology (with fertilizer, with irrigation) 1	2	3	4	5	10	11-25
Production										
Coconut	nut	2.40	672	739	655	739	857	974	1,344	1,344
Leaves	no	0.50	35	44	44	44	44	44	44	44
Dried pathes, etc.	tree	1.00	7	7	7	7	7	7	7	7
Arecanut tree	nuts	0.14	945	945	1,365	1,785	2,202	2,737	5,320	5,600
Peppervines on areca	kg	32.25	290	484	722	758	868	906	1,403	1,403
Banana										
Table variety	kg	3.50	252	0	0	0	0	0	0	0
Nendran	kg	4.50	0	270	270	270	270	270	270	270
Tapioca	kg	1.00	30	40	40	40	40	40	40	40
Jack fruit	kg	2.00	150	150	150	150	150	150	150	150
Mango	kg	3.00	150	180	180	180	180	180	180	180
Colocasia	kg	2.50	6	6	6	6	6	6	6	6
Yam Dioscorea	kg	4.00	72	120	120	120	120	120	120	120
Amorphophalus	kg	4.00	36	48	48	48	48	48	48	48
Total production			2,646	3,033	3,608	4,147	4,792	5,483	8,932	9,212
Operating										
Inputs										
Planting										
Arecanut	seedling	3.00	0	30	0	0	0	0	0	0
Pepper	vine	0.50	0	9	0	0	0	0	0	0
Banana	sucker	2.00	0	12	12	12	12	12	12	12
Fertilizer										
Coconut										
urea	kg	2.41	0	84	84	84	84	84	84	84
muss. phosph.	kg	0.80	0	24	24	24	24	24	24	24
mur. potash	kg	1.33	0	93	93	93	93	93	93	93
Areca										
urea	kg	2.41	0	17	34	48	48	48	48	48
muss. phosph.	kg	0.80	0	6	11	16	16	16	16	16
mur. potash	kg	1.33	0	11	21	33	33	33	33	33
Pepper										
urea	kg	2.41	0	17	24	48	48	48	48	48
muss. phosph.	kg	0.80	0	6	8	16	16	16	16	16
mur. potash	kg	1.33	0	11	17	33	33	33	33	33
Organic matter										
Coconut	kg	0.50	40	40	40	40	40	40	40	40
Arecanut tree	kg	0.50	38	63	63	63	63	63	63	63
Banana	kg	0.50	23	15	15	15	15	15	15	15
Tapioca	kg	0.50	20	20	20	20	20	20	20	20
Colocasia	kg	0.50	5	5	5	5	5	5	5	5
Yam Dioscorea	kg	0.50	6	10	10	10	10	10	10	10
Amorphophalus	kg	0.50	3	4	4	4	4	4	4	4
Labour										
Male	day	35.00	280	385	385	385	385	385	385	385
Female	day	21.00	210	210	210	210	210	210	210	210
Hired labour (harvesting)										
Coconut	no of climbings	1.25	90	90	90	90	90	90	90	90
Areca	100 bunch	60.00	72	120	120	120	120	120	120	120
Pepper	dry kg	10.00	180	180	270	283	308	338	525	525
Total inputs (excl. male and female labour)			476	865	966	1,058	1,083	1,113	1,300	1,300
Income (before labour costs)			2,170	2,169	2,642	3,089	3,709	4,370	7,632	7,912
Total labour costs			490	595	595	595	595	595	595	595
Income (after labour costs)			1,680	1,574	2,047	2,494	3,114	3,775	7,037	7,317

Table A.5 (continued)

	Without project (with fertilizer, without irrigation)				With project (with fertilizer, with irrigation)						
	1	5	10	14-25	1	2	3	4	5	10	14-25
Farm income before financing	6,766	6,934	7,658	7,790	(10,900)	4,221	4,070	6,553	8,934	29,654	30,271
Sources of finance											
Subsidy investment loan					4,425						
Disbursements on long term loan					15,000	5,300	6,300	4,150	2,100		
Disbursements on short term loan											
Transfer from previous period	1,446	1,446	1,446	1,446	8,666	8,666	8,998	9,400	9,662	10,064	10,018
Less transfer to next period	1,446	1,446	1,446	1,446	8,666	8,998	9,400	9,662	9,994	9,994	10,018
Sub-total	0	0	0	0	19,425	4,968	5,898	3,888	1,768	70	0
Loan repayments											
Long term principal					0	0	0	0	0	6,570	
Long term interest					1,800	2,436	3,192	3,690	3,942	788	
Short term principal											
Short term interest											
Sub-total	0	0	0	0	1,800	2,436	3,192	3,690	3,942	7,358	0
Cash flow after financing	5,615	5,783	6,507	6,639	5,524	5,552	5,575	5,550	5,559	21,164	29,070
Farm income after financing	6,766	6,934	7,658	7,790	6,725	6,753	6,776	6,751	6,760	22,365	30,271
Return per family day of labour	205	210	232	236	140	141	141	141	141	466	631

Table A.8 (continued)

	Without project (with fertilizer, without irrigation)	With project (with fertilizer, with irrigation)						
	1-25	1	2	3	4	5	10	11-25
Farm income before financing	2,170	(1,096)	2,327	2,774	3,394	4,055	7,317	7,597
Sources of finance								
Subsidy investment loan		885						
Disbursements on long term loan		2,650	300					
Disbursements on short term loan								
Transfer from previous period	476	1,281	1,281	1,373	1,398	1,428	1,615	1,615
Less transfer to next period	476	1,281	1,373	1,398	1,428	1,479	1,615	1,615
Sub-total	0	3,535	208	(25)	(30)	(51)	0	0
Loan repayments								
Long term principal		0	0	0	0	0	590	
Long term interest		265	295	295	295	295	59	
Short term principal								
Short term interest								
Sub-total	0	265	295	295	295	295	649	0
Cash flow after financing	1,291	1,292	1,358	1,572	2,187	2,827	5,786	6,715
Farm income after financing	2,170	2,174	2,240	2,454	3,069	3,709	6,668	7,597
Return per family day of labour	121	104	107	117	146	177	318	362

COMPOUNDING AND DISCOUNTING TABLES

2. *Three-decimal Table for Present Worth of an Annuity Factor, Various Rates*

PRESENT WORTH OF AN ANNUITY FACTOR—
How much 1 received or paid annually for X years is worth today.

Year	1%	3%	5%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%	Year
1	990	971	952	943	926	909	893	877	870	862	847	833	820	806	800	794	781	769	741	714	690	667	1
2	1 970	1 913	1 859	1 833	1 783	1 736	1 690	1 647	1 626	1 605	1 566	1 528	1 492	1 457	1 440	1 424	1 392	1 361	1 289	1 224	1 165	1 111	2
3	2 941	2 829	2 723	2 673	2 577	2 487	2 402	2 322	2 283	2 246	2 174	2 106	2 042	1 981	1 952	1 923	1 868	1 816	1 696	1 589	1 493	1 407	3
4	3 902	3 717	3 546	3 465	3 312	3 170	3 037	2 914	2 855	2 798	2 690	2 589	2 494	2 404	2 362	2 320	2 241	2 166	1 997	1 849	1 720	1 605	4
5	4 853	4 580	4 329	4 212	3 993	3 791	3 605	3 433	3 352	3 274	3 127	2 991	2 864	2 745	2 689	2 635	2 532	2 436	2 220	2 035	1 876	1 737	5
6	5 795	5 417	5 076	4 917	4 623	4 355	4 111	3 889	3 784	3 685	3 498	3 326	3 167	3 020	2 951	2 885	2 759	2 643	2 385	2 168	1 983	1 824	6
7	6 728	6 230	5 786	5 582	5 206	4 868	4 564	4 288	4 160	4 039	3 812	3 605	3 416	3 242	3 161	3 083	2 937	2 802	2 508	2 263	2 057	1 883	7
8	7 652	7 020	6 463	6 210	5 747	5 335	4 968	4 639	4 487	4 344	4 078	3 837	3 619	3 421	3 329	3 241	3 076	2 925	2 598	2 331	2 108	1 922	8
9	8 566	7 786	7 108	6 802	6 247	5 759	5 328	4 946	4 772	4 607	4 303	4 031	3 786	3 566	3 463	3 366	3 184	3 019	2 665	2 379	2 144	1 948	9
10	9 471	8 530	7 722	7 360	6 710	6 145	5 650	5 216	5 019	4 833	4 494	4 192	3 923	3 682	3 571	3 465	3 269	3 092	2 715	2 414	2 168	1 965	10
11	10 368	9 253	8 306	7 887	7 139	6 495	5 938	5 453	5 234	5 029	4 656	4 327	4 035	3 776	3 656	3 543	3 335	3 147	2 752	2 438	2 185	1 977	11
12	11 255	9 954	8 863	8 384	7 536	6 814	6 194	5 660	5 421	5 197	4 793	4 439	4 127	3 851	3 725	3 606	3 387	3 190	2 779	2 456	2 196	1 985	12
13	12 134	10 635	9 394	8 853	7 904	7 103	6 424	5 842	5 583	5 342	4 910	4 533	4 203	3 912	3 780	3 656	3 427	3 223	2 799	2 469	2 204	1 990	13
14	13 004	11 296	9 899	9 295	8 244	7 367	6 628	6 002	5 724	5 468	5 008	4 611	4 265	3 962	3 824	3 695	3 459	3 249	2 814	2 478	2 210	1 993	14
15	13 865	11 938	10 380	9 712	8 559	7 606	6 811	6 142	5 847	5 575	5 092	4 675	4 315	4 001	3 859	3 726	3 483	3 268	2 825	2 484	2 214	1 995	15
16	14 718	12 561	10 838	10 106	8 851	7 824	6 974	6 265	5 954	5 668	5 162	4 730	4 357	4 033	3 887	3 751	3 503	3 283	2 834	2 489	2 216	1 997	16
17	15 562	13 166	11 274	10 477	9 122	8 022	7 120	6 373	6 047	5 749	5 222	4 775	4 391	4 059	3 910	3 771	3 518	3 295	2 840	2 492	2 218	1 998	17
18	16 398	13 754	11 690	10 828	9 372	8 201	7 250	6 467	6 128	5 818	5 273	4 812	4 419	4 080	3 928	3 786	3 529	3 304	2 844	2 494	2 219	1 999	18
19	17 226	14 324	12 085	11 158	9 604	8 365	7 366	6 550	6 198	5 877	5 316	4 843	4 442	4 097	3 942	3 799	3 539	3 311	2 848	2 496	2 220	1 999	19
20	18 046	14 877	12 462	11 470	9 818	8 514	7 469	6 623	6 259	5 929	5 353	4 870	4 460	4 110	3 954	3 808	3 546	3 316	2 850	2 497	2 221	1 999	20
21	18 857	15 415	12 821	11 764	10 017	8 649	7 562	6 687	6 312	5 973	5 384	4 891	4 476	4 121	3 963	3 816	3 551	3 320	2 852	2 498	2 221	2 000	21
22	19 660	15 937	13 163	12 042	10 201	8 772	7 645	6 743	6 359	6 011	5 410	4 909	4 488	4 130	3 970	3 822	3 556	3 323	2 853	2 498	2 222	2 000	22
23	20 456	16 444	13 489	12 303	10 371	8 883	7 718	6 792	6 399	6 044	5 432	4 925	4 499	4 137	3 976	3 827	3 559	3 325	2 854	2 499	2 222	2 000	23
24	21 243	16 936	13 799	12 550	10 529	8 985	7 784	6 835	6 434	6 073	5 451	4 937	4 507	4 143	3 981	3 831	3 562	3 327	2 855	2 499	2 222	2 000	24
25	22 023	17 413	14 094	12 783	10 675	9 077	7 843	6 873	6 464	6 097	5 467	4 948	4 514	4 147	3 985	3 834	3 564	3 329	2 856	2 499	2 222	2 000	25
26	22 795	17 877	14 375	13 003	10 810	9 161	7 896	6 906	6 491	6 118	5 480	4 956	4 520	4 151	3 988	3 837	3 566	3 330	2 856	2 500	2 222	2 000	26
27	23 560	18 327	14 643	13 211	10 935	9 237	7 943	6 935	6 514	6 136	5 492	4 964	4 524	4 154	3 990	3 839	3 567	3 331	2 856	2 500	2 222	2 000	27
28	24 316	18 764	14 898	13 406	11 051	9 307	7 984	6 961	6 534	6 152	5 502	4 970	4 528	4 157	3 992	3 840	3 568	3 331	2 857	2 500	2 222	2 000	28
29	25 066	19 188	15 141	13 591	11 158	9 370	8 022	6 983	6 551	6 166	5 510	4 975	4 531	4 159	3 994	3 841	3 569	3 332	2 857	2 500	2 222	2 000	29
30	25 808	19 600	15 372	13 765	11 258	9 427	8 055	7 003	6 566	6 177	5 517	4 979	4 534	4 160	3 995	3 842	3 569	3 332	2 857	2 500	2 222	2 000	30
35	29 409	21 487	16 374	14 498	11 655	9 644	8 176	7 070	6 617	6 215	5 539	4 992	4 541	4 164	3 998	3 845	3 571	3 333	2 857	2 500	2 222	2 000	35
40	32 835	23 115	17 159	15 046	11 925	9 779	8 244	7 105	6 642	6 233	5 548	4 997	4 544	4 166	3 999	3 846	3 571	3 333	2 857	2 500	2 222	2 000	40
45	36 095	24 519	17 774	15 456	12 108	9 863	8 283	7 123	6 654	6 242	5 552	4 999	4 545	4 166	4 000	3 846	3 571	3 333	2 857	2 500	2 222	2 000	45
50	39 196	25 730	18 256	15 762	12 233	9 915	8 304	7 133	6 661	6 246	5 554	4 999	4 545	4 167	4 000	3 846	3 571	3 333	2 857	2 500	2 222	2 000	50

Source: Gittinger (1982, pp. 104-05)

3 Economic analysis

3.1 Introduction

Economic analysis aims at assessing the contribution of a project to a country's welfare, which is expressed in terms of an economic rate of return (or a similar indicator). Economic CBA shares many features with financial profitability analysis, which results in rates of return from private points of view. This chapter sets out to explain the similarities between financial and economic profitability analysis (section 3.2). Next, the differences are treated, by elaborating on possible explanations for different values of financial and economic rates of return (section 3.3).

