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Cost-Benefit Analysis of Community Forestry Development Project in Nepal

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INTRODUCTION

Of the 14.75 million hectares of total area of Nepal, about 35 percent is under natural forest and about 5 percent as degraded forest and shrubland. Forestry plays an important role in the national economy of Nepal. It forms as an integral part of the farming system, and central part of the natural resource base on which rural production system depends. About 15 percent of GDP and 75 percent of energy needs are derived from this sector. Employment provided by this sector is about 1.36 million full time jobs of which, about 1.1 million jobs are however in non-monetary occupation such as fuelwood and fodder collection.

Forests are not only major source of energy supply to the increasing population of the country but it also helps to control flood and landslide, maintain ecological balance and provide raw materials for forest based industries and pasturing for livestock. National forests are also the main elements of national park and wildlife reservation, covering about one third of the land area. Moreover, forest covered area can play an important role in attracting tourists and generating substantial revenue to the country.

Forest Resource and Its Status

Almost every known forest type, with the exception of equatorial tropical rain forest, is found in Nepal. This wide range of forest resource arises from the equally wide range of climatic and topographic conditions. Forest above 2600 meter consists mainly of conifers, with some hard wood; much of this forest is over-mature and not easily accessible. In the hills and foot hills, Fir (Abies sp.) and Oak (Quercus sp.) predominate at higher altitude, gradually giving way to chirpine (Pinus roxburghii), Prunus, Castanopsis, Schima and Alnus at medium elevation, and ultimately at lower elevation, to Sal (Shorea rubusta), a hard wood.

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A critical issue on the resource front has been the extent of forest degradation and deforestation, a major problem facing the country. Nepal's forests, once characterized by the proverb "Hariyo Ban Nepalko Dhan" (Green forests are Nepal's wealth) have been depleting both in quantity and quality at an alarming rate for almost three decades especially, after the nationalization of forests in 1957 which the rural people considered as an appropriation of their right and property. Estimates indicate that Nepal's forest area decreased by nearly one half from 6.4 to 3.8 million hectares - in the last 20 years. In addition to the reduction of forest area, there has been a severe degradation of growing stock which is being reduced by 2 percent each year. As this stock dwindles growth which is probably not more than 2 cum/ha. per year also declines. Considering that presently available total yield is substantially less than the total demand, further exploitation of remaining accessible forest mainly consisting of mature and over mature stand is unavoidable which will in turn result in further degradation of growing stock thereby widening the gap between future demand and supply of forest products. This damage has in turn aggrevated soil erosion and run off, downstream sedimentation and has caused loss in agricultural productivity, loss of wildlife inhabitant and biological diversity.

The cause of deforestation in Nepal has been well documented elsewhere in the literature. The general consensus is that the nationalization of forest in 1957 was the point of departure for this trend. Local responsibility for forest protection disappeared after this nationalization because villagers believed that their traditional right to access and use had been curtailed. The government was incapable of managing the forest and even of controlling the access to it. As a result, forest was and has been effectively an open access common property. This is a direct result of the conflict between the parochial interests of villagers and national interest at large.

Following the nationalization of forests, Nepal passed a number of laws regarding forest use but these laws were little enforced. The government had neither the technical capability nor the manpower to manage forests on a wide scale especially in the hills. By 1970 it was therefore apparent that forestry department would never be able to fulfill the task of managing the forests and that the involvement of community in production, management and distribution of forest products was indispensable.

COMMUNITY FORESTRY IN NEPAL

From its modest beginning in the forest management committee set up through the Chautara Divisional Forest Office in the early 1970s, aided by the new regulation about Panchayat Forest (PF) and Panchayat Protected Forests (PPF) promulgated by HMG in 1978, and encouraged by the willingness of foreign donors to support such activities, community forestry has come to Nepal in a big way.

Amongst more than 12 foreign aided projects dealing with community forestry in Nepal, (including those integrated development projects with a community forestry component), the Community Forestry Development and Training Project (CFDTP) of HMG/IDA and its technical assistance component in the Community Forestry Development Project (CFDP) supported by UNDP/FAO is the largest of all in terms of regional coverage in Nepal. Starting in 1979/80 for a five year period followed by its three extensions upto July 1988, the CFDP has implemented community forestry activities in 752 panchayats (as of Mid-July 1988) in 29 hill districts of Nepal. The project has already completed its first phase and is preparing for the second phase.

The major objectives of the CFD Project are to:

(a) increase the supply of fuelwood, fodder and other forest products for the hill population;

(b) decrease the consumption of fuelwood through the development and distribution of improved stoves;

(c) promote self-reliance of hill communities through their full participation in the management of forest resource;

(d) strengthen the capability of CFAD to run CFD Programs; and

(e) reduce environmental degradation and conserve soil and water resources.

To fulfill the above mentioned objectives, the major activities undertaken during the Phase I of CFDP include: (a) establishment of nursery, (b) establishment of PF and PPF, (c) dissemination of improved stoves, (d) distribution of seedlings for private plantation, (e) preparation of management plans, and (f) promotion of awareness through extension and training program.

SEPARATION OF COMPONENTS FOR COST-BENEFIT ANALYSIS

For cost-benefit analysis, three major components of CFDP activities can be identified with their respective sequence of activities:

(a) Extension-training - nursery construction - reforestation/plantation in Panchayat Forests (PF) and Panchayat Protected Forest (PPF) - community forestry management;

(b) Nursery construction - private seedling distribution - private plantation; and

(c) Extension - improved stove distribution.

Ignoring some minor activities (such as soil conservation work) the sum of the above three components can be taken to represent the source of all benefits arising from CFDP. This procedure, it may be noted, avoids double counting of benefits. We will perform cost-benefit analysis for the project as a whole and for each component separately. It makes little sense however, to spend much time on detailed analysis of components after a project alternative has been shaped, designed in detail, and also implemented. Yet the componential analysis we perform can be useful for future phases of such projects.

STEPS INVOLVED IN FINANCIAL AND ECONOMIC ANALYSES

In the present evaluation we will perform two types of analyses. First, "Financial Analysis" will be done to estimate commercial profitability for the project from the point of view of the entities involved in the project and the residents of the project area. Second, "Economic Analysis" will be performed to measure efficiency of resource use in the project from society's point of view. The main differences between the two approaches are briefly summarized below:

(a) In financial analysis market prices including taxes and subsidies are used. In economic analysis these prices are adjusted to obtain the so-called "shadow prices", or "accounting or efficiency prices" or "opportunity costs".

(b) In financial analysis taxes are treated as cost and subsidies as return. In economic analysis these are treated as transfer payments.

(b) Financial analysis deals primarily with the revenue earning aspect and is concerned with whether the project would be able to secure the funds it needs. On the other hand, economic analysis is directed towards determining whether the contributions of the project are large enough to justify the use of the scarce resources used by it.

In this evaluation the imputed values of project benefits had to be used even in financial analysis because the increased forest outputs are mostly collected freely for self-consumption in the hill districts.

Notwithstanding their differences, both financial and economic analyses have much in common in terms of information requirements and procedure. In practice, a step in the financial analysis is completed first (because of relative simplicity) and is used as a point of departure for the parallel step in the economic analysis. The steps involved are briefly summarized below:

Identifying Inputs and Outputs

Physical input and output tables for financial analysis in the present evaluation include those inputs which have to be purchased or are owned by the entities and those outputs which are sold or self-consumed by the entities involved in the project (namely the project and residents in the project area). For economic analysis certain additional inputs and outputs may have to be added (to the physical flow table) in order to take account of all effects (direct and indirect) of the project. The indirect effects shown in physical flow table are quantifiable "externalities" or "spillover" effects. Non-quantifiable indirect effects are discussed separately rather than being included in the physical flow tables. An effect of a project activity has been identified and measured on the basis of the difference in a given situation with and without the project and not on the basis of "before" and "after" concept because some changes would likely have taken place even without the project.

Unit Value Tables

For financial analysis prices of inputs and outputs are estimated for the time of purchase or sale or consumption, and then adjusted for inflation. In the economic analysis opportunity cost principle is used to arrive at "shadow" or "efficiency" prices. Indirect effects are by their nature valued only in terms of shadow prices.

