The socio-economic evaluation of agroforestry in Orissa (India)

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ABSTRACT


The paper evaluates agroforestry in the State of Orissa within the framework of its stated socio-economic objectives. The estimated values of socio-economic parameters such as elasticity of social marginal utility of consumption, social discount rate, marginal productivity of capital, marginal productivity of labour, and inter-temporal consumption weight are \(-1.4, 2.05\%\), \(0.142\), \(0.33 \times \text{wage rate}\), and \(6.77\), respectively. The intra-temporal consumption weights for the society, the main workers and the subsidiary workers are \(1.005\), \(0.573\), and \(2.204\), respectively. Both the distributional equity and efficiency aspects have been accounted for in the analysis. Based on two criteria (present net worth and land expectation value) the socio-economic profitability and optimum rotations have been determined for agroforestry on three site qualities, SQ I (Site index = 20-23), SQ II (Site index = 17-20) and SQ III (Site index = 14-17), and contrasted with the results of financial analysis. The net socio-economic benefits are shown to be quite large for SQ I and II. In SQ III, as socio-economic costs outweigh the socio-economic benefits, it is suggested that for the agroforestry system to be socially profitable, the investment funds should be acquired by diverting consumption-oriented funds from rural development programmes such as 'Food for Work'.

INTRODUCTION

Subsistence oriented agroforestry systems are being implemented in India as a component of social forestry, mainly to satisfy the poor's basic needs for staple food, fuelwood and small timber for construction and agricultural implements (Government of India, 1984). Apart from their production objectives, the emphasis is on providing employment for the poor as a rural development objective. Employment generation is used as a means of generating adequate income for the rural poor in order to raise them above the poverty consumption level (Government of India, 1986; OFD, 1987; Tiwari, 1983). Agroforestry, therefore, needs to be evaluated in such a way as to incorporate...
these two main objectives. Most of the work hitherto done on the economic evaluation of agroforestry is focussed on the production objective through simple financial profitability (Mathur et al., 1984; Srivastava and Pant, 1979), while important socio-economic aspects are either neglected or at best dealt with superficially (FAO, 1985). The distribution of income generated by an agroforestry enterprise, and equity of that distribution, are also factors which concern policy makers and need to be accounted for in any comprehensive analysis of agroforestry. To evaluate agroforestry within the framework of its stated objectives, a case study is taken from the state of Orissa, where agroforestry as a component of the Forest Farming for Rural Poor (FFRP) has been implemented from the early eighties with investment funds from both Forest and Rural Development Departments. The results obtained from socio-economic analysis are contrasted with that of conventional financial analysis.

SOCIO-ECONOMIC ENVIRONMENT OF ORISSA

The State of Orissa is located in the eastern region of India and is recognised as an economically backward state. 88% of its population reside in more than 50 000 villages and the economy is predominantly agrarian. Agriculture accounts for 69% of the state’s domestic product and provides employment for 79% of the working population. In 1983 the incidence of poverty in Orissa was higher than the national average (Panda, 1987), and 51% of the total population were below the poverty consumption level (i.e. the per capita consumption expenditure level required to achieve an energy intake of 2800 calories per capita per day, fixed on a normative basis). Nearly 23% of the total population are tribals, who are mainly dependent on the forest economy.

Land ownership is highly skewed in favour of the big farmers and the remaining holdings are small and fragmented. Small and marginal farmers (owning less than 2 ha) farm 75% of the land holdings but control less than 40% of the agricultural land, while farmers with more than 5 ha account for only 7% of total holdings and control 35% of the land. The main activities are cultivation, agricultural labourers, village artisans, forestry, fishing, etc. Official statistics show that 43% of the state is under forests but as a result of degradation, the actual area under forest cover (estimated from satellite imagery) is not more than 20%.

Fuelwood is the main source of domestic energy. The increasing scarcity of fuelwood and fodder has resulted in commercialisation of fuelwood collection. As a result, the traditional village forests, on which the poor villagers depended for their livelihood, are being depleted rapidly (Sharma et al., 1990). A scarcity of fuelwood has also resulted in the rural peasantry burning cattle dung, which would have otherwise been used as manure to enhance
agricultural productivity on cultivated lands. This vicious circle of land degrada-
tion has led to large areas of land becoming degraded and presently nearly
41% of the total land area has been classified as wasteland. The national strat-
egy now reflects the need to develop these degraded lands through massive
afforestation under social forestry which includes agroforestry as an impor-
tant component. The establishment of agroforestry will, in addition to halting
and/or reversing land degradation, supply fuelwood, staplefood, fodder and
small timber to the rural poor.