Differences between financial and economic analysis for developing countries particularly show in the valuation of effects. Opportunity costs and world market prices serve as guiding principles for shadow-pricing in economic CBA (section 3.4). An overview is presented of the two most frequently applied systems for economic analysis. In section 3.5, theoretical principles of economic CBA are illustrated in a number of case-studies. Section 3.6 is devoted to economic CEA, which may be applied if economic benefits cannot be assessed in monetary terms (but costs can).

Should a project be accepted that has a financial NPV of -25 and an economic NPV of 30 (or vice versa)? In section 3.7, possible directions for dealing with such conflicting outcomes of financial and economic analysis are listed.

Section 3.8 concludes with guidelines for a sensible use of economic CBA. This includes a sound application of theoretical principles, as well as an appreciation of specific characteristics of a project and its macro-economic environment. A sensible use might sometimes involve the application of general principles of economic CBA as a way of thinking instead of the application of (all) features of economic CBA as a technique.

The main elements in a Terms of Reference with respect to economic analysis are gathered in section 3.9.

3.2 From financial to economic rates of return

In chapter 2 on financial project appraisal, a distinction was made between profitability (CBA) analysis and liquidity analysis. Economic CBA involves the adjustment of calculations conducted in financial CBA. In other words, economic CBA builds upon financial CBA, particularly on estimates of non-financial cash-flows (see section 2.2). Going from financial to economic analysis, adjustments are required because the perspective changes from a *private* to a *national* point of view (see section 1.5.1). The results are measures of profitability of investments over the life-time of a project to, in the former case, investors, project managers, banks and so on, and in the latter case, to a country. Whereas the perspective differs, the *structure* of financial and economic CBA is basically similar. Consider the following overview of corresponding issues (see chapter 1 for explanations of notions in italics).

- both techniques address the *efficiency* criterion, i.e. are resources used in such a way that benefits are maximized? In economic jargon: the objective is to

as final goods[1]. Assume a proposal to establish a car assembly plant in a developing country. All parts need to be imported, and the import tax amounts to 20% of the CIF value (CIF = cost, insurance and freight; the costs of a product including international transport, insurance and associated costs). If the total CIF value in a year in local currency amounts to Rs 10 mn, corresponding outlays in the financial CBA are Rs 10 mn. The higher the import tariff, the lower the financial IRR.

In economic analysis a key question is whether cash-flows affect a country's welfare. If the car assembly plant pays Rs 200,000 to the government annually, the country gets richer nor poorer. Of course, the factory gets poorer and the government richer, but the distribution of income is irrelevant in economic analysis. Hence, economic CBA ignores this transfer. In economic analysis, there will be a cost item of Rs 10 mn for imported parts, against Rs 12 mn in financial CBA. All other things equal, the financial IRR will be lower than the economic IRR.

Governments in many developing countries have paid large sums of money to inefficient industrial enterprises, as a part of import-substitution strategies. Subsidization may, for instance, take the form of the supply of very cheap raw materials to a factory. In that way, a firm may keep its production costs below prices of imported commodities, and artificially high financial IRRs result. Direct subsidies should be ignored in economic analysis. They involve a transfer of funds from the government to a factory, but the country gets richer nor poorer. The economic IRR will, all other things assumed equal, be lower than the financial IRR.

A second ground for moving from financial to economic CBA is the expectation that a project will cause important *external effects*. They can be defined as all changes in society attributable to the project, for which the project does not pay or receive financial compensation (i.e. there is no balancing outlay or receipt item). In other words, others than those involved in the project experience such positive or negative externalities. This definition implies that whereas financial CBA ignores external effects, economic CBA requires their incorporation. All other things equal, the economic IRR will be higher than the financial IRR if a project has a positive external effect, and vice versa.

The most interesting type of external (often negative) effects, which should fully be reflected in economic CBA, are impacts on the environment. As long as there is no or a very low financial charge for overexploitation and degradation of natural resources, such impacts are beyond the scope of a financial CBA. Chapter 4 is devoted to the question of how to incorporate unpriced or underpriced environmental effects in economic CBA.

Examples of positive external effects may be found in the field of, for instance, training and health. If a child is effectively immunized against a transmittable disease, the direct benefit is that the child concerned will not be ill. Positive externalities arise because that child will not pass on the disease to others, with favourable impacts on productivity levels and health sector budgets.

There are several types of impacts of a project on others in society which involve markets. For reasons of convenience, they are also termed external effects here, but they should clearly be distinguished from the examples above. Well-known categories of market-based external effects are backward and forward linkages, and multiplier effects. Some examples may illustrate these notions:

[1]Final goods are used by consumers, whereas the other products are used by firms and the government.

networks, and so on. The "project" would then not be confined to the establishment of the plant, but should include these extra outlays of farmers as well.

Finally, economic CBA may be used to appraise a project if severe *price distortions* in the economy affect its feasibility. Here the linkage between the viability of a single project and its macro-economic environment is demonstrated most clearly. Economic analysis is particularly concerned with tracing differences between private and national valuations. Such differences worry economists: if water is provided free to consumers, that does not mean that the country does not experience costs. Prices of goods and services provide signals ("incentives") to producers and consumers, who take them into account in deciding what to produce and what to consume. Economic theory says that market prices are not distorted if they are determined by demand (i.e. consumers) and supply (producers) only. If such prices apply, the argument continues, producers and consumers will choose to allocate a country's scarce resources (labour, capital, natural environment) in such a way that real national income is maximized. Consequently, if prices are distorted, as they often are in developing (and developed!) countries, decisions of agents in an economy will be sub-optimal and income will increase at a lower pace or even decrease.

In a financial analysis *actual* market prices are used, whether or not they are distorted. Investors base their decisions on these prices. In economic CBA, a wider perspective is taken. The aim is to filter out the price distortions, and to assess the "real" value of all effects of a project to a country. Market prices are converted into *shadow* prices, also known as economic, efficiency, or accounting prices. These *hypothetical* prices show the value of goods and services as well as resources ("factors of production") under the assumption that distortions would be removed. Before explaining how these shadow prices can be estimated, several types of price distortions and their possible consequences for an economy will be summarized.

Perhaps the most important distortion occurring in many developing countries is an *overvalued exchange rate* at the market for foreign currency. The exchange rate shows the price of local currency in terms of foreign currency. In most countries producers and consumers are highly sensitive to this price. For instance: if the rate is Rs 15 = US$ 1, the dollar is more expensive (the Rupee is cheaper) then if the rate is Rs 10 = US$ 1. It is in the interest of foreigners visiting or investing in the country that the former rate applies, whereas domestic importers of raw materials would favour the latter rate.

When should a currency be considered overvalued? A quick way to answer that question is to ask whether a black market for foreign exchange exists. If there is no sign of such a market whatsoever, the official exchange rate (OER) is probably more or less "correct". If a foreign visitor, however, is offered 25% more Kwachas for a US dollar at the black market than by a formal sector bank, overvaluation exists. At the official rate, dollars are worth less than at the black market rate. In other words, importing goods and services (expressed in the "demand" for foreign exchange) at the former rate is much cheaper than at the latter rate. Similarly, exporting goods and services (the "supply" of foreign exchange) is relatively unattractive at the official rate. Overvaluation and a black market for foreign exchange are often two sides of the same coin.

Overvaluation arises, for instance, if domestic and foreign inflation rates diverge considerably and the exchange rate is not adjusted accordingly. There will

on, relative to similar industries abroad or other sectors in the country. In fact, many "import-substituting" firms were foreign exchange losers: importing all required inputs is more expensive than importing the final product.

In such cases, macro-economic government policies have a favourable impact on the financial analysis of inefficient, high-cost activities. In the economic analysis of projects, the aim is to obtain a correct impression of the performance by removing the private advantages of artificially cheap imports.

Policies have often been biased against exports, particularly of agricultural products. Although agricultural development has been a widely supported development objective, the desire to satisfy the local demand for cheap food, especially in urban areas, has often encouraged policies with the opposite effect. In many developing countries, overvaluation has depressed exports of agricultural products, while local producers were able to produce at relatively low costs at international standards (the country has a "comparative advantage"). Assume a Tanzanian farmer who produces one ton of sisal at a cost of Tsh 75,000. The world market price of sisal is US$ 500 per ton, which of course cannot be influenced by the farmer. At the official exchange rate (Tsh 100 = US$ 1), he will receive 500 ($) * 100 (Tsh/$) = Tsh 50,000. The farmer will not produce for the export market, as receipts do not cover production costs. Assume that the official exchange rate is regarded overvalued, and that the estimate of a "free-market" exchange rate is Tsh 200 = 1 US$. If the government would apply that rate, the farmer certainly caters for the export market: one ton of sisal would earn him 500 ($) * 200 (Tsh/$) = Tsh 100,000. Hence, due to the policies of the government, an internationally competitive farmer will decide not to produce. The government produces the "wrong" kinds of signals to companies. Like in the case of inefficient import-substituting firms, private appraisal of potential export activities is strongly influenced by actual government policies. If such policies are regarded distorted, the aim of economic CBA is to assess a project's real efficiency score by removing the distortion.

Government *control of prices of goods and services* is a second major type of price distortion in many developing countries. Distortion occurs if a government sets a price at a level which deviates substantially from the "free-market" price, which would result from demand and supply only. Due to government interference in price setting, consumers and producers may arrive at decisions that are undesirable from a national point of view. Some examples of government control of prices of *final* products and services, which are sold to consumers, are presented below:

- Governments often aim at keeping food prices low. An important reason has been the desire to avoid social unrest, especially in urban areas. At low prices, the urban population (the demand side) can obtain food relatively cheap. This policy has often been at the expense of rural producers of food crops (the supply side). Sometimes, selling prices were lower than the production costs, and farmers chose to reduce supply of their products to urban markets. Despite the government objective of ensuring sufficient nutritient levels in urban areas, shortages (demand exceeds supply) are likely to occur. To avoid such a situation, public bodies have often been made responsible for purchasement and distribution of food crops. In extreme cases, farmers have had to sell their products compulsory. Undoubtedly, such policies have provided few incentives to maximize food production. In any case, urban consumers have been subsidized at the expense of rural producers.

borrowing). Another effect of low interest rates is the encouragement of capital-intensive (large use of machines) instead of labour-intensive (large use of labour) technology, thereby contributing to under- and unemployment in labour-rich countries.
- Labour is often overpriced in developing countries. Governments as well as trade unions, especially in industry, have favoured wages at relatively high levels. Unintentionally, this may have reduced employment levels, as the production factor of labour becomes too expensive to employers.

Many social and infrastructure projects have showed a weak financial performance due to such types of price distortions. Similarly, the financial feasibility of large-scale agricultural and industrial projects has often been particularly attractive due to government policies rather than their own efficiency. In economic CBA distortions are "corrected" by applying shadow prices, for foreign exchange, goods and services, as well as factors of production (labour, capital, natural resources). The next section explains principles of shadow-pricing.

In the 1980s, many developing countries have embarked upon structural adjustment programmes, which have price distortions as a main point of attention. Possible consequences for project appraisal are addressed in section 3.8.

3.4 Main principles of shadow-pricing

3.4.1 Opportunity costs as the common valuation principle for two approaches

By removing price distortions, actual domestic market prices are converted into economic or shadow prices, showing the value of goods and services to a country. There are two key issues that underlie the determination of shadow prices in economic appraisal, viz.:
- opportunity costs as a bench mark for all shadow prices;
- the specific features of shadow prices for internationally traded and non-traded goods and services.

Shadow-pricing involves an application of the with-without principle, particularly the *"opportunity cost"* principle. A shadow price may be obtained by posing the question: how is a country's welfare affected by a project, either through it use of inputs or its output, compared with the situation in the absence of the project? An example: what is the true cost of employing a rural labourer in off-farm activities? Answer: the foregone agricultural production, viz. income that will not materialize because the worker is employed by the project rather than by farmers. Another example: what is the true value of sisal produced and consumed in Tanzania? Answer: the value of foregone exports, viz. exports that will not occur because sisal will be used domestically.

As these examples show, the choice of the "without" case may be of two kinds. If an internationally traded good or service is concerned, the world market provides the natural alternative for the domestic market. Instead of producing fertilizer in Pakistan, it may be imported. Such an alternative is lacking in the case

3.4.2 Classification of cost and benefit items

To allow economic valuation, benefit and cost items are divided into *inputs* and *outputs*[3]. Inputs are resources used by the project: machines, trucks, bulk raw material, intermediate products, labour, management and so on. Outputs represent the goods or services produced by the project: increased drinking water supply, maize, electricity, education, etc. For both inputs and outputs the next step is to indicate whether they are *traded* or *non-traded*. As explained above, this distinction is crucial to economic CBA because a) these two categories have different types of "without" cases, and b) UNIDO and LMST take one category as numéraire and adjust items in the other category.

A traded good can be:
- an *actually* imported input or exported output. Hence, the project imports fertilizer, fuel or machines, or the project exports sisal or cotton products;
- a good *substituting* for imports or *diverting* exports. Hence, a project produces machines for the domestic market which without the project would have been imported (the project results in lower imports). Or: the project uses inputs which in the absence of the project would have been exported (the project results in lower exports). Although the project itself does not import inputs or export outputs, through its impact on other firms or consumers, it changes the level of a country's imports or exports compared to the without-case.

Together these items comprise the *foreign exchange component* of the costs and benefits of a project. Directly (imports and exports by the project) or indirectly (import substitution and export diversion by the project), projects use or earn foreign exchange.

Non-traded items may be of three kinds:
- goods and services that might in principle be traded internationally, but effectively never are traded. Government interference in the form of quotas, high import barriers or excessive export taxes may cause such a situation. A second reason may be that transporting products from their origin to the international harbour or airport is extremely expensive. For instance, natural products (timber) may come from areas that are practically inaccessible. Whereas logging itself might not be expensive by international standards, the domestic costs of moving the product to the international port may be too high.
- goods and services that due to their specific features never enter the world market. Box 3.3 contains a number of well-known non-tradables. The share of non-traded goods and services in national income may be as high as 50 to 60%.
- factors of production used by the project (inputs), particularly labour and natural resources. Labour is generally not-traded, although for instance many Arab countries employ a great number of temporary workers from abroad. A distinction is usually made between skilled and unskilled labour in view of the different features of the markets at which their price is determined. A project will also use natural resources, particularly land on which buildings will be located.