Recently, project analysts have started using what is commonly called "social prices" where the impact of the project on income distribution and consumption/investment allocation of resources are incorporated into the analysis through the use of suitable "social" weights (see for example Squire and Tak 1975). While such a combination of efficiency and redistribution aspects is conceptually sound, this is not at a stage where it can be applied realistically in practice especially for a country like Nepal, where there is much arbitrariness, spuriousness and uncertainty regarding the weights (or value measures) to be assigned. Therefore, the present evaluation applies only "economic efficiency" analysis assuming that the existing distribution of income and consumption/investment allocation of resources are correct from society's point of view, or that community forestry project is not designed with the explicit objective of redistribution of income and allocation of resources between consumption and investment.

Cash Flow/Economic Value Flow Tables

Combining the information from the two previous steps we can prepare "cash flow" and "economic value flow" tables. In a project analysis such as the present one, where costs have already occurred it is simpler to use the total cost data obtained from project budget and annual reports. Benefit flows are calculated using Physical Flow Table and unit values.

Measuring Project Worth

Using the net value flow figures (benefits less costs) by year, measures of commercial profitability (financial analysis) and economic efficiency (economic analysis) are derived. There are three criteria that can be used to assess the project's worth:

(a) its benefits are at least as large as its costs;

(b) for each separable component of the project, benefits are at least equal to costs;

(c) there is no known lower cost means actually available to achieve the same project benefits. If no decision has been made at the time of analysis whether to implement the project or not, all the three criterion have to be applied. If decision has already been made that the project benefit will be achieved or will continue to be achieved (even if the project is rejected), then benefits with or without the project will be the same and, therefore, the analyst should focus on the third criterion. This type of analysis is called "least cost analysis" or a "cost-effectiveness" analysis.

There are three types of measures of project worth which take into account the time value of money or the time preference for present consumption over future consumption. These three measures are Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio (B/C ratio). NPV is present value (or sum of ciscounted flow) of benefits less present value of costs at a specified opportunity cost of capital. Investment is worthwhile only if NPV is positive. In the case of a selection of a project from a number of alternative projects, the projects would be arranged in a descending order of NPV. The B/C ratio is derived by dividing the present value of benefit stream by the present value of cost stream at a specified discount rate (or opportunity cost of capital). The B/C ratio indicates benefits per unit of cost and is greater than, equal to, or less than one according as NPV is positive, zero, or negative. Alternative projects can be arranged in a descending order of B/C ratio for selection. For both NPV and B/C ratio the selection of the discount rate is necessary, which is a limitation of these measures.

The other limitations of B/C ratio are that it discriminates against projects with relatively high gross returns and operating cost. The third measure is IRR which is that discount rate at which NPV would be exactly zero (and B/C ratio equal to 1). IRR does not depend on exogenously given social rate of discount. It represents the average earning power of money use in the project over the project's life. To use IRR for selection the following two criteria are used:

(a) Choose a project only if IRR is greater than the market rate of interest, social discount rate, or the opportunity cost of capital (r*); and

(b) With more than one project, rank the projects in a descending order of values of IRR and choose that set of projects for which IRR exceeds r* subject to available investment funds. However, different projects have different life-spans and also different investment and recurring cost flows, in which case IRR may not be suitable for ranking projects. Sometimes, there is another problem with IRR, that of multiple solutions of the equation NPV = 0.

DIRECT INPUTS AND OUTPUTS OF CFDP

The direct costs and benefits are generally the most important in terms of total project effects and are central to the economic as well as financial analysis of a project. In most forestry projects, they are the only effects which are given explicit consideration in terms of monetary values.

Direct Inputs

The Direct Costs of CFDP are grouped in the following categories:

Expatriate Labour

The costs here are technical assistance, salaries, allowances, travel and training expenses of home - and Nepal - based expatriate staff including consultants. We must distinguish for the purpose of economic analysis that part of technical assistance which is provided by domestic manpower.

Local Skilled Labour

This covers salaries, allowances and TA/DA for professional and office staff including drivers, typists, accountants, etc. Another example of local skilled labour is improved stove promoter (related to Improved Stove Component only).

Local Unskilled and Semi-skilled Labour

This covers wage payments to permanent and casual labour employed by the project, mainly as nursery naikes, forest watchers, construction labourers, and casual labour engaged in pitting, planting, cutting and handling, weeding, demarcation, etc. If voluntary labour is used, its opportunity cost should be included in economic analysis. In case of private plantation component of the project, the cost of transportation of seedlings, weeding, cutting and handling, and plantation and replantation costs are borne by the individuals involved and not by the project. Yet, these costs are included even in financial analysis because the benefits to private farmers are also included.

Imported Materials, Equipment and Services

Imports include large items such as vehicles and fuel, pipe and cement, etc. Some portion of materials for nursery operation and construction, demarcation and maintenance are also imported. Similarly, office goods, journals, etc. are also mainly imported. Finally, the costs of sending, Nepalese overseas for training for the project should also be included in this category. Nearly,all imports pass through India but its currency is not convertible. However, we cannot differentiate between imports produced in India and those that only pass through India, because of the lack of data.

Domestic Materials, Equipment and Services

These include expenditure on items such as locally-produced building materials, tools and equipment, some materials for demarcation and maintenance, services and utilities, and land purchase. Also included in this category are expenses incurred in community training, extension and demonstration over and above the wage costs of extension workers. Similarly, materials and furnitures used in the production of improved stoves and furnitures used in the project offices are also locally produced.

Direct Benefits

The direct benefits of the project accrue to the residents of the project area (covered districts). These benefits are individually discussed below:

Fuelwood

The project has brought about incremental outputs of fuelwood through plantation and protection activities. This includes branch and stemwood used as fuel. In a country like Nepal with no petroleum products of its own and rural population predominantly dependent on fuelwood for cooking, baking and heating purposes, this is a major component of direct benefits. Yield estimates for fuelwood is discussed later.

Fodder

The project has increased the supply of both grass and leaf fodder for livestock. The former is mainly related to Panchayat Forest and Panchayat Protected Forests, whereas in private plantation, leaf fodder is the main benefit. As with fuelwood, timber and litter (and other forest products), the time taken for collection will in many areas increase initially and subsequently decline as new plantations and protected forests reach harvestable age. An accurate technique of shadow pricing would reflect these changes in labour time in prices imputed to forest products.

Timber/Poles

The project has also increased the supply of timber and poles for building and construction through protection and plantation. As in the case of fuelwood and fodder, there are very limited markets for these forest products, the great bulk being gathered for personal consumption. Therefore, theoretically these nonmarketed benefits should be included in economic analysis only. However, we will use the market prices for these direct and measurable effects of the projects in the financial analysis and their shadow prices in the economic analysis.

Litter

The project has also increased the supply of litter for animal bedding. The incremental mass of litter and the three other forest products mentioned above due to the CFD project have been estimated using various secondary data. However, it should be noted that yield tables generally overestimate the yields as they assume normal yields and full stocking and neglect the likelihood of losses due to trespass, fire, and disease. That is, they make the generous assumption that all goes right between the initial planting and the final harvest dates. On the other hand, the opportunity for using exotic or tropical species (e.g. leucinia, mostly for fodder) which produce greater yields, may compensate for this overestimation problem.

Erosion Control

Reforestation, by stabilizing the soil, can contribute to the control of soil erosion which is a serious problem for agricultural production. Output declines as a result of both soil loss and sediment deposition. The extent to which deforestation adds to the natural process of erosion (in a region of extreme geological instability) is very uncertain; other factors such as walking paths, roads and cattle movement are also important. Although it is generally accepted that reforestation has a major impact on erosion control, measurement of its contribution to greater agricultural output is at best speculative. APROSC estimated this benefit to approximately NR 12 per ha/year or a present value of NR 88 for the discounted value of the perpetual time stream (APROSC, 1979, App. L, Table 4, p. 49). However, this estimate is clearly biased downward because it considers only the benefit of erosion control due to reduced soil deposition (and ignores the saving of crops which would be lost by erosion itself). In our economic analysis we will adjust the above figure upward for inflation.