FOREST FARMING FOR THE RURAL POOR

Forest Farming for the Rural Poor (FFRP) is an important plantation
component in the Orissa social forestry programme and closely resembles in
objectives the 'Economic Rehabilitation of the Rural Poor' programme for
rural development. The major objective of the FFRP programme is to raise
the income and consequently consumption level of the landless rural poor.
This is being achieved by allowing landless rural households to practise agro-
forestry on government wastelands in and around their villages. The guide-
lines for the FFRP programme state that the landless poor are to be the be-
neficiaries, with usufruct rights (which refer to villager's free rights to
agricultural and forestry produce from agroforestry established on unutilised
government lands without inferring any ownership rights to that land). Each
beneficiary household is allotted 0.5 ha of unused government land. The be-
neficiaries, with technical and financial support from the Forest Department,
manage agroforestry enterprises of fast growing biomass species such as Eu-
calyptus. The beneficiary is closely associated in all the aspects of the manage-
ment of the land and between 250 to 300 worker days are spent tending a 0.5
ha block. Much of the work is wage earning and along with the annual income
from agricultural crops in the initial three years this means that a sustainable
income can be maintained while waiting for the longer gestation enterprise:
forestry.

DECISION CRITERIA

The financial model based on market prices derives its validity from a clas-
sical economic model which uses efficiency as the basic criterion of accepta-
bility and viability of agroforestry enterprises. Although there are many non-
discounting investment criteria (Sharma, 1988a), these do not take into ac-
count the time value of money. Among the discounting type criteria, the main
three are: present net worth (PNW), benefit cost ratio (BCR), and internal rate
of return (IRR). Although the suitability of these criteria will depend on the
particular situation of the project, the PNW is suitable in case of subsistence-
oriented agroforestry systems [see Sharma (1988a) for a review]. The PNW
model applicable for single rotation of the three species, expresses net difference between discounted benefits and costs. The model for an infinite series of rotations from the land, based on the theory of capital and asset replacement, is given as

\[ \text{LEV} = \text{PNW} \cdot \frac{(1 + r)'}{\left( (1 + r)' - 1 \right)} \]

where

- \( \text{LEV} \) = land expectation value.
- \( t \) = the tree rotation length for a particular species.
- \( r \) = the discount rate (expressed as a decimal).

The LEV gives the capital value of an infinite number of returns each received \( t \) years apart.

FINANCIAL EVALUATION

A computer program for computing PNW and LEV for variable rotations and discount rates (DRS) was developed in FORTRAN 77 and run on the Edinburgh Multi-Access System (EMAS). Three site qualities (SQ) were chosen for analysis. These were (Sharma, 1978):

- SQ I – Site index 20–23;
- SQ II – Site index 17–20;
- SQ III – Site index 14–17.

Cost estimates (per unit land area in ha) for various operations for the agroforestry system to be established having the following specifications were taken from Orissa Forest Department (OFD, 1987):

- Eucalyptus hybrid (tree species) + Sorghum or gram (crop species), (agricultural crops are raised only for initial three years);
- Density = 4000 tree seedlings per ha;
- Tree spacing = 4 m–1 m \( \times \) 1 m – 4 m (two rows of trees at a spacing of 1 m \( \times \) 1 m separated by alleys, with sorghum or gram, of 4 m width).

The yield and crop diameters for Eucalyptus for Site Quality (SQ) I, II and III are estimated from yield models developed by the Indian Forest Research Institute (Sharma et al., 1990). The yields and prices for the agricultural crop are taken from OFD (1987). The differential rates of stumpage prices for the produce, i.e. fuelwood, poles and small timber, and timber, are (based on crop diameters) calculated from open auction rates of OFD for the year 1987. The PNW and LEV are computed for a range of rotations from 5 to 20 years and at various DRS. The financial optimum rotations for SQ I, II and III based on PNW and LEV criteria are presented in Table 1.