[3]In this section it is assumed that external effects do not occur, and that transfers have been accounted for.

This example represents the simplest type of valuation problem: an actually imported input, without any domestic costs of transport and other non-traded services. Now consider the example of an output, Tanzanian sugar, that producers are required to sell at low prices to local parastatals for domestic consumption. In the financial analysis the actual price paid to producers should be used, say Tsh 12,000. While sugar is actually consumed domestically, it might have been exported. Therefore, sugar is treated as a traded commodity in economic analysis. The economic value of sugar equals the value of the foregone benefits of exports (= opportunity costs = the value in the without-case). Hence, the FOB (Free On Board; includes all costs of handling and related services in the exporting country) world market price should be applied. As in this example sugar is not actually exported, no international price is directly known to the project. The appraisal team will therefore need to turn to other sources to obtain estimates, for instance the London Exchange Market. If the London Daily Price is US$ 260, and the official exchange rate is US$ 1 = Tsh 100, the internationally-based ("border") price relevant to a LMST economic analysis is Tsh 26,000. This economic price is much higher than the government-determined local selling price[4]. Hence in economic analysis the output of a sugar production project is valued higher than in financial CBA.

Estimating world market prices may not be easy, particularly over the full life-time of the project. For instance, what price would an economist have applied to a sugar project in 1965? With a twenty-year project period, he should have taken an estimate of the price in the period 1965-1985. With the benefit of hindsight, we know that the price (US $/ton) developed as follows: 45 in 1965, 654 in 1974 and 90 in 1985! Who would now blame the economist for making an incorrect forecast in his 1965 study? Present forecasts of the World Bank for the period 1995-2000 put the price at US$ 250.

Using international prices may raise other problems. For instance, there may be considerable quality differences between the local product and the comparable traded product. Rice from Bangladesh may be of lower quality than Indian rice. The economic price of Bangladeshi rice, even if it is traded, should not -without adjustments- be based upon the international price of Indian rice, although the latter price may be obtained more easily. Valuation may also be problematic if special prices apply to a project, for instance if goods are only supplied against quotations. In such and some other related cases, valuation in terms of international prices requires much attention by the appraisal team, and any remaining uncertainty should clearly be explained in the report.

Application of the LMST system to *non-traded goods and services* is more problematic, as by definition there is no direct way to assess their value in international prices. This problem may be solved at different levels. Start by considering a specific *input* used by the project, say a building to be constructed at the project site. It is a non-traded good, for which only a domestic price is known: Rs 400,000. To obtain the economic value of the building, one may try to estimate the value in international prices of the various inputs of the building itself. This is

[4]Note that an exporter only receives this full amount if he is based in Dar-es-Salaam, the international port, and if handling costs are zero. If not, from this border price (valid in Dar-es-Salaam) costs of domestic transport and other services need to be deducted. These are typically non-traded items, to be distinguished from the foreign currency component for sugar itself.

decomposition takes place), whatever the specific type of distortion applies to the particular good or service used by the project[5].

We will not elaborate on how an SCF can be calculated[6]. In theory, such nation-wide parameters should be provided by the government of the recipient country. In fact, consultants often turn to the World Bank and other (multilateral or bilateral) development agencies for advice. In view of many data required to estimate a reliable SCF, a mission whose main task is to evaluate a specific project should not be asked to make their own assessment of this factor.

In summary, the use of international prices as the numéraire in LMST has two consequences:

- traded goods are valued directly at their international price, and expressed in local currency through the OER;
- at the most aggregative level, the economic value of non-traded goods may be estimated by multiplication of the financial value by the SCF. In this way a proxy is obtained for the value in international prices. In most developing countries, the SCF < 1, which implies that domestic prices are adjusted downwards to arrive at the international price equivalent.

The UNIDO system shows the opposite approach: domestic prices are taken as the numéraire, which implies that a distorted ratio of national and international prices should be reflected in adjustments to prices of traded goods and services. To understand the basic principle, recall the features of a black market for foreign exchange. For instance, the official exchange rate might be US$ 1 = YR 10, whereas at the black market YR 12 is offered. Such a gap between official and black market prices for foreign exchange implies an overvalued local currency: the demand for dollars exceeds the supply of dollars by the formal sector banks. A flourishing black market shows that consumers and producers are prepared to pay more for scarce dollars than the official exchange rate suggests[7]. Consequently, the actual value of a dollar, and hence of a traded good, is higher than that rate. The UNIDO approach operates in a similar way. To arrive at the domestic price equivalent of the dollar-price of a traded input or output, a *Shadow Exchange Rate* (SER) is applied instead of the official exchange rate. If there are no distortions, SER = OER, and financial and economic values coincide. In most developing countries SER > OER, which implies that the economic value of traded goods exceeds the financial value.

Return to the example of sugar production in Tanzania. In LMST, the economic price of sugar (Tsh 26,000) is equal to the world market price in dollars, expressed in foreign exchange through the OER. Whereas UNIDO would start from

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[5]An intermediate approach consists of the calculation of sector-specific conversion factors. Such factors show the degree of distortion in a particular sector, like energy, construction, and telecommunications. The costs of the use of electricity, for instance, would be adjusted through the energy sector conversion factor. The construction conversion factor is relevant for the construction of buildings. Sectoral conversion factors are more precise than a SCF, but less targeted than results from decomposition.

[6]A crude approximation of the nation-wide distortion between world market and domestic prices, and hence the SCF, can be obtained by calculating the following ratio:

CIF value of all imports + FOB value of all exports/

CIF value of all imports *plus (net) import taxes* + FOB value of all exports *plus (net) export taxes*.

[7]Similarly, foreigners are able to obtain more Rials for one dollar at the black market than through formal channels.

Given this relation between SER, OER and SCF, UNIDO and LMST systems are fully equivalent if applied at the same level of aggregation. The latter condition implies:

- in LMST the international (dollar) value of *all* traded goods and services are multiplied by the OER, and in UNIDO by the SER;
- in UNIDO domestic prices of *all* non-traded goods and services are not adjusted, whereas in LMST they are multiplied by the SCF.

If these principles are complied with, LMST and UNIDO always give the same recommendations whether to accept or reject a project. Differences only arise if the two systems are applied at different levels of aggregation. For instance, in the UNIDO study the procedure above is applied, whereas in the LMST variant non-traded goods would be valued on the basis of the specific distortions, rather than through the aggregative SCF. Hence, instead of multiplying the financial value of a building by a SCF= 0.80, it is decomposed and its inputs are valued considering their specific distortions.

From the above follows that it does not really matter which system is applied, as long as it is applied in a consistent way. This implies that only in LMST studies the OER and the SCF should occur. Similarly, only in UNIDO studies may the SER be applied. If in one particular study both the SCF and the SER are used, a basic error has been committed.

3.4.4 Basic similarities between LMST and UNIDO systems

LMST and UNIDO differ in the treatment of distortions between international prices (traded goods) and domestic prices (non-traded goods). Because both systems are based on opportunity costs, they follow the same path in all other respects. These remaining issues in economic CBA are explained below.

Valuation of non-traded outputs

Many social sector projects produce outputs that are not traded internationally: clean drinking water, improved health services, better education, and so on. Valuing such outputs is among the most difficult parts in economic CBA (which explains the frequent use of economic CEA in such sectors, see section 3.6). There is no international price available by definition. In searching for the value of such services to society, the financial price (i.e. user charges) may be a starting point if cost recovery is reasonable. If not, user charges are a weak guide: if education is provided free of charge, the value to society of course is not zero! In such cases, economists may turn to consumers and ask them how much they would be willing to pay for these social services. By adding these individual (hypothetical) payments, the value to society can be approximated[8]. Going from financial to economic CBA,

[8]The notion of "consumer surplus" refers to the difference between willingness-to-pay by consumers and the amount they actually pay.

The SWR for skilled labour is often more or less equal to the actual market rate. Unemployment more frequently occurs among unskilled labourers: typical values for SWRs for unskilled labour are in the range of 60 to 90% of market wages.

As labour often constitutes an important part of total costs, the economic feasibility of a project will strongly be influenced by the choice of the SWR. Logically, supporters of projects tend to favour very low SWRs, zero in the extreme case. However, in developing countries people are rarely (fully) unemployed. The SWR should reflect any without-the-project economic activities, whether or not full-time, whether in formal or informal sectors, or in modern or subsistence agriculture. Therefore if an extremely low SWR is applied, consultants should always be asked to specify their assumptions and data basis.

Shadow-pricing land

Land may be an important cost factor for new activities. Projects may need it for the construction of buildings or factories, but also for agricultural purposes. In financial CBA, the project is charged the actual price paid for land. Sometimes this price may diverge considerably from the value to the country, for instance if the government provides the land free of charge to the project. The shadow price of land is only zero if the land would not have been utilized in the absence of the project (opportunity costs = benefits foregone = 0). Otherwise, the project may pay much less than the real costs. If land is regarded an important input, its economic price may be determined by assessing opportunity costs (see box 3.6).

Land for an industrial project is offered at a price of Rs 1,000 per square meter. Using the land for the project implies that it is not available for wheat production. The economic value of wheat produced at a square meter is estimated at Rs 200, whereas the economic value of inputs (fertilizer, labour and so on) equals Rs 120, both on an annual basis. Hence using land for the project implies foregone annual benefits of Rs 80. The value of land equals the discounted value of the annual net benefits. If it assumed that these benefits would continue at infinity, and that the interest rate is 10%, the economic value of these benefits over time amounts to 80/.1 = Rs 800. In economic CBA, this shadow price of land replaces the actual price paid by the project. If the land was provided free of charge, the economic IRR may be much lower than the financial IRR.

Source: Kuyvenhoven and Mennnes, 1985

box 3.6 Shadow-pricing land

Inflation

Like in financial CBA, economic cost and benefit values should be adjusted for inflation. Generally, studies will be in constant prices, which means that the prices in year 0 are applied over the life time of the project. Implicitly, this approach assumes that prices of all inputs and outputs will increase at the same rate.

a narrow range to all countries. The World Bank, for instance, uses a 10-12% rate for all countries, whether dirt-poor Mali or an Asian tiger like Thailand. This policy, though administratively practically, lacks a sound theoretical basis.

At which rate should economic costs and benefits be discounted, considering these international practices? Consultants should generally not be asked to determine complex nation-wide discount rates as a part of the appraisals of specific projects. The recommendable approach would then be the following:

- start from the rate of discount applied by the recipient country, and/or by bilateral or multilateral aid agencies;
- use this rate (or these rates) as the centre point of an interval for the rate of discount. For instance, if the country uses 10%, a range of 8-12% for the rate of discount in project appraisal may be appropriate;
- make an assessment of the reliability of the rate of discount (interval) in the light of what you know about the economy. For instance, in poor African countries with no or negative economic growth rates, reasonable discount rates may be not much above 5%. In many South-East Asian countries rates above 10% may be justified.

The decision rules for approval of a project in economic analysis are similar to those used in financial CBA:

- economic NPV (discounted at the economic rate of discount) >0;
- economic IRR >economic rate of discount;
- economic BCR (both costs and benefits discounted at the economic rate of discount) >1.

Uncertainty

In financial CBA uncertainty particularly refers to forecasts about a) market prices, b) the size of the market for the outputs, c) the level of investment and recurrent costs, and d) the timing of outlays and receipts, including the period required for achieving full production levels. By definition, uncertainty about these issues should be taken into account in the appreciation of economic CBA outcomes as well. Sensitivity analysis, including the determination of switching values, should hence explore the consequences for economic rates of return of possible deviations from initial assumptions about long-term price developments, markets for outputs (whether goods or services) and timing of costs and benefits. Economic analysis, however, involves some additional fields of uncertainty and risk.

The first concerns the level of shadow prices. Estimating such prices may be more difficult than actual market prices. Whereas the latter type can be based on prices at existing markets, the former type requires in insight in linkages between micro- and macro-level policies. A judgement on how reliable outcomes of economic CBA are should hence focus on the justification consultants give for the applied long-term world market prices (traded goods), SWR (labour), SER (traded goods) or SCF (non-traded goods), the rate of discount and other important valuation items. The fact that the World Bank used a SCF of 0.75 eight years ago is not a convincing argument for application of the same factor now.

The second item that may raise additional uncertainty concerns the incorporation of external effects. The estimation of such effects is often difficult, particularly in monetary terms. In chapter 4 this will be explained in detail regarding environmental effects, which often involve externalities.

Table 3.1 Financial analysis shoe factory

item	category	value in US$ ('000)	value in Rs ('000)
investments (year 0)			
.buildings, machines and so on	traded goods	-400 **(CIF)**	-4,000 **(CIF*OER[1])**
.labour	production factor		-1,000
recurrent receipts (year 1-25)			
.sales of shoes	traded goods	200 **(FOB)**	2,000 **(FOB*OER)**
.25% export taxes on shoes	transfer		- 500 **(25%*sales)**
recurrent outlays (year 1-25)			
.leather (input)	non-traded goods		- 200
.labour	production factor		- 400
.income taxes	transfer		- 100
	NPV (15%)=		149

[1] OER = Official Exchange Rate: US$ 1 = Rs 10

Traded goods (investments in imported facilities and exported shoes) have been calculated as the international price multiplied by the official exchange rate. All outlays for non-traded inputs, labour and transfers are in actual domestic market prices. Receipts and outlays have been discounted at the market interest rate (15%) relevant to the project. In financial terms the project appears to be marginally feasible.

Both LMST and UNIDO have been applied to this project. Table 3.2 summarizes the outcomes:

The NPV is determined using an economic rate of discount, assumed to be 10% under both LMST and UNIDO systems[10]. Outcomes are much more favourable than in financial CBA. The two approaches show different outcomes in absolute values, but the common recommendation is to approve the project.

3.5.2 Community irrigation pilot project, India

In section 2.7 a financial analysis was conducted of the Community irrigation pilot project (CIPP) in Kerala. Here the economic analysis of the same project is shown, following the LMST methodology. The text is taken from the mission report (NEI, 1991).