Decreased Pressure on Forest for Fuelwood

The distribution of fuel-efficient stoves among households has reduced the pressure on the forest for fuelwood. This is a demand side effect in contrast to increased outputs discussed above, which were supply side effects. This effect can be measured in two ways. The decreased wood consumption (per household/year) can be measured in weight (kg/per HH/year). Alternatively, the decreased time for fuelwood collection can be measured in labour time saved (Hr/p.c./day decrease). The effect of improved stoves is dependent on the suitability of the model for the households in the project area, the fuel-efficiency, the number of stoves distributed, the percentage of households using the distributed stoves (regularly or exclusively), and the breakage and damage rates. Moreover, the installers are sometimes found to have modified installation with the result that the stove is less fuel efficient and is smoke producing (thus leading to low usage rate). Therefore, an accurate estimation of total fuelwood saved is very difficult to achieve.

INDIRECT EFFECTS OF CFDP

Indirect effects are also as real as direct effects. Although many of them cannot be meaningfully valued in monetary terms, they should still be identified in quantitative physical terms, if possible, and otherwise at least specified in descriptive terms. Regardless of whether or not they have an identifiable monetary value, they may be important in the broader context of decision-making, where many considerations other than monetary values are important. Indirect effects are usually external effects which potentially increase the welfare of people outside of the project area and are therefore relevant only for economic analysis.

Some of the indirect effects, however, are also related to the people in the project area but are those which are not clearly visible, or are not directly altributable to the project because many other socio-economic and environmental activities and other projects are at least equally responsible for those effects. This type of indirect effects, too, are not included in financial analysis, and are only discussed in general descriptive terms in economic and particularly in social cost benefit analysis.

A final point to be noted about indirect effects is that the analyst should be careful to find out any corresponding indirect effects (cost) required to bring about the positive one. It is only the Net indirect effects that can be attributed to the project.

The indirect positive effects of community forestry project are as described below:

Regional Effects

From the viewpoint of the national distribution of forest products, the rural hill districts are relatively resource-poor districts in Nepal. The people of the hill districts of Nepal have lower living standards, on average, than those in the Terai. Therefore, the projects in the hills will tend to be of greater benefit to the poor.

Cleaner Water

Pipes used to carry water to nurseries sometimes pass through villages and provide cleaner drinking water to the inhabitants which is considered by many people in the hills as the first development priority. Nevertheless, the project's contribution to welfare through health improvement in the project area is probably marginal and difficult to assess.

Increased Soil Fertility

Decomposition of organic matter within the forest provides nutrients some of which are washed directly into agricultural land. Moreover, some forest products flow directly via cattle in the form of fodder and litter and help increase the production of dung and manure. The contribution of community forestry to increased soil fertility would be extremely difficult to quantify and evaluate.

Training, Demonstration and Information Generating Effects

The community forestry project also involved training of labour which increased their productivity. These better trained labours will be more productive in future forestry projects or in other related jobs. It is, however, very difficult to quantify and value this benefit. Therefore, we could include only the description about number of labourers trained to do various forestry and improved stoves related jobs. Similarly, the project has also generated significant demonstration effect. Once the surrounding communities see the benefits to be derived from plantations, protections and use of fuel-efficient stoves, they may be expected on their own to start such plantations, protections and distribution of improved stoves. The 'with and without' concept can be applied can be applied to see which net benefit would not have been expected to result without the project. It can be safely said about CFDP that it has been successful in creating awareness about the role of forestry at the local panchayat levels. It has helped to lay the foundation for appropriate institutional mechanisms for the future development of forestry at the community level. While it is not possible to quantify the "motivational spillover", it is feasible to estimate the "technical spillover" effects of the project. This could be done by comparing the level of effectiveness that other projects which follow CFDP Phase I will attain with the level they would hypothetically have attained in the absence of CFDP Phase I. As a result of the knowledge created by CFDP Phase I and disseminated after the project, we can expect other projects to become more effective because of both increased output of biomass per hectare planted and reduced costs per hectare of plantation. These effects could be achieved for example, by improved matching of species to soil types and attitude, and greatly improved seedling production and plantation techniques. However, it has not been possible in this evaluation to assign numbers on such future output enhancing or cost reducing effects on other projects.

Indirect Boosting of Local Economy

The increased economic activity in the project region will generate a stimulating effect on the depressed local hill economy by increasing employment and use of resources in the project. Local impact studies in some other forestry project evaluation suggest that net indirect benefits derived from increased use of resources which would remain idle without the project are roughly equivalent to 80 percent of local monetary wages in the project. In our case, we conservatively assume this coefficient as 50 percent. However, considering the uncertainty surrounding this figure, appraisal results are presented both with and without including this indirect effect.

PROJECT INPUTS OUTPUTS: VALUATION METHOD

Financial Prices

Financial prices of project outputs used in this evaluation are from Master Plan financial prices for mountain areas. Project costs were obtained directly in monetary terms from budget and annual reports except for a few items such as cutting and handling, additional costs to private planters in addition to seedling costs, and costs to stove users besides price of stoves. These costs were calculated based on mandays per unit (per ha. or per stove), and wage rate. The wage rates for the different project years were calculated based on recent studies (including Master Plan and IDS, 1989).

The Choice Between World Bank and UNIDO Methods

Economic prices were calculated using Shadow Wage Rates and Standard Conversion Factor. We follow World Bank method of valuation which was originally proposed in 1975 (Squire and vander Tak) and is an extension of the OECD (or Little-Mirlees) approach. Some authors have argued that for forestry projects in Nepal, UNIDO method of valuation is more appropriate because project outputs are not only non-traded but also non-marketed, especially in the hills. In UNIDO method, rather than calculating world prices of traded and non-traded goods, domestic shadow prices are employed and the values of imported goods and services are adjusted by a shadow exchange rate (SER). On the other hand, domestic prices are adjusted by standard conversion factor in World Bank approach, which is distinct from the UNIDO method in that it uses the basic unit of account what is known as "government income, (or savings), at world prices" rather than the UNIDO unit of account, "aggregate consumption at domestic prices."

The UNIDO approach to price distortions induced by the existence of non-optimal barriers to trade require that, in converting financial prices to economic prices, the foreign exchange components be translated into domestic consumption value using a SER. The value of SER will depend on the domestic to world price ratios of the set of goods entering into trade at the margin, weighted by the proportion of each in rising imports or falling exports (Irvin, G., 1978, pp. 84-86).

In applying the World Bank or LMST (Little-Mirlees Squire-Tak) method, it is more appropriate to calculate a specific conversion factor for labour, as well as for any other major non-traded items such as transport and power which might appear in the project.

At the broadest level of abstraction there is little difference between the two approaches, except for the choice of numeraire. However, the essential difference between the two methods go beyond the formal choice of numeraire, and concerns the more critical question of how far indirect foreign exchange effects of a project are to be investigated. In the project under consideration we have both traded and non-traded constituents. Therefore, the UNIDO method can best be regarded as a "rough and ready" variant of LMST rather than as a formally equivalent alternative (Irvin, G., 1978, p. 87). Since both methodologies ultimately take trade efficiency as the basis of economic pricing, it follows that where identical conventions are adopted with respect to the extent of decomposition, the UNIDO methodology becomes redundant (Irvin, G., 1978, p. 99).

Valuation of Forest Projects

Most of the forest products included in the cost-benefit analysis (e.g., fuelwood, fodder and litter) are currently collected by family members at no cost other than the time and labour involved. For forest products there are four alternative methods of calculating shadow prices as briefly described below for fuelwood as an example.

Substitution Method

In this method the prices of alternative sources of energy are considered. Examples of commercial substitutes for fuelwood are kerosene and electricity. Similarly, the non-traded substitutes are dung and crop residue. However, in the project area the use of these alternatives are extremely limited (as already shown in Chapter IV of this study).

Therefore, using the price of kerosene, or the value of dung (derived indirectly from the value of crop production foregone through the lack of dung as fertilizer), or the value of crop residue burnt (derived from the loss in milk, dung and drought power provided by the cattle which otherwise would consume it), seems pointless. Therefore, this alternative was discarded in the present evaluation study.

Market Prices

Because of the lack of monopoly profits, taxes or related distortions in the hills, the market prices of the forest products (although only a small portion of these are marketed) can be expected to closely approximate their economic prices. However, market prices were not used for valuing fuelwood, fodder and litter because of the fact that these would highly overestimate the value to local consumers due to difficult transportation in the hills from forests to markets. In the case of timber and poles, however, market price method was adopted because of the relatively well developed markets in urban areas.

