WESTERN GHATS

FORESTRY AND ENVIRONMENT PROJECT

KARNATAKA

INDIA

DRAFT

PROJECT PROPOSAL DOCUMENT

July 1990

Part II : ANNEXES

CONTENTS

ANNEX I. **ENVIRONMENT**

Contents

1 ENVIRONMENTAL IMPACT ASSESSMENT

The principal environmental impacts associated with the forests of the Western Ghats are on climate, global warming, soil erosion, water resources, and floods. A qualitative assessment of these impacts is given below.

1.1 Climate

Forests have an impact on microclimate and, if of sufficiently large size, on meso and global climate also.

Microscale. To anyone walking into a forest on a sunny day the microclimate differences are obvious; they are also easily measurable and the processes responsible are relatively well understood.

Qualitative impact assessment with respect to the project:

The impact is of only local significance; shade effects may be important for man and animals; the impact may have ecological importance for sustainability of flora and fauna. **Low priority for research. Positive benefit.**

Mesoscale. When forests are of a sufficient scale, probably of the order of 10 km linear dimension or greater (The exact scale is controversial, see Calder, 1985, 1987 and Morton, 1984, 1985) the enhanced evaporation from forest as compared with other vegetation types may cause a significant cooling and humidification of the atmosphere over similar distance scales (10 - 100 km) in the direction of the atmospheric movement.

Order of magnitude calculations using a simple "box" model suggest that the presence of a forest of 100km dimension may, in post monsoon periods, reduce the mean temperature of the planetary boundary layer downwind of the forest by about a degree and reduce atmospheric humidity deficits by about 15%. This would indicate that crop evaporation rates downwind of the forest could be reduced by as much as 7%. A similar increase in the duration of the post monsoon growing season (7%) might be expected to result. This model would predict that the effects would be roughly proportional to the extent of the forest, eg. a forest of 200 km dimension would be expected to reduce evaporation rates by 14%.

The effect of forests on mesoscale climate cannot be readily measured by conventional comparative experimental methods. For example, although the effects of forests on water resources can readily be demonstrated by measurements on runoff from say one square kilometre catchments much larger areas would be required for the effects on mesoscale climate to be measurable. The percentage effects of forests on water resources within a catchment are independent of the size of the catchment; the percentage effects on mesosclimate are cumulative with respect to the area under forestry. At present the only feasible method

for demonstrating the effects on mesoscale climate is through modelling studies; the accuracy of the predictions will therefore be dependent both on the realism of the model and the accuracy of the input data which will define the surface fluxes from the different land uses.

The cooling and humidification of the atmosphere may also have a secondary impact on the rainfall generation process. Meher-Homji (1980) has shown that within the state of Karnataka, over the last hundred years, there has been a small change in the annual total rainfall and there is some evidence for a decrease in the number of raindays. Meher-Homji attributed these decreases to the effects of the deforestation that had taken place over the period. A causal relationship between deforestation and rainfall generation was not established and this remains an area of much controversy and an area where research is urgently required.

Qualitative impact assessment with respect to the project:

The geographic scale and the magnitude of the impact is uncertain but could be of great significance to agricultural production in adjacent areas if, through reduced atmospheric demand growing seasons are increased or if, through a more even distribution of rainfall, soil moisture stress during the growing period is reduced.

However, net climatic benefits can only be claimed for forests on catchments where the runoff is not being utilised susequently for irrigation. Where the runoff from a catchment is being utilised essentially the same amount of water will be returned to the atmosphere either directly if the forest is present or, if the forest is not present, indirectly from the irrigation scheme which benefits from the increased flows into the reservoir. The net effect on climate is likely to be similar in both situations although the most marked effect on climate is likely to be adjacent to the areas where the increased evaporation takes place.

Although the impact cannot be adequately quantified at present it is possible that the economic benefits associated with increased crop production will partially offset the negative benefit on water resources which are associated with the presence of forests. **High priority for research. Positive environmental benefit.**

Global scale.

The direct impact of forests on global climate can only be studied through simulations performed with global circulation models (GCMs). Clearly any such effects will have a global importance.

Qualitative impact assessment with respect to the project:

Hydrological research studies carried out within the project area would be able to parameterise the surface fluxes of sensible and

latent heat from a wide range of tropical forest types. This information would be of great value, as a "spinoff", for the calibration of GCMs. **High priority for research on evaporation studies related to forest type. Positive environmental benefit.**

1.2 Global warming

It is generally agreed that the present trend towards increased carbon dioxide concentrations will lead to global warming. The impact of global warming is likely to be socially and economically disastrous in some regions but beneficial in others. There is no consensus as to whether, overall, the impacts on mankind of the warming will be beneficial or harmful.

Trees absorb carbon dioxide from the atmosphere as they grow and release it as they or their products decay or are burnt. Indigenous, climax forest is therefore, over seasonal periods, neutral with respect to being a source or sink of carbon dioxide. (An exception will occur in those situations where decay takes place in anaerobic conditions, in for example swamps, where the carbon content of the soil may continually accumulate as peat.)

When previously non forested areas are afforested there will be a "lock up" of carbon in the biomass as the forest grows. Order of magnitude calculations indicate that if a mean annual increment for the forest biomass of 5.0 m^3 ha^{-1} is assumed, together with a figure of 225 kg m^{-3} for the carbon content of the timber, the total carbon fixed over a period of 20 years will be 22,500 kg ha^{-1} (equivalent to the fixing of 82,500 kg ha^{-1} of CO_2). These figures may be representative of the moist deciduous forests of the Western Ghats and would indicate, after 20 years, a mature standing biomass of 100 m^3 ha^{-1} which agrees with the figure given in the "red book".

Qualitative impact assessment with respect to the project:

In Zone I of the project area there will not therefore be any net effect on atmospheric carbon dioxide concentrations other than that arising from the additional "lock up" of carbon in the biomass of stands as they are allowed to reach natural maturity. Afforestation of previously non forested in the other Zones will also "lock up" carbon as the biomass develops towards the mature form. One approach to estimating the economic benefits of this "lock up" is that adopted by Swedforest (********,1990). They related the value of carbon fixing to the magnitude of the proposed Swedish tax on combusting fossil fuels. On this basis the value of fixing 1 kg of carbon dioxide would be 2.5 English pence (0.7, Rupees). Following this argument, the value to the world over a period of twenty years of afforesting 1 ha would be £2000 (50,000 Rupees). The value per annum (for the first 20 years) would be £100 (2,500 Rupees) per hectare afforested.

The value of the forest for carbon fixing would cease when the forest had reached maturity, when rates of carbon fixing are balanced by decomposition rates. Additional benefits would accrue

(in Zones other than Zone 1) if a) the forest products were "locked up" in a form which was not oxidised over long time period or b) the wood was used as a substitute for fossil fuels. It can be argued that both scenarios will result in a net reduction in the emissions of carbon dioxide to the atmosphere.

Low priority for research. Positive reduction in carbon dioxide concentration.

1.3 Erosion

Erosion, whether on forest or non forest land is more related to the implementation of bad management practises rather than the presence or absence of the forest itself. Studies carried out at Ooty, Tamil Nadu (an area on the edge of the Western Ghats) have established that erosion from permanent pasture is no more than that from the natural forest (C.S. & W.C.R. & T.I., 1987). The studies also showed that slopes of 16 to 33% can be cultivated with minimum soil erosion after bench terraces have been constructed; slopes greater than 33% require permanent cover of forest or grassland to prevent erosion.

Erosion has hydrological consequences in terms of a) ultimately reducing infiltration rates when the soil cover has been lost and b) through siltation which reduces the water holding capacity of reservoirs.

Erosion also has a consequence in terms of reducing the agricultural or forestry productivity of the land and thereby reducing land values.

In some countries erosion and sediment transport can be considered to be a positive benefit to the recipient of the sediment. Within the project area there is little data available on the magnitude and economic significance of this effect but it is assumed to be small in relation to the other disbenefits of erosion.

The present exploitation of forested catchments in the Western Ghats for agriculture and grazing undoubtedly overall leads to greater erosion as a result of poor attention being paid to soil conservation measures. Published figures for erosion rates for catchments in the Western Ghats tend to be very site specific and range from those established on the Glenmorgan catchments at Ooty which are essentially zero for both the forested and grassland catchments, to the figures quoted by James et al. (1987) for catchments on the western slopes of the Western Ghats, which indicate erosion rates six times higher from "exploited" catchments as compared with those under indigenous forest, to the figure quoted for the sediment transport in the Godavari (an exploited ctchment) at Polavaram (Rao 1979) of 192 $m^3\ km^{-1}\ a^{-1}$.

Costs for dredging and transportation of silt from reservoirs in Karnataka were estimated by Mr H. Handumantharaya, Executive Engineer, Command Area Development Authority, Shimoga, as 50 -

100 Rupees per cubic metre. The costs to the reservoir authorities of "exploiting" forested catchments in the Western Ghats might therefore range from 0 to 96 or at the higher dredging rate, 0 to 192 Rupees ha^{-1} a^{-1}. For "exploited" areas which are converted to forest as part of the project activities, and assuming that ideal soil conservation measures are employed, the above figures would represent a postive economic benefit.

Qualitative impact assessment with respect to the project:

Adoption of good soil conservation measures in Zones III, IV and V will reduce soil erosion. **High priority for research and monitoring within the project to improve soil conservation operations used in the project. Positive environmental benefit.**

1.4 Water resources

For the reasons that afforestation will have a positive benefit on climate: increased evaporation, there will be a negative benefit in terms of water yield from forested as opposed to non forested catchments. This negative benefit, of course, only comes into effect if the water resource is actually being utilised, whether for supply, irrigation or hydropower purposes.

The results in terms of total water yield from catchment experiments have been reviewed by Hewlett and Hibbert (1967) and Bosch and Hewlett (1982). From an analysis of results from 94 catchments worldwide Bosch and Hewlett concluded that:

a) pine and eucalypt types cause an average change of 40 mm a^{-1} in water yield per 10% change in cover,

b) deciduous hardwood cause an average change of 25 mm a^{-1}.

Making use of the analysis from 55 of the catchments reviewed by Bosch and Hewlett (1982) and from a further 10 catchments in the Southern Piedmont, USA, Trimble et al. (1983) showed that the annual reduction in streamflow (expressed in millimetres depth over the catchment), L could be fitted to the percentage change of forest cover, F, via the constrained regression relationship:

$$L = 3.39F \qquad (1)$$

where:

L = annual loss in yield (mm)
F = fractional forest coverage (%, dimensionless)

The fit gave an r^2 of 0.5 and the standard error of the estimate was 89 mm.

The Trimble method provides one "broad brush" estimate of the effects of afforestation although of course local site factors will introduce considerable variation on the global relationship.

Another approach is to make the not unreasonable assumption that, in wet regions, the increased evaporation from forests is largely the result of interception (Calder, 1990). James et al. (1989) have reported that for unexploited forested catchments in the Western Ghats in Kerala where the annual rainfall is 4500 mm the interception loss is about 10% . Calder et al. (1986) found that for lowland rainforest in Java where the annual rainfall is 2500 mm the interception loss was 21%. For a non-rainforest situation, where the number of raindays per year are less we would expect the interception ratio also to be less, say 16%.

Assuming an exponential relationship between annual interception loss I_a (mm) and annual rainfall P_a (mm) of the same form that has been used to describe daily interception loss (Calder 1990) annual interception loss can be expressed as:

$$I_a = A(1 - e^{(-BPa)}) \qquad (2)$$

The parameter values:

$$A = 462$$

$$B = -0.0008132$$

give a good fit to the observed data points.

Equation 2. can be recast with the incorporation of a term f, to take into account the percentage canopy cover (for an evergreen rainforest the f value may approach 100%; for plantation forestry with a mix of ages and roads running through the forest a typical value for f may be about 66%):

$$L = 4.62f(1 - e^{(-0.0008132Pa)}) \qquad (3)$$

For an annual rainfall of 1650 mm and f = 100%, this equation gives an annual interception loss equal to the Trimble estimate for the reduction in annual yield. For annual rainfall below this figure, the Trimble relationship would predict greater losses; for annual rainfall greater than this the Trimble method would predict less. It is encouraging that both methods give broadly similar estimates.

The value of 1 cubic metre of water for irrigation purposes has been estimated by Mr H. Handumantharaya as 0.50 Rupees.
Using the Trimble equation the loss in value of the water resulting from afforesting 1 square kilometre of previously totally non-forested land would therefore be 169,500 Rupees per annum.

The value of water for hydropower (hydel) is directly proportional to the potential energy difference (or pressure head) exploited by the scheme. Over an altitudinal difference of 300 metres the value of 1 cubic metre of water would be approximately equivalent (at 0.50 Rupees per cubic metre) to that for irrigation. For some schemes, where the water is used both

for irrigation and hydropower generation, the value of the water is the sum of that for both components.

Traditionally catchments used for water supply purposes have been designated as protected to maintain the biological purity of the water and thus reduce or obviate water treatment. In many countries the protected status limits the land use and forestry has been recognised as a suitable treatment.

Water quality is not at present a major issue within the project area. Current rates of application of fertilizers and pesticides are not causing major quality problems nor is "acid rain" a problem at present. However, the situation may change within the next ten years.

Qualitative impact assessment with respect to the project:

Within the project area in Zones II, III, IV, and V increased forestry will reduce water yields. **High priority for research. Negative benefit in terms of water quantity. Possible positive benefit in terms of quality.**

1.5 Floods

Soil conservation measures which improve infiltration in degraded lands will tend to reduce surface runoff and reduce flood generation.

Qualitative impact assessment with respect to the project:

Improved soil conservation measures imposed in zones 4 and 5 of the project area will have a mitigating effect on flood generation. **Low priority for research. Positive benefit.**

2. PROPOSALS FOR RESEARCH AND MONITORING AND ENVIRONMENTAL IMPACT STUDIES.

The proposals for research and monitoring and environmental impact studies are presented as five subproposals. Subproposal 2.1 can "stand alone" but all the other subpropoals cannot; they would require information from 2.1 as a prerequisit. Similarly 2.5 would require data from 2.4 and cannot "stand alone".

2.1 Research and environmental impact study to investigate the relationship between the hydrology and the different forest types within the Western Ghats with particular reference to:

a) the water use and the energy balance and
b) sustainability and regeneration.

An understanding of the water use and energy balance of the different indigenous forest types of the Western Ghats is central to both studies on the effects of the forest on the environment and to studies on the sustainability and regeneration of the forests.

This study would be a prerequisite for all of the other environmental research and impact studies.

Studies would be required at a minimum of four sites representative of the dry deciduous, moist deciduous/ semi evergreen, evergreen and shola/grassy blank zones.

These studies would be directed to establishing:

a) the water balance of the different forest types which will be calculated in terms of annual estimates of transpiration and interception;

b) energy balance as it relates to the partioning of incoming solar radiation into latent heat and sensible heat components and

c) providing estimates of the photosynthetic uptake rates from index species in the different forest types;

d) providing basic information on the meteorological and hydrological regimes operating in the different forest types and in particular providing parameterisations of the surface fluxes for use in climate model studies.

It is expected that large variations will be found in both the water and energy balance between forest types: the water use of the evergreen forest may well exceed that of the dry deciduous by 100%.