It is clear from Table 1 that rotation is highly sensitive to DRS and decreases with increase in DRS. An explanation of this lies in the fact that discount factor, being an exponential function of time, critically influences the management options in agroforestry, wherein the benefits from the tree component accrue after a significant time from the initial investments. The LEV criterion gave a
TABLE I

Financial optimum tree rotations for agroforestry with varying discount rate and decision criteria

<table>
<thead>
<tr>
<th>Discount rate (%)</th>
<th>Optimum tree rotation (in years)</th>
<th>LEV criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PNW criterion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SQ I</td>
<td>SQ II</td>
</tr>
<tr>
<td>2</td>
<td>17</td>
<td>20</td>
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<tr>
<td>3</td>
<td>16</td>
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<td>5</td>
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<td>15</td>
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<td>12</td>
</tr>
</tbody>
</table>

|                   | LEV criterion                   |               |
|                   | SQ I   | SQ II  | SQ III |               |
| 2                 | 12     | 12     | 16     | 16             |
| 3                 | 12     | 12     | 16     | 16             |
| 5                 | 12     | 12     | 14     | 14             |
| 7                 | 12     | 12     | 13     | 13             |
| 10                | 12     | 12     | 13     | 13             |
| 12                | 12     | 12     | nf     | nf             |
| 14                | 12     | 12     | nf     | nf             |
| 15                | 12     | 12     | nf     | nf             |

\(^1\)nf: none feasible.

shorter rotation than that based on PNW. The reasons for this result which mainly stem from LEV being a measure of land value (unlike PNW which gives the present value of returns from harvesting the current crop) are as follows.

1. The LEV model (unlike the PNW model) takes into account benefits which could accrue from future rotations. So if the land is permanently dedicated to agroforestry, a shorter rotation would allow the successive crops to utilise the land earlier and give larger returns.

2. If the land for agroforestry is rented, a shorter rotation will curtail rent payments.

3. If the land has a potential alternative use and so can be sold, a shorter rotation would reduce the loss by postponing sale.

4. If the land is highly productive, as in SQ I, the profitability of successor crops would be greater, and this implies a greater urgency for replacing the existing crop.

SOCIO-ECONOMIC EVALUATION

The socio-economic analysis is concerned with the equity and efficiency with which projects such as agroforestry create overall social utility (i.e. increase in social significance of consumption). To correct the deficiencies of the market and the distributional mechanisms, the market prices for the factors of production and produce from agroforestry need to be replaced by their shadow prices (Sharma, 1988b). These are functions of the increase in social welfare from any marginal change in the availability of factors of production and are determined by the interaction of the fundamental objectives, socio-economic environment and basic resource availabilities (Squire and Van der
The social welfare function

The marginal social utility of consumption for an individual or groups of individuals at the consumption level $C_i$, is expressed as (Kula, 1988; Squire and Van der Tak, 1975):

$$\frac{dU(C_i)}{dC_i} = A(C_i)^{e_u}$$

where $A$ is a constant and $e_u$ is the elasticity of social marginal utility of consumption ($e_u$ shows how much the marginal social utility of consumption changes with each percent increase in the average level of consumption). Sharma et al. (1991) have estimated the parameter $e_u$ as $-1.4$ (this estimated value of $e_u$ implies that the social significance of extra consumption would decline by 1.4% with each percentage increase in the average level of consumption) and specified the social utility ($U$) and the social welfare functions ($SWF$) for agroforestry as

$$U(C_i) = A(C_i)^{1+e_u}/(1+e_u) = A(C_i)^{1-1.4}/(1-1.4)$$

and

$$SWF = \left[ A/(1+e_u) \right] \sum_{i=1}^{n} (C_i)^{1+e_u} - \left[ A/(1+e_u) \right] \sum_{i=p+1}^{n} (C_i)^{1+e_u}$$

where $p$ represents the number of individuals or groups of individuals who are at or below the poverty consumption level ($C_{pi}$) in an $n$-member society. The Indian Planning Commission classifies the total population into 13 groups based on their consumption levels. Orissa state includes four groups of individuals which are at or below the poverty consumption level with the remaining nine groups above this level.

**Numeraire**

The unit of account or numeraire for measuring the socio-economic values within the framework of the social welfare function specified above is taken as, 'net present consumption benefits in the hands of people (i.e. groups of individuals) at poverty consumption level in the private sector in terms of constant domestic accounting rupees'. Defining numeraire based on poverty consumption level means that additional income going to an individual or
groups of individuals at the poverty level, is as valuable to the government as additional income going to the government itself. This is because the poverty consumption level has been chosen as a reference or benchmark in judging the agroforestry policy.