Labour-Time Method

This is the method used for valuing fuelwood, fodder and litter in this study. The average labour-time spent by a household in a year to gather fuelwood, fodder and litter is multiplied by the shadow wate rate for unskilled labour (separately for peak and slack seasons) and then divided by the average quantity required per household per year, to obtain the per ton economic price.

Modelling Method

A general equilibrium model based on a physical input-output table of the local economy would probably give the best estimates of shadow prices for major products of the local economy including forest products and labour. However, this method has not been applied in Nepal mainly because of prohibitive data collection problems (Hamilton, C., 1985, p. 15).

BASIC ASSUMPTIONS

This section describes the underlying assumptions on which the cost-break-down and cost and benefit flow projections are based.

Cost Breakdown and Allocation

The CFDP/HMG budgetary format is not directly applicable for cost-benefit analysis, mainly because the "Other Construction" heading covers costs related to activities such as nursery establishment and operation, plantation, weeding and distribution of improved stoves for which disaggregated data was not available. Moreover, the heading "Donation and Contribution" includes costs related to watcher costs and, nursery and plantation tools. Therefore, a breakdown and appropriate cost allocation was necessary before a cost-benefit analysis could be performed. The breakdown was done by utilizing the standard norm/rate of each of these activities on the basis of per unit labour and material input as prepared by HMG/MSFC for forestry activities. On the other hand, in order to estimate nursery and plantation tools cost, the assumptions made in the Master Plan (1988) were used as shown below:

(a) Nursery Tools Cost Per Seedling Produced:

Per 2000 seedling, with 2 year life costs NR 360. Therefore per seedling cost per year equals NR 0.09.

(b) Plantation Tool Cost/Ha:

Cost per ha. with two year life is NR 100. Therefore cost per ha/yr. equals NR 5.

The costs related to technical assistance (UNDP contribution) were broken down into local and foreign components assuming 90 percent foreign and 10 percent local. Similarly, the training cost was broken down into local and foreign components assuming 10 percent foreign and 90 percent local.

In addition to above, the joint costs were allocated among the three identified project components in the following manner: The plantation and management component (PF/PPF) was allocated 75 percent of joint costs such as HMG salary, allowance, TA/DA, vehicle plus fuels, machine and equipment, building, land purchase, service and utilities, etc. The other two components, namely, private planting and improved stove, were allocated 12.5 percent of these costs each. However, for each component another scenario including directly related costs only (i.e., without joint cost) were also analysed.

The nursery related costs were divided between PF/PPF and PTP by first calculating per seedling cost (each year) and allocating seedling cost to PTP according to the number of seedling distributed. The remaining costs were included in plantation and management component.

Apart from the above cost allocations, such additional cost items were also added for each component which were considered necessary to realize the benefits but were not explicitly incurred by the project itself. These costs include cutting and handling for plantation and management, and PTP; transportation costs for PTP and improved stoves, and maintenance costs for improved stoves.

Cost Projections

For projection purpose two general assumptions were made (a) that there will be no plantation activities after the termination of Phase I (1979/80 - 1987/88). Although, this is an unrealistic assumption, it was made to provide the expost evaluation of the CFDP activities already undertaken. An ex-ante evaluation of a much more expanded form of CFDP (called the CFDP Phase II) has already been done by other sources (World

Bank, May 1989). Therefore, it was considered a duplication of work to perform similar evaluation assuming future plantation (and other related) activities. (b) Since the major benefits of the CFDP are not realized within the first phase period, it was mandatory to assume the future flow of benefits and necessary costs even after the termination of Phase I. For this, a 30 years benefit flow period was assumed for plantation and protection activities of each year. A longer period of flow would have only negligible impact on the results obtained because of discounting. The total number of years thus comes as 38 (including the period 1979/80 to 1987/88).

More specifically, the cost projections related to the different cost components are described below:

(a) Salary, allowance and TA/DA: 10 percent of last year (1987/88) for the future years.

(b) Nursery Naike, Nursery Operations and Demarcation; (including materials): 25 percent of last year lump sum.

(c) Replacement: 25 percent of last year's plantation cost, lump sum.

(d) Weeding: Using 22 mandays/ha., and the current average wage of NR 28/manday, and the last year's plantation hectares, for two years only.

(e) Watcher Cost: Last year's cost continued for future years.

(f) Cutting and Handling: 3.2 mandays per ton for fodder, 5.3 mandays per ton for fuelwood, and 5 mandays per m3 for timber (Master Plan, Main Report, 1988, p. 289).

(g) Maintenance: 25 percent of last year continued.

(h) Fuels: 10 percent of last year continued.

(i) Stove Maintenance: Projected for two years assuming 10 percent of cost.

(j) Management Plans: 10 percent of last year continued.

Estimation of Physical Benefit Flows

The major direct benefits of the project are the incremental production of fuelwood, fodder, litter, poles, and logs. For the purpose of cost-benefit analysis we used the yield tables prepared by the master plan for mountain areas. The yield tables for PF/PPF used in the present evaluation are given below. In case of PTP (private planting), two scenarios are used. Under scenario I, it has been assumed that the yield rates are 10 percent higher than PF as per the assumption made in Master Plan (Main Report, 1988, p. 36). The reason given for this in the Master Plan is that private tree farm are usually grown on better sites and are more itensively managed. However, in case of Nepal this may not be true because of poor seedling quality and lack of proper knowledge in private planting. Hence, under scenario II it has been assumed that yield rates in PTP and PF are same. In order to make the yield rate for PTP and PF are same. In order to make the yield rate for PTP comparable to that of PF on per hectare basis, the stocking rate of 1600 per hectare has been assumed.

It should be noted that the Master Plan does not give yearly flow of incremental fodder output directly. So, it has to be calculated on the basis of information about TDN given in Table 3.12 of Master Plan Report. The relevant details are given in the yield Table 1.

Moreover, since the Master Plan does not give information about the yield for litter, we have used the yield rate estimation of NAFP (Hamilton, C. 1985) for PF only. Because of two different sources of yield rates we have performed two scenario analysis with and without litter. The yield rates of litter are shown in Table 1.

It should be noted that we have assumed incremental grass fodder from PF for the initial five years at a declining rate because of the following reason.

In the initial year of plantation the crown of trees do not close and therefore leave plantly of open space for grass to come up. However, as the age of plantation increases the tree will have bigger crown reducing the open space. As a result, further growth of grass is inhibited due to the absence of sun light on the ground.

The direct benefit from improved stove used is the net saving of fuelwood over the traditional stove. There can be two approaches of estimating this bbnefit.

The first approach is to estimate the net saving of fuel according to the degree of use as done by Campbell and Bhattarai (1983, Table 10, p. V-14). Following this approach we have estimated the fuelwood saved per distributed stove as 458 kg per year. Another approach involves the widely used assumption of 25 percent saving per used stove after adjusting the number of distributed stoves by the utilization/adoption rate. Assuming 60 percent utilization rate and 3840 kg per family per year requirement of fuelwood, the FAO/World Bank Report (1987 Annex 2/p. 6) estimated 576 kg of fuelwood saved per distributed stove. We have used both approaches in our cost-benefit analysis thereby obtaining different results under these two scenarios.

The life of improved stove varies from 2 to 5 years but we have assumed 3 years' life span as our best estimate.