The proposed methodology would include:

Meteorological measurements: Automatic weather stations mounted on towers above the forest, manual, ground level meteorological stations;

Physiological measurements: Diffusion porometry, gas analysers to measure photosynthetic rates, pressure bombs to measure leaf water potential;

Direct measurements of transpiration rates: deuterium tracing, heat pulse measurements;

Interception measurements: plastic-sheet net-rainfall gauges, disdrometers to measure the influence of drop size on the interception process;

Soil moisture measurements: neutron probe, gypsum blocks, tensiometers.

PROJECT FRAMEWORK

PROJECT TITLE: Hydrological impact of the different forest types of the Western Ghats.

PERIOD OF ODA FUNDING: March 1991 - March 1996.

DESCRIPTION: To assess the relationship between the forest and the hydrology.

DATE PF PREPARED: June 1990

PROJECT STRUCTURE	INDICATORS OF ACHIEVEMENTS AND VALUE	HOW INDICATORS CAN BE QUANTIFIED OR ASSESSED	ASSUMPTIONS, RISKS AND CONDITIONS
WIDER (i.e. SECTOR AND NATIONAL) OBJECTIVES			
To provide information on the environmental impact of different tropical forest types. To provide information for the improved management of the forest on a sustainable basis with particular reference to the shola and evergreen forests.	Availability of data as basis for project management. Dissemination of results in national and international conferences and journals.	Use of results in resolving land-use conflicts. Quality and acceptability of papers and presentations.	Adequate logistic support provided by the local collaborative organisations.
IMMEDIATE OBJECTIVES			
Provision of a system for the collection of data and the development and calibration of models relating to the energy balance and water use for the major forest types: shola, evergreen, moist and dry deciduous.	Installation of instruments at four main sites. Regular maintenance of instruments. Regular data collection. Timely processing and analysis of data.	Number of sites instrumented. % of sites operative. % data retrieved. Number of months backlog. Acceptance of results in refereed publications.	Site managers and local staff are recruited. Vehicles to be supplied for the project are adequately maintained and reserved for project use. Maintenance of instruments can be carried out by local agents. Agreements are made either for the importation of equipment duty free or for the payment of duty by KFD.

PROJECT STRUCTURE	INDICATORS OF ACHIEVEMENTS AND VALUE	HOW INDICATORS CAN BE QUANTIFIED OR ASSESSED	ASSUMPTIONS, RISKS AND CONDITIONS
INPUTS			
1. Staff salaries.	Staff on project	No. of staff.	Staff input provided
2. Consultancy costs.	Missions,	No. of missions.	Staff input provided
3. Infrastructure at experimental sites.	Sites operational	No. of sites op.	
4. Vehicles.		No available.	
5. Specialist instrumentation.	Instuments operating	% operating	Customs duty paid
6. Specialist training.	Courses completed	No. completed	
OUTPUTS			
Data on water use and the energy balance of the major forest types.	Results made available for planning decisions to be made: a) within the project b) nationally c) internationally.	Production of periodic reports reports to G.O.I. and O.D.A. Dissemenation of information at National and International conferences and publications in scientific journal and through local media.	
Data on the sensitivity of the forest types, in terms of sustainability and regeneration to hydrological factors			
Local staff trained in environmental environmental impact studies and forest hydrology.		Number of staff trained and applying their training in post.	

2.2 Environmental impact study to investigate climate modification by tropical forest in the Western Ghats

It is a commonly held view that the removal, or plantation, of forest changes the climate. On a local scale there are unquestionably changes in the micro-climate associated with afforestation. On the global scale GCM experiments show that changing the vegetation of a continent can cause changes in the global circulation. Evidence for the effects of meso-scale (1 to 100 km) changes are difficult to find. It is on this scale, however, that deforestation, and reafforestation, are taking place. It is possible that feedbacks between changes in forest cover, evaporation and atmospheric humidity have important consequences for the acceleration of desertification and for the re-establishment of forest on degraded lands.

In Southern India the forest cover has decreased significantly in the last century. This decrease has been accompanied by a small decrease in rainfall and in the number of rain days. However a causal link has not been established.

The establishment of a forest will change the surface fluxes. Measurements by the Institute of Hydrology in Karnataka have shown that in the post-monsoon period the bare soil evaporation is essentially zero, while the forest evaporation can be 3 to 4 mm per day. Simple one dimensional models show that such a change can have a very significant effect on the temperature and humidity within the Planetary Boundary Layer (the lowest one to three kilometres of the atmosphere). Such changes will reduce the evaporative demand on the forest and increase the likelihood of convective rainfall. With simple one dimensional models it is difficult to estimate the size of the forest at which these effects become significant or the likely effects on precipitation. However, very crude calculations using a one dimensional 'box' model indicate that an area of at least 10 km across is required for a measurable effect to occur within Planetary Boundary Layer.

Proposed experiment

It is proposed to investigate the effects of the forests in the Western Ghats on the temperature, humidity and turbulent structure of the Planetary Boundary Layer (PBL) and the formation of convective rainfall. To approach this problem experimentally would require measurements to be made over large experimental areas (greater than 10 X 10 km) which have forest and non forest treatments. Even if this were logistically possible present experimental techniques would be insufficient to distinguish the small differences in temperature and humidity anticipated from the effects introduced by the steep topography. The only possible approach at present is through the use of a three dimensional, meso-scale, numerical model.

The modelling approach would involve:

a) the adaption of a current three dimensional mesoscale

climate model to take into account the actual surface topography of the Western Ghats in Karnataka;

b) the incorporation of surface flux parameterisations appropriate to forest for the existing forest areas of the Ghats (the present scenario);

c) verifying the present scenario model by collecting temperature and humidity data though the PBL using radiosonde ascents.

d) investigating the effects of different model scenarios with greater or lesser forest coverage.

Suitable parameterisations of the surface fluxes either already exist or would be obtained from the hydrology research studies proposed within this project for the different forest types. These proposed hydrology studies will also be able to provide estimates of soil moisture and surface meteorology as inputs to define the lower boundary condition of the model.

A suitable meso-scale model would be of the type used by the British Meteorological Office (MO) for detailed forecasting. This would require a number of small modifications for use in the study: a modification of the surface parameterisation and a change in the horizontal and vertical grid lengths. The suitable model 'box' would be 400 km by 400 km with a depth of 15 km and a horizontal grid length of 4 km. Data on the topography, land use and radiosonde soundings to initialise the model will be required. The model would be run for approximately 24 hours. For the existing land use the model would be validated against frequent, 2 hourly, radiosonde soundings through the study days and also with surface flux measurements. Following the validation on existing land use, surface parameterisations relating to forest areas of various sizes and arrangements would be introduced. Model runs should be made at two critical periods of the year: 1. post monsoon (December/January), when the contrast between surface fluxes from forest and agriculture are greatest. and 2. pre-monsoon (May/June), when the formation of pre-monsoon showers is probably very sensitive to surface inputs.

(N.B. Within the phase 2 project proposal for the fast growing trees project in Karnataka a case is made for similar studies to investigate the impact on climate of large plantation forestry in the dry zone. These studies would be complementary to the objectives of the Western Ghats studies.)

2.3 **Research and monitoring programme to investigate the processes involved in infiltration and erosion beneath forest and alternative vegetation types with particular reference to:**

a) tree species selection in relation to local rainfall and slope and

b) the effectiveness of different soil conservation measures - eg. contour bunding and grass stabilisation.

The studies are envisaged to address the following areas of concern relevant to the aims of the project:

(a) infiltration and surface redistribution of water within the different forest types, with particular reference to the factors controlling these processes.

(b) measurement of the hydraulic properties of soil at sites representative of the different forest types.

(c) modelling of the soil water processes. This will allow the results of plot studies to be extrapolated to wider areas for comparison with catchment scale studies and will also enable "what if" predictions to be made of the effects of changing management practices related both to silviculture and to soil and water conservation.

(d) Monitoring of project activities with respect to soil and water conservation.

Methodology:

The project would make use of the data collected within the "water use and energy balance" programme but would also require the instrumentation of additional sites to monitor the soil and water conservation activities of the project.

2.4 Catchment flow regimes of ghats forest types.

This study would aim to quantify the flow regimes (floods, low flows, annual total), on a catchment scale, from the major forest types of the Western ghats, with particular reference to the effects on flow regime of degradation of the forests and the effects on flow regime as areas of the forest are "restored" as part of the projects activities.

It is proposed that five catchments, of approximately 5 km^2 scale, would be instrumented within the evergreen, moist deciduous, and dry deciduous forest types. Within the evergreen forest, catchments would be selected on areas of undisturbed, degraded and "restored" forest.

The instrumentation would comprise flow measuring structures (flumes or V notch weirs, as appropriate) together with chart and electronic recording devices and raingauge networks.

2.5 Groundwater regime changes during Ghats forest restoration incorporating perennial river flow survey after dry season recession.

This study would investigate the effects of the forest, and alterations to the forest as a result of the project activities, on the groundwater regime.

It would make use of the large quantity of both historic and current data on groundwater levels within the Ghats, collected by the Department of Mines. The study would use this data for developing methods and principles for predicting changes in groundwater regime as a result of land use changes within the Ghats.

The study would make particular use of runoff data collected as part of the catchment study (Annex 1.5.).

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4. TRAINING

Environmental studies.

The proposed training component would comprise:

Course	Location	Numbers
MSc\Phd hydrology	U.K.	3
Msc\Phd environmental physics	U.K.	2
MSc\Phd plant physiology	U.K.	1
Msc\Phd meteorology	U.K.	1
Hydrology "on the job"	U.K.	7
Ecology	U.K.	4
Soil and Water conservation	Local	5
Hydrometric techniques	Local	10
Computer programming	Local	7

ANNEX II ECOLOGY

Contents

1. TERMS OF REFERENCE FOR FORTI ECOLOGICAL RESEARCH UNITS.

Research is vital for good forest management and conservation and its neglect will make the ecological problems of the Ghats insoluble. A first priority is to provide a good description of the vegetation and wildlife. Whilst the outlines are known at present the degree of knowledge is insufficient to carry out ecological management. The importance of these descriptions - which will lead to refined vegetation and wildlife maps - cannot be overemphasized. Secondly research must be carried out to enable the effects of the most serious threats to the forest to be minimized. The research will be aimed at the main immediate threats; fire, fuelwood collection, and grazing. These threats are by no means restricted to Zone I forests and be research will be carried out in other forest Zones.

Two research units are proposed. Each research unit will be made up of a number of field sections. Each section will have a leader (KFD staff member (RFO) aiming for PhD) and will be supported by expatriate consultants. The teams will have the following tasks, personnel, and research brief:

1.1 Research Division A. Vegetation and Wildlife Description

Tasks:

- survey and inventory of W. Ghats flora and fauna.
- mapping Zones I, II & III.
- long-term monitoring of permanent vegetation plots and important wildlife species.
  assessing the effects of logging using KFD records and present descriptions.

Staffing:

The unit consists of 5 field sections:

2 vegetation description and survey sections
2 wildlife survey sections
1 long-term monitoring section,

1 support section (computer operators and secretaries).

A. 1 & 2. Vegetation description and survey sections:

1 section leader (RFO aiming for PhD)

1 section co-ordinator (Sen Technician)
1 plant taxonomist* (Sen technician)
0.5 soil scientist (consultant)
2 technicians*
3 labourers
1 driver

1 section leader (Sen Technician)
1 plant taxonomist* (Sen Technician)
0.5 soil scientist (consultant)
2 technicians*
3 labourers
1 driver

A.3. Long-term forest monitoring section

1 section leader (RFO)
1 taxonomist* (Sen Technician)
2 technicians*
3 labourers
1 driver

* Herbarium staff

A. 4 & 5. Wildlife Description sections:

1 section leader, a mammalogist (RFO aiming for PhD)

1 section co-ordinator (Sen Technician)
1 ornithologist
1 invertebrate zoologist (e.g. butterflies and moths) (consultant)
1 technician
1 technician**
3 labourers
1 driver
1 (bat zoologist) (Sen Technician)
1 herpetologist (Sen Technician)
1 invertebrate zoologist (e.g.termites) (consultant)
1 technician
1 technician**
3 labourers
1 driver

A. 6. Support section

2 computer operators (RFO)

1 stenographer
2 clerical assistants

Aims for Research Division A:

To survey in detail the distribution and density of vegetation and wildlife throughout the Ghats in Karnataka.

2. To prepare detailed maps of habitat and species distribution.

To identify priority areas for conservation (Zone I), based on the following criteria:

- areas supporting communities or species of plants and animals that are endemic; limited in geographic range; rare, threatened, or vulnerable; or with specialist habitat preferences;
- areas of high environmental value, for example with forests growing on steep slopes;
- centres of maximum species diversity;
- least disturbed and least accessible areas of forest, for their pristine value;
- established permanent plots (some of which may date from the nineteenth century).

To assign conservation values to species and locations on the basis of the above criteria, in order to rank them in priority.

To identify the boundaries for the ecological management zone (Zone I), and effective buffer zones (Zones II & III), based on conservation values for species and habitats.

6. To identify priority areas for ecological restoration, such as vital corridors linking Zone I forest, or degraded areas harbouring threatened species of animal or plant, or areas of which environmental value for soil or water conservation;

To identify key species for research into plant-animal interactions (pollination, seed-dispersal, germination) that are important for forest regeneration and long-term ecological equilibria; and to identify rare or endangered species whose ecology needs investigation for the purposes of conservation management.

8. To study long-term dynamics in undisturbed forests, both for vegetation and wildlife. These are necessary to provide base-line information for forest management.

To study long-term dynamics in logged-over forests to assess the effects of different logging intensities.

Activities for Research Division A:

The vegetation and wildlife sections will coordinate their work closely. The sections will use a variety of methods appropriate to the taxa being surveyed:

1. Set up replicated and representative 50 x 50m plots, in each of the major vegetation types and their variants.

2. Provide a full description of each plot including quantification of non-tree taxa, and plot history, particularly disturbances due to logging.

   About 1000 such sample plots will be described for the Ghats as a whole, and will include grasslands and savannas as well as forested areas.

   Some 50 x 50m plots will be used for long-term monitoring studies, and may be expanded up to 50ha.

5. Transect lines will be used to census large mammals and birds.

6. Live-trapping (mark & release) techniques will be used to survey small or nocturnal vertebrates; and mist-netting for birds and bats.

   Mapping species distributions.

1.2 Research Division B. Impacts on Vegetation and Wildlife

This is an applied ecology unit, comprising 3 research teams, studying major threats and benefits to the forest and wildlife from:

- fire
- firewood collection
- grazing
- removal of minor forest product
- developments such as hydro-electric schemes and mining

1.2.1 Section B1 - B3 Vegetation Ecology

Staffing

3	section co-ordinators (plant ecologists) (RFO)
6	plant ecologists (specialising in grazing, fire and firewood collection) (Sen Technician)
3	plant taxonomists* (Sen Technician)
1	soil scientist (Consultant)
9	technicians
3	drivers
12	labourers

* Herbarium staff

Aims for vegetation ecology teams B.1. - B.3.

To study the ecological effects of fire, firewood collection and grazing on the forest plant community.