**Social discount rate**

Based on an inter-temporal social utility model, Sharma et al. (1991) have estimated the social discount rate \( r_s \) as 2.05%.

**Marginal productivity of capital \( (q) \)**

The parameter \( q \) reflecting the rate of return on public investments is used as an estimate for opportunity cost of capital or economic price of capital. The model for estimating \( q \) can be written as (Rao, 1983):

\[
Y_{t+1} = (1 + q \cdot s) Y_t + E
\]

where \( Y_t \) is the national domestic product (NDP) in year \( t \) (in real terms) for constant labour, \( s \) is the marginal propensity to save and \( E \) is an additive error term. This model provides the basis for estimation of \( q \) by autoregression of NDP on itself lagged by one year, if \( s \) is known. The parameter \( s \) is estimated from the model:

\[
S = A_2 + s \cdot Y + E'
\]

(as \( \frac{dS}{dY} = s \)), where \( S \) is the total savings, \( Y \) is the GNP, \( A_2 \) is a constant term and \( E' \) is the additive error term. The data for \( S \) and \( Y \) are compiled from (UN, 1987) over the period 1960–1985 and the regression analysis gives the best fit for model (2) as

\[
S = -19.8 + 0.211Y \quad (R^2 = 99.4\%)
\]

The NDP at current prices are compiled from (IMF, 1987) and are converted at 1980 prices by using deflators. To calculate NDP for constant labour, the private consumption expenditure (PCE), compiled from (UN, 1987) over the years and converted at 1980 prices by using deflators, is used as the share going for labour. The difference in PCE, over the base year 1965, is then subtracted from NDP for each year, to arrive at NDP at constant labour. The autoregression of NDP at constant labour lagged by one year, gives the best fit for model (1) as

\[
Y_{t+1} = -7.8 + 1.03Y_t \quad (R^2 = 95.0\%)
\]

giving the value for \( 1 + qs \) of 1.03 which, after putting \( s = 0.211 \), gives an estimate for \( q \) of 0.142. This estimated value of \( q \) lies within its range (i.e. 0.10 to 0.175) (Harberger, 1972; Reserve Bank of India, 1987).
Marginal productivity of labour ($m$)

Many agroforestry systems being labour intensive, can help in mitigating unemployment and underemployment by employing surplus labour, without much loss of productivity elsewhere in the economy (Sharma, 1988b). The economic wage rate ($EWR$) approximated from marginal productivity of capital ($m$) needs to reflect this aspect of agroforestry systems and so should be estimated on the basis of the productivity and time criterion of unemployment. According to the productivity criterion, unemployment and underemployment exist when the withdrawal of a worker from a sector does not affect the total production. The surplus labour theory is based on this criterion. The time criterion, however, regards a worker unemployed or underemployed if he/she is gainfully employed for a number of days (or hours) less than some specified days (or hours) in a reference period (the period under consideration; a week in case of unemployment estimates for India) defined as full employment. For estimating $m$, figures for main workers (workers who remain in employment for more than half the reference period), marginal workers (workers who get employment for half or less than half the reference period) and non-workers (workers who do not get employment during the reference period) are compiled from Economic Table Series-I (Government of India, 1987). The total number of persons available for work from marginal workers and non-workers comes out to be 15.227% of total rural population of Orissa, while that for main workers is 33.10%. The figures on status of employment in rural areas are taken from the survey published by NSSO (1981). The average number of days of unemployment in the reference week for marginal workers and non-workers (termed as subsidiary workers hereafter) works out to be 3.20 and that of main workers as 0.1246, giving the following proportion of labour:

$$\frac{\text{subsidiary labour days}}{\text{main labour days}} = \frac{(\% \text{ of subsidiary workers} \times 3.20)}{(\% \text{ of main workers} \times 0.1246)} = \frac{15.227 \times 3.20}{33.10 \times 0.1246} = 11.82$$

Also from NSSO (1981), an average main worker worked for 6.73 labour days, while an average subsidiary worker worked for only 1.944 labour days during the reference period. So the marginal productivity of an average main worker for one day would be $(6.726/7.0)W = 0.96W$ and that for an average subsidiary worker would be $(1.944/7.0)W = 0.278W$, where $W$ is the agricultural wage rate. The marginal product of labour foregone by society will then be:

$$m = \frac{(1.00 \times 0.96W + 11.82 \times 0.278W)}{12.82} = 0.33W$$

Inter-temporal consumption or savings impact weight ($v$)