Table 1
Estimated Yield of PF, PPF and PTP

	Panchayat Forest* (PF)				Panchayat Protected Forest[@] (PPF)				Private Tree Planting[¢] (PTP)		
Year	Fuelwood (t/ha)	Fodder (t/ha)	Pole (Cu m/ha)	Litter (t/ha)	Fuelwood (t/ha)	Fodder (t/ha)	Pole (Cu m/ha)	Log (Cu m/ha)	Fuelwood (t/ha)	Fodder (t/ha)	Pole (Cu m/ha)
1.	–	–	–	0.45	0.10	2.88	–	–	–	–	–
2.	0.10	5.76	–	0.45	0.40	2.88	–	–	0.11	–	–
3.	0.20	5.76	–	0.58	0.60	2.88	–	–	0.22	–	–
4.	0.40	5.76	–	0.58	0.80	2.88	–	–	0.44	–	–
5.	0.60	5.76	–	0.47	1.10	2.88	–	–	0.66	–	–
6.	1.10	5.16	–	0.47	1.40	2.88	–	–	1.21	5.68	–
7.	2.50	4.58	–	0.47	1.60	2.88	–	–	2.75	5.05	–
8.	3.70	4.02	–	0.49	1.70	2.88	–	–	4.07	4.42	–
9.	3.20	3.87	–	0.49	1.90	2.88	–	–	3.52	4.26	–
10.	2.40	2.87	–	0.50	1.60	2.88	0.57	–	2.64	3.16	–
11.	3.00	2.87	–	0.50	1.68	2.88	0.60	–	3.30	3.16	–
12.	3.40	2.87	–	0.50	1.76	2.88	0.63	–	3.74	3.16	–
13.	3.90	2.87	–	0.50	1.92	2.88	0.69	–	4.29	3.16	–
14.	4.50	2.87	–	0.50	2.00	2.88	0.71	–	4.95	3.16	–
15.	28.40	2.87	9.14	0.50	2.08	2.88	0.74	–	31.24	3.16	10.06
16.	2.40	2.87	–	0.50	2.16	2.88	0.77	–	2.64	3.16	–
17.	3.00	2.87	–	0.50	2.16	2.88	0.77	–	3.30	3.16	–
18.	2.90	2.87	–	0.50	2.16	2.88	0.77	–	3.19	3.16	–
19.	3.50	2.87	–	0.50	2.24	2.88	0.80	–	3.85	3.16	–
20.	13.40	2.87	4.71	0.51	2.32	2.88	0.83	–	14.74	3.16	5.19
21.	3.00	2.87	–	0.51	2.40	2.88	–	0.86	3.30	3.16	–
22.	3.40	2.87	–	0.51	2.40	2.88	–	0.86	3.74	3.16	–
23.	2.70	2.87	–	0.51	2.48	2.88	–	0.89	2.97	3.16	–
24.	3.30	2.87	–	0.51	2.48	2.88	–	0.89	3.63	3.16	–
25.	18.30	2.87	6.29	0.51	2.56	2.88	–	0.91	20.13	3.16	6.91
26.	1.70	2.87	–	0.51	2.56	2.88	–	0.91	1.87	3.16	–
27.	1.90	2.87	–	0.51	2.56	2.88	–	0.91	2.09	3.16	–
28.	5.20	2.87	–	0.51	2.56	2.88	–	0.91	5.72	3.16	–
29.	5.60	2.87	–	0.52	2.56	2.88	–	0.91	6.16	3.16	–
30.	24.20	2.87	8.29	0.52	2.56	2.88	–	0.91	26.62	3.16	9.11

Notes: *Yield for fuelwood (FWD) and Pole derived from Master Plan for the Forestry Sector Project Main Report (1988), Appendix Table 3.5, p. 195; values for Pole converted into cu m/ha (at 1 cu m=0.7 ton).

-Yield for Fodder (FDR) from year 1 to 4 derived from MPFSP Man Report (1988), Table 3.12, p. 37, i.e., given in green weight calculated by multiplying total digestible nitrogen (TDN) in plantations by 4.

-Yield for Fodder assumed to decrease from year 5 and remains constant from year 10 onwards.

@Yield for Fuelwood, Pole and Logs derived from additional wood output (AWO), in MPFSP Main Report (1988), Table 3.1, p. 36, i.e. assumptions are added, that AWO remains constant from year 26 to 30; Fuelwood yield is 100 percent of AWO from year 1 to 9 and 80 percent from year 10 onwards; yield of Pole is from year 10 to 20 and Logs from year 21 to 30, both at 20 percent of AWO converted into cu m/ha.

-Yield for fodder from year 1 to 25 (extended through year 30) derived from MPFSP Main Report (1988), Table 3.12, p. 37, i.e. given in green weight calculated by multiplying TDN in protected forests by 4.

¢Yield for fuelwood, fodder and pole assumed as 10 percent higher than Panchayat Forests.

Source: MPFSP Main Report 1988, for all Fuelwood, Fodder, Pole and Log.
For Panchayat Forest Litter, Project Document Nepal Australia Forestry Project, Phase 3, October 1985.

Input Price and Conversion Factor

Standard Conversion Factors (SCF)

All inputs, except for unskilled labour, are valued at border prices by adjusting the domestic price equalents by the standard conversion factor of 0.9.

Labour

Wages for unskilled labour in the project area varies between NR 20-25 per manday during the slack season and NR 30-35/md during the peak season (IDS, 1989). On average, the financial wage rate has been assumed as NR 28. The opportunity cost factor for unskilled labour during the peak season is taken as 0.8, and for slack season as 0.6. For skilled labour it is assumed that market wage reflects the opportunity cost. Assuming that the peak season is for 4 month and the slack season for 8 months, the average of these conversion factors for unskilled labour comes as 0.67 which when adjusted by the SCF gives the shadow wage rate as NR 16.8 (or a factor of 0.6).

Output Prices

Fuelwood

There are wide variations in the estimates of shadow price of fuelwood in Nepal as shown in the following table 2.

Table 2
Estimates of Shadow Price of Fuelwood (Nepalese Rupees per air-dried tonnes)

Source		Year	Estimate	Method
APROSC	(1979)	1979	333	b
FAO	(1983)	1982	629	a
Compbell et. al.	(1983)	1983	447	?
Dargavel	(1984)	1984	717	a
Dargavel	(1984)	1984	600	b
Hamilton	(1985)	1984	200	c
Master Plan	(1988)	?	660	b
IDS	(1989)	1988	368	c

Note: a = Substitution method
b = Market price
c = Labour time method

Based on the above range of values our best estimate (somewhat subjective) is NR 475 per tonne of fuelwood.

Fodder

Some authors have (IDS, 1989) estimated the time taken to collect one tonne of fodder as two-third of the time taken to collect one tonne of fuelwood. Therefore, the estimated economic price using the labour time method comes as NR 245 per tonne. However, the shadow prices of fodder estimated by other authors have wide variation ranging from NR 100 to NR 217 as shown in Table 3 below.

Table 3
Estimates of Shadow Price of Fodder (Nepalese Rupees per air dried tonne)

Source		Year	Estimate	Method
APROSC	(1979)	1979	120	?
FAO	(1983)	1982	200	a
Compbell et. al.	(1983)	1983	217	?
Dargavel	(1984)	1984	120	a
Hamilton	(1985)	1984	100	c
Master Plan	(1988)	?	130	b
IDS	(1989)	1988	245	c

Based on the above range of value, our best estimate for economic price of fodder is NR 175 per tonne.

Litter

According to some estimates (IDS, 1989), the time required for collecting litter is only 55 percent of the time required for collecting equal quantity of fuelwood. Therefore, the economic price of litter is estimated as NR 202 per tonne using the same method as above. Since the range of estimates in Nepal, including ours, is between NR 64 (Dargavel, 1984) and NR 202 (IDS, 1989), the best estimate of economic price of litter (used in the present analysis) is NR 150 per tonne.

Pole

The economic price of pole is based on the estimations by the Master Plan (Main Report, p. 290) and FAO/WB (1987, Annex 6, Table 6). The Master Plan estimate is NR 673/m^3 and that of FAO/WB is NR 770 (as shown in Table 4 below). Therefore, our best estimate is NR 720/m^3.

Logs

There are wide variations in the estimates of economic price of logs in different studies. For example, the Master Plan (p. 290) gives the estimate for E. Camaldulensis as NRs 1078/c.m.3 and that for others as NRs 3589/c.m.3. The estimate by FAO/WB as shown in Table 4 below is NRs 2300/c.m.3 which is between the two prices. We have used the FAO/WB estimate for our evaluation purpose (see FAO/WB, 1987, Annex 6 for detailed explanation of the financial price).