Economic Prices

The farm models have been used to calculate the incremental benefits resulting from the project in economic prices. It is assumed that each CIP would have an average command area of 4 ha, in which 15 farmers with a landholding of 0.2 ha and 25 farmers with a landholding of 0.04 ha operate. It is expected that 107 CIPs will be installed (26 in project year 2, 26 in year 3, 39 in year 4, and 6 in year 5).

Economic import/export parity prices were calculated for coconuts, pepper and the various types of fertilizer applied in the field. Table 3.3 shows the calculations. It should be noted that the current world market price for copra is extremely low (US$ 233.0/tonne). Since 1985, prices for copra have always been higher than US$ 300/tonne (with the exception of 1986 when it reached US$ 197/tonne). Nevertheless, no attempt has been made to correct the current world market price for seasonal and/or annual fluctuations. Table 3.3 shows that the economic price of coconut is Rs. 0.8/nut as compared to a financial price Rs. 2.4/nut, which indicates that coconut growers in Kerala operate behind protective barriers. With regard to fertilizer, a similar picture arises in the sense that the production of fertilizer in India is heavily subsidized. The shadow price of fertilizer is generally more than two times the financial price. All financial and economic prices of the agricultural outputs and inputs used in the project have been presented in table H.1 (section 2.7.2).

[10]In LMST this rate is often referred to as Accounting Rate of Interest, whereas in UNIDO studies it is called Consumption Rate of Interest.

industrial sector after taxes, and is used by the Indian Planning Commission in its economic analyses of projects. Due to limited amount of time available for the reformulation of the project, the two parameters have been applied as such and no serious attempt has been made to re-estimate them. It is possible, however, that a SCF of 0.8 is somewhat low. The observed exchange rate at the parallel exchange market exceeds the Official Exchange Rate (OER) to the US$ by two to four rupees. Given an OER of Rs. 18.4 = US$ 1.0, this might indicate that the rupee is overvalued by ten to twenty percent. It is extremely difficult, however, to predict, given for example the uncertain situation in the Middle East, how the relationship between the two exchange rates will evolve. Since, as will be shown, the Internal Rate of Return (IRR) does not depend much on the level of the SCF, it has been decided to apply the SCF = 0.8 (with the exception that a conversion factor of 0.4 has been used for unskilled labour).

With regard to the valuation in economic prices of the project costs, a number of aspects deserve further discussion. The project is regarded as a pilot project and if this pilot phase will produce promising results the activities can be expanded to cover other districts as well. It should be noted in this regard that the original project proposal assumed that 1200 CIPs would be put into operation, while in the current pilot phase only 107 CIPs are expected. Technical assistance is provided to the project to ensure that the pilot activities will be carried out as expected. The purpose of this technical assistance is therefore to lay the foundation for successful and efficient CIPs which will be financed after the pilot phase. In other words, from a methodological point of view, it would be incorrect to attribute the full amount of the technical assistance to the pilot project. Since it might be expected that a multitude of CIPs could result from the pilot activities, only 50% of the costs of technical assistance has been taken into account in the economic evaluation of the project.

The second aspect is related to the equipment. Under the project, funds will be made available for the purchase of necessary equipment to ensure a proper installation of the CIPs in all technical aspects (such as siting investigations, drilling, pump testing, well commissioning, environmental/hydrogeological monitoring, transport, computers, etc.) Usually the economic lifespan of these various types of equipment is ten years and it would thus be incorrect to attribute all investment costs of these types of equipment to the pilot project. Most of the activities in terms of construction and installation of CIPs take place in the first four years of the project. Therefore, only 50% of the investments are assumed to be part of the project costs and thus a residual value of this equipment has been applied as negative costs in year 6 of the project.

Finally, to avoid double counting in the calculation of the incremental farm incomes, the investment costs are taken out because they are included in the project cost. In addition, depreciation changes which were included in the watercharges in the financial farm models, were removed for the economic analysis. Instead, economic values of necessary replacement investments for the CIPs have been entered separately as costs to the project.

Table 3.4 continued

	25
Benefits	
Farms (0.2 ha,no livest.)	28107
Farms (0.04ha/no livest.)	9817
Total benefits	37924
Costs	
Equipment	-
Vehicles	-
Operation & maintenance	-
Local Staff	-
technical Assistance	-
Residual value	-
Replacement investm. CIPs	-
Total costs	-
Net benefits	
Net incremental benefits	37924

Internal Rate of Return = 16%

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Table 3.5 Switching values at 12.0%

Stream	Appraisal Value	Switching Value	Percentage Change
Benefits	93301616	57550560	-38%
Costs	57550560	93301616	62%

Net Present Value at OCC 12.0% = 35751056.6
Internal Rate of Return = 16.3%

A switching analysis (table 3.5) performed on the total costs and benefits shows that benefits can decline by 38% or that costs can increase by 62% to arrive at an IRR of 12% (or, which is the same, at a net present value of 0 at an opportunity costs of capital of 12%).

A sensitivity analysis on various combinations of mutually changing benefits and costs is shown in the following matrix (table 3.6). The matrix shows that if costs increase by 50%, while benefits remain the same, the IRR will be 12.7% and the project will still be feasible. The matrix shows therefore that the project is solid in the sense that it can stand substantial changes in combinations of benefits and costs.

As a complete by separate case, and for illustration purposes only, the same analysis has been applied attributing all technical assistance expenditures to the project. The resulting IRR is 14% and thus shows that the project under these circumstances is still economically viable.

projects. Economic cost-effectiveness analysis (CEA) can substitute for economic CBA in two cases.

In the first case, alternatives have the *same benefits in all respects*. For instance: two different technologies may be applied to achieve a certain pollution threshold. Or: health clinics can be located at different sites, but coverage and services would be similar. It is important to recognize that benefits should not only be equal in quantitative terms (i.e. same numbers of people with improved health conditions), but also in qualitative terms (i.e. the degree and type of health improvement should be the same).

If benefits are equal, economic CEA is confined to calculating the total discounted economic costs for each alternative. Like in economic CBA, such costs should be shadow priced, and be adjusted for transfers and externalities. The alternative with the lowest discounted costs is the most attractive from an economic point of view.

In the second case where CEA may be applied, *benefits are qualitatively similar, but differ in quantitative terms*. For instance, at site A a clinic would have a coverage of 2,000 people, at site B of 4,000 people. If the costs at site B exceed those at site A, and if for budgetary reasons only one site can be selected, the choice is not unequivocal. Calculating the discounted total economic costs for the two sites is a necessary, but insufficient step in the appraisal. In a simple CEA application, the ratio would be calculated of discounted economic costs and coverage (see table 3.7):

Table 3.7 Example of cost effectiveness analysis

alternative	present value of economic costs ($)	coverage (number of people)	costs per person
site A	8,000	2,000	4
site B	20,000	4,000	5

From an efficiency point of view, site A is more attractive than site B.

Sometimes, benefits of a project are not a given number (like coverage above), but change over time. Particularly if alternatives show different temporal patterns of benefits, the approach should be adjusted somewhat. Physical benefits are discounted as well. Next, the ratio is calculated of discounted (monetary) costs and discounted (physical) benefits. On that basis, the alternative with the lowest costs per unit of benefits (or the highest benefits per unit of costs) can be calculated.

A case-study, based upon USAID (1987), may illustrate the use of CEA. A USAID mission compared three alternatives for an immunization strategy in a developing country, viz. routine services provided by fixed health centres, routine services provided by mobile teams, and a mass campaign in large urban centres. CEA of this project involves the following steps:

- calculation of economic costs for each alternative. To arrive at a single figure, the present value is determined of all investment costs (buildings, cars, medical equipment, and so on) and recurrent costs (transport, vaccines, management, and so on). All costs are shadow-priced, i.e. adjusted for economic distortions. Outcomes are gathered in table 3.8:

Table 3.10 Cost-effectiveness immunization strategies I

Alternative	Costs/benefits ($/vaccinated child)	
	0-5 years	0-1 years
Clinics	6.83	20.69
Mobile teams	17.37	148.44
Mass campaign	8.97	95.38

The Mobile teams alternative appears to be most expensive in both age groups, whereas Clinics is most cost-effective.
Instead of calculating costs per unit of benefit, benefits per unit of costs may be assessed: how many children can be vaccinated for each dollar spent on the program? In other words, what is the ratio of (discounted) numbers of vaccinated children and (discounted) economic costs? (see table 3.11)

Table 3.11 Cost-effectiveness immunization strategies II

Alternative	Benefits/costs (number of vaccinated children/ '000 $)	
	0-5 years	0-1 years
Clinics	146	48
Mobile teams	58	7
Mass campaign	112	10

Logically, Mobile teams provides the lowest, and Clinics the highest coverage per dollar.

Economic *CBA* results in an unequivocal recommendation whether an alternative should be selected or rejected from a national (efficiency) point of view. Economic *CEA* does not, as can be seen from the example. On the basis of CEA only, Clinics should be selected, as it is cheaper than the other alternatives. But there exists a trade-off with benefits: a higher coverage can be achieved by selecting a more expensive alternative. With the risk of simplification: an economist will favour the Clinics alternative, a doctor will support Mass campaigns (or Mobile teams if there is a special concern with the youngest children). CEA hence only provides basic information to decision-makers, whose final choice will depend on the weighting of cost-effectiveness and effectiveness in terms of achievement of health policy objectives.

Above it was assumed that appraisals should use either CBA or CEA. In reality, they may be complementing tools. Take the example of projects aimed at reducing sedimentation in existing water reservoirs. In the first phase, for which not much

- the project needs to pay high import tariffs on imported inputs;
- the project needs to obtain foreign currency at extremely high black market rates;
- the project is obliged to buy domestic inputs from public firms at unreasonably high prices;
- the project sells its final products to the government at low, fixed prices;
- the project cannot export its internationally competitive products due to overvaluation of the local currency;
- the project has positive externalities, in terms of impacts on health of the population, education or training.

The recommendation to support these projects on the basis of their economic performance is indeed sound, but should be subjected to the condition that a solution can be found for the weak financial performance. Otherwise, who is going to pay for the project, in the investment phase as well as in the long-run? A first-best solution is the removal of the distortions: lower taxes, devaluation, lowering of import tariffs, less government interference in prices, and so on. The financial return would enhance, and the project might even become attractive to the private sector. But governments will not embark on such drastic overall policy changes in view of the favourable impact on a single project. They are usually a part of nation- or sector-wide adjustment programmes.

A second-best solution may be to compensate the project financially for price distortions or externalities. In other words, the project will be subsidized to make it financially viable. In commercial sectors, subsidization is likely to compensate for unfair price distortions. In social sectors subsidization will often be aimed at realizing unpriced positive externalities. The latter group of projects raise a country's welfare by enhancing health conditions, drinking water availability or education levels, but users pay little for the services.

If subsidization can be justified on economic grounds, the next question is who will provide the subsidy, not only in the short run but over the project's entire life-time. Sometimes governments of recipient countries may be willing to subsidize the project, but budget constraints have become more severe since the introduction of adjustment programmes. The alternative is the use of development aid funds. Such funds may be used to finance investments and even recurrent costs (in the latter case the long-term continuation of the project is doubtful). In social sectors many donors use their funds in this way in view of the externalities involved. Few would be enthusiastic, however, to subsidize commercial activities to compensate for the negative effects of government economic policies they disagree with.

The evaluation of outcomes of financial and economic CBA hence involves important types of policy questions for both the recipient and the donor country: which projects should be supported? how can economically attractive projects be made financially viable? should economically sound, but due to policy distortions financially weak activities be supported? to what extent are unpriced externalities to be taken as a guiding principle for allocating aid funds?

and sectoral adjustment programmes (often in co-operation with the Bank), involving sometimes drastic changes in exchange rate, pricing and other macro-economic policies, which should be reflected in changing CBA parameters. In fact, the Bank seems to continue to apply parameters which date from several years ago. As said earlier, the universal use of a 10% discount rate is not commensurate with the fact that this parameter is country- and time-specific. Few would say that the marginal rate of return on projects is equal in Mali and Thailand, yet this proposition implicitly underlies a policy of a common discount rate. As long as the empirical basis for shadow-pricing remains weak, outcomes of economic CBA studies conducted on behalf of the Bank should hence be interpreted with caution.

With respect to estimation of effects, ex post evaluations of projects financed by the Bank learn that ex ante appraisals tend to be optimistic. Projects evaluated in 1987 had an average "recalculated" rate of return of 25.9%, whereas the average economic IRR in the ex ante appraisal amounted to 15.2%. A major explanation is that the role of management and institutional aspects have been underestimated in appraisals. By devoting more attention to these issues, the Bank hopes to narrow the gap between ex ante and ex post rates of return.

Comprehensive economic CBA studies are not frequently conducted at DGIS. A recent study put the number at about fifty annually. The same study concluded that it should have been applied in about 200 cases, on the basis of criteria like sector, financial size and type of aid (financial/technical assistance). Numerous explanations have been given for this situation, some of which are debatable. First, DGIS projects often involve continuation of existing activities. This by itself is not a reason not to apply CBA, as it is based on the "with-without" approach. Second, DGIS is not a bank, like the World Bank, and consequently applies other types of criteria. This argument is not convincing, as projects without a sound financial and economic basis frequently fail, also with respect to other types of criteria. Third, DGIS generally supports projects in "social" sectors and in the field of institutional development. This is indeed a reason why economic CBA is less applicable, but does not explain the gap between the number of actual and required applications (where this factor was accounted for), also with respect to CEA. In conclusion, although the type of aid programmes DGIS supports would suggest a more modest role for economic CBA than at the World Bank (as well as a more frequent use of CEA!), it seems that DGIS is underutilizing this appraisal tool.

3.8.2 When to apply economic CBA/CEA

The basic rules for deciding whether economic CBA or CEA may be relevant are summarized below[11]:

1. *features of project*
   economic CBA is especially useful if a) a project's financial feasibility is affected strongly by transfers, b) a project has significant external effects, and c) price distortions have a strong impact on financial feasibility. A study is particularly recommendable in the case of projects with:

[11]The discussion here centres on project aid. CBA is seldom applied to emergency aid, programme aid (multi-sector activities) and balance-of-payments support.