An expression for $v$, also known as social value of unit reinvestment, is given
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(Dasgupta et al., 1972; Hanson, 1986; Irwin, 1978; Little and Mirrlees, 1974)
as:

$$v = \begin{cases} 
\frac{(1-s)q}{(r_s-sq)} & \text{when } sq < r_s \\
\frac{(1-s)q}{(r_s-sq)} \cdot \left[1 - \left(\frac{1+sq}{1+r_s}\right)^T\right] & \text{otherwise}
\end{cases}$$

where $T+1$ is the time required by the suboptimal economy to reach an optimal path. As in this case study $r_s < sq$, the latter case is applicable. The value of $T+1$ is taken as 50 years (Lal, 1980). Putting the estimated values for parameters $q$, $s$ and $r_s$ in expression (3) the value of $v$ comes out as 6.77, which implies that saving is preferable, a characteristic of a developing economy.

**Intra-temporal consumption weights ($d_i$)**

The consumption weights ($d_i$) for the society and main workers are estimated from the expression

$$d_i = \left(\frac{C_i}{C_{pl}}\right)^{e_u}$$

applicable to marginal increase in consumption; those for subsidiary workers are estimated from the expression

$$d_i = \frac{(C_{i2})^{1+e_u} - (C_{i1})^{1+e_u}}{(1+e_u)(C_{pl})^{e_u}(C_{i2} - C_{i1})}$$

applicable to non-marginal increases in consumption. The increase in consumption of subsidiary workers, i.e. from $C_{i1}$ to $C_{i2}$, due to agroforestry is significant (i.e. non-marginal) as they are below or at poverty level of consumption so the latter expression is used for estimation of weights for the subsidiary workers. Using the estimates for poverty line in rural Orissa as given by Panda (1987) and the estimates for consumption levels of different groups as published by NSSO (1968) and updating them using the whole scale price index for agricultural labourers, the consumption weights for the society, the main workers and subsidiary workers are estimated as 1.005, 0.573 and 2.204, respectively.

**Combined distributional impact weights**

For estimation of the socio-economic costs and benefits, the inter-temporal and intra-temporal consumption weights as estimated in the two previous sections need to be integrated. On applying the combined distributional impact weights to cost and benefit streams accruing from agroforestry to various groups would then give the estimates of socio-economic costs and benefits. However these combined weights would depend in the type of investments for agroforestry. Although the major source of investment in agroforestry is
from the Forest Department, some investment is also made from the Rural Development Department. So the following two main cases are identified:

Case 1. The agroforestry may be funded by the Forest Department. This implies that, had the agroforestry not been implemented, the funds would have been invested elsewhere in the economy, yielding returns. The combined distributional impact weight for the society’s consumption losses would be $6.77 \times 1.005$ and that for the consumption gains of main workers and subsidiary workers as $1 \times 0.573$ and $1 \times 2.204$, respectively (as savings impact weight $v$ is unity).

Case 2. If the agroforestry draws investment funds by reducing consumption expenditures, the savings impact weight will be unity. This would be the case for that part of investment funds for agroforestry which are allocated by the Rural Development Department, by diverting consumption-oriented funds mainly under the ‘Food for Work’ programme. So the combined distributional impact weights for the society’s consumption losses would be $1 \times 1.005$ and those for the consumption gains of main workers and subsidiary workers would be $1 \times 0.573$ and $1 \times 2.204$, respectively.

The socio-economic cost and investment funds in case 2 are thus significantly less than in case 1 and hence the socio-economic profitability of agroforestry would be significantly higher in case 2. The following socio-economic analysis is limited to the more general case 1 only.

Distribution of workers

For every labour day generated in agroforestry $1/(1 + 11.82) = 0.078$ labour days will be drawn from main workers and the rest $11.82/(1 + 11.82) = 0.92$ labour days from subsidiary workers (see section on ‘Marginal productivity of labour’). Based on these estimates and total labour requirements for each operation in agroforestry compiled from OFD (1987), the total labour required is classified in two categories, i.e. main and subsidiary worker’s share.