To monitor long-term changes in the forests which have occurred and are occurring in response to these disturbances.

To provide guidelines for the sustainable removal of firewood and fodder from the forest.

To provide guidelines for the protection of forests which are threatened by the disturbances.

To respond to new threats to the forest such as hydro-electric schemes, mining, and roads by assessing the potential damage and providing guidelines on how to minimise it.

To highlight particular plant species which are threatened and to provide guidelines on their conservation.

To study selected aspects of the ecology of plantation forests.

Activities for Vegetation ecology teams B.1.- B.3.

See B4 & B5 activities.

1.2.2 Sections B4 & B5 Wildlife Ecology

Staffing

2	section co-ordinators (bird and mammal ecologists) (RFO)
4	animal ecologists (specialising in 4 key species) (Sen Technician)
6	technicians
12	labourers
2	drivers

Aims:

to study the ecological effects of fire, firewood collection and grazing, in the forest, using key indicator species of mammals, birds and invertebrates.

2. to monitor long-term changes in the populations of these key species in response to various management regimes, and exclusion of the various threats.

to study herbivore ecology at the boundary between shola forest and upland grassland, to guide decisions about management of these grasslands, and their potential use for forestry.

to study the ecology of key species of mammals and birds, focusing on those which are most threatened by current forest activities. Certain species can receive immediate priority, the endemic and highly threatened lion-tailed macaque, Nilgiri langur, and giant Malabar hornbill (all of which appear to be suffering serious population declines, and all of which will not be restricted to Zone 1 areas); other priority species should be identified during the survey.

to identify 'keystone plant resources' for wildlife, i.e. that restricted set of food species that sustains animals through the lean period of each year and without which populations would crash. It is crucial to identify cases where keystone plants are also of commercial interest.

Activities:

The Vegetation and Wildlife Ecology sections will co-ordinate their work closely and it will extend through all the zones. They will be particularly concerned with understanding the impacts of fire, firewood collection and grazing on the forests and wildlife and will research the means to minimise these impacts where they seriously threaten forest production, regeneration or wildlife. Base-line ecological data will be provided for species which are sensitive to environmental change and which will act as indicators of improvement in habitat and management.

These will be key studies for understanding the long-term effects of different forest disturbances. The sections will work closely with the Vegetation and Wildlife Description sections to set up permanent plots for long-term monitoring of forest impacts, using control and exclusion plots in undisturbed, degraded, and plantation forests. The following points should be noted.

Exclusion plots to study the effects of fires will be set up, and require strict fire-break clearance and constant vigilance.

The biomass of firewood collected will be measured in a range of sites and related to its effect on forest structure and abundance of wildlife.

Exclusion plots to study the effect of grazing and trampling on plant regeneration will be made using sturdy exclosures.

Permanent plots in the forestry plantation sites will study the effects of different silvicultural management regimes on understorey regeneration.

There will be detailed study of the breeding and food requirements of key animal species, including radio-tracking the movements of wide-ranging indicator species.

6. Specific threats to these observed ecological requirements will be identified.

Seed-dispersal and seed-predation patterns by fruit-eating mammals and birds related to forest regeneration will be studied.

1.2.3 Section B.6 Human Ecology

1 leader (human ecologist and geographer) (RFO)
1 ethnographer (Sen Technician)
1 plant taxonomist* (Sen technician)
3 technicians
4 labourers
1 driver

* Herbarium staff

Aims:

to map the distribution of tribal societies.

to describe the traditional uses made of plants and animals in the forest by these societies. These include uses for construction, food, livestock grazing, and medicine.

to study the impact of these activities on the forest ecosystem and whether they are sustainable at current population densities.

4. to study contemporary changes in traditional forest use that may threaten the sustainability of the forest (e.g. the introduction of cattle, or a cash economy).

5. to investigate ways in which tribals may be allowed the continued use of Zone I, including assessment of the carrying capacity of the forest.

6. to devise methods of quantification of forest use and impact, as necessary, following the initial decriptions.

Activities:

Ecological and ethnobiological description (based initially on interviews and observations) will be a major component of this research, not only to investigate possible threats to the forest (e.g. from commercialised overuse of certain minor forest products), but positive ways in which we can learn to diversify use of the forest.

1.2.4 Section B.7 Support

This section will provide secretarial support for the B Division.

2 HERBARIUM AND INVERTEBRATE COLLECTION

2.1 Establishment of a herbarium

All vegetation description work depends on the availability of competent taxonomists who are able to identify the plant species. The present programme makes provision for the training of taxonomists and must also provide them with a plant reference collection - a herbarium. There is no comprehensive herbarium in Karnataka and there is a state need for such a facility which should be centred in Bangalore and be used as a base for the taxonomists. The herbarium collections will be built up during the project and possibly satellite herbaria, using duplicate material, will be set up at the research stations associated with the Forest Department Circles.

2.2 Establishment of an invertebrate collection

Invertebrates are an important part of the fauna of Karnataka, in terms of their great species diversity and abundance, their benefits and potential threats to the forest, and their role as indicators of habitat status and ecological change in the W. Ghats. Unlike reptiles, birds and mammals, the invertebrates are poorly described in taxonomically very complex. For this reason, and as a service for the long-term monitoring of invertebrate populations in response to different forest management regimes, a reference collection of invertebrates is necessary.

As the taxonomy of vertebrates is well understood, no collection will be made of reptiles, amphibians, birds or mammals.

The Invertebrate Collection will be housed with the Herbarium, and maintained and catalogued by the 2 invertebrate zoologists in the Wildlife Description teams: possibly a specialist in Lepidoptera (butterflies and moths) and possibly a specialist in Isoptera (termites). These two specialists will be contracted in, already trained and their precise specialisation requires further consultation with KFD and wildlife experts.

2.3 Other roles of the Herbarium and Invertebrate Collection

The facility could be expanded to house collections of harmful micro-organisms (bacteria and fungi) and arthropods (e.g. insects and mites) which were the subject of separate forest pest research not connected with the main ecological programme.

3. MANAGEMENT OF ZONE I

The primary management objectives in Zone I will require a programme of a substantial effort in forest protection, applied ecological research and active habitat manipulation in certain circumstances.

3.1 Forest Protection:

The major priority in Zone I management is protection, since the present arrangements are inadequate to meet threats from poachers and smugglers. Recommendations for the protection of Biosphere Reserves in India (Mukundan, 1987) suggest the following manpower levels for patrolling and policing conservation areas:

Zone I forests should be divided into small sections of 20-30 km^2 (about 8 sections per range of 250 km^2), depending upon the terrain, and one forester with 8 forest guards posted to each section. This represents a doubling of normal territorial manpower at the section level. Each section forester should have a small office which should function 24 hours per day, with a radio communication system. Each range should have a 4 wheel drive vehicle.

Additional duties of protection officers will include fire-prevention in sensitive areas, and the regulation of tribal access to Zone I areas, where this is permitted.

3.2 Staffing Levels:

To calculate staffing levels and costs, as rough estimate of the total area of Zone I has been made as follows:

National Parks and Wildlife Sanctuaries currently cover 6500 km^2 in Karnataka. Assuming one third of this area meets the criteria of Zone I (i.e. the core areas of Parks and Sanctuaries, excluding tourist and buffer zones, totalling 2200 km^2), and assuming an additional 3800 km^2 of new Zone I areas, the total estimate of Zone I in the State is 6000 km^2. The represents 24 ranges of 250 km^2. Staffing at the higher levels recommended produces the following requirements:

Grade	Existing	New	Total
RFO	24	0	24
Foresters (8 per range)	96	96	192
Guards (8 per section)	384	1152	1536

3.3 Applied Ecological Research:

This programme is outlined in Section 1 above.

3.4 Habitat Manipulation:

restoration of degraded vegetation at key sites, such as linking corridors, steep slopes, degraded enclaves within pristine forest. This may involve enrichment planting or other silvicultural manipulation, as necessary and in the light of particular circumstances.

maintenance of habitat disturbance in cases where plant or animal communities exist only because of such disturbances (e.g. forest openings or grasslands for herbivores; disturbed habitat that creates particular conditions for endemic or rare plants).

3.5 Training

8 plant taxonomists per year will be trained at the University of Bangalore.

A number of ecologists (20 in year 1, 5 per year in years 2 - 5) will be trained on a specially designed summer course involving the Universities of Oxford and Stirling and the Forest Research Institute of Malaysia (Kepong). The ecologists will be trained in practical skills such as plant and animal surveys, field ecology and long-term monitoring as well as receiving a background in general forest ecology.

8 section leaders (ACF, for PhD) and 10 others (RFO, for MSc) in research units A and B will be registered at British Universities and submit their project work for the Higher degree.

4. ECOLOGICAL RESEARCH COSTS

4.1 Capital costs

(A) In Sterling

Item	Unit cost (Sterling)	1	2	3	4	5
Radio tracking receivers and collars	100-1000	6,000				
Anaesthetic dart guns (2)	1,000	2,000				
Hip chains (5)	100	500				
Mist nets	20	500	100	100	100	100
Hage guages (4)	150	600				
Binoculars (13)	200	2,600				
Small mammal live traps	10-100	10,000				
Cassette recorder, microphones (5)	100	500				
Laptop computers (5)	2,000	10,000				
Surveyors tapes	25	1,250	1,000	1,000	1,000	1,000
Cameras (4)	250	1,000				
Miscellaneous	1,000	1,000	1,000	1,000	1,000	1,000
Total		36,500	2,100	2,100	2,100	2,100

(B) In Rupees

Item	Unit cost (Rupees)	1	2	3	4	5
Bird ringing materials		1,000				
Insect nets and traps		1,000				
Keys & guide books		1,500				
Animal holding cages		1,500				
Lab equipment		1,500	1,500	1,500	1,500	1,500
Permanent marking posts (and transport)		2,000	2,000	2,000	2,000	2,000
Laboratory analyses (plant and soil)		2,000	2,000	2,000	2,000	2,000
Miscellaneous		1,000	1,000	1,000	1,000	1,000
Total		11,500	6,500	6,500	6,500	6,500

4.2 Operational costs

In Rupees

Item	Unit cost (Sterling)	1	2	3	4	5
Computer consumables		10,000	1,000	1,000	1,000	1,000
Steel tapes (2m)		200	200	200	200	200
Aluminium tree tags	£10 per 1000	1,000	1,000	1,000	1,000	1,000
Aluminum nails	£ 2 per 1000	200	200	200	200	200
Plant presses	10	300	300	300	300	300
Newspapers		700	700	700	700	700
Camping equipment		2,000	2,000	2,000	2,000	2,000
Tarpaulins		2,000	2,000	2,000	2,000	2,000
Mosquito nets		1,000	1,000	1,000	1,000	1,000
Hammocks		1,500	1,500	1,500	1,500	1,500
Fencing equipment		1,500	1,500	1,500	1,500	1,500
Hand lens	20	260	60	60	60	60
Laboratory consumables		1,500	1,500	1,500	1,500	1,500
Total		22,160	12,960	12,960	12,960	12,960

Petrol etc 20,000 km per annum at Rs 1.50 per km
x 8 vehicles = Rs 240,000 per annum

Labour 10,000 mandays per annum at Rs 17.50 per day
= Rs 175,000 per annum

4.3 UK Training costs

4.3.1 Higher degrees

Item	Unit cost (Sterling)	1	2	3	4	5
Ph.D's (8)						
Fee	6,280	50,240	50,240	50,240		
Travel to the UK	750			6,000		
Subsistence in UK	544 p.m.			26,112		
Additional allowances	628			2,024		
M.Sc's (10)						
Fee	6,280		31,400		31,400	
Travel to the UK	750		3,750		3,750	
Subsistence in UK	544 p.m.		2,720		2,720	
Additional allowances	628		3,140		3,140	
Total		50,240	91,250	87,376	41,010	

4.3.2 Short courses

(Numbers of students in parenthesis)

	Unit cost (Sterling)	1 (20)	2 (5)	3 (5)	4 (5)	5 (5)
Oxford Tuition (28 days)	840	16,800	4,200	4,200	4,200	4,200
Excursions	325	6,500	1,625	1,625	1,625	1,625
Sterling Tuition (28 days)	840	16,800	4,200	4,200	4,200	4,200
Exercusions	325	6,500	1,625	1,625	1,625	1,625
Malaysia Tuition (28 days)	840	16,800	4,200	4,200	4,200	4,200
Exercusions	1,500	20,000	5,000	5,000	5,000	5,000
Allowances UK	628	12,560	3,140	3,140	3,140	3,140
Malaysia	500	10,000	2,500	2,500	2,500	2,500
Travel International	1,500	30,000	7,500	7,500	7,500	7,500
UK	60	1,200	300	300	300	300
Total		137,160	34,290	34,290	34,290	34,290

Training costs in UK:	Sterling
Higher degrees	269,876
Short courses	274,196
Total (over 5 years)	544,196

5. PRE-PROJECT ACTIVITIES

5.1 Literature Survey

It is essential to conduct a pre-project literature survey of material in all Institutions relevant to the W. Ghats.

This will involve visits to relevant institutions to identify pertinent literature. This cannot be done by correspondence or bibliographic search in Britain. A number of institutions have been covered already by JP or MH Pondicherry, Bombay Natural History Society, and Bangalore), but others are important (e.g. Dehra Dun, Coimbatore, Kerala Forest Department, Kerala Forest Research Institute, Travandrum, institutes in Goa and Maharashtra,etc.) The aim would be to produce an annotated bibliography of all existing W. Ghats research relevant to this project. The opportunity would be taken to use old forest records to re-locate old permanent plots which exist in many places in the ghats.

5.2 Recruitment

At the same time as the literature survey contacts can be made with potential personnel for the research teams, a number of whom will have to come from outside the KFD. A start should also be made on formation of the research teams.

5.3 Provisional Forest Zonation:

The forest zones will be roughly delimited using the following aids:

(a) 1:50000 maps of the areas.
(b) 1:250000 vegetation maps (from Pascal).
(c) Literature survey including making plans and notes on permanent observation plots from KFD and Debra Dun.
(d) Consultation with local foresters.
(e) Consultation with the French Institute, Pondicherry.
(f) Consultation with local wildlife experts.

These zones will be regarded as potential but will be vital to getting the survey work started and highlighting area in need of immediate attention.

5.4 Terms of reference:

Pre-project activities on Vegetation and Wildlife

To carry out a literature survey and produce an annotated bibliography of all works relevant to the ecology of Western Ghats Forest and other vegetation.

2. To visit Forestry Research Institute, Oxford for about two weeks to search their library for material.

To visit several Institutions in India: e.g. the Forest Departments of Karnataka, Kerala, Goa, and Mararashtra; Forest Research Institutes at Peechi and Coimbatore; French Institute at Pondicherry; Indian Institute of Science, Bangalore; Universities of Bangalore, Agricultural Sciences in Bangalore, of Calicut, and of Mangalore, Zoological Survey of India, Calicut; Forest Survey of India, Bangalore; Botanical Survey of India, Coimbatore; and Dehra Dun. This will be necessary to investigate the wealth of unpublished information that exists for the Ghats.

During the literature survey to collate information relating to old permanent plots established in the Ghats.