Table 4
Economic Stampage Prices of Logs and Poles

NRs

			Logs	Poles
1.	Average market price (after adjusting financial price by S.C.F. = 9)		119	117
2.	Average market price sawn/m^3	4225		-
3.	Average market price roundwood (at a conversion rate of 0.6)		2535	
4.	Wastage (30 percent wastage used as fuelwood at an economic price of NRs 550)		165	
			2700	
5.	Costs (6 mds at NRs 10 and 11 mds at NRs 20 for felling, loading, unloading and sawing plus transportation of NR 20 adjusted by SCF of 0.90 for logs and 4 mds at the rate of NRs 10 for poles		400	40 77 per piece or 770/M^3
6.	Economic stumpage price		2300	

Source: FAO/WB (1987), Annex 6, Table 6.

1. Poles, NRs 762/m^3 x 0.9 (conversion factor) less NRs 25/m^3 x 0.5 (conversion factor) for handling.

The financial prices of the above products used in the present evaluation are as follows:

(i) Fuelwood: NRs 690/ton (The Master Plan, p. 290).
(ii) Fodder : NRs 100/ton (The Master Plan, Ibid).
(iii) Litter : NRs 85/ton (Our Estimate based on Survey).
(iv) Poles : NRs 737 (The Master Plan, Ibid).
(v) Logs :NRs 2346 (Stampage price in FAO/WB, Annex 6).

COST-BENEFIT ANALYSIS RESULTS

In this section the results of financial and economic cost/benefit analyses for the overall project and its separable components are presented along with the results of various scenarios and sensitivity analyses.

The Project as a Whole:

The cost-benefit flows at 1987/88 prices for financial and economic cost-benefit analysis are shown in Table 5 below for a period of 38 years (30 years after the first phase of CFD).

Table 5
Cost/Benefit for Over-all Project

(In '000 Rs.)

	Year	Financial			Economic		
		Total Benefit	Cost	Net Benefit	Total Benefit	Cost	Net Benefit
1.	1979/80	10.6	8194.8	-8184.1	16.9	7108.9	-7092.0
2.	1980/81	172.6	22390.0	-22217.4	267.1	19697.3	-19430.3
3.	1981/82	1129.8	26570.9	-25441.1	1623.2	21676.5	-20053.3
4.	1982/83	3813.3	30864.0	-27050.7	4949.2	24624.8	-19675.6
5.	1983/84	8996.8	39150.0	-29153.1	11420.9	29430.0	-18009.1
6.	1984/85	16863.1	68816.2	-51953.1	20997.4	51973.0	-31075.7
7.	1985/86	26736.0	92968.5	-66232.5	32350.3	68044.8	-35694.5
8.	1986/87	39592.9	96296.1	-56703.2	46656.2	69414.7	-22758.6
9.	1987/88	54107.8	111517.1	-57409.3	61316.0	78836.1	-17520.1
10.	1988/89	66971.9	52507.2	14464.6	72691.3	32559.0	40132.4
11.	1989/90	78004.0	47530.3	30473.7	79948.6	29309.8	50638.8
12.	1990/91	90280.7	46363.1	43917.6	87923.3	28585.6	59337.7
13.	1991/92	105466.0	49123.5	56342.6	97816.4	30241.8	67574.6
14.	1992/93	120277.1	51438.7	68838.4	107855.8	31530.9	76224.9
15.	1993/94	134819.6	53056.0	81763.6	117727.6	32601.3	85126.3
16.	1994/95	153706.6	55074.4	98632.2	131587.9	33812.4	97775.6
17.	1995/96	174779.5	57611.4	117168.1	147717.2	35334.6	112382.6
18.	1996/97	199092.2	60935.6	138156.6	166218.8	37329.1	128889.7
19.	1997/98	240185.3	68059.2	172126.1	197444.5	41603.2	155841.3
20.	1998/99	266215.7	72541.5	193674.2	217262.2	44292.6	172969.6
21.	1999/2000	323567.0	81815.2	241751.8	261683.2	49855.8	311826.4
22.	2000/01	307835.9	78792.0	229043.8	250145.0	48042.9	202102.0
23.	2001/02	307573.0	78039.7	229533.3	251018.5	47591.6	203427.0
24.	2002/03	193052.6	58618.6	134434.0	163808.5	35938.9	127869.6
25.	2003/04	216622.9	61939.0	153683.9	182592.1	37931.1	144661.0
26.	2004/05	257493.9	67934.7	189559.2	217090.6	41528.6	175562.1
27.	2005/06	270635.9	69449.5	201186.4	229185.0	42437.4	186747.5
28.	2006/07	288666.9	71643.2	217023.7	245084.5	43753.6	201330.9
29.	2007/08	259299.2	66669.6	192629.6	223562.7	40769.5	182793.2
30.	2008/09	276383.6	69449.6	206934.0	236831.9	42437.5	194394.4
31.	2009/10	320444.9	76394.6	244050.4	271145.3	46604.5	224540.8
32.	2010/11	322603.6	76631.9	245971.7	372388.9	46746.9	225642.0
33.	2011/12	330561.5	77376.2	253185.3	277582.3	47193.4	230388.8
34.	2012/13	267169.2	66567.3	200601.8	226340.7	40708.1	185632.6
35.	2013/14	260904.0	64039.0	196864.9	217341.3	39191.1	178150.1
36.	2014/15	270746.9	63317.2	207429.7	220444.8	38758.1	181686.7
37.	2015/16	200817.5	48066.7	152750.7	162380.5	29607.8	132772.7
38.	2016/17	149674.9	36207.2	113467.7	119524.3	22492.0	97032.2
	Total	6604274.9	2322960.0	4281315.0	5631840.6	1489696.3	4142144.3
	IRR			0.1634			0.2104

The calculated rates of return (IRR), net present value (NPV) and Benefit/Cost ratio (B/C ratio) are shown in Table 6 below.

Table 6
IRR, NPV and B/C Ratio for the Overall Project

Items	Financial	Economic
IRR	16.3	21.0
B/C Ratio	1.52	1.98
NPV at 5 percent	1605.1	1687.7
NPV at 10 percent	566.0	729.5

Note 1: NPVs are calculated in million NRs. with 1987/88 as base year.

2: B/C ratio is calculated at 10 percent discount rate.

The World Bank estimate of economic IRR for the second phase of CFDP is 36 percent, which is much higher than our estimate (21.0 percent). Similarly, the Terai Community Forestry Project estimate as 27 percent is significantly higher than our estimate. However, the Master Plan estimate (for forest plantation in mountain areas) of 22 percent economic rate of return is only slightly larger than our estimate. On the other hand, the estimate of economic IRR for Nepal-Australia Forestry Project is only 9.9 percent.

In case of financial IRR, we see that it is much lower than economic IRR, showing the subsidized nature of the project. But it is significantly above the discount rate of 10 percent assumed in this study. The Master Plan estimates financial IRR for Forest Plantations (PF) in mountain areas as 14.8 percent when cost of seedlings and technicians are subsidized, and as 37.7 percent when cost of seedlings are subsidized only for first two years, except harvesting. Thus our estimate falls between these two extremes. In case of 10 percent enriched PPF the master plan estimate of financial IRR is much higher (39.3 percent). Similarly, the estimate of financial IRR for Terai (World Bank, 1983, p. 35 and p. 85) is 33 percent for panchayat plantings, which far exceeds our estimates.

The B/C ratio shows that the total cost flow has to increase by 98 percent or benefit flow has to decrease by 49.5 percent before economic NPV falls to zero, at 10 percent opportunity cost of capital.

The net benefit to the society from the overall project at 10 percent discount rate comes as 729.5 million NRs with 1987/88 as the base year. This is about one-seventh of the NPV calculated for the second phase of CFDP as 5058 million NRs (WB, 1989, p. 41).

PLANTATION AND MANAGEMENT COMPONENT

The cost-benefit flows are not shown here to save space, but the calculated IRR, B/C ratio and NPV are shown below in Table 7.

Table 7
IRR, NPV, and B/C Ratio for Plantation and Management Component
(NPV in 1987/88 Prices in Million NRs)

Items	Financial	Economic
IRR	18.8	21.6
B/C Ratio*	1.68	1.92
NPV at 5 percent	1520.0	1488.7
NPV at 10 percent	596.3	641.6

*B/C Ratio at 10 percent discount rate.