Socio-economic costs

There are two components of the socio-economic costs to the society. The first is the societal consumption loss experienced as a result of the economic costs of agroforestry. The second is an additional socio-economic cost resulting from the consumption loss to which the economy is committed. This latter loss results from the increased consumption by workers, because their marginal productivity is less than the market wage rate. However, raising the consumption levels of the workers is a desirable effect and is an objective of agroforestry. Therefore, the socio-economic benefits to the main and subsid-
 VIRIARY WORKERS, ACCRUING FROM THE INCREASED CONSUMPTION LEVELS ARE SUBTRACTED FROM THE TOTAL SOCIO-ECONOMIC COSTS, TO ARRIVE AT THE NET SOCIO-ECONOMIC COSTS TO SOCIETY.

**Socio-economic benefits**

The socio-economic benefits will again depend on how the income or produce from agroforestry is shared between the people and the Forest Department. Their entire produce from agroforestry may be distributed among the associated rural households under the supervision of a Village Forest Committee for the consumption – a management model being followed in Orissa. As there are no savings and hence no investments to the economy through the Forest Department, in this case the value of \( v \) will be unity. However if a portion of produce is shared by the Forest Department as revenue, then the value of \( v \) will be 6.77 for the revenue and unity for the portion appropriated by the people. Also the produce may be distributed to any of the three categories of people, i.e. the society in general, main workers or subsidiary workers. However, as agroforestry is being implemented mainly for the poor, it is plausible to assume that produce will go mainly to subsidiary workers and so the combined distributional impact weight to be applied to the benefit stream is \( 1 \times 2.204 \).

**TABLE 2**

Results of the socio-economic analysis for agroforestry on site qualities (SQ) I, II and III (using social discount rate 2.05%)

<table>
<thead>
<tr>
<th>Tree rotation (years)</th>
<th>PNW (in Rsw)</th>
<th>LEV (in Rsw)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SQ I</td>
<td>SQ II</td>
</tr>
<tr>
<td>5</td>
<td>53111</td>
<td>-34242</td>
</tr>
<tr>
<td>6</td>
<td>71176</td>
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<td>18574</td>
</tr>
<tr>
<td>18</td>
<td>-</td>
<td>19479</td>
</tr>
</tbody>
</table>

Note: underlined numbers are the values of PNW and LEV in SQ I and II corresponding to the socio-economic optimum rotation of Eucalyptus hybrid.
RESULTS AND DISCUSSION

The computer program was suitably modified to compute the socio-economic analysis for a range of tree rotations in agroforestry for each of the three site qualities. The results of this analysis for various rotations are presented in Table 2 (figures in Rupees worth, Rsw). The socio-economic PNW and LEV are very high in SQ I and SQ II. As the socio-economic costs in case 1 are comparatively high, the socio-economic benefits should be correspondingly large enough to give positive values for the socio-economic PNW and LEV. Since the discounted socio-economic costs outweigh the discounted socio-economic benefits in SQ III, negative values for socio-economic PNW and LEV are obtained (Table 2). However, if investments are made from the Rural Development Department by diverting consumption-oriented funds (case 2), the socio-economic costs would be far less in comparison to case 1, giving positive values for PNW and LEV.

Based on the PNW criterion the socio-economic optimum rotations of *Eucalyptus* hybrid are 17 and 18 years in SQ I and II, respectively, and decrease to 8 and 17 years based on LEV.

CONCLUSIONS

Agroforestry systems need to be evaluated within the framework of their stated objectives, because the social objectives are as equally important as the economic objectives. This means that a full socio-economic analysis should be carried out when analysing such programmes rather than simple financial profitability analysis. To avoid subjectivity almost all the parameters for the socio-economic analysis have been estimated objectively. The net socio-economic benefits from agroforestry are larger than the net financial benefits mainly because of internalization of the socio-economic externalities into the analysis. The socio-economic optimal rotation is longer than the financial optimum rotation, because of the use of the social discount rate in the analysis. This means that the socio-economic analysis not only avoids adopting exploitative types of management options, but also takes into account the sustainability of agroforestry systems. In SQ III, where agroforestry is not socio-economically viable (case 1), investments should be made by diverting consumption-oriented funds under rural development programmes such as ‘Food for Work’.

ACKNOWLEDGEMENTS

Thanks are due to Dr. W.E.S. Mutch, Dr. J.F. Blyth, Prof. P.G. Jarvis and two anonymous referees for their constructive comments and suggestions for improvements on an earlier draft of this paper. However remaining blemishes are ours.
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