During visits to institutions during the literature survey to advertise the KFD-ODA Western Ghats project and to discuss it with potential recruits to the Ecology Research activities.

To visit Circle Headquarters and to consult with local foresters about further literature not found during previous search, and to use the collated literature and local forestry expertise to produce a provisional map of Zones I - IV to be used during the project.

Consultants: 6 man-weeks in UK
2 x 2 man-months in India
+ 2 Indian counterparts.

ANNEX III FORESTRY

Contents

1. INTRODUCTION

The forests of the Western Ghats of Karnataka State cover an area of over 20,000 km2 including a range of types from Evergreen, Semi-evergreen to Deciduous. The Evergreen Forest in particular is of great interest being the best forest of its type remaining in India.

Unfortunately only ten per cent of the forests can be classified as closed forest with a canopy of over 80 per cent complete. The rest is degraded, partly through excessive logging of species such as teak and rosewood but most serious is the lack of regeneration. Over 75 per cent of the forests have no seedling nor sapling regeneration. Without regeneration, management under the traditional variation of the Selection System is not possible, the forest will die out and be replaced by derelict scrub land.

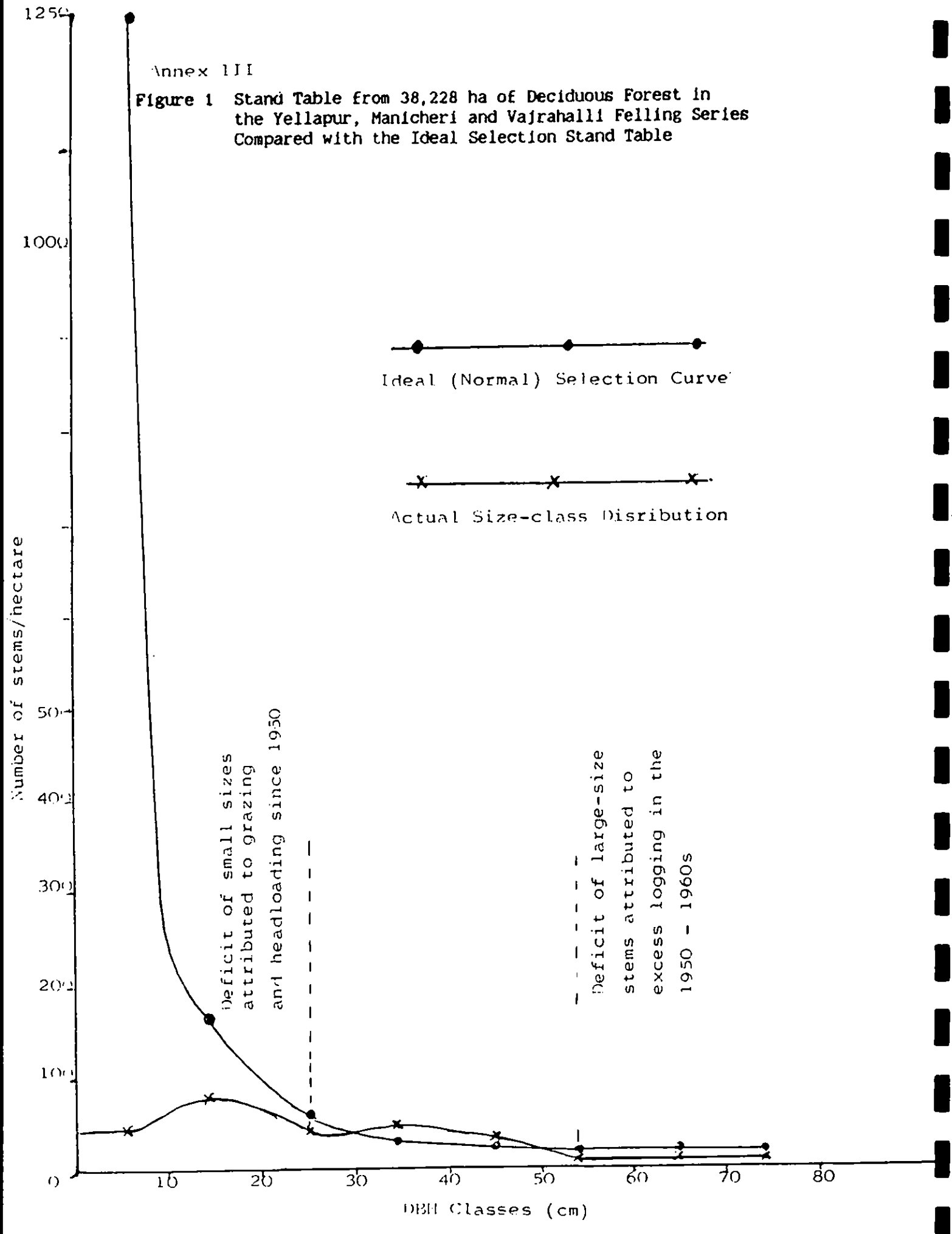
Figure 1 illustrates the situation.

The lack of regeneration is attributed to three major causes: theft for fuel and small-size building material, trampling and grazing by cattle, and fire. If this unique forest is destroyed, not only will the local population be deprived of fuel, green manure and a wide range of other forest products, but there will be no timber for furniture or construction, and the plant and animal genetic resources will be irrevocably lost to India. As much of the forest is on steeply sloping land the indirect effect of flooding and soil erosion would be detrimental far beyond the immediate boundaries of the forests.

The Forest Department of Karnataka State (KFD) wishes to halt this degradation and the proposed project is an attempt to strengthen the capabilities of the Department in its efforts.

Annex III

Figure 1 Stand Table from 38,228 ha of Deciduous Forest in the Yellapur, Manicheri and Vajrahalli Felling Series Compared with the Ideal Selection Stand Table



Annex III, Figure 1 Stand Table from 38,228 ha of Deciduous Forest in the Yellapur, Manicheri and Vajrahalli Felling Series Compared with the Ideal Selection Stand Table

2. GEOGRAPHICAL BACKGROUND

2.1 Geography

The Western Ghats are the range of high hills that run about1,600 km along the west coast of India from the river Tapti (21oN) to the southernmost point of India (about 8oN). The west slope is steep whilst that to the east is more gentle. The Ghats are very variable climatically and geologically along this length (Pascal,1982). The Karnataka Ghats fall in the central part and range in height from 700 to 1,000 m in the northern part of the State and then fluctuate in altitude southwards from the sudden elevation to 1,343 m at Kodachadri, 645 m at Agumbe to 1,892 m at Kudremukh and 1,713 m at Puchpagiri. At Karwar the Ghats reach the sea and south of this there is a flat coastal zone, South Kannada, which reaches 80 km in width, narrowing to about 30 km in the vicinity of Coorg, when it is called Malabar

2.2 Geology and Soils

The rocks of the Ghats are very old, being granites, gneisses, quartzites, and associated rocks of the Pre-Cambrian era. They form steeply dipping strata in dominant ridges that tend to run NNW - SSE.

Soils vary from alluvium on the coastal plain to the south-west; laterites and lateritic soils form a broad band running parallel to and almost reaching the coast in the north-west; in the centre and east the soils are fertile red loams, with black cotton soils in the north-east.

The lateritic soils form extensive ironstone pavements in the north-west which present difficult reforestation problems. The Department has developed a successful technique of ripping, using heavy equipment, and building up fertility using an initial crop of Acacia auriculiformis, a nitrogen-fixing species.

Soils generally have a fairly high clay content which make them relatively stable. They are not particularly prone to erosion despite monsoonal rainfall intensities but they are easily compacted by cattle trampling. The highly compacted surface makes seedling establishment difficult without soil working and it encourages surface run-off of rain water.

2.3 Climate

The climate of the Western Ghats is monsoonal: the north-east monsoon is dry whilst that from the south-west brings much rain during July to September. The rainfall varies along three gradients: south-north, east-west, and altitudinally. It reaches a mean of 7,460 mm at Agumbe. The rainfall is very variable from year from year and at Agumbe since 1946 has ranged from 4,012 to 12,918 mm. In all areas there is a marked rain shadow effect of the Ghats with annual totals usually falling to below 1,000 mm about 120 km from the coast. The length of the dry season varies from a mean of about 3 months, at high altitude in the south of

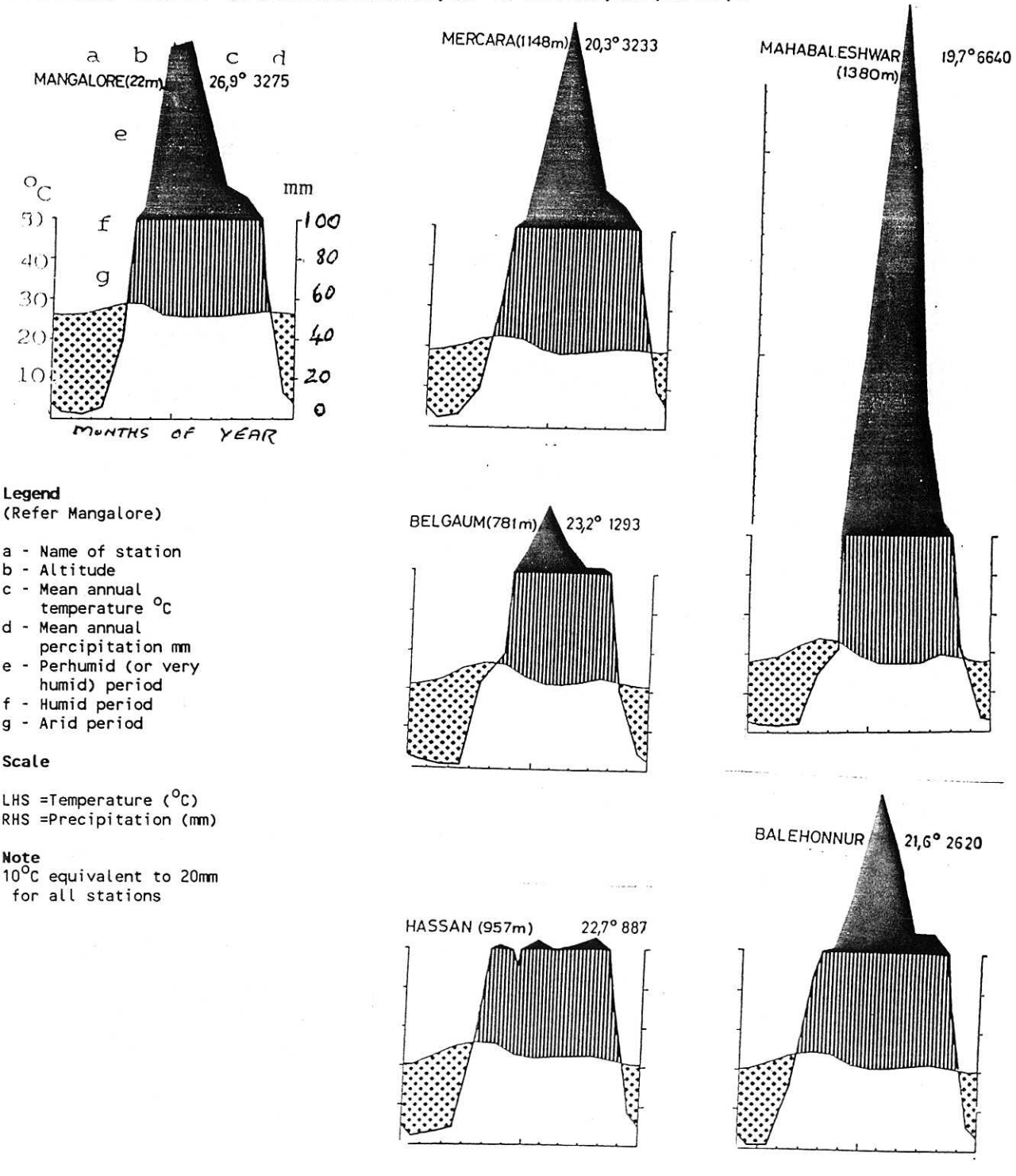
the region, to about 8 months on the eastern side of the Ghats in the north. The wetter places of the Ghats are perhaps unique in combining very high rainfall with such seasonality: thus the mean of around 7,000 mm at Agumbe is concentrated in 128 rain days (see Figure 2).

In addition to the short concentration of the rains and the variability of the total, the onset of the rains varies from year to year. These aspects pose especial problems for reforestation. Sound ground preparation is necessary to ensure that the rain penetrates instead of running off the surface - it is claimed that this can extend the effective growing season by as much as two months, making a great improvement in survival and initial growth. Nursery stock has to be ready in a plantable state so that planting can begin immediately with the onset of the rains, in case they end early. The planting operation has to be completed in a very short season of two or three weeks: all available manpower resources have to concentrate on planting for the short season involved.

There is also substantial seasonality in the temperature with mean monthly maxima in the lowlands reaching about 33o C at the end of the dry season and 29o C in the middle of the wet season. The lowlands minima vary from about 21o C in the middle of the dry season to about 25o C at the beginning of the wet season. Some climatic diagrams for localities in the Ghats are shown in Figure 2.

Most places in the Ghats have winds in the range 1 - 19 km/hr for most days throughout the year. Winds up to 60 km/hr may occur for several days in each month at certain sites, but winds above 60 km/hr are not usual.

Annex III, Figure 2 Climatic Diagrams for Selected Sites in the Western Ghats (Source:Walter,H. & Lieth,H.(1967).



Legend
(Refer Mangalore)

a - Name of station
b - Altitude
c - Mean annual temperature °C
d - Mean annual percipitation mm
e - Perhumid (or very humid) period
f - Humid period
g - Arid period

Scale

LHS =Temperature (°C)
RHS =Precipitation (mm)

Note
10°C equivalent to 20mm for all stations

2.4 Land Use

The administrative districts which include the Ghats (see Table 1) under the present project cover a geographical area of over 45,000 km2 of which 30 per cent is Reserved Forest and a further 5 per cent Protected and 'Unclassed, Village and Private' Forest. The human population totals almost 8 million giving a per capitata area of land available for farming of only 0.4 ha.

The problems associated with the small area of land available for food crops are accentuated by the considerable areas given over to permanent cash crops. On higher land in the west/central portion of the Ghats there are 100,000 ha of coffee estates and 56,000 ha of Areca gardens. Cashew (37,000 ha), cardamom (31,000 ha) and coconut (50,000 ha) are also widely planted, with smaller areas of rubber plantations in the coastal plain. These perennial crops are a sound form of land use if well managed, but in some cases soil conservation works are not well carried out. Locally the manpower needs of plantation crops may give rise to a shortage of casual labour during the tree planting season.

The majority of the rural population are subsistence farmers growing rice and a range of other food crops. Traditionally the population depends on green leaf manure and dry leaf mulch to maintain the nutritional level and structure of the soil, particularly in the Areca gardens. As population has grown, the demand far outstrips supply and has led to the complete devastation of most forests adjacent to villages and is a major factor in forest degradation in the vicinity of agricultural lands.