3.9 Elements in Terms of Reference

Understanding the logic of economic CBA is not easy for most non-economists, and difficulties accumulate if detailed and not always well-presented calculations of consultants in that field should be appreciated. To reduce the risk of inaccessible studies, TORs may specify the issues that need to be addressed. Below some major questions are listed, assuming that cash-flows for non-financial operations, prepared in the framework of financial CBA, are available. Consultants should be instructed about the system that should be applied (UNIDO or LMST), as well as on the required depth and scope of the analysis.

1. Adjustments for transfers
Consultants should start by identifying all transfers that affect the financial viability of the project. They may be to the benefit of the project (subsidies), but also reduce the financial profitability. Transfers should be excluded from economic CBA calculations.

2. Classification of costs and benefits
The remaining cash-flows should be classified simultaneously in:
a) inputs and outputs;
b) traded and non-traded goods and services. The former group (foreign currency component) should comprise all actual imports and exports, as well as import substitution and export diversion items. The latter group (local currency component) should distinguish between goods and services, and factors of production (particularly labour and land).

Outcomes may be presented in a matrix-format, which should also provide insight in the temporal pattern (not shown here):

	traded	non-traded
input output	imports/exports import substitution/ export diversion	goods and services/ labour/ land

Items with both a foreign currency and a local currency components should be indicated.

3. Determination of external effects
All project-specific externalities should be accounted for in economic CBA. Consultants should identify possible externalities (on the environment, health, markets, etc), and explain why they feel they are attributable to the project.

4. Evaluation of market prices relevant to the project
Apart from the treatment of transfers and externalities, economic CBA is recommendable if domestic market prices of inputs and outputs appear to be

4 Environment, ecological sustainability and economic cost-benefit analysis

4.1 Introduction

Since the mid-1980s, environment and sustainability rank among the most important issues in development and development co-operation. For several years, *environment* has been considered one of the "themes" of the Netherlands development co-operation policy. In 1990, the Minister for Development Co-operation decided that the overall objective of the programme, viz. structural combat of poverty, not only comprises growth of production and a fair distribution, but also *ecological sustainability* (see section 1.1). Other donors, like the World Bank, have also strongly intensified their efforts to arrive at ecologically sound development assistance.

This reorientation will have two important consequences. The first is that the environmental impact of projects in all sectors (agriculture, industry, infrastructure, and so on) has become a major issue in appraisal studies. The second is an increase in the number of projects that primarily address environmental concerns ("free-standing environmental projects" in World Bank terminology). Examples of project (components) focused on environmental improvement are: protection of biodiversity, flood control, soil conservation, pollution control, watershed management, reforestation and agroforestry.

How may a concern for environment and ecological sustainability affect economic CBA? This question is the subject of the present chapter. Recently, Little and Mirrlees, two pioneers in the field of project appraisal for developing countries, addressed that question at a World Bank conference (Little and Mirrlees, 1990). They argued that incorporating environmental effects in CBA is not a new problem at all: such effects "should always have been considered and quantified if possible". Sustainability "is more of a buzz-word, probably derived from the environment lobby, than a genuine concept. It has no merit. Whether a project is sustainable (...) has nothing to do with whether it is desirable".

This chapter would be superfluous if these statements could be fully supported, but in our view they should not. To understand this, we will first (section 4.2.) explain the meaning of sustainable development and how this objective may be addressed in project appraisal. Briefly, problems involved in measuring environmental effects (and hence sustainability) in physical terms are outlined. Whereas estimating ecological effects usually is not the responsibility of the economist, the results of this phase are important in view of CBA's requirement that effects should be known in quantitative terms.

In section 4.3 -the core of this chapter- the focus is on difficulties that may arise in the remaining steps in the incorporation of environmental effects in economic CBA:

- how to estimate the economic value of environmental effects?,
- is discounting of ecological effects commensurate with long-term environmental and sustainability concerns?

Illustrated by numerous examples, an overview is presented of possible approaches to solve these problems within the CBA framework. It is shown that because these

events, ecologically sustainable development requires that the present generation limits its use of scarce ecological resources. What are to be considered sustainable levels of resource use is a normative, political question. Many ecologists will argue that extreme reductions are required. Traditional economists might say that the "opportunity costs", in terms of income losses, should be taken into account and that such measures may not be necessary anyway because of -for instance- expected technological progress. DGIS' position in this respect will be outlined in 4.2.2.

4.2.2 Sustainability-oriented project appraisal

DGIS's main objectives, and consequently project appraisal criteria, are income generation, the distribution of welfare among the poor and the rich and among men and women, and ecological sustainability. The latter criterion imposes constraints on project selection processes. Whatever the economic feasibility (economic IRR) and the attractiveness of distribution patterns, outcomes are subjected to the condition that the use of environmental resources should remain below acceptable levels.

DGIS favours the *strong sustainability* approach. This means that any decline in the "stock of natural resources", i.e. the total of all environmental components, is considered unacceptable. "Strong sustainability" secures future generations access to the same ecological resources as the present generation. Under this approach it is impossible to compensate a decline in environmental capital by an increase in other types of resources (if substitution is allowed, the notion of "weak" sustainability applies). The choice for the "strong sustainability" approach underscores the dominant role of environmental considerations in DGIS policy.

Environmental issues may furthermore be emphasized through the choice of the spatial level at which sustainability is to be achieved. Consider a recent plan of Dutch energy suppliers, who proposed to contribute to reforestation in Brazil to compensate for negative environmental effects of a new power station in the Netherlands. Environmental decay in the Netherlands is hence considered acceptable because of a corresponding amount of environment is created elsewhere in the world. In other words, the energy company strives for *global* sustainability, meaning that a project might harm the environment if another activity provides compensation. This plan may be unacceptable if the sustainability objective is applied at a lower level, particularly at the *project* level. In that case, no single project may negatively affect the environment. DGIS is still in the process of operationalizing the sustainability constraint, but it seems that it indeed supports this most stringent approach.

Adopting such a dominating sustainability criterion may seem an attractive strategy as it will result in an enhanced ecological performance of development aid programmes. Policy-makers responsible for selecting development projects, however, will face new difficulties because they continue to aim at combating poverty as well. In principle, projects might simultaneously a) increase income levels, b) improve the position of the poor and women, and c) not exceed sustainable levels of resource use. In fact, efficiency, equity and sustainability are likely to be conflicting objectives. As the director of the World Bank Environment Department says: "there will always be a tension between economic feasibility and

sedimentation in downstream hydro-electric schemes and reservoirs, impacts on aquatic life, flooding due to increased run-offs, and so on. Measurement problems may be significant, mainly due to our limited knowledge of ecosystems and of how human activities affect the environment. Obtaining reliable information about environmental effects may be time-consuming, and hence adds to the costs of feasibility studies.

To assess whether an in-depth environmental impact assessment (EIA) is required for a project, DGIS (and many other donors) apply an "initial environmental screening". The outcome of such a brief evaluation in the identification phase is the recommendation whether or not an EIA should be conducted in subsequent stages. An EIA aims at assessing all environmental consequences of projects. Checklists are available indicating which types of projects usually require an EIA. These are in the following categories: exploitation of forests, fishing and farming practices, exploitation of water resources (including dams and reservoirs), infrastructure (like large-scale electrical transmission and roads), industry, extractive industry and urban development. Moreover, an EIA is required if projects will be in ecologically sensitive areas, like primary tropical forests, arid and semi-arid zones and soil conservation areas. Projects in the field of institutional development, education and family planning normally do not require an environmental analysis.

A prerequisite for an assessment of environmental effects is insight in existing ecological conditions in the project area (and hence the "without-case"). DGIS has recently embarked upon the preparation of "environmental profiles" for countries and regions where many Dutch projects are located. Such a profile elaborates on existing environmental problems (nature, degree, evolution) and whether critical levels are being approached or have already been crossed. Until now such studies have devoted relatively little attention to linkages between human activities and ecosystems: in what way depend people, and particularly the poor, on environmental resources? To what extent does the environment impose limits on economic development? Including information on such linkages would greatly enhance the usefulness of environmental profiles to EIA studies.

4.3 The incorporation of environmental effects in economic cost-benefit analysis

4.3.1 General

In principle, the incorporation of environmental effects in CBA follows the general path outlined in chapter 1:

- A distinction can be made between the private (financial CBA) and the national point of view (economic CBA). Environmental effects are typically external effects, which by definition do not enter the former type of analysis but should be accounted for in the latter type. Therefore, the present chapter is concerned with economic CBA. However, especially in the case of projects aimed at enhancing environmental conditions, financial and ecological variables are related. An example is presented in box 4.1.
- As illustrated in box 4.1, the with-without principle underlies CBA calculations. This implies that consultants should specify and justify their assumptions regarding present and expected environmental conditions in the without-case.

4.3.2 Valuation of environmental effects

General principles

If biologists, ecologists and other physical scientists succeed in quantifying ecological effects, CBA-economists should try to determine their value to society. In the past, environmental effects have often -unsatisfactorily- been listed as a "p.m." item in CBA, meaning "we know it exists but we don't know its value". The CBA outcome (IRR, NPV) then fails to provide a comprehensive picture of a project's efficiency. This may be tolerable in the case of negligible environmental effects, but otherwise does not inspire confidence in CBA outcomes. The current emphasis on the environment provides a strong stimulus to economists to devote much more attention to the valuation of environmental effects.

Why is valuing environmental effects problematic? A major problem is that, in contrast to many man-made products, environmental goods and services are often not traded in markets. Basically because nobody owns environmental amenities like clean air, species, natural beauty and the ozone layer, they lack a market price. Environmental effects in these fields are typically external, i.e. unpriced effects. How then may a CBA analyst estimate the value to society of enhanced air quality (objective of pollution control project), siltation (side-effect of irrigation project), sedimentation (side-effect of dam project), and so on?

Economists are not without tools to value the environment. A brief overview is presented of valuation methods for environmental effects. It allows an identification of the opportunities to account for environmental effects in economic CBA, as well as their limitations.

To understand the principle underlying all valuation methods, consider the question of how to value erosion. Assume that erosion reduces agricultural output. The value of the ecological effect (increased erosion) might be estimated by investigating the loss of agricultural production it causes. Similarly, the ecological benefits of an erosion control project (reduced erosion) may be valued through the resulting increase in agricultural output. Hence, the value of ecological costs are the benefits foregone in agriculture; a proxy for the value of ecological benefits is the avoided costs in agriculture. This principle, an application of "opportunity costs", is shown in box 4.2.

environmental effect	effect on agricultural production
costs of deforestation= increased erosion	lower production= *benefits foregone*
benefits of soil conservation= less erosion	higher production= *avoided costs*

box 4.2 valuation of environmental costs and benefits

to estimate the value of acidification and the related loss of trees, the costs of reforestation may be taken.

the construction of an oil palm mill may result in the discharge of waste water into a nearby stream. As a consequence, a downstream intake for a domestic water supply should be relocated. The costs of relocation may be a proxy for the environmental costs of water pollution.

box 4.4 replacing or relocating costs

flood prevention schemes may destroy environmental services like fish production and a habitat for birds. The costs of the loss of these services may be estimated by calculating the costs of creating an artificial lagoon nearby offering similar environmental services.

box 4.5 shadow project

Due to development projects, irreversible damage may be inflicted on environmental goods and services.
A *shadow project* may be implemented that would create as much environment as was lost due to the original project (see box 4.5).

The valuation techniques illustrated above all related environmental quality changes to existing markets for man-made products. If such markets do not exist, a hypothetical market may be created by asking individuals how they value environmental services (*contingent valuation method*).

Through surveys, people may express their willingness-to-pay (WTP) for being protected against environmental degradation. Alternatively, they may express their willingness-to-accept (WTA) financial compensation for being exposed to environmental decay (see box 4.6).

people might be asked to say how much they are prepared to pay for improvements in drinking water quality.

promoters of airport expansion plans may offer neighbours financial compensation for increased noise nuisance.

box 4.6 willingness-to-pay

Benefit approaches

Environmental services are often inputs to the production of marketed goods and services. Consequently, environmental quality changes will directly affect *productivity* in income-generating activities. This implies that a given quantity of resources will result in a lower production level, and therefore in decreased income. The loss of income due to the decline in environmental productivity may be considered the value of environmental quality changes (see box 4.7).

between environmental services and markets exists, the notion of *surrogate markets* is often used. Three approaches in this category will be presented here.

. differences in prices of houses, land or other property at sites that only differ in terms of the quality of environmental services may be attributed to the environment factor (*hedonic price method*) (see box 4.10).

in a unique wilderness area a project might be implemented for the generation of hydroelectric power. Through CBA the net present value of this project might be calculated. Not building the dam would have two consequences: the wilderness area would be preserved and additional expenses would have to be made to generate power elsewhere. The opportunity costs of preservation would be the additional costs of the alternative project.

box 4.9 opportunity costs of preservation

all other things assumed equal, a given type of house may cost 40% less in a city with severe air pollution than in an otherwise similar city where citizens enjoy clean air. The price differential might be considered the value of clean air.

box 4.10 hedonic price approach

employers may have to pay relatively high wages to attract labourers for work at polluted sites.

box 4.11 wage differential

. *wage differentials* for similar jobs may be explained by differences in working or living conditions due to differences in environmental quality (see box 4.11).

. the *travel cost* approach may be used to value recreational areas (see box 4.12).

where admission fees are lacking or artificially low, the amount people are prepared to pay for transport to the area may be a proxy for the value of the natural area.

box 4.12 travel cost approach

Limitations

These (and several other) approaches show that despite the lack of a market for environmental products and services, several ways exist to estimate the value of environmental effects. To enhance the scope and coverage of CBA studies, evaluators should make more and better use of valuation methods. At the same time, their limitations should be acknowledged, especially in the context of developing countries:

Winpenny (1991) summarizes the main findings of the Korup Forest project in Cameroon, which combined the objectives of natural conservation and economic development. The main elements of the project are: a) establishment of the Korup National Park, aimed at preserving rain forest, b) resettling of several communities based in the park, and c) the development of economic activities in the buffer zone.