Again the economic IRR exceeds the financial IRR, but the margin of difference is smaller than that for total project. The economic IRR of this component is only slightly larger than that of overall project. The economic IRRs for PF and PPF (10 percent enrichment) estimated by the Master Plan are 22 percent and 64.9 percent respectively. Thus our estimate is quite close to that for PF in mountain areas but substantially below that for PPF (with 10 percent enrichment). The master plan estimates of financial IRRs are 14.8 percent and 39.3 percent for PF and PPF respectively. Thus our estimate lies between these two extremes (but closer to PF estimate). The estimates of economic and financial IRRs for Terai forestry (WB, 1983, pp. 35-38) are 30 percent and 38 percent respectively, which are much higher than our estimates.

Table 7 shows that the economy realizes a net benefit of 641.6 million NRs (1987/88 prices) at 10 percent discount rate from the investment in this component of CFDP. The benefit cost ratio shows that costs have to rise by 92 percent or benefits fall by about 48 percent for NPV (at 10 percent) to be zero.

PRIVATE PLANTATION COMPONENT

The Cost-Benefit Flows related to this component are also not shown here.

The calculated IRR, NPV and B/C ratio are presented in Table 8 below.

In this case too, the economic IRRs exceed the financial IRR. The estimate for economic IRR is higher than that for the project as a whole and the plantation and management component, but the financial IRR is much higher, both in the case of 10 percent higher yield and equal yield (as PF). Our estimates are also higher than those of IDS 1989 for Urban Areas of Kathmandu Valley (USAID/IDS. The Forest Products Marketing System in Nepal, 1989, p. 102) which calculates financial IRR for private plantation as 17.5 percent.

Table 8
IRR, NPV and B/C Ratio for Private Plantation Component
(NPV in Million NRs with base year 1987/88)

Items	Financial	Economic
10 Percent Higher Yield Case		
IRR	20.8	23.4
B/C Ratio*	2.01	2.43
NPV at 5 percent	170.8	152.2
NPV at 10 percent	70.4	66.7
Equal Yield Case		
IRR	19.3	21.9
B/C Ratio*	1.82	2.20
NPV at 5 percent	146.1	132.3
NPV at 10 percent	57.6	56.4

*At 10 percent discount rate.

The B/C ratio shows that economic costs have to rise by 143 percent or benefits fall by 58.8 percent for the NPV to fall to zero, in case of 10 percent higher yield. Similarly, for equal yield (as PF), costs have to rise by 120 percent or benefits fall by 54.5 percent for NPV to fall to zero.

From the investment in this component the society derives a net benefit of 66.7 million NRs if 10 percent higher yield is assumed, or 56.4 million NRs if equal yield is assumed (1987/88 prices) at 10 percent discount rate.

Finally, note that the assumption of 10 percent higher yield only marginally changes the results from equal yield case, showing the robustness of our results (also discussed in detail later).

IMPROVED STOVE COMPONENT

The calculated IRR, NPV, and B/C ratios are shown in Table 9 below.

Table 9 shows many interesting results. In this case (and this case only), the economic IRRs are far below the financial IRRs in both approaches of fuel saving. On one hand, the financial IRRs are considerably higher than those for the overall project and other components; on the other, the economic IRR in case of first approach is the lowest of all. If second approach is followed, then this component seems to be the best in terms of rate of return. For the first approach, this component seems highly profitable according to financial return, but only marginally profitable according to economic return.

These somewhat peculiar results may be because of the 12.5 percent share allocation of joint costs, which is perhaps not justified. Lacking any other specific information about the share of this components in the joint cost, this is, however, the only reasonable assumption that could be made.

Table 9
IRR, NPV and B/C Ratio for Improved Stove Component
(NPV in Million NRs with base year 1987/88)

Items	Financial	Economic
First Approach of Fuel Saving*		
IRR	44.7	10.0
B/C Ratio@	1.27	1.0
NPV at 5 percent	6.5	0.7
NPV at 10 percent	5.8	0.0
Second Approach of Fuel Saving¢		
IRR	76.2	43.4
B/C Ratio@	1.59	1.1
NPV at 5 percent	13.5	5.5
NPV at 10 percent	12.9	4.9

*Using 458 kg fuel saving per distributed stove per year.

@At 10 percent discount rate.

¢Using 576 kg fuel saving per distributed stove per year = 3840* .25 *.6.

SENSITIVITY ANALYSES

In this section, we perform various sensitivity analyses with respect to the base case scenarios of the previous section. In order to check the robustness of our results and the risks associated with the several assumptions on which the cost-benefit analyses are based, we recalculate the economic IRRs and NPVs for the overall project and its separable components by changing the cost and benefit flows in a variety of ways as discussed in detail below.

Sensitivity Analysis of the Overall Project

The base case for the overall project includes litter, excludes indirect benefits, and uses the first approach (as explained above) of estimating the net saving of fuel by improved stoves. Therefore, the different scenarios presented in Table 10 below are related to the alterations in these assumptions. Besides, the widely used method of increasing costs and decreasing benefits by 20 percent is also attempted on the base case.

Table 10 shows that the exclusion of litter from the set of direct benefits causes the economic IRR to drop only marginally from 21.0 percent to 20.6 percent and the net benefit to society (at 10 percent discount rate) to drop from 729.5 million NRs to 706.6 million NRs. Similarly, the inclusion of erosion control benefit raises the IRR marginally to 21.2 percent and NPV to 735.2 million NRs. This mild effect of erosion control benefit may be due to the underestimation of the net effect of erosion control benefit by the secondary source (APROSC, 1979) from which the relevant data was borrowed.

Table 10

Sensitivity Analysis of Overall Project

	Scenarios	Economic IRR	NPV in 1987/88 Million NRs at 5 percent D.R.	at 10 percent D.R.*
1.	Base Case	21.0	1687.7	729.5
2.	Excluding Litter	20.6	1654.6	706.6
3.	Including Erosion Control Benefit	21.2	1693.1	735.2
4.	Including Employment Benefit	28.5	2228.3	1092.1
5.	Including both Indirect Benefits	28.8	2233.6	1097.7
6.	20 percent Increase in Cost	17.9	1504.7	586.1
7.	20 percent Decrease in Benefit	17.1	1161.8	434.6
8.	+20 percent Cost and -20 percent Benefit	14.1	973.5	285.5
9.	Second Approach of Fuel-wood Saving	21.2	1692.6	734.4
10.	Erosion Control and Second Approach of Fuel Saving	21.4	1697.9	740.1

*D.R. = Discount Rate.

However, we see a remarkably large impact of employment generation benefit on IRR (raised to 28.5 percent) and NPV (raised to 1092.1 million NRs). When both indirect benefits are included, the IRR rises from 21 percent to 28.8 percent) and NPV increases by 50 percent. In our case, employment generation seems to be the most important indirect effect of CFDP even when we took only 50 percent of the local monetary wages instead of 80 percent as other studies have done (Economic Analysis of Forestry Projects, p. 158).

The sensitivity analysis related to increase and decrease of costs and benefits respectively by 20 percent shows the robustness of our results. For example, the effect of increasing total costs by 20 percent each year is only to reduce IRR from 21 percent to 17.9 percent, and the effect of reducing total benefits by 20 percent each year is nearly the same. However, the effect on NPV is significant because it drops by 20 percent for 20 percent cost increase, and by 40 percent for 20 percent benefit decrease. When both changes are done simultaneously, the IRR drops to 14.1 percent and consequently, the NPV drops by about 61 percent.

Finally, we find a quite insignificant effect of switching to second approach of net fuel saving on the overall project result, although that implies an increase of about 26 percent in the benefit flow associated with Improved Stove Component.

Sensitivity Analysis of Plantation and Management (PF/PPF) Component

For this component, the sensitivity analysis involves the inclusion of erosion control benefit, exclusion of litter, and 20 percent change in the cost and benefit flows. The results are shown in Table 11 below.