In the rural areas there are almost as many cattle as there are people. Buffaloes, sheep and goats almost equal the number of cattle and it is estimated that numbers have increased threefold in the last hundred years. There is not enough fodder for all these livestock and matters have been made worse by many 'gomal' or traditional grazing lands being brought under the plough. It is estimated that at least 10 per cent of fodder requirements are met by free grazing in the forest and the grazing of village livestock in the forest is a source of livelihood for many of the poor, nearly 70 per cent of whom are estimated to be at or below the poverty line (Rs.780 per capita per annum). It is estimated that overall 14 per cent of the rural population are landless labourers who can only find employment during the agricultural season and the rest of the year seek a.livelihood from the forest by grazing cattle or headloading firewood, mostly for sale to urban centres.

3. FORESTRY IN THE WESTERN GHATS

3.1 The Forest Estate

3.1.1 Status of forest areas

Reserved Forests are constituted by law under the management of the Department of Forestry. In these areas rights and privileges are granted to traditional users of the land and in particular include grazing and firewood collection. Grazing is supposed to be regulated under permits which charge grazing fees for livestock in excess of a certain number per individual. Firewood collection is supposedly restricted to dead wood.

The areas of forests are given in Table 1.

Table 1 Administrative divisions which include the Western ghats Reserve forst areas and human and cattle population

Division	Geographic area (km^2)	Reserved Forest (km^2)	Protected Forest (km^2)	Percent area (RF+PF)	Human Popln ('000)	Cattle popln ('000)
Belguam	13,415	2,057	12	15%	2,980	1,841
Hassan	6,814	449	0	7%	1,357	1,075
Coorg	4,102	1,130	27	28%	462	323
Shimoga	10,553	1,946	1,298	31%	1,657	1,087
U.Kannara	10,291	7,728	543	80%	1,072	510
Total	45,175	13,316	1,880	34%	7,528	4,836

In addition, there are 451 km^2 of unclassed village and private forest.

Important areas of the forest have been alienated to other uses. Mines and hydro-electric installations have made signal contributions to the national,economy, but at a cost of the loss of 200,000 ha of forest, and 50,000 ha have been allocated for cultivation, rehabilitation of displaced people, and other purposes. A further 24,500 ha have been illegally encroached in the forests of the Western Ghats, largely by cultivators. Control of encroachment is made more difficult where the gazetted boundaries are not clearly demarcated on the ground. Grazing today is unrestricted and unregulated, and firewood collection is widely extended to the cutting of live material such as saplings and small poles which are removed as headloads. Associated with this harmful use of the forest is fire which is widespread in the deciduous forest types and in the grassy areas within the forest. Unless the Department is able to regain control of the Reserved Forests it will not be possible to manage

them on a sustained yield basis.

Protected Forests are forests declared as state forests and which are undergoing demarcation and legal proclamation as Reserved Forests. Other forests are designated community privilege areas such as district forests, minor forests and gomal lands, from which villagers are supposed to meet their needs for small-size agricultural timber, firewood, fodder, and mulch. Unfortunately many gomal lands have been brought under cultivation and in many areas the 'betta' and 'sopinabetta' lands, which were set aside to provide mulch, have been degraded and many are totally unproductive.

The result today is that the Reserved Forests are only half-stocked and in serious decline, and the lands outside the Reserved Forests are degraded to the extent that they can no longer meet the requirements of the rural population.

3.1.2. Forest types

The forests of the Western Ghats fall into the following types, as described by Champion and Seth (1968):

Wet Evergreen
Semi-Evergreen
Moist Deciduous
Dry Deciduous.

Enumeration data of the Forest Survey of India (1987) for the forests of the Chikmalagur and Hassan Districts were analysed to determine the relative density (density of a species as a percentage of total density) and the relative basal area (basal area of a species as a percentage of the total basal area) of each species in the forest types Evergreen, Semi-evergreen and Deciduous. The sum of these relative parameters divided by two gives the 'importance value' (IV) for each species out of a maximum score of 100, thus balancing the importance in a stand of a species have many small-sized individuals against a species having a smaller number of large-sized stems.

The 20 most important species for each of the three types of forest are listed in Table 2, together with notes on the uses of the important species valued as timber. It is interesting to note that 143 species were identified in Evergreen Forest compared with only 68 in Deciduous Forest but species totalling an IV of 24.45 were unidentified in Evergreen Forest, compared with species totalling an IV of only 6.40 in Deciduous forest. If the enumerators of the Forest Survey of India fail to identify such a large proportion of species there appears to be a great need for improving the taxonomic knowledge of the tree species of the Western Ghats.

Annex III, Table 2

The Twenty Most Important Species in the Forest Types of the Western Ghats

EVERGREEN	Iv. No.	SEMI EVERGREEN	Iv. No.	DECIDOUS (incl. TEAK)	Inv. No
Tabernaemontana heyneana	4.24	Terminalia paniculata	11.94	Tectona grandis	22.77
Hopea wightiana	3.72	Terminalia crenulata (tomentosa)	10.82	Anogeissus latifolia	13.97
Terminalia paniculata	3.22	Xylia xylocarpa	6.58	Terminalia crenulata (tomentosa)	8.18
Canarium strictum	3.13	Dillenia pentagyna	4.88	Terminalia paniculata	3.87
Syzgium cuminii	2.52	Kydia calycina	3.74	Dalbergia latifolia	3.07
Terminalia crenulata (tomentosa)	2.40	Grewia tiliaefolia	3.66	Xylia xylocarpa	3.07
Euphoria Nephelium longana	2.31	Lagerstroemia lanceolata	3.15	Butea monsperma	2.98
Garcinia sp.	2.27	Pterocarpus marsupium	3.01	Grewia tiliaefoli	2.92
Scheichera trijuga	2.27	Dalbergia latifolia	2.97	Lagerstroemia lanceolata	2.04
Poeciloneuron indicum	1.92	Terminalia belerica	2.31	Pterocarpus marsupium	2.03
Aporosa lindleyana	1.90	Tabernaemontana heyneana	1.94	Dalbergia paniculata	1.88
Calophyllum inophyllum	1.86	Syzygium cuminii	1.62	Kydia calycina	1.77
Symplocos laurina	1.74	Careya arborea	1.48	Dillenia pentagyna	1.56
Elaeocarpus tuberculatus	1.55	Wrightia tinctoria	1.35	Grewia sp.	1.54
Mimusops elengi	1.51	Emblica officinalis	1.34	Terminalia belerica	1.37
Diospyros paniculata	1.49	Scheichera trijuga	1.33	Boswellia serrata	1.26
Lagerstroemia lanceolata	1.42	Randia dumentorum	1.23	Emblica officinalis	1.25
Diospyros sp.	1.41	Aporosa lindleyana	1.22	Scheichera trijuga	1.25
Ficus sp.	1.34	Anogeissus latifolia	1.04	Stereospermum personatum	1.14
Vitex altissima	1.27	Tectona grandis	1.04	Diospyros sp.	1.08
IV% of top 20 species	43.49	IV% of top 20 species	66.65	IV% of top 20 species	79.00
No. of species identified = 143		No. of species identified = 127		No. of species identified = 60	
IV% of unidentified species	24.45	IV% of unidentified species	8.89	IV% of unidentified species	6.40

Annex III, Table 3 Timber uses of the principal species found in the forests of the Western Ghats (Source: Pearson & Brown,1932)

Species	Uses
Anogeissus latifolia (Axlewood, dindal)	Highly esteemed for cart axles,shaft, poles ploughs and tool handles. Construction. Excellent fuelwood and charcoal.
Boswellia serrata	Cheap furniture, packing cases, match splints.
Calophyllum inophyllum (Toon, Irai)	Ship building, cabinet work, panelling
Canarium strictum (Indian White Mahogany)	Packing cases, plywood.
Careya arborea (Kumbi, kaval)	Housebuilding posts, carts, cartwheels, boats and oars, furniture and cabinet work.
Dalbergia latifolia (Indian rosewood, shissum, biti)	Veneers, high class furniture and cabinet work, carts and wheels, boat building, carving, agricultural implements, knife and tools handles.
Dillenia pentagyna (Dillenia, karmal)	Houseposts, rafters, furniture and panelling.
Elaeocarpus tuberculatus	Packing cases, cheap planking, plywood.
Emblica (Phyllanthus) officinalis (Myrobalan, nelli)	Cheap construction and furniture, poles firewood and charcoal. Valued mainly for its fruit.
Grewia tiliaefolia (Dhaman)	Poles, shafts, carts, furniture
Hopea wightiana	Heavy beams, posts and rafters, Cart wheels. Excellent fuel.
Kydia calycina	Interior construction, ploughs, match splints.
Lagerstroemia lanceolata (benteak, bilinanadi)	Rafters, door and window frames, posts, masts and spars in boat building, general carpentry and furniture making, shafts, carts and trucks.
Mimusops elengi	Bridges, general building,(Bullet wood) carts (wheel spokes), boat building, tool handles. Excellent fuel.
Poeciloneuron indicum	Very strong - piles, posts and general construction.
Pterocarpus marsupium. (Bijasal)	Door and window frames, rafter beams and posts; cart wheels; ship building and wagon construction.

Species	Uses
Randia dumetorum (Kat-mangri)	Ploughs, fencing, combs and fuel
Schleichera trijuga (Ceylon (oak, kusam)	Wheel hubs and stocks of carts; tool handles; posts. Source of 'macassar oil'.
Syzygium cuminii *(Eugenia jambolana)* (Jambul, jam, jaman)	Posts,beams and rafters; cart and boat and boat construction; oars and masts
Tectona grandis (teak, tegina)	Veneers, furniture, high class carpentry and joinery; boat and ship building; posts and piles.
Terminalia belerica (Tare)	Inferior timber to the other Terminalia species but used for ploughs, carts, rafters; boards and plywood.
Terminalia crenulata *(tomentosa)* (Laurel, matti)	Construction; door and window frames; cart frames and wheelspokes; boat building; posts, ladders, piles; tool handles; carpentry, furniture, doors; cabinet work.
Terminalia paniculata (Kindal)	Construction; door and window frames; rafters, furniture; boat and cart building; ladders.

The whole of the Western Ghats was probably forested before the advent of man. Due to logging, burning, grazing and firewood collection the moister forests tend to revert to a drier type, particularly the Deciduous Forest which is most vulnerable to fire. The result is the present mosaic of types shown on the maps by Pascal (1982). Sinha (1988) quantifies the extent of the remaining forest types as follows:

Evergreen and Semi-Evergreen	20%
Moist deciduous	9%
Dry Deciduous	12%

The remaining 59 percent are classified as degraded.

3.1.3 Forest condition

Well stocked forest is considered that with a canopy over 80 per cent closed. Degraded forest is subdivided into three categories based on canopy cover:

Medium density	canopy 0.4 to 0.8
Partially open	canopy 0.2 to 0.4
Severely degraded	canopy less than 0.2.

It is estimated that 30 per cent of the Reserved Forest is now in the severely degraded category.

3.2 Forest Policy and Management

Karnataka State follows the National Forest Policy 1988 and the objectives of this policy can be summarized as follows:

1. Maintenance of environmental stability and restoration of the ecological balance that has been adversely disturbed by depletion of the forests.

2. Conserve India's natural heritage of variety of flora and fauna and the diverse genetic resources.

   Check soil erosion and denudation of catchment areas in the interest of soil and water conservation, for mitigating floods and droughts and for the retardation of siltation of reservoirs.

4. Check extension of sand dunes.

5. Increase substantially the forest/tree cover through massive afforestation and social forestry programmes, especially on all denuded, degraded and unproductive lands.

   Meet the requirements of rural and tribal populations for fuelwood, fodder, minor forest products and small timber.

   Increase productivity of forests to meet essential national needs.

8. Encourage efficient utilization of forest produce and maximise substitution of wood.

   Create a massive peoples movement with the involvement of women to achieve these objectives.

The Department has already made considerable achievements in meeting these objectives:

Objectives 1 and 2: KFD has instigated a ban on the felling of'green' trees and is currently only logging dead and fallen timber.

Objectives 5, 6 and 9: During the past decade an extensive programme of social forestry has been carried out with the following achievements:

Progress of the KFD Social Forestry Programme
1979-80 to 1987-88

Roadside planting	4,758 km
Canal bank planting	988 km
Tank foreshore planting	4,721 ha
Gomal, wasteland and C & D planting	34,142 ha
Bamboo planting	1,571 ha
Distribution of seedlings for planting on farmlands (farm forestry)	997 million

Objective 7: Recently the programme of reforestation has been expanded in the Reserved Forests, although the heavy emphasis on the Social Forestry Programme has restricted the funds and manpower available.

3.3 Survey, mapping and inventory

The Forest Department has prepared maps of the vegetative cover of the Reserved Forests on a scale of 1:1,000,000 showing three categories of crown cover: 0 - 0.2, severely degraded; 0.2 to 0.4, partially degraded; and above 0.4, moderate to complete crown cover. The Department has also cooperated with J.P.Pascal of the French Institute, Pondicherry, to produce detailed vegetation maps of the whole of the Western Ghats on a scale of 1:250,000.

The Western Ghats have also been covered by 1:50,000 topographical maps which show contours in sufficient detail for the preparation of slope maps. These 1:50:000 maps are used as a basis for mapping forest reserves under management plans prepared by the Department. The Department proposes a programme of boundary consolidation which will provide an opportunity for revising maps where necessary

3.4 Forest management

The present information system for forest management is based on Working Plans which are drawn up for each block of the forest estate. Preparation involves compilation of maps; description of the topography, soils and vegetation; study of the growth rates of species suited to the area; studies of market demands and the social needs of the area; and an evaluation of the economic alternatives possible. Records are maintained in compartment registers and on the management maps, and at the end of each year control forms are completed to compare actual achievements of production, revenue and expenditure with forecasts.

It is intended that each plan should be re-made every ten years based on the previous plan, plus the forest operations carried out over the previous ten-year period. Today it is proving difficult to maintain the control forms and compartment registers, and revision of Working Plans is building up a backlog. Twenty-one Working Plans are now out of date and the Department is anxious to prepare new plans as soon as possible. Murthy (1990) present an interesting note on the history of Indian Working Plans and the status of the Haliyal Forests of the Western Ghats.

3.5 Forest Research

The Department has a research unit at Bangalore headed by a Conservator of Forests and three regional silviculturalists (DCF) stations at Mercara, Dharwad and Bangalore to cover the wet, intermediate and dry zones. The University of Agricultural Sciences at Bangalore has a Farm Forestry Department which carries out research related to social forestry. The Indian Institute of Science, Bangalore, also carries out forestry research related to sociological aspects and to tissue culture.

The Department recognizing the importance of good planting material, has concentrated on tree improvement research but has also carried out other studies, notably on nursery techniques. At present plus trees have been identified for 12 species which, apart from teak, are mainly fruit trees and other species used in social forestry. Seed orchards covering a total of 328 ha have been established for nine species and the Department has established seed processing, testing and distribution facilities. The achievements are commendable considering the relatively low manpower and financial resources that have been available for research.

Plans for expansion include the silviculture of natural forest regeneration and the dynamics of forest growth, the taxonomy and ecology of the flora and fauna, and an expansion of activities in nursery and plantation, including aerial seeding, silviculture.

There is a recognized need for greater coordination with research establishments in other states and with universities, particularly with FRI, Dehra Dun, and its Forest Genetics and Tree Breeding Institute in Coimbatore.