The appraisal's most interesting part is the appraisal of the economic benefits of the project. Several types of benefits were distinguished:

- "sustained forest use": the benefits to neighbouring residents from the existence of the forest and buffer zone;
- "replaced subsistence production": the benefits from livelihoods recreated outside the main forest for resettled communities;
- "tourism": spendings of new visitors to the park;
- "genetic value": the potential usefulness of extractions from the park to industries;
- "watershed protection": protection of the coastal fisheries affected by the watershed in the park;
- others: control of flood risk, soil productivity maintenance, agricultural productivity increase, induced forestry, induced cash crops.

At the cost side, the main elements are investments in roads and other infrastructure, foregone income of commercial logging and of the use of the forest by local residents.

The economic NPV was found to be positive at the 13% economic discount rate.

box 4.13 valuation of the establishment of a natural park in Cameroon.

resources is becoming extremely important. The reason is that market prices of environmental resources affect people's behaviour, and particularly their use of such resources. The lower the price, the stronger the incentive to exploit natural resources. Higher prices will encourage conservation.

Assume a producer of textiles who pollutes a river adjacent to the factory. If the polluter does not pay, the environmental damage is not made a part of production costs and hence sales prices. This provides an incentive to consumers to buy textiles who will thereby indirectly contribute to environmental decay. If the factory is obliged to pay for pollution (environmental costs are "internalized"), he either will face pollution charges or choose to invest in measures to prevent pollution. Either way production costs will increase and so will probably consumer prices. Demand will decrease, thereby reducing pollution.

Irrigation water is often heavily subsidized or even provided free of charge. Adverse affects may be of several kinds. Use and consequently wastage is encouraged, leading to lower ground water levels. Low payments for water often result in insufficient maintenance, because the responsible organizations lack funds. As a result, siltation and erosion may occur.

Hence a first question regarding marketed natural resources is the price people actually need to pay, whether in the form of free market prices or user charges determined by the government. This price has already been assessed and used in the financial analysis. In the economic analysis the appropriateness of this market price is investigated. In other words to what extent is that price a guide to the value of environmental goods to society? For instance, what is the real, economic price (value to society) of timber? Usually domestic and world market prices only include

In the project area in Yemen (see box 4.14) the charge for irrigation water amounts to 2% of a farmer's income. In the project area mentioned above, actual charges totalled YR 151m. Starting from the (direct) costs of surface water estimated earlier, hypothetical receipts have been calculated under three cost recovery policies, respectively aimed at 25%, 50% and 100% coverage of investment and recurrent costs of dams. The results are shown below:

coverage of costs	receipts (YRm) required to cover costs		
	investments	recurrent costs	total costs
25%	59	50	109
50%	117	100	217
100%	235	200	435

Actual receipts appear to be insufficient to even recover recurrent costs. By definition receipts are less than the total costs of the dams, let alone the total economic costs, including environmental costs of water use. In any case, because the charge is not linked to quantities of water used, the financial arrangement does not provide an incentive to minimize usage. Present pricing policies for irrigation water may be understandable from a socio-political point of view. Only a strategy of increasing tariffs, however, would be commensurate with the high priority assigned to solving Yemen's water shortages.

box 4.15 cost recovery and irrigation water charges

4.3.3 Discounting

The problem

Discounting of future costs and benefits is perhaps the most widely criticized element in CBA's treatment of environmental effects. A recent policy document of the Dutch Minister for Development Co-operation blames "high" discount rates for the low feasibility of environmentally sound projects. Similarly, discount rates are an important explanation for the many projects that pass feasibility tests despite extremely harmful long-run ecological effects.

The impact of discounting can be understood from Table 4.1. It shows the present value of one unit of costs or benefits occurring 30, 40 or 50 years after the start of the project at various discount rates.

To illustrate the impact of long-term ecological effects on economic feasibility, take the example of a dam. The time horizon is 40 years. Two cases are distinguished. In case I, assume the following costs and benefits:

Year	investments	recurrent costs	agricultural production
1	-4,000		
2	-2,500		
3-40 (annually)		- 100	830

The NPV at a 10% discount rate is 2,341, the economic IRR amounts to 14%. In case II it is assumed that in addition to the costs and benefits shown above, environmental damage is expected to occur between years 30 and 40 amounting to -4,000 annually. Although the annual environmental damage from year 30 onwards amounts to about two-thirds of the initial investment, the NPV remains positive at 703. The IRR decreases to just only 12%.

box 4.16 the impact of long-term ecological effects on NPV

can be proven that under certain assumptions, CBA recommends to annihilate all whales or cut all forests immediately if the rate of discount exceeds the natural growth rate. Given that forests grow at rates between 3 and 10%, discounting at 10% favours rapid felling of all trees. Several assumptions, however, may not be realistic. One of them says that real profit margins (selling price minus costs of extraction and distribution, both adjusted for inflation) remain constant over time. The more likely scenario is that growing scarcity of environmental resources will push selling prices upwards and therefore contribute to increasing margins.

Possible solutions

Undoubtedly, the relation between the rate of discount and long-run environmental effects is problematic[4]. Many solutions to this problem have been proposed, some of them sound, others debatable. CBA application only makes sense if the theoretical foundations of this tool are complied with. This implies that if limits to the applicability of CBA are approached, a solution cannot be arrived at by manipulating the discount rate. In our view, four principles should be adhered to. The first and second guideline for the treatment of the discounting-environment problem are not directly related to environmental effects, in contrast to the third and fourth guideline, which bear a direct relation.

1. Acknowledge the limited purpose of CBA
Governments do not embark on expensive education programmes on the basis of discounted net economic benefits. Many of such programmes would not pass

[4]Many effects on the environment occur mainly in the short run. Discounting does not cause specific problems in such cases.

4. A cautious approach to adjusting the rate of discount for environmental considerations

In addition to better measurement and valuation practices -affecting the IRR of individual projects- the discounting problem may also be tackled through adjustments to the discount rate itself or through changes in discounting practices.

Numerous proposals have been put forward for adjustments to the rate of discount as a direct response to the adverse impacts of the rate of discount on long-term (environmental) effects. These can be classified as follows:

- Many ecologists and some economists have argued that discounting is harmful to future generations by definition. Consequently, they advocate a discount rate of zero, which implies that discounting is abandoned. This view often goes together with the belief that CBA in general should not be used when ecological effects are involved, and that policies should be exclusively based on ecological parameters. Considering the solid theory underlying the discount rate (see chapter 3), particularly its dependency on opportunity costs and income growth, we feel discount rates should not be zero. At the same time, however, outcomes of discounting practices may be subjected to higher-level environmental objectives (see guideline 1).
- It has been advocated to lower the discount rate (but not to zero) for all projects. The composition of the total set of accepted project would change: ecologically sound projects will be accepted more often whereas ecologically harmful projects will be rejected more frequently. Nevertheless, it may well be that the cumulative use of natural resources across all accepted projects would increase. The reason is that every project, whatever its nature, has a higher chance of being accepted at lower discount rates. And a larger number of accepted projects may exercise an upward pressure on total resource use. It remains to be seen which of the two opposite changes will have the upper hand. We therefore consider an across-the-board reduction in the discount rate an inefficient means to achieve the objective of enhancing environmental quality.
- Another option is to use multiple discount rates, the lower rates being applied to environmentally-sensitive projects, "sustainable" projects, or "multi-generation" projects. The usual discount rate would continue to apply to all other types of projects. The former group would need to show an IRR of only, say, 5%, against 10% for the remaining classes of projects. This approach is more attractive than a general reduction in the discount rate because the shift towards more ecologically sound project packages will be achieved without negative consequences of the larger number of accepted projects. Nevertheless, some important questions remain unsolved. First, the choice of projects eligible for a lower discount rate is fairly arbitrary. Second, without further theoretical elaborations, the levels at which multiple discount rates should be established is uncertain.
- It has been proposed to apply a lower discount rate in the case of immeasurable environmental effects and in the case of high risks or uncertainty. These approaches are highly debatable, as the means (reducing the discount rate) does not have a direct relation to the problem (measuring environmental effects, respectively accounting for risk and uncertainty). The correct approach is to tackle the problem at the root, i.e. better measurement and valuation of environmental effects (see 4.3.2) and improved methods to account for risk and uncertainty.

In the first phase, in which CBA does not play a role, alternatives are evaluated regarding their performance on the sustainability criterion only. If actual resource use exceeds sustainable levels, there are two possibilities. Either the project is rejected immediately, or it is adjusted in such a way that it satisfies the sustainability constraint in the second round. Adjustments may consist of extra investments in facilities to prevent, mitigate or reduce environmental damage. They may also refer to "shadow projects" or "compensating projects". These are additional activities which involve the "creation" of as much environment as is lost due to the project itself. The example given earlier of tree-planting in Brazil to compensate for emissions of carbon dioxide by a new power facility in the Netherlands involves a compensating project. The negative effects of the construction of a dam might be compensated for by investments in reforestation, soil conservation, agroforestry etc. The scope for compensating projects greatly depends on the level at which sustainability is defined. Under DGIS policies it is applied at the project level, which implies that each project involving resource use should have its own shadow project. An alternative would be to apply it at the national level. Compensating projects would then only be required if the aggregated use of environmental resources across all projects in a country exceeds the national threshold. It is emphasized that compensating projects should actually be implemented.

In the second phase, all project alternatives that, possibly after adjustment, satisfy sustainability conditions should be subjected to conventional CBA. In other words, provided that environmental constraints are respected, CBA is used to select between alternatives. It is important that eventual adjustments are fully reflected in CBA calculations. This involves a) including the costs of adjustments, and b) reassessment of all other effects.

This procedure assumes that policy-makers would not allow resource use in excess of sustainable levels, whatever the scores on other criteria. In reality, this is often not the case, as shown by several plans for expansion of national airports. The local environment obviously suffers from increased air traffic. The fact that governments often tend to agree with expansion of airports proves that other criteria, particularly income and employment, dominate the environment criterion. In such cases, the two-tier approach does not apply. Either CBA is conducted in the traditional way, accounting for all environmental resource use, or an MCA is applied covering separate economic and ecological criteria (see next section).

4.4 Alternative approaches

4.4.1 Cost-effectiveness analysis

CEA can be applied instead of CBA when costs can be monetarized but benefits cannot. CEA may than be used to select the alternative with the lowest monetary costs per unit of physical benefits. For instance: if the aim (benefit) is to combat erosion, various strategies may be selected, such as afforestation, soil conservation measures, improved irrigation, and so on. Application of CEA requires that expected outlays for each alternative for investments, recurrent costs and any other cost element (including external effects) are available in monetary (shadow-priced) terms. With respect to benefits of reduced erosion two possibilities need to be distinguished:

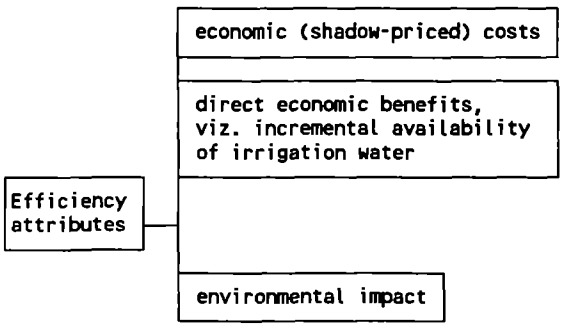
irrigation project in Yemen, described in box 4.14. Some additional assumptions will be made to illustrate MCA's applicability.

Four *alternatives* are distinguished:

- increased pumping of ground water (referred to as Pumping);
- construction of one large dam (One dam);
- construction of two medium-sized dams (Two dams);
- improvement of the traditional system of temporal dykes (Improvement).

To obtain the efficiency score, attributes shown in diagram 4.1 should be accounted for.

Diagram 4.1 Criteria Wadi Siham



The *impact* matrix is shown in box 4.18.

Attribute	Alternatives			
	Pumping	One dam	Two dams	Improvement traditional system
Economic costs (PV* mn YR)	-124	-103	-167	-96
Incremental irrigation water (PV mcm)	98	122	154	78
Environment (ordinal)	–	—	–	+ +

*PV = present value

Box 4.18 Impact matrix irrigation project

The analysis comprised the following steps:

- As shown in the first row in the impact matrix, all shadow-priced costs for investments and recurrent costs were discounted. Benefits, comprising incremental water availability, were assessed in physical terms. The environmental effects could only be indicated qualitatively. In view of the mixture of data, CBA cannot be applied to obtain the efficiency score.

incorporated as a third key appraisal criterion besides efficiency (and equity). Basically, there are two possible scores: "the sustainability constraint is complied with", and "the sustainability constraint is not complied with", or "+,-", or "yes, no". In the former case estimated resource use remains below sustainable levels, in the latter case it is higher. Evaluators provide more information if they are able to tell something about the distance between actual and sustainable resource use. For instance, a score of 0 might be assigned to an alternative if actual resource use is equal to sustainable resource use. A positive (negative) score would refer to resource use below (above) sustainable levels. The greater the distance between actual and sustainable levels, the larger the score. Information may be presented on a quantitative scale (-0.9, +1.5, etc) or on a qualitative scale ("a little above sustainable levels", "far below sustainable levels", and so on).

MCA can be applied to a set of multiple objectives, including efficiency and ecological sustainability. In box 4.19 a hypothetical example is presented, on the basis of a mixed-data impact matrix. It also includes an equity score.

An impact matrix with efficiency, equity and sustainability as key criteria might look as follows:

criterion	scale	alternative		
		A	B	C
efficiency	NPV($)	500	1000	5
equity	% of benefits accruing to target groups	30	20	80
sustainability	distance to sustainable resource use	-	—	++

If a positive score on the sustainability criterion is a precondition for approval of a project, only alternative C is acceptable. Otherwise, trade-offs between criteria can be clarified through mixed-data MCA methods. Assume that the following qualitative weights are known: sustainability > equity > efficiency. Application of the Regime MCA method, not shown here, results in a ranking: alternative C is most attractive, followed by alternative A and alternative B. Obviously, a higher weight assigned to particularly the efficiency criterion would give a different outcome.

box 4.19 impact matrix with three key criteria

Considering only criteria and effects requirements, MCA offers better opportunities than CBA to treat environmental effects and sustainability concerns. In section 1.6 it was already indicated that other factors may limit the scope for MCA applications.