Table 11
Plantation and Management Component: Sensitivity Analysis

Scenarios	Economic IRR	NPV in 1987/88 Million NRs at 5 percent	at 10 percent D.R.
1. Base Case	21.6	1488.7	641.6
2. Including Erosion Control Benefit	21.8	1493.4	646.6
3. Excluding Litter	21.1	1455.6	618.7
4. 20 percent Increase in Cost	17.9	1307.9	501.4
5. 20 percent Decrease in Benefit	17.2	1010.2	373.1
6. 20 percent Increase in Costs and Decrease in Benefits	14.0	829.4	232.9

The table shows that the erosion control benefit has negligible impact on IRR and NPV (less than 1 percent change). The exclusion of litter has relatively more effect but still involves only 0.5 percent point drop in IRR and only a 3.6 percent change in NPV. However, a 20 percent increase in total cost flow brings down the IRR to 17.9 percent and NPV to 501.4 million NRs (a 21.9 percent drop). A 20 percent decrease in benefits has relatively larger impact as IRR drops to 17.2 percent and NPV by 41.8 percent. If 20 percent increase in cost and 20 percent decrease in benefit are applied simultaneously, the economic IRR drops to 14.0 percent and NPV to 232.9 million NRs (a 63.7 percent decline). However, the economic IRR is still well above the social opportunity cost of capital assumed in the study.

Sensitivity Analysis of Private Plantation Component

The base case for private plantation component assumed 10 percent higher yield rate than PF plantation, and also included a 12.5 percent share of essential joint costs. Therefore, the sensitivity analysis involves the assumption of yield rate for private plantation equal to PF plantation, 20 percent increase and decrease in total costs and benefit flows, respectively, and inclusion of erosion control benefits associated with private plantation. The results are presented in Table 12 below.

Table 12 shows that the effect of assuming equal yield rate (which is in fact equivalent to a 10 percent decrease in total benefit flow), is only to decrease IRR from 23.4 percent to 21.9 percent and NPV from 66.7 million NRs to 56.4 million NRs (at 10 percent opportunity cost of the capital). Similarly, a 20 percent increase in costs decreases IRR to 20.5 percent and NPV to 57.3 percent, while a 20 percent decrease in benefit has relatively larger impact as it reduces IRR to 19.9 percent and NPV to 44.0 million NRs. Even the combined effect of a 20 percent increase in costs and a 20 percent decrease in benefits is only to drop IRR to 17.2 percent and NPV to 34.6 million NRs, showing a significant robustness. As in case of overall project and plantation and management component, the effect of including soil erosion benefit is only marginal.

Table 12

Sensitivity Analysis of Private Plantation Component

Scenarios	Economic IRR Percent	NPV in Million NRs at 5 percent	NPV in Million NRs at 10 percent
1. Base Case	23.4	152.2	66.7
2. Equal Yield Rate as PF	21.9	132.3	56.4
3. 20 percent Increase in Cost	20.5	140.0	57.3
4. 20 percent Decrease in Benefit	19.9	108.5	44.0
5. (+) 20 percent Cost and (-) 20 percent Benefit	17.2	95.3	34.6
6. Including Erosion Control Benefit	23.8	152.8	67.4
7. Soil Erosion Benefit and Equal Yield Rate	22.3	133.0	57.0

Sensitivity Analysis of Improved Stove Component

The base cases of this component involved the two approaches of fuel saving estimation and inclusion of 12.5 percent share in the essential joint costs. Therefore, the sensitivity analysis involves exclusion of joint costs, and 20 percent changes in the cost and benefit flows. The direct costs of improved stove use are: production cost, installation cost, stove promoter cost, maintenance cost and other directly supporting staff costs. The results of the sensitivity analysis are shown in Table 13 below.

Table 13 shows that the results for IS distribution are highly sensitive to cost benefit assumptions. For example, the switch from first approach to second approach (involving a 25.8 percent increase in benefit flow) causes IRR to jump from 10 percent to 43.4 percent and NPV to rise from negligible amount to 4.9 million NRs. Similarly, the exclusion of joint costs increases IRR to 184.3 percent and NPV to 12.5 million NRs. On the other hand, a more 20 percent decrease in benefit or a 20 percent increase in cost causes the IRR to be negative (from 10 percent) and NPV to be large negative (about 4.0 million NRs as loss). Similarly, a 20 percent increase in cost under the second approach reduces IRR from 43.4 percent to 16.8 percent and makes NPV only 1.1 million NRs. A 20 percent decrease in benefit causes IRR to drop further to 10.9 percent and NPV to 0.1 million NRs. If both changes are applied, IRR and NPV become negative even under second approach.

Thus, the results of Improved Stove Component are highly sensitive to the underlying assumptions and, therefore, not very reliable, unlike those of the overall project and other components.

Table 13
Sensitivity Analysis of Improved Stove Component
(NPV in Million NRs with 1987/88 as base year)

Scenarios	Economic IRR percent	NPV at 5 percent	NPV at 10 percent
1. Base Case	10.0	0.7	0.0
2. Second Approach of Fuel Saving	43.4	5.5	4.9
3. Direct Cost only+	184.3	12.7	12.5
4. + 20 percent Base Cost	-13.2	*	*
5. - 20 percent Base Benefit	-17.6	*	*
6. ± 20 percent Base Cost/Benefit	-34.0	*	*
7. + 20 percent Second Cost	16.8	1.9	1.1
8. - 20 percent Second Benefit	10.9	0.8	0.1
9. ± 20 percent Second Cost/Benefit	-12.6	-2.8	-3.7

+Direct Costs and First Approach.

*Large Negative Values.

COMPARISON OF RESULTS

Table 14 presents the economic rates of return, B/C ratio and NPV (at 10 percent discount rate with 1987/88 as base year) for the base case of different components and the overall project.

The table shows that the highest NPV is associated with the overall project followed closely by Plantation and Management (PF/PPF) component. Moreover, the sum of the NPVs of the different components comes as 708.3 million NRs (or 97.1 percent of NPV of Total Project). The very small discrepancy between the sum of NPVs and the total NPV of overall project clearly shows that the assumptions underlying the cost allocations were highly plausible. Although the difference is too small to warrant an

Table 14

Summary of Economic Analysis by Component: Base Cases

	Component	Economic IRR percent	B/C Ratio	NPV at 10 percent D.R. (Million NRs., 1987/88 as Base Year)
1.	The Project as a Whole	21.0	1.98	729.5
2.	Plantation and Management	21.6	1.92	641.6
3A.	Private Plantation (10 percent higher)	23.4	2.43	66.7
3B.	Private Plantation (Equal Yield Case)	21.9	2.20	56.4
4A.	Improved Stoves: First Approach of Fuel Saving	10.0	1.00	0.0
4B.	Improved Stoves: Second Approach of Fuel Saving	43.4	1.1	4.9

elaborate explanation, it is to be acknowledged that when different project activities are combined, the total benefit is usually larger (howsoever, separable the components) than the arithmetic sum of separate benefits. Among others, one reason for this is the economy of scale, especially concerning the joint costs.

The private plantation component ranks highest with regard to economic IRR and B/C ratio followed by Plantation and Management and overall project. If however, second approach of fuel-saving is adopted, then improved stove component ranks highest in economic IRR. But the very low B/C ratio and the highly sensitive nature of the results for improved stove component indicate that the high IRR for second approach of improved stove may be quite misleading.

It should be noted that the economic analysis of the CFDP Project shows that it satisfies the two important criteria set for above. Not only the present value of benefits for the overall project exceed the (present value of) costs at the assumed rate of opportunity cost of capital, but the same is also true for each component separately. The third criterion is difficult to apply for the overall project because there are no comparable projects in Nepal which generate the benefit flows as the CFDP.

SUMMARY OF MAIN FINDINGS

Wages for unskilled labour in the project area (for various activities) varies between NRs 20-25 per manday during the slack season (about 8 months) and between NRs 30-35 per manday during the peak season (about 4 months). The average financial wage has been calculated as NR 28/manday for the base year of this study (1987/88). Applying the opportunity costs of 0.6 and 0.8 for slack and peak seasons respectively and the standard conversion factor of 0.9, the shadow wage rate has been estimated as NRs 16.8 per manday for the hill area of Nepal covered by CFDP.

Applying the labour-time method, the economic prices of fuelwood, fodder and litter are calculated as NRs 368, NRs 245, and NRs 202 per ton respectively.

The economic IRRs for the total project, plantation and management component, private plantation component, and improved stove component are respectively 21.0 percent, 21.6 percent, 23.4 percent and 10.0 percent. The results for the overall project and its components are highly robust except in case of improved stove component. The results of improved stove component are highly sensitive to cost-benefit assumptions and the economic viability completely disappears under a scenario of 20 percent increase in costs even for the second approach for which IRR is as high as 43.4 percent.

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