3.6 Education, Training and Extension

Most of the professional staff (RFO and above) are trained at the Government of India Forest Training Institutes at Dehra Dun, Burnihat and Coimbatore. The two year programme is very strong in traditional forestry subjects, particularly Forest biology, Silviculture, Forest Engineering, Forest Management and Economics, but weak in Rural Sociology and Forest Extension, the latter subjects being covered in a single course of only 30 lectures. This is quite inappropriate to present day forestry in India which spends over half its forestry budget on projects related to social forestry.

The Department has a training school for Foresters at Dandeli which provides a 15-month programme for an annual output of 50. There are two schools for Forest Guards at Bidar and Kushalnagar which provide a six month programme and have a combined annual output of 240. There is a Social Forestry Training Centre at Tattihalla which also runs training courses for Forest Guards and for surveyors.

There is an urgent need for in-service training at the professional and technical levels in Rural Sociology and Forest Extension. Training programmes in Soil and Water Conservation, and in Fodder Production, are also needed. Equally important is the need for worker training in many aspects of forestry, from logging to silviculture.

4. PROPOSED FORESTRY DEVELOPMENTS

4.1 Introduction

The Department plans to maintain the environment and conserve the genetic resources of the Western Ghat forests and at the same time to maximize productivity consistent with these aims. The fundamental strategy is that local communities will be involved as much as possible in the planning and execution of activities. It will be an attempt to achieve development with the cooperation of local communities, rather than by prohibition and coercion.

The most degraded lands are, in general, those nearest to villages. If these lands can be developed jointly with the people to supply their needs for poles, fuelwood, fodder, fruit, green manure and other products, they will have less pneed to graze their cattle far in the interior of the forest, and if landless labourers can be found paid employment they will be less likely to work as 'headloaders' supplying fuel to urban markets.

The forest will be managed in five zones: Zone I will be for conservation of genetic resources, Zone II will be for timber production on a sustained yield basis, Zone III will supply produce specifically for forest dwelling communities, Zone IV will be Reserved Forest rehabilitated and jointly managed to meet the needs of the villagers, and Zone V will involve communal lands outside the Reserved Forest but jointly managed to meet villagers' needs.

4.2 Management Strategy

4.2.1 Mapping and resource surveys

The 1:50,000 maps will continue to be used for the management of natural forest but for short rotation crops and compartment registers a scale of 1:10,000 or 1:25,000, at most, will be used, since the afforestation areas to meet villagers' needs will be numerous and often in small blocks.

Four categories of slope will be recognised and marked on map overlays: above 75%, 50 - 75%, 20 - 50%, and below 20%. Roads will not be constructed on slopes unless properly engineered and all trenching and subsoil ripping will be along the contour. Where cattle proof trenches have to be constructed they will not be made on slopes over 20% and then adequate cross-ties will be left to prevent gully erosion. Land above 75% slope will normally be excluded from logging and given protection from fire and grazing to increase the vegetative cover. Planting will be carried out on such slopes only if the site is completely denuded; otherwise the ground will be left undisturbed. However, such plantations would not be available for commercial exploitation at a later stage.

Remote sensing with adequate ground verification will be employed to classify the forest reserves on the 1:50,000 maps by the four

major vegetation types: Evergreen, Moist Deciduous, and Dry Deciduous Forest, and man-made plantations. The first three categories will be further sub-divided by four categories of crown cover. Such detailed maps are necessary to stratify the vegetation when planning efficient inventories. Over the years the forest has become a mosaic of forest types with varying degrees of canopy disturbance, making mapping difficult unless modern methods of remote sensing and inventory techniques can be employed.

In preparing maps for village plantations, which will often be on severely degraded sites, areas of rock and predominantly stony sites, and areas already at an advanced stage of erosion, will be delineated, as they may require special treatment.

GOI carried out inventories of forests by Districts or groups of Districts, separating the data by vegetation types. These data provide an overall picture but, as the stocking varies considerably from place to place, detailed inventories by compartments or groups of compartments are needed for the preparation of regeneration, thinning and harvesting schedules.

Two such GOI inventories carried out in 1987 in the Chickmalagur, Hassan and Shimoga Districts (Govt. of India, Min. of Environment and Forests;1987a & b) indicated that the Deciduous Forests were only 25 per cent stocked in some areas, and that the Teak Forests were less than half stocked. Perhaps the most alarming conclusion from these extensive inventories is that there is an absence of regeneration of valuable timber species in over 75 per cent of the area, attributed to biotic influences: illegal cutting, and browsing and trampling by cattle. It is only in parts of the Evergreen Forest that stocking approaches normality. For this reason emphasis will be placed on enrichment planting and gap planting.

Inventories of the larger size classes by Felling Series will be needed in each Working Circle in order to plan the logging sequence under selection management. For example, if the felling cycle is fixed at 30 years and the management plan period at 10 years, the first 10 annual coupes to be fixed would be those containing the greatest concentration of trees exceeding the girth limit. The coupes remaining, to be felled during years 11 to 30 of the cycle, will be thinned, where necessary, to achieve a normal selection size class distribution. In addition to collecting inventory data, it is also necessary to maintain certain plots permanently to monitor seedling recruitment, tree growth rates and mortality. These data are needed to fix felling cycles and the annual allowable cut; they also show the effect of silvicultural treatments.

In the year immediately after logging a compartment, an inventory will be carried out of stems over 10 cm DBH (10 x 10 m quadrats) to ascertain the size class distribution, with a sub-sample (2 x 2 m quadrats) of seedlings and small pole-size advance growth. The size class distribution should be plotted on a graph and compared with the size-class distribution for a normal selection

forest (see Fig. 1, Appendix III). If there is excess in any size class this will be thinned to bring the forest towards a normal selection forest structure. Regeneration treatment will depend on whether the smaller size classes are adequately represented, i.e. contain over 200 plots (out of a potential of 2,500 stocked 2 x 2 m quadrats/ha) stocked with a sapling over 1 m in height (see Yellow Book, Table VI.2). It can then be determined whether the area was 'stocked' or whether enrichment planting should be carried out (see Yellow Book, Table VI.1).

4.2.2 Working Plans

The traditional system of Working Plan preparation was quite adequate for planning and monitoring forestry operations in a situation where the Forestry Department could operate largely in isolation from the rest of society, where the needs for forest produce were mainly confined to wood for industrial use and in which supply-led planning was appropriate. In this situation rights to collect other forest products were conceded to various local or regional parties in a manner which, it was envisaged, would not interfere with the growth of the main forest trees and/or with the central objectives of forest management.

That situation no longer exists. Future Working Plans will be prepared for each zone: Zone I being areas of ecological interest will have a research orientated plan, Zone II will be the major timber producing forests and be covered by the traditional type of Working Plan, Zone III will comprise land inhabited by forest-dwelling communities, and Zone IV will be land within 5 km of villages outside the Reserved forest boundary but excluding land requiring special environmental protection, e.g. slopes over 75 per cent. Zones III, IV, and Zone V (areas outside the Reserved Forest) would have management plans formulated jointly by the local communities in partnership with the Forest Department. The boundaries between zones would be fixed provisionally as traditional management plans are prepared for Zone II but, as detailed plans are formulated for Zones I, III and IV, these boundaries will be revised appropriately.

The traditional Working Plan has rigid operational prescriptions which cannot be deviated from without approval from the Conservator of Forests, or higher authority. The Joint Forest Management Plan will be a compilation of numerous community plans. The Joint Forest Management Planning and Management System will have guidelines for the compilation of community plans and for the various management prescription options they would contain. These prescriptions will be modified through the JFPM process as perceived needs change. The authority to approve such changes will lie with the local DCF or by delegation to the ACF. This is a much more flexible system than the traditional Working Plan System and it requires a precise monitoring system in order to collate developments within each microplan community plan.

In sum, the complexity of present-day demands for forest produce make it necessary to have a more sophisticated information system

at the service of forest management.

4.2.3 Management of high forest for sustained timber production

Most degraded forests are deficient in regeneration and also in large sized stems. Basal areas are often below 10m2/ha and such forest designated for sustained timber production will be in Zone II of the project. Felling will involve mainly over-mature and degraded stems not likely to produce even a single sawlog of minimum length 4m, care being taken by directional felling not to damage advance growth of valuable species. Regeneration will be augmented by planting indigenous species but teak planting should be restricted to slopes below 50 per cent. Pure stands of teak should be planted only on slopes less than 20 per cent. because teak litter is very inflammable and accidental fires leave the ground surface bare and prone to erosion in the early monsoon rains.

Moderately stocked forest in Zone II will be managed under the Selection System. The least disturbed areas and areas of special ecological interest being set aside as Zone I. Data from Rai (1983), Akbar Sha (1990), and various Working Plans indicate that many forests have an abnormal size class distribution and widely varying basal areas. Figure 1 illustrates the typical situation: large sizes are deficient due to excessive logging and small sizes are deficient because of illegal removals and destruction of regeneration. Stands with basal area less than 20 m2/ha will receive priority for enrichment planting.

4.2.4 Management of forests to meet village requirements

Management of Zones III, IV and V will be planned jointly by the Department of Forestry and the communities concerned through the Joint Forest Planning and Monitoring process, in which knowledge of local needs for produce of all kinds, of forestry service and of environmental and ecological requirements are brought together in a systematic way.

The number of possible species of tree and grass is too large to list, but some of the more likely tree species are given in Table 4.

Annex III, Table 4. Recommended species for village planting.

Species	Uses	Remarks
Acacia nilotica	Timber, fuel, N2-fixing, fodder	
Albizia lebbek	Timber, fuel, N2-fixing, fodder	
Anacardium occidentale	Cashew nut, liquor distillation, industrial resin	Export potential
Artocarpus heterophyllus	Jack fruit, timber	
Azadirachta indica	Timber, fuel, insecticides	
Bambusa arundacea	Poles, canes	Cottage industry
Borassus flabellifera	Jaggery, liquor, food, timber and leaves	Cottage industry
Calamus spp.	Canes	Cottage industry
Casuarina equisetifolia	Poles, fuel, N2-fixing	
Ceiba pentandra	Kapok, timber	'Singapore' variety used
Dendrocalamus strictus	Poles, canes	Cottage industry
Emblica officinalis	Fruit, poles	
Erythrina variegata	Fodder, N2-fixing	
Eucalyptus teteticornis	Poles, fuel, pulpwood	
Hardwickia binnata	Timber, fuel, fodder	
Hibiscus tiliaceus	Fodder, fibre	
Leucaena spp	Fodder, fuel, N2-fixing	Psyllid resistant varieties to be obtained from Hawaii
Prosopis juliflora	Fuel, fodder, N2-fixing	Thornless poles supply to be developed
Samanea saman	Fodder, green manure	
Sesbania grandiflora	Fodder, N2-fixing, fuel	
Tamarindus indica	Fruit, fodder, fuel	

In addition, the following forage legumes are recommended for direct sowing in the conservation trenches prepared for tree planting:

Cajanus cajan, Calliandra calothyrsus, Centrosema brasilianum, Desmanthus virgatus, Desmodium intortum, Macroptilium atropurpureum, and Macroptyloma axillare

5. RESEARCH PRIORITIES

5.1 Plant and animal genetic resources

Initial surveys will enable the boundaries of Zone I to be provisionally delimited. This work will require training in plant and animal taxonomy and the establishment of a herbarium to assist management in the identification of tree species. Permanent monitoring plots in the forest types of Zone I and the managed forests of Zone II will quantify the effects of silvicultural treatment and permit the continuous refinement of the techniques employed. In a similar manner, research in Zone I will be relevant to wildlife management throughout the State. Much of this research will undertaken by the vegetation and wildlife ecology teams described in Annex II.

5.2 Tree improvement and seed production

Existing resources require strengthening to expand the production of high quality seed from selected genotypes. The present plans to continue the selection of plus trees, study their propagation and expand the area of seed orchards should be facilitated. Concurrently, the resources to process, test, store and distribute seeds requires expansion.

Close cooperation should be maintained with the GOI Forest Genetics and Tree Breeding Research Institute, Coimbatore, which will concentrate on the more basic aspects of tree genetics.

5.3 Ecology of high forest

Many of the past failures of high forest silviculture and management have been due to the lack of knowledge and understanding of the ecology of individual species and their interrelationships in the forest community. In particular the relative light requirement status and their response to silvicultural treatment has not been understood. For example, in West Africa, this ignorance led to domination of the forest by light demanding weeds and climber tangles. The research on forest ecology is basic to the development of regeneration techniques and the success of enrichment planting.

5.4 Recruitment, growth and mortality studies

Limited growth data are available from Linear Tree Increment (LTI) plots dating from 1939. Although not statistically laid out, these plots are sufficiently mature to give useful estimates of tree growth rates. Data analysed by Rai (1988) indicate that, in the unmanaged forest, teak and its associates would need 177 years to reach a DBH of 60 cm. Growth in plantations is probably twice as fast, and in well-managed forest somewhere in between. Until more data are available it would be prudent to assume, for dominant and co-dominant trees of the average species, a period of 100 years is required to reach 60 cm DBH in managed Evergreen Forest, 125 years in Moist Deciduous Forest and 150 years in Dry

Deciduous Forest. This would indicate felling cycles of 20 years, 25 years and 30 years for these forest types. Further studies are required to fix precisely these periods and the annual allowable cut precisely.

Static inventory is useful only to the logger and the short-term planner. Management planning requires information on growth rates to monitor changes between successive inventories. Information on recruitment, growth and mortality cannot be obtained from a comparison of recurrent girth-class enumerations because recurrent low-fraction samples have overlapping sampling errors which mask any differences due to time. It is to obtain information on the dynamics of forest regeneration and growth that permanent plots would be laid out in the forests of both Zone I and Zone II (see Dawkins,1980).

Approximately 50 plots of 1 ha would be need in each of the major forest types distributed throughout Zone II. A similar series of plots would be established in Zone I where these would include more detailed studies of the total flora. Plots in Zone II would receive normal silvicultural management and those in Zone I, being strictly protected, would serve as controls.

5.5 Autecology and silviculture of principal species

Research would involve trials of seeding and planting of the principal tree and other forest product species to ascertain the conditions of light, shade and other environmental factors which favour their growth and development in the nursery and in the field. These studies would be integrated with the ecological studies referred to above. The objective would be to develop more efficient nursery techniques, and improve enrichment planting and plantation establishment in general. Research would include nutritional studies to make fertilization more specific to the species and site.

5.6 Hydrology, soil and water conservation

These studies would ascertain the water use of the various forest types and their effect on local
and global climate. Soil and water conservation studies would improve field techniques presently used in reforestation. This research is detailed in the proposals for soil and hydrology detailed in Annex I.

5.7 Forest protection

Research would include studies on harmful insects and pathogens, and on symbiosis involving mycorrhizal fungi and nitrogen-fixing organisms. Reference collections would be established and incorporated with the invertebrate and plant collections described in Annex II.

5.8 Education and Training

Overseas and in-country in-service training will be given to professional officers in Rural Sociology, Forest Extension and Communications. Technical staff will receive formal training in these subjects, in Soil and Water Conservation and in Fodder Production. Workers will receive on-the-job training in logging, soil conservation techniques and silvicultural operations such as bamboo harvesting, thinning etc.