2. *Environmental impact assessment*

An EIA should address several questions, which can be summarized as follows:

a. A description of the existing environmental conditions in the project area and elsewhere (as far as relevant). Moreover, an estimate on how environmental conditions are expected to change in the future in the absence of the project ("without-case"). Insight should be provided in how sensitive possibly affected ecosystems are. It makes a great difference if projects are implemented in mountain watersheds or wetlands, instead of flat areas with robust topsoil. The analysis of actual and expected environmental conditions should preferably be disaggregated in various types of natural resources. Moreover, linkages between ecological and economic systems should be taken into account. To what extent is the population dependent on the environment? What are economic causes (poverty, commercial activities, etc) for environmental problems? What are economic consequences (income-generating potential) of these problems? What are resources available to combat ecological decay?

b. What are expected environmental effects of the project alternatives? This is EIA in a narrow sense, on which most checklists focus. The findings under a) are the basis for this type of analysis. TORs should provide some guidance regarding the types of environmental effects to be investigated. For instance, major types of adverse environmental effects of agricultural projects are (Winpenny, 1991):
   - natural vegetation: changes in land use (including deforestation, bush clearance, shorter fallowing and so on), soil erosion, siltation and deposition, loss of soil fertility;
   - hydrological: irrigation impact on groundwater levels, river flows, changes in watershed run-off, salinisation, contamination;
   - public health: water contamination and eutrophication, aquatic diseases, agro-chemicals entering food chains and body systems;
   - biodiversity and wildlife: loss of habitats, interruptions to trails, extinction of exotic species, hunting and collecting.

   Other, not mutually exclusive, classifications are:
   - on-site versus off-site effects (give rise to different measurement problems);
   - long-term versus short-term effects (important for intergenerational equity, discounting);
   - expected and unexpected, adverse and beneficial, direct and indirect.

   Environmental effects may have very different consequences for social groups. Think as an example of the impacts of flooding on rich farmers, who can invest in protection measures, and poor farmers, who cannot[7]. Any EIA should elaborate on the distributive aspects of the environmental effects analyzed earlier, both in terms of differences in access to natural resources as well as consequences for income levels.

c. "Score" of project alternatives on the sustainability criterion

   The assessment of the score on the sustainability criterion involves the comparison of information gathered in previous stages:
   - the sustainability policy of the decision-makers, i.e. the views on acceptable levels of resource use;
   - the "without" analysis of existing resource use patterns in the project setting; and
   - the environmental impacts of project alternatives (EIA).

[7]See also chapter 5.

5 The poor and women: distributional analysis and project appraisal[1]

5.1 Introduction

In the 1950s and 1960s it was widely assumed that benefits of economic growth would "trickle down" automatically to the poorest groups. Consequently, there was no particular need to address separately the distributional impact of development activities in project appraisal. In reality, however, income did not accrue to all population groups equally and central governments appeared to be unable to redistribute income. Efficiency and equity turned out to be potentially conflicting goals. In the late 1960s, redistribution of income to the benefit of low-income groups became a second key objective in project appraisal for developing countries. Because distribution (equity) is considered an important development objective, knowledge about *total* (net) economic benefits of projects is insufficient for decision-making. Depending on the precise objectives of donors and governments in developing countries (which need not be the same!), additional information is required about who are beneficiaries of development projects and who are negatively affected, both in terms of income and other aspects.

Section 1.2 explained that the general DGIS objective, viz. structural combat of poverty, has three components: growth of production, a "fair" distribution and ecological sustainability. The present chapter focuses on the second attribute. DGIS aims at particularly supporting two types of *target groups*, viz. the poorest groups and women. Development projects supported by DGIS should particularly benefit these, partly overlapping, groups. In section 5.2 the equity objectives of DGIS are treated in greater detail, with particular attention to the translation of general objectives into operational criteria at the project level.

The emphasis on target groups has two important consequences for appraisals. First, the analysis of the socio-economic and cultural *setting* of a project should pay particular attention to the position of target groups. The success of projects focused at such groups will depend to a great extent on their *willingness* and *ability* to participate in various ways. For example, existing patterns of land ownership in a project areas will strongly affect the effectiveness of embankment projects. Another example: whether drinking water supply projects will continue to have a sound financial basis after a donor has ended its involvement ("project sustainability", see section 1.2) will primarily be determined by the ability and willingness of poor groups to pay for water. The analysis of the "without-the-project" position of target groups is treated in section 5.3.

Second, whereas an economic analysis is not concerned with the question of who are losers and winners of development projects, a focus on target groups implies that appraisals should clarify the distributive *impacts*. In other words, to what extent are projects expected to benefit the poor and women? This question is taken up in section 5.4.

Distribution analysis should be linked to other appraisal topics. Section 5.5 explores linkages between *financial analysis* and distribution analysis. In social

[1] A first version of this chapter was prepared in co-operation with Annelies Zoomers.

their land. An irrigation project may be beneficial to those who live in the project area, but have negative consequences for poor downstream farmers.

Finally, policy-makers may express a special concern for the question of how income generated by a project is *used*. Some purposes may be considered more desirable than others. Two important examples are the following:

- projects may make a different contribution to economic growth ("intertemporal equity", see section 1.2). This depends on whether additional income is consumed immediately or saved and consequently invested. Compare the following examples; a) labourers employed by a project spend their additional income on food only, b) an irrigation project improves the financial position of the local government, who uses the additional revenues for investments in rural roads and extension services. Donors emphasizing economic growth should especially support the latter type of project: money invested now will result in future consumption. The examples show that intra- and intertemporal objectives may not be commensurate;
- decision-makers may also have a preference for the use of project benefits for specific activities, such as support to women organizations, basic needs improvement, environmental improvement, etc.

Officers in aid agencies responsible for the appraisal of proposals for development projects should explain consultants how to interpret the general DGIS equity objectives in a particular case. Hence, the consultant should know about target groups, about the respects in which their position should be improved, and whether there exists a preference for specific uses of income generated by the project. Vague descriptions ("projects should benefit the poorest groups") give less guidelines than more precise statements. For instance:

- the project must produce an income increase for at least 50% of all the farmers in the project area;
- the project may not produce any benefits for farmers with areas of land larger than 500 ha;
- under no circumstances may the project be at the cost of landless farmers;
- minimally 30% of the income generated by the project must be used for 'land improvement';
- at least 50% of project income should accrue to the poorest groups;
- the position of women in terms of income or access to resources should improve.

Different preferences of donors and governments of recipient countries should be outlined. It is important to be clear about these issues because distribution is an ethical issue, and the value judgements of policy-makers should be incorporated, not those of consultants.

Policy-makers should also explain their views on the relative priority of distribution vis-a-vis other objectives, particularly financial feasibility, economic feasibility and ecological sustainability. These may often be conflicting objectives, and consultants should now about the approach to trade-offs. See sections 5.5-5.7 for possible responses.

in involving people in construction works who without the project would have been involuntary unemployed. The situation is very different if participation in development projects would be at the expense of off-farm income-generating activities. Or if contributions to operation and maintenance would harm traditional social relationships. Or if the burden falls on women, while men reap the benefits. This illustrates the importance of investigating the (opportunity) costs of participation.

The exploration of the costs and benefits of participation will underlie the full set of receipts and outlays (financial analysis) and national costs and benefits (economic analysis). Addressing the question of willingness and ability to participate requires a careful analysis of the economic, socio-cultural and political position of the target groups (as far as relevant for the project). In the past, economists have often tended to focus particularly on aggregates and averages ("the average regional income is ...") with little attention for differences between social groups ("the income levels of poor farmers, medium-income farmers and rich farmers are respectively ...."). This neglect is an important explanation for the many ultimately disappointing projects with high ex ante economic rates of return.

Several issues should be explored in investigating the probabilities that target groups will participate.

Ownership of *land* is a key determinant of the performance of many agricultural and rural development projects. The assumption that an irrigation project will result in large production increases in agriculture, for example, may be irrealistic if the majority of the farmers involved have extremely small plots of land, and are involved in subsistence agriculture. If, alternatively, the main benefits of the project accrue to a small number of large landowners, the majority of (small) farmers will not be very motivated to help in the construction and maintenance of irrigation works. Some important issues in land tenure are (FAO, 1986): total cultivated area per household, size of plots per type of land, size of plots per type of tenure, size of plots per crop, number/proportion of farmers by size of holding, proportion of owner-occupying, tenant and sharecropping cultivators, and distribution of irrigated land among farmers.

Attention should be given to the consequences of differences in *income* and *socio-economic status*. With respect to farmers it may be important to distinguish between the more dynamic and wealthier farmers and the poorer farmers, who often are the target groups of aid projects (FAO, 1986). The latter group often has a much less favourable position in terms of financial means to buy inputs and equipment, organizational strength, access to productive resources, access to credit schemes, and opportunities to take risks associated with innovation. Donors should acknowledge traditional preferences of farmers. An FAO project in Africa failed because it aimed at developing meat production among traditional livestock breeders whose main interests where in milk production and maintaining stock numbers. Projects aimed at promoting a particular crop failed because credit and production inputs were allocated to men (the family heads), whereas women traditionally were responsible for that crop. In a project in Sierra Leone women had no access to credit because of the small size of their plots. If credits are channeled through co-operatives in only men can become a member, women are denied access to credits (World Bank, 1988). Project designers should build in measures to prevent the benefits to accrue to the better-off. Institutional arrangements should reflect this

c. if the distributive impacts are unacceptable to the decision-makers, possibilities to change the design of the project or to include socially compensating activities may be considered.

Description

A major task of consultants is to present in an accessible way the results of their investigations of the distributive impact of alternatives. As this step is not specifically related to any appraisal technique, there are no requirements regarding the measurement scale at which effects are shown. Especially if appraisal teams have limited time and means available for their study, a mixture of quantitative and qualitative data will result.

The irrigation project in Yemen - see box 4.14 - involved considerable distribution effects. Traditionally, farmers built a system of numerous small, temporary and simple dams in "wadi's", which carry water from the mountains to the sea. In times of low rainfall, the (rich) upstream farmers were better-off because the dams contained the water. Regularly, however, the floods were much too strong for the dykes, which were demolished to the benefit of (poorer) downstream farmers.

Consultants proposed to build a large dam in the wadi. With respect to the economic benefits a critical assumption was that these dams would result in great quantities of *additional* water to be used for irrigation. The consultants argued that without the project this water would be "lost". Consequently, the argument went, upstream farmers would benefit without hurting downstream farmers. This view raised criticism. Without the project water would not be lost, but benefit downstream farmers either in the form of surface water as in the past, or in the form of increased ground water (which may be pumped). The dams were likely to increase evaporation and reduce the supply of water for downstream farmers (which, accidently, were outside the consultant's project area). Also considering user charges policies (see box 4.15), the project would supply additional irrigation water at low costs to rich farmers and harm the income-generation potential of poorer families. In view of these adverse effects, new alternatives for the project were investigated. One of them was increased pumping of groundwater levels, the other the construction of two dams instead of one dam.

box 5.1 Distribution impacts of dam construction

Outcomes may be gathered in a distribution matrix. It shows how each alternative affects the position of specified target groups (possibly vis-a-vis other groups) and in what way (income, assets, socio-political status, and so on). An example is shown in table 5.1.

Who will benefit from irrigation schemes? Such schemes and other improvements in land and water resources by definition lead to a rise in the value of land. Consequently, it becomes more interesting from a commercial point of view. A prerequisite for knowing who will ultimately be the beneficiaries of such projects is an insight in differences in bargaining position of poor target groups and other, richer agents. If the increase in land value is significant and the poor are not well organized, landlords, businessmen and other relatively wealthy parties may reap the benefits instead of target groups. Such processes are also not uncommon in urban development schemes. Distribution analysis should hence explore power imbalances in markets.

source: FAO, 1986

box 5.2 land and distribution

Evaluation

In the second stage the distributive patterns of alternatives are appreciated with the policy-makers' preferences as a bench mark. In some cases this is a relatively straightforward affair. For instance: if the donor feels at least 50% of the net benefits of a project should accrue to the poorest groups, an alternative with a score of 60% will be appreciated positively (although the margin is not large). An alternative of which benefits completely accrue to the target groups is more attractive. By confronting the equity objectives of the donor and the actual distributional performance of alternatives, alternatives can be ranked regarding their attractiveness on this criterion.

Assessing the overal equity score may be complicated if either several types of target groups or several classes of equity attributes are involved (see table 5.1). Several techniques may be applied in such cases. In the appraisal of embankment projects in Bangladesh, the mission developed an interesting approach to the weighting of benefits accruing to various groups of farmers (EIP-Cell, 1986). For each proposed embankment project the mission calculated a *social index* (SI). This index is the weighted average of the shares of various classes of rural social groups in the embanked land. Weights reflect the mission's view on the decision-makers' policy regarding the relative priority of these groups (unfortunately, policy-makers were not actually consulted). For example, assume that a piece of land of 200 ha is embanked, of which 100 ha is owned by poor (small-scale) farmers, 50 ha by medium-income farmers and 50 ha by rich (large-scale) farmers. Shares in the embanked area are hence 50%, 25% and 25%, respectively. The mission applied the following weights: landless labourers 3, small farmers 2, medium-income farmers 1 and rich farmers 0. The SI then equals: (3*0 + 2*50 + 1*25 + 0*25)/100 = 1.25. A project at another site with a SI of .8 would be less attractive from an equity point of view.

The major advantage of the SI is that the basic data, viz. landownership in the project area, can be collected fairly easy. Information on how the income position of various groups changes as a result of a project is more problematic (see box 5.3). The major drawback of the SI is that it fails to give a comprehensive picture of distribution, as landless labourers -assigned the highest weight being the

MCA technique requires the definition of the relative priority of the various social groups. Assume the following priority:

landless labourers > women > smallfarmers > medium-scalefarmers > large-scalefarmers

Using the Regime MCA technique, a project at site A appears the most attractive, followed by respectively, site B and site C. The ranking of alternatives is highly sensitive to the weights. Table 5.3 gives rankings of alternatives for four hypothetical combinations of weights.