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ANNEX IV THE SOCIAL AND INSTITUTIONAL FRAMEWORK

Contents

1. INTRODUCTION

1.1 Terms of Reference

The overall objective of the proposed ODA funded project for the Western Ghats forests of Karnataka is to conserve and rehabilitate a set of environmental resources of world importance. The Karnataka Forest Department (KFD) considers that these environmental objectives cannot be achieved except with the wholehearted participation of those people whose livelihood currently derives in whole or in part form the forest.

In the short to medium term the environmental and sociological components of conservation may be in conflict. There is a considerable danger that measures taken to conserve and protect the forest will be, or will be perceived to be, at the expense of forest dwellers and users. Moreover the adoption of measures that might suggest to the population that the forest is in no way their responsibility but is solely that of the KFD or some other agency is liable to be counterproductive and to weaken community awareness of conservation requirements rather than to strengthen them.

The detailed terms of reference relevant to the sociologist require the need for particular attention to:

(1) the methods to be adopted in order to ensure appropriate levels of community participation in forest management;

(2) the social feasibility of regulating people's access to parts of the forest and the institutional and social means by which any regulation can be realistically and equitably achieved;

(3) criteria for defining and delineating forest management zones.

(4) special measures to ensure the project is compatible with the interests of vulnerable groups, in particular tribal, the landless and women;

(5) specify the role in implementation of KFD and of local government and non-governmental organisations;

(6) design a programme of research giving priority to topics concerning social uncertainties and social issues relevant to project success;

(7) the training requirements of KFD;

(8) consider the need for modification in the role, structure and organisation of the KFD bearing in mind the need for KFD to be responsive to local situations;

(9) selection of indicators of project achievement.

In summary, the project's objectives and the sociological context of those objectives can be stated as matters of:

(A) Process and Organisation

- the institutional search for sustainable solutions

(B) Understanding and Research

- knowledge of social context, responses and impacts

(C) Operational Activities

- systems for planning, protection and investment

2. BACKGROUND INFORMATION

2.1 The Forest Districts

Seven of Karnataka's nineteen administrative districts have significant portions of the district's territory within the Western Ghats forest area. One other district, Mysore, has major forest areas which are very similar in environmental management terms to the main Western Ghats forest and of which they are physical extensions. These areas of Mysore were included in the KFD's project proposal - the 'Red Book' - and their management will affect a relatively large population of tribal and scheduled caste communities within Mysore. It is recommended that ODA funding should include support for activities within Mysore District within the five year project period. Its inclusion means that eight administrative districts are effected by the project at full development potentially creating a major impact on the social and economic activities of Karnataka and effecting each of the four administrative divisions of the State except the Culbarga division in the State's northeast. Despite the activities, since 1974, of a project for 'The Integrated Development of the Western Ghats' there is, however, little systematic knowledge of the social and economic dynamics of this important forest region or of trends affecting its ability to continue its present significant contribution to state revenue.

2.2 Inadequate Statistical Information

It is difficult at present to give consolidated social and economic data on the Western Ghats forest region within the State. The eight districts have a combined human population of 15 million and with their total area under forest falling within the range of 80% to 5%. Most of the eight districts have substantial areas of land and population outside the forest so that statistics based on the major divisions of civil administration or forest administration are almost meaningless. Moreover, the relationship of forest produce to human population will depend on trading relationships and transport distances which are at present extremely difficult to specify.

Terms of reference were written for a local consultant to compile the necessary raw socio-economic data through the detailed comparison of forest statistics at Range level with those of the civil administration at Mandal Panchayat and village levels. The aim of this planned exercise was to identify 'forest zone villages' and then to access information on their social and economic characteristics. The study could not, unfortunately, be resourced by the proposed contractor. The consultants' attempt to compile the data for Uttara Kannada alone - with 80 per cent forest land - and with all the available data on village and Mandal names on computer files showed that it would be possible to prepare useful, perhaps essential, data in this way. it was not possible to complete the work necessary for detailed analysis within the time available in Karnataka. Resources for the preparation and analysis of baseline socio-economic data for the Western Ghats should be made available through the project.

One measure of socio-economic conditions is to take district data for Uttara Kannada, which is predominantly a forest district, and then to make the necessary corrections for the other districts. Quantitative comparisons with Kodagu (Coorg) and Shimoga are sometimes useful since in both cases the area of Reserve and/or Protected Forest is approximately 30% of these districts' total land areas. Uttara Kannada had, in 1981, a total population of just below 11 million and a cattle population of 5.1 million with a Reserve Forest area of some 7,700 ha. If the people and cattle were evenly distributed - which they are not - each average hectare of forest would be used by ten people and four cattle. In Shimoga district, 3,244 ha of Reserve and Protected Forest were being used in 1981 by an unknown proportion of the total human population of 17 Million and a cattle population of 11 million.

2.3 Variation in Social Structure

Karnataka State was created in 1956 (although it was known as Mysore State from that date until 1973 when it assumed its present name). The districts of Belgaum and Uttara Kannada in the north of the State's Western Ghats forest were originally the southern-most districts of the colonial Bombay Presidency. Kodagu district was previously the princely State of Coorg. The other six Western Ghats districts were previously part of the old princely State of Mysore. These differences in administrative history, physical geography and the interaction of cultures and development patterns have led to important differences in social structure able to influence responses to the project, but not, so far, studied in a systematic way.

These differences in social structure can occur despite similarities in economic and geographical circumstance. Shimoga and Uttara Kannada, for example, are comparable in rainfall and the range of crops grown. The dominant castes of Shimoga are Brahmin, Lingayat and Okkaligas. Landlords often cultivate their best lands under personal supervision and lease out substantial areas. Big landlords called Gowdas control the villages where they live and large areas of land and settlement beyond. Holdings in Shimoga are much large than in Uttara Kannada. In this last district the narrow coastal strip has urban resident Brahmin landlords whereas in the upland Ghats area a Brahmin group living on the land and cultivating upland Ghats arecanut gardens under personal supervision is dominant. On the coastal strip the dominant castes other than Brahmins are Naiks who are not among the socially less advantaged than those other groups. Land holdings in this strip are smaller than those of dominant landlord groups elsewhere in the forest region. In the Kodagu area, with the highest per capita income of all districts in the State, the landlords are planters with large coffee estates. The other dominant social and economic groups within the district are labourers and marginalised tribal rather than the complex range of peasant tenants and proprietors with caste based social structures which are found in the other districts.

Tribal people are less than 1% of the population of Karnataka.

There are, however, major concentrations of them in Mysore district and a large number of more dispersed tribal villages in Dakshin Kannada. Their participation in the project will need to be carefully specified when the project turns to the Southern Ghats districts.

Scheduled tribes are not the only or most significant of the forest dwelling communities. The other forest dwelling groups are described in the feasibility report. Their general social circumstances are known from previous studies. Provision for detailed planning studies and for consultation procedures have been made in the project document.

2.4 Poverty and Vulnerability

The extent of poverty associated with the forest region and which would be influenced by the project is unknown. Provision has been made for a participatory planning system and for forest management schemes and services in which vulnerable social groups and categories can participate. Training provisions have to be made to assist the KFD to train Circle staff to understand the social context of their work and to implement the planning and forest management procedures taking into account equity and local circumstances.

The forest districts may have been subject to hardship and susceptible to famine throughout the nineteenth century. Kynch (pers. comm.) has been reviewing historical statistics on famine in India and considers that the forest districts of the southern extremity of the Bombay Presidency (Belgaum and Uttara Kannada) were highly susceptible to famine and hardship up to Independence. Decennial growth rates in population since 1901 (Madaiah et al, 1989:9) show that six of the eight Western Ghats districts declined in population in the early years of this century. Assuming that the data is reliable and comparable at district level it appears that population loss from Uttara Kannada and Dharwad was extremely high, reaching 7% per decade between 1901 and 1921. There was a modest growth in population in the same period of Dakshina Kannada (which includes the city of Mangalore) and for Mysore (including the city of Mysore). The implications of these past patterns of hardship and poverty should be examined within the context of an assessment of the project's social impact.

2.5 Economic Pressure on Forest Resources

The pattern of a shrinking or static population in the forest areas and of population growth elsewhere in Karnataka began to change in the 1920s. After Independence the pattern was almost reversed; at that point the districts of highest population growth become the forest districts. Kadagu (Coorg) grew at about 38% between 1941 and 1961. Shimoga grew by 53% between 1951 and 1961; Uttara Kannada grew by 33% in the same decade. Not all this population increase occurred within the forest zones of these districts; Shimoga has major irrigation schemes which may have accounted for some of the growth. Nonetheless, industrial growth and development projects supporting that growth did have profound consequences for the forest zones. Significant in-migration to these districts took place stimulated by industrial development and the settlement of refugees and displaced people. Whereas the rate of decennial population growth to 1951 was 13 per cent for India as a whole, it was 20 per cent in Shimoga and 17 per cent in Uttara Kannada. The comparable rates of growth to 1961 were 22% for India and 53% for Shimoga and 33% for Uttara Kannada.

There was a sharp rise in the demand for timber in the wake of the Second World war and private sector consumers of pulpwood and timber set up in Uttara Kannada whereas state-owned timber mills played a major role in Shimoga district. The industries concerned usually entered into long-term agreements with government to provide raw materials from the forests at prices which did not cover regeneration. The KFD was under constant pressure to make available forest produce to support the drive for industrialisation. Widespread electrification schemes in the 1950s created a massive demand for wooden poles. Major forest areas were submerged by hydroelectric projects and cleared for the resettlement of displaced people, particularly in the Uttara Kannada and Shimoga district.

According to official sources the land area under forest declined by nearly 223,000 ha; of this loss, 30 per cent was due to encroachment and 70 per cent was created through infrastructural and related development. These losses of forest land were more than compensated in spatial terms by the transfer to KFD of uncultivated revenue lands for their afforestation. Whereas the additional areas had little if any tree wealth the areas lost through development projects were usually rich forest, particularly in Uttar Kannada which has los 84,000 ha of prime forest since 1956, or 38% of the total lost in the State. Only one quarter of the forest lost in Uttara Kannada was through the extension of cultivation.

2.6 Permitted Use, Rights and Privileges

There are a complex set of permitted use rights in the forest which have been codified and carried forward from the open access rights before Forest Settlement. There are major variations with the forest arising from the separate political and administrative traditions of its pre-Independence divisions. These rights are

stated in general terms within the Department's Forest Rules and Manuals. The rights and their application are not, however, well publicised. Local groups do not know when they are breaking forest rules nor can they be sure their rights are being protected by particular officials. It is essential that KFD's obligation to manage the forest and the need of local communities to protect their livelihoods are assessed in a balanced manner. The project design and resourcing should not give undue weight to only one of these aspects of right and privilege. In some cases there is conflict over what is permitted and what is needed. In other areas of the forest the locals have very little understanding of the rationale and background to the sometimes complex land and tree tenure arrangements which are specified within the Forest rules and the background paragraphs contained within the Working Plans. The consultants' field visits alerted them to these gaps in understanding in a number of cases. There was little detailed knowledge, for example, of the way that permitted use rights were applied to Minor Forests and little agreement on the contemporary application of grazing land rights or of the shifting cultivation rights known as hakkals. To judge from villagers' accounts some of these permitted use rights were now of only historical importance. In other cases, junior departmental officials were trying to regulate 'privileges' with inadequate knowledge of the original provision or its contemporary application.

The joint planning procedures which are being created within the project will allow KFD and local communities to specify to each other their existing rights and customary uses, any need the department may have to amend these permitted rights and the compensatory investment and protection it envisages. There should be no attempt to specify these rights further without this participatory planning exercise.

3. LESSONS FROM PREVIOUS RESEARCH AND PROJECTS

3.1 Introduction

Participatory forestry and social forestry are fairly recent phenomena and subject to much debate about their prospects and chances of success. It may, therefore, be useful to identify lessons from programmes in rural development which have longer experience and known successes. The most promising activities in recent Indian rural development have followed the launching of a major programme of dairy development, known as Operation Flood, in 1970. A recent major commentary has concluded, however, that although there is a widespread belief that cooperative dairy development is one of the most effective strategies for helping the poor in India there has been no serious indepth sociological study of the subject. It is usually asserted that the 'white revolution' based on the Anand pattern of integrated dairy development has overcome the three obstacles of caste, class and power which frustrated previous programmes of rural development. It is argued that it has done so through a programme which can create assets for the landless, a marketing arrangement which is cooperative and outside the power structure and through a product, milk, which is outside the considerations of pollution in Hindu thought. In fact, none of these claims can be documented and the relationship of mild producers to the cooperatives and to village social structure remains unknown. Baviskar (1988) provides one detailed study which suggests that the relationship between dairy development and poverty alleviation is far more limited than has been claimed.

The lack of detailed sociological knowledge of the reasons for, and character of, the Anand success questions the replicability of the model and the extent to which the success story can be repeated in, say, Karnataka. There are minor direct implications for the Western Ghats project in this finding in that they question the strategy for grazing regulation through intensive fodder production. The major implication, however, is that projects which aim to create major new assets at village levels will become subject to local social structures and must make provision for the study of local responses and pressures and for the incorporation of sociological perspectives within the implementing agencies.

3.2 Lessons from Social Forestry Projects

The rural development activity which is most comparable to that envisaged within the Western Ghats project is social forestry. The ODA supported project within Karnataka has provided many valuable lessons for the department. One is that the initial training for staff was inadequate and that it would have been beneficial to have included community motivators from the beginning of the project. Another is that insufficient attention was shown to the detailed social patterning of groups and categories which would need to be involved with community and social security woodlots and to prior assessments of the detailed requirements of the poor who were intended to benefit from the

woodlots components.

An evaluation of a SIDA supported social forestry project in Tamil Nadu concluded that the target groups for the project were on the whole left untouched by it except to the extent they received employment from it. Conflicting interests within the villages and 'burdensome administrative procedures for handing over plantations' meant that it proved extremely difficult to gain villagers' participation (Arnold et al; 1988).

3.3 Lessons from Academic Research in Karnataka

A major contributor to the understanding of forest use and needs within Karnataka has been Professor Madav Gadgil of the Centre for Ecological Sciences, Indian Institute of Science. His many writings on the topic identify the need for a clearer understanding of both the resource and how it can be best utilised within the spectrum of people's needs. A major contribution has been to show that timber and other forest produce prices are heavily subsidised and understate the costs of regeneration. The experimental work of the CES field stations also shows that sustainable species selection is more complex than simple allowing villagers to state their preferences, based on immediate need and memories of past activities, for trees and tree products.

The work of CES and Professor Gadgil have added greatly to the knowledge of forest biology, forest heritage and ecology. They have also contributed to the debate concerning public participation in the regeneration of the forest and have suggested designs for participation. The main emphasis is on aggregated individual human consumption of forest products and on the hierarchy of committees which might be desirable to arrange for forest protection. Educational institutions can play a major role, Professor Gadgil points out, in elucidating the context and level of human consumption needs for forest products and the scope for popular participation.