Table 5.3 Ranking of alternatives on the equity criterion, under different weight sets

relative priority social groups					resulting ranking of alternative		
L	S	M	R	W	site A	site B	site C
1	3	4	5	2	1	2	3
2	3	4	5	1	2	3	1
1	3	4	4	1	1	2	3
2	1	4	4	2	1	3	2

L=landless labourers, S=small-scale farmers, M=medium-scale farmers, R=large-scale farmers, W=women

In most cases, site A is most attractive. Only if the impact on women is more important than the impact on landless labourers, site A becomes second-best and site C obtains the first place. The latter two cases show the possibility of assigning equal weights to social groups. In the third case, for instance, landless labourers and women are considered to have the same priority, as well as medium and high-income farmers. Site B does not obtain the first ranking under any of the weight sets explored here.

Design adjustment and compensating activities

DGIS projects may not negatively affect target groups, in particularly the poorest groups and women. This implies that if an alternative does not comply with this constraint, it should either be rejected or adjusted. In the latter case, two options may be considered. The first is to change the design of the project in such a way that in the second round the constraint is satisfied. For instance, instead of benefiting only men, conditions of credit schemes may be adjusted to ensure that women have a fair chance of making use of available funds. Or information campaigns may be targeted at women instead of the family head (viz. men).

Instead of changing the design, aimed at avoiding unacceptable distribution impacts, additional (compensating) distributive measures may be included in a project. Providing off-site shelter and income opportunities for resettled poor farmers in the framework of dam construction projects comprises a well-known example. Costs of such measures should be included in the total costs of a project, and will hence affect its financial and economic feasibility. The original project may need to be rejected if socially compensating activities lead to negative NPVs in

policy is to set user fees at a level that covers only operation and maintenance costs.

Given this financially justified tariff, based on costs only, the question should be addressed whether the group of potential users will actually be *willing* and *able* to pay that amount for services. Whether they are willing to pay a given charge mainly depends on whether they feel the service provided suits their needs. And this inter alia depends on the without-case: if the project is not implemented, how and at what price do people obtain drinking water, education and so on? If a natural spring nearby is available, people may not be very interesting in paying for a new project in that field. The question of whether people are able to pay for services primarily depends on income levels: richer people can pay much more for education or health than poor people can. Here both financial and distributional objectives need to be taken into account. What should be the approach if the financially justified user charge would turn out to be too high for the majority of the people in the project area, and particularly for the target groups? A probably theoretical option for most donors would be to supply only services to those who can afford higher charges. Given the emphasis an equity and poverty reduction, more appropriate solutions will be searched for, by example:

- the project is rejected because it does not meet the objective of helping the poor;
- the project is made cheaper, for instance by replacing house-connections by public taps. The financially justified user charge will decrease. If the target groups can and are willing to pay the new charge, the project is both financially sound and equitable. The project may also be made cheaper by improving the organisational capacities of the government agency in charge of service provision. For instance: wastage of water may be reduced, collection of fees can be made more effective, and so on;
- without changing the design of the project, the user charge is set at the maximum level target groups are willing and able to pay. From an equity point of view this approach is attractive, but a solution is required to overcome the financial gap between costs and user payments. If cost recovery through user charges is only partial, other sources of funds need to be available. Without subsidization the project will probably fail due to a lack of funds for maintaining facilities and other recurrent costs. The present policy of most donors is to demand that users pay at least for the operation and maintenance costs. Consequently, their own support will mainly refer to investments. Most developing countries are in a process of reducing government outlays, which makes massive domestic subsidization unlikely.
- the tariff structure is differentiated by introducing cross-subsidization. Poor people are charged a lower fee than financialy justified, rich people need to pay more. Administratively this is a more complex approach, and there will be limits to rich people's solidarity, but it is both financially sound and equitable.

5.6 Distributional and economic analysis

Project appraisal outcomes may be such that one of a group of alternatives shows the best performance in terms of both contribution to real national income (economic CBA) and contribution to distribution objectives (see 5.4). In such rare cases there is no conflict between the efficiency and equity scores. In reality, trade-offs between income and distribution are likely to occur. Two possible approaches

with appraisal techniques

1. social cost-benefit analysis

Economic CBA involves an assessment of *aggregate* cost and benefit flows, irrespective of the distribution of these flows among social groups. Social CBA shares all the features of economic CBA -including shadow-pricing, discounting, and so on- but the treatment of the distributive impacts[3]. Starting from the results of economic CBA, social CBA involves two *additional* steps. The first comprises an ("objective") description of the (intratemporal) distribution of economic costs and benefits (see section 5.4). Social CBA usually focuses specifically on the distribution of income. Income flows may be specified for target groups and non-target groups, for instance "poor" and "rich" or "women" and "men"[4].

In a second step, the outcomes of the first phase (i.e. cost and benefit flows by social group) are evaluated by incorporating value judgements of policy-makers on desirable patterns of (re)distribution of income. A prerequisite for social CBA application is a willingness to assign different (quantitative) *weights* to income in the hands of the poor and of the rich, or to income in the hands of women and of men. For instance, decision-makers may feel that a dollar accruing to a poor farmer is worth twice as much as a dollar in the hands of a rich farmer. Whereas in economic CBA income flows to different groups are simply added, which implies equal weights for social groups, in social CBA they are valued differently[5]. As a result the outcomes of social and economic CBA, for instance an economic IRR vis-a-vis a social IRR, may differ.

The main principle of social CBA will be illustrated by a simplified example of an agricultural project, for which two alternatives are considered. Assume that the economic NPV amounts to -50 for alternative A and 360 for alternative B. These are unweighted sums of the net benefits (=gross benefits less costs) to different social groups. On the basis of the economic analysis, alternative A should be rejected (having a negative NPV), and alternative B should be selected.

Social CBA starts by distinguishing between income impacts for various groups. Suppose that four classes are affected, viz. landless labourers, small farmers, medium-scale farmers and large farmers. Their assumed respective shares in aggregate net economic benefits are shown in table 5.4.

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[3]The notion of "social" CBA is somewhat confusing, as it may easily lead to the interpretation that this type of CBA offers the opportunity to account for all types of social concerns. In reality, the emphasis is on income distribution only. In view of its widespread international use, this text refers to "social" CBA despite this problem.

[4]In addition, the question of how income earned in projects is *used*, particularly for either consumption or savings (see section 5.2), may be addressed.

[5]In addition, preferences regarding economic growth may be expressed in different weights for consumption and savings (intertemporal distribution). A dollar used for savings, leading to investments and hence economic growth, may be valued higher than a dollar used for consumption ("savings premium").

them, medium- and large-scale farmers will probably not participate in the project. The project may only be feasible if the donor is willing to bear a large part of the costs. Whereas this solution might be satisfactory in the short-run, continuation of the project after the donor withdraws his assistance is unlikely ("project sustainability").

In the example alternative A showed a trade-off between a negative economic return and a favourable distributive patttern. The decision had probably been easier if alternative A would have had a positive economic NPV, although still lower than alternative B's NPV. In that case, most donors would be willing to sacrifice economic benefits for distribution gains.

Going from this example to a comprehensive application of social CBA, complexities increase considerably. The theoretically correct approach is to incorporate income weights directly or indirectly in the levels of all shadow prices: most economic prices are converted into social prices. As a consequence, for instance, the social shadow wage rate for poor labourers may be lower than the economic shadow wage rate for that group. Hence, if a project employs a large part of its labourers from this group, it will experience lower labour costs and (all other things equal) hence a higher rate of return in social CBA than in economic CBA. Similarly, through the use of income weights, economic prices for non-tradables, capital (rate of discount!) and other items are converted into social prices.

This approach to social CBA has been applied in the appraisal of a rehabilitation project for solar salt works on East Madura, Indonesia[6]. Here different weights were assigned to regions instead of social classes. An increase in consumption in Madura, a poor region, was valued more than twice as high as an equal increase in the average consumption in Indonesia. This led to lower costs for unskilled labour, other labour and non-tradable goods in the social analysis compared to the economic analysis. As a result, the social IRR was 11.8% as against 8.8% for the economic IRR. Despite the rather poor economic performance, the appraisal mission recommended to approve the project in view of its beneficial distribution impact.

Complexities in social CBA increase if besides intratemporal equity objectives, further adjustments are made for preferences regarding how fast an economy should grow (intertemporal equity). A comprehensive social CBA incorporating both types of distribution objectives and involving adjustments of all prices is rarely conducted. Appraisals tend to treat distribution in a qualitative way, separately from the quantitative efficiency analysis. Due to the high degree of technical sophistication of the technique, collecting the necessary quantitative data in reasonable periods of time is extremely cumbersome. Another explanation is that many policy-makers hesitate to express their value judgements on income distribution in terms of quantitative weights. Application of a comprehensive social CBA might therefore only be appropriate in the case of in-depth studies of large and expensive projects where trade-offs between efficiency and equity are expected. Otherwise, a simple form of social CBA, like in the example above, may at least provide some insight into possible consequences of (perhaps hypothetical) distribution weight sets on the attractiveness of projects. Outcomes should be considered of an indicative nature, and hence be interpreted with caution.

[6]For a full description of the appraisal of this project, see Kuyvenhoven and Mennes (1985).

No alternative appears to have the highest NPV as well as the most preferable distribution pattern. Neither does any alternative combine the worst performance in both fields. Application of MCA can be considered. Application of several mixed-data MCA techniques (not shown here) learns that only a very high distribution weight would make site A the most attractive alternative. As the NPV gap between sites B and C is fairly close, a somewhat higher weight for distribution would put site B first.

Whereas this example provides the basic cornerstones for an MCA application, its relevance will show more clearly if the number of alternatives and especially (sub)criteria is higher. In that case the trade-offs are less obvious than in the example. At the same time weighting becomes more complex. For several reasons, decision-makers may still show a greater willingness to participate in MCA studies than in social CBA calculations. Several MCA-techniques are more accessible for non-experts than social CBA. More important, assigning quantitative income weights is probably politically more sensitive than assigning less "hard" weights to more generally defined criteria. Sometimes decision-makers may not be inclined to provide weights themselves, but instruct consultants to apply MCA starting from several (hypothetical) weight sets. Such procedures should clearly be explained in appraisal reports. Sometimes reports fail to explicitly state where the value judgements of policy-makers are involved and where their own views are used.

5.7 Distributional analysis and environment

There may be important linkages between the issues of natural resources and distribution, which in their turn may affect financial and economic analysis. A few examples are presented below.

- Large parts of the rural population, and particularly the poorest, are often directly dependent on the physical environment. Consequently, natural resource degradation as well as preservation usually have a strong impact on these social groups. Consider reforestation. In many regions, the poor depend on firewood as the prime and sometimes only source of energy. Successful reforestation projects may therefore favourably affect the long-term availability of energy sources for target groups. If it is marketed, the price of firewood might decrease, at the advantage of the main users, viz. the poor.
- Is improvement of access of the poor to natural resources a suitable means to conservation of natural resources? This issue is highly sensitive: if the answer is yes, distribution and ecological sustainability would not be conflicting objectives! The answer is likely to differ in time and space. In general, ownership of land may be a strong incentive for poor farmers to preserve this natural asset. Long-term income security may be an extremely important motive. Owners will be more inclined to take a cautious approach to exploitation than tenants. At extremely low income levels, however, this argument may not be valid. Then the need to survive may overrule all other motivations, including long-term objectives. Richer farmers have more financial resources available to temporarily sacrifice income opportunities at fragile land.
- Environmental impact assessments (EIA) should have a clear distributive focus. In other words, it is not only important to estimate overall environmental

costs? Consultants should investigate whether policy-makers' views are suitable and feasible in view of local circumstances. A prerequisite for making reliable estimates on the effects of development projects is an insight into the *willingness* and *ability* of target groups to participate.

The first issue focuses on the question whether target groups perceive the benefits, both of the project itself as well as its organisation, as the project promotors expect. Consultants should be provided guidelines on the to be investigated aspects of the willingness to participate, for instance:

- to what extent are organisational arrangements commensurate with local socio-cultural customs? To what extent are all segments (poor/rich, women/men) of the population of villages represented in committees?
- are people willing to supply labour in investment and operation and maintenance phases?
- how much are people willing to pay in monetary terms for services and products?

The analysis of the ability to participate focuses on the question whether target groups can be expected to have sufficient means of the right type available. Some examples (issues differ between sectors and countries, and over time):

- are local organisational arrangements appropriate in view of the tasks ahead?
- what are income-levels of target groups, and are these commensurate with expected payments in monetary terms?
- to what extent may labour contributions to the project be at the expense of other activities, whether income-generating or social?
- to what extent might local power imbalances cause a crowding-out effect, whereby wealthier groups reap the benefits instead of target groups?
- are conditions for participation in schemes for the provision of credits, mortgages, agricultural inputs, education, and so on discriminating against the poor or women?

3. Measurement, evaluation and compensation

The TOR should give guidelines on the approach towards the estimation of the "scores" of project alternatives on the equity criterion, i.e. the distributive impacts. A distinction should be made between:

- an "objective" description of the various types of estimated distributive impacts. The TOR should especially indicate what types of impacts on target groups should be estimated, i.e. expected changes in terms of income, access to resources, socio-political power, organisational strength and so on. Results should be presented in a distribution matrix, showing for each alternative expected consequences in these fields for specific (target) groups. Any available information should be presented, whether quantitative estimates or qualitative guesses.
- a "subjective" evaluation, i.e. an analysis of how desirable the results gathered in the distribution matrix are in the light of the preferences and objectives of policy-makers. This confrontation between objectives and estimated impacts may be relatively easy in some cases, but techniques like MCA might be required if several target groups and/or distribution aspects are to be taken into account. Weights to be employed in applications of such techniques should be determined

method uncertainty, and so on), and particularly on the weight determination procedure. Are weights provided ex ante, or is an interactive procedure prefered? In any case, it should be assured that consultants at any moment in the study indicate whose value judgements are incorporated.

6. Linkages between distributional and environmental analysis

Finally, consultants should evaluate the outcomes of the distributional analysis in the light of the outcomes of environmental impact assessment (EIA). This particularly includes the identification of possible conflicts between equity objectives and ecological (sustainability) objectives. In other words, to what extent may ecological sustainabilility objectives, which usually involve a limited or reduced use of natural resources, conflict with the objective to support target groups, both in the short and the long run? Similarly, an analysis should be made of the possibility that supporting target groups is not commensurate with natural resource conservation. If conflicts arise, consultants may suggest mitigating or compensating measures, accompanied by an analysis of their (opportunity) costs.

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