Professor M V Nadkani and his team from the Institute for Social and Economic Change, Bangalore, have analyzed the social and economic forces which have been at play in the Ghats. Historical analysis is combined with an account of the interaction of income classes with the forest in four villages of Sirsi forest division in Uttara Kannada. The analysis is based on a socio-economic survey, at one point in time, of 92 households drawn from the four villages. The emphasis within the historical chapters is on conflicting economic class interest within the rural society and the way these relate to the wider political economy and the priority given to industrial development in the key historical period after Independence. Nadkarni envisages a further historical stage of 'enlightened forest management' in which one set of institutions evolve to take care of the degraded reserved forests under government control and another set develop based on co-operative community management. The leadership of the Forest Department will be essential to stimulate these institutions and afforestation investment. The empirical

chapters discuss the contribution of forest product collections to household income by income class. 'Poor peasants' have the greatest dependence on the forest to maintain income levels; one quarter of their income is derived in this way. The dependence of all the income levels on the forest is never less than ten per cent.

The leading scholars in Karnataka are thus agreed that the consumption of forest products is critical to the maintenance of human income and welfare. They are also agreed that new human institutions must evolve if the pressures on the forest are to be managed and contained. These institutions, they argue, must involve cooperative arrangements between government and the local communities.

In view of this broad consensus it is disturbing that so little is known about the socio-economic circumstances of forest conservation and development in the State: the only detailed research information available is that provided by Nadkarni et al based on 92 households in one specific forest division. This division with its *sopina betta* privilege lands is less representative of the range of variation within the social and economic circumstances of the forest than other divisions which might have been chosen.

If socio-economic information is extremely thin research on the local institutions and social structures is non-existent. There have been a few very useful planning studies of forest and social problems in Uttara Kannada carried out under the terms of the Diploma in Social Forestry at Dehra Dun. The consultants have examined useful if initial studies of Gowli pastoralists and the Hakkal lands of the Kanara Circle. Otherwise, there are no sociological studies available for use in designing a project which many are agreed will require the evolution of institutional forms through research, public experiment and careful project monitoring.

3.5 Lessons from elsewhere in India and South Asia

Evidence from forestry projects and research in other States and other countries of South Asia confirms the importance of local institutional arrangements and the need for valid identification of potential user/producer groups for forestry protection and asset creation.

A review of the role of 'user groups' in an ODA supported community forestry project in Nepal (ERL 1989) concluded that they had only limited success and identifies the reasons behind the disappointing performance and the areas which need attention. The problems revealed include the following:

> an over-emphasis on formal, hierarchical decision-making which made it difficult to make use of existing informal groups and excluded the most needy benefactors;
>
> the decision-making structure was also unusually complex

because the nature and structure of groups was set down by law;

project targets led DFOs to set up groups to meet quotas and diverted them from sociological appraisal requirements;

forest department staff were not given sufficient training to allow them to move from the role of policeman to that of development facilitator;

the inability of the formal groups to reach women who were major resource managers and community motivators;

the failure to recognise the major contribution of existing social groups;

A World bank supported project in Pakistan encountered related problems when it assumed, without any sociological investigation, that village communities would act as the social units supporting fuelwood plantations. The assumption was incorrect. Cernea (1989) considers the alternative units of social organisation which might have been offered participation in the project.

The difficulties with user/producer groups arise because of a lack of sociological specification. Wade (1989) in a very careful research study of village common pool resource management in Andra Pradesh concludes that the potential for common pool resource management in Indian villages is much greater than is usually accepted. These management potentials are not generalisable, however, and the conditions for their use and success in specific cases will need to be identified.

3.6 NGO Initiative

The innovative role of NGOs needs to be more widely recognised. Nadkarni makes this point for Karnataka in the forestry field (1989:168,176). The work of VGKK in the BRT Hills of Mysore, IDS(C) in Dharwad and the Sew Sagar Trust in Shimoga need a special mention as pilot work in the area of participatory forest management and public education. Outside commentators tend to over-emphasise the lobbying and advocacy roles of the NGOs to the detriment of their social innovations.

4 RISKS AND POLICY CONDITIONS

The project aims to assist environmental balance within the W.Ghats forest and in its relations with the neighbouring parts of the State. Balance between the role of KFD's forest management and that of co-operative community management will also be essential to achieve the physical, plant community and wildlife conservation aims. There are two risks associated with this question of balance which should be emphasised and two conditions of success which should be explored and agreed before the project begins.

Risk 1: The alienation of community based environmental management

It is unlikely that KFD will be able to conserve the Western Ghats forests in the absence of cooperation from the neighbouring communities. The department strongly emphasises the need for participation. There is a danger though that the project will underestimate the magnitude of the task involved. Slow progress in breaking down the suspicions of decades may lead some officers to become impatient with experiments in participatory planning and community management. If they have spent their careers carrying out policing functions it is unlikely that they will easily change to the style required of a development consultant and facilitator. The KFD's decision that JFPM must be co-ordinated through the territorial divisions is understandable. There is the danger, however that the existing territorial management structures will find it most hard to change their attitudes and practices and to carry through major change in attitudes among territorial staff. The risk is that, despite goodwill towards the concept of community management the practice will not change sufficiently and that local groups will simply find the KFD performing more efficiently in a generalised rather than a specific way in support of joint planning and management.

Risk 2: The unravelling of the Forest Department's management system

There is an alternative risk and this, too, should not be understated. The most degraded lands are those under community and privatised control. Much of this degradation was brought about by the local people themselves through open access grazing and firing to promote grass cover and from hacking off branches for green manure and other purposes. Unless the JFPM mechanisms are spelt out very carefully and then fully supported the result will vary from excessive policing following the least failure (Risk 1) to an excessive respect for unstructured participation and populism (Risk 2). Experience shows that if the KFD controls are withdrawn, rural economic forces in favour of the

privatisation of the natural resource will dominate local communities and the result will be further degradation rather than conservation.

Condition 1: Clarification, by GOI and GOK, of user rights permitted under Joint Management options

Because of the parallel risks of excessive populism and excessive bureaucracy, it is essential that GOI and GOK agree a set of guidelines permitting user rights for a defined period and subject to a management agreement on Reserve Forest land. In most cases the Reserve Forest land will be of Minor Forest or Protected Forest status; in other cases the land will be regenerated or over which compensatory permitted use rights will be granted will be main Reserve Forest land. It is difficult to see that there can be any meaningful JFPM activity without these guidelines.

Condition 2: Approbation and enforcement of written agreements for the distribution of JFM produce

The small-scale experiments in JFM services provision and investments which are working at present all suffer from a lack of clarity in the distribution of revenue or produce. The consultants have modelled a set of JFM arrangements in which a number of mixed product plantations have contrasted outputs and contrasted distribution of revenue. GOK permission should be sought to ensure that officers at DCF(T) and DCF(JFPM) level or above can sign valid enforceable agreements for the distribution of plantation products and revenue according to the predicted viability of a range of JFM models. Those arrangements will need more careful investigation by consultants and by the Circle Planning and Management teams. Revenue sharing could use principles ranging from:

Option 1: simple share-cropping (half-and-half of everything)

Option 2: all timber harvested by clear felling to KFD; all the associated produce (fodder, green manure, fruit and MFP) to the partner group.

Option 3: a 'passbook method' in which the precise contributions and receipts of each individual and of the department were recorded subject to limits set down at the beginning of the agreement.

5. JOINT FOREST PLANNING AND MANAGEMENT

5.1 Concept and Approach

The project has, as its principal objective, the improved management of the forest resource in the face of conflicts between environmental aims and between different users of forest products. The ultimate output of the project will be a sustainable planning and management process which will apply techniques of policy analysis and public consultation in order to reconcile the conflicting demands on the forest resource. The concept of Joint Forest Planning and Management (JFPM) can be understood, severally, as **process and organisation**, as **improved understanding and knowledge** and as a set of **operational activities**. The Joint Forest Planning and Management approach therefore includes:

- o processes of organisational development within the Forest Department;
- o the accompanying growth of institutional capacity on the part of the Forest Department's partners and link organisations;
- o improved understanding of the social framework of conservation, deforestation and resource regeneration and development; and
- o the iterative design of sets of standardised consultation and microplanning procedures, protection services and investment models.

The project's wider objectives concern both ecological balance and environmental stability and the sustainability of livelihoods and production levels based on forest products. The JFPM concept draws attention to the fact that environmental understanding, like any other kind of understanding, does not produce a particular outcome. Outcomes have to do with how understanding is applied and that will always remain a matter of human judgement. In the final analysis those judgements will be expressed as social policy and will be determined by national and state means and not by scientific machinery alone. The scientific problem is to ensure that the knowledge used to inform political and social judgements about environmental management is valid. The sociological problem is to design and institute a planning process which can offer to reconcile the competition between objectives and users.

5.2 Location and Forest Zoning

In keeping with this concept, the JFPM operational activities will be launched at the edge of the main forest where the conflict between various categories of forest use and regeneration is most intense and the need for joint remedial action most urgent. Nonetheless, the JFPM concept need not only apply to the forest edge (Zone IV) or to compensatory planting

outside the forest (Zone V). There are various types of forest dweller who will need to be consulted about the enrichment and protection activities planned for the main forest and the effect on their livelihoods will need to be determined. The declaration of Zone I core forest areas could also affect existing rights and privileges of forage, collection and grazing so that consultation and cooperation in conservation will be needed there as well.

The definition and delineation of the Forest Zones identified for contrasted management purposes will be brought within the planning process. The Forest Circle planning and management teams to be set up within the project will play an active role in identifying the need for consultation and in assessing integrated and feasible options which balance socio-economic and environmental priorities. The actual demarkation of zones will only proceed after these assessments have been completed. The zonation will need to be reviewed periodically in the light of biotic, technological, social and population changes.

5.3 Assessments of Local Planning Capability

The Forest Department has begun to prepare a computerised database of local notables, local NGOs, schools and voluntary societies by forest division and range. This work should be continued and Circle Planning and Management Teams should be charged with maintaining and updating the records. Care will be needed to ensure that the database includes the names and affiliations of all clubs, associations and local political and social leaders. This information will be of great use in the Joint Forest Planning exercises and these will in turn provide valuable information for any further joint planning consultations.

Further analysis will be needed to identify the most likely technical options appropriate to the range of community institutions (and the afforestation and 'forest-harvesting' associations derived from them) most likely to join the Forest Department and act as its partners in specific local consultations and investment and protection schemes. This analysis should draw on the initial analysis of possible arrangements in Annex IV - 'The Social and Institutional Framework '- of this report and Cernea (1989). An initial project consultancy will be needed to advance this understanding and further integrated sociological and economics advice to the Forest Department will be required throughout the project. Provisional results suggest that Gram Sabha or 'village' meetings will be the best vehicles for Joint Forest Planning consultations and that from these meetings Village Forest Protection Committees may eventually be formed. Local associations able to sustain joint work in afforestation and/or forest-harvesting are likely to be based on more narrowly-defined social categories, for example, women's business associations, the grazing associations of the landless and marginal farmers, tribal societies and artisan societies.

The Forest Department's day-to-day joint planning and management work would benefit greatly if it could associate with a Link Organisation experienced in community resource management schemes and in work with vulnerable social categories. This organisation would be able to recruit and train the community facilitators who, it is intended, will work alongside Forest Department staff to implement the JFPM operations. If a possible Link Organisation can be identified, there will need to be a further visit to Karnataka by a Social Development Adviser or consultant to detail the procedures for cooperation and to prepare detailed costings and arrangements for parallel or associated funding. If there is no obvious existing Link Organisation detailed proposals will be needed on alternative ways to recruit, support and train the group of community facilitators who are essential to the project process.

5.4 Socioeconomic Planning Studies

A number of local and regional planning studies will need to be undertaken or commissioned within the first months of the project and before operations start in Zones I, II and III of the initial Circle. By definition Zone I should be restricted to those parts of the forest least subject to human disturbance and least subject to uses competing with plant conservation and wildlife. The need to further regulate and manage forest uses in Zones II and III and the establishment of Zone IV afforestation, regeneration, regulation and compensatory planting will have profound implications for certain social and income groups highly dependent on the forest but whose activities are believed to have a negative effect on forest regeneration. In the Kanara Circle there will be a particular need to conduct a number of reviews and planning studies which will include, but not be restricted to, issues concerning the following social groups and regional flows:

- grazing regulation of Gowli pastoralists
- options for Halliki Gowda firewood collectors
- impact of expanded forest operations on Sidi labourers and subsistence cultivators
- trends and options in urban fuelwood trade
- regeneration of Sopina Betta privilege lands
- the impact of regional cattle movements
- rapid assessments, preparatory to JFP consultations, of the range of technical options for the rehabilitation of the Kanara coast minor forests which command the greatest social support.

It is expected that the planning and management specialists going for overseas training in social development, regional planning and economic analysis will undertake or supervise these planning studies either as part of their training or immediately they return to post.

5.5 Headquarters Monitoring and Support

5.5.1 Project Planning and Monitoring

An optimum structure for the Project Planning and Monitoring Unit based at Bangalore has been discussed with the Forest Department. A Conservator of Forests (Planning) would be assisted by the following staff:

- DCF (Institutional Monitoring)
- DCF (Physical Monitoring)
- DCF (MIS/PPBS)
- Specialist in Publicity (on contract)

This annex restricts its comment to the institutional monitoring post: details of the other posts are dealt with in main text. A key requirement for the Headquarters Planning and Monitoring Unit will be to plan and monitor the impact on the department as a whole of JFPM developments and other procedural innovations being introduced at Circle level. It is assumed that this planning and monitoring specialist will be trained in the same group as the Circle level planning and management trainees. They will have had the experience of working together and the opportunity to articulate with their lecturers and tutors a set of institutional indicators of achievement which they consider are both meaningful and capable of verification.

5.5.2 Institute for Forest Research, Training and Education

Further support at Headquarters will be provided by this Institute which will combine Forest Department staff and specialists on secondment from other organisations. The more standardised training packages will be developed in the Institute. Training modules in management development and communication and negotiation skills are anticipated. It is particularly recommended that the Institute provide training in the following:

- o career assessment procedures relevant to JPFM operations and objectives, in particular to make field staff feel confident that they will evaluated favourably by superiors for showing initiative in community relations and participatory conservation work;
- o extension, communication and negotiation skills courses.
- o a gender issues course to increase awareness of women's roles in forestry and conservation.

5.5.3 Project Commissioning at Circle Level

The challenge of the new project has created considerable enthusiasm and the department and its staff will naturally wish to make progress with the new directions as speedily as possible. It is essential, however, that the commencement of operations begins a process of policy experimentation and review and controlled incremental change rather than any abrupt new departures which have been insufficiently researched. Social

systems - perhaps with some similarity to forest ecological systems - evolve slowly. Major technical and institutional changes affecting individual households often need seven to eight years before they take hold and adopt a final form. Staff involved in the process of incremental change should not be constrained in their consultations by pressing physical targets and overly-restrictive forest development models. Those trainees returning from courses in planning and management together with short-course participants from the territorial divisions should be asked to contribute to seminars and workshops which will develop draft Guidelines for the Circle and for the Conservator of Forests (Territorial) and Headquarters to consider adopting for project implementation purposes.

5.5.4 Establishment of the Circle Planning and Management Team

Within the Circle the CF would be supported by three DCF's with project planning and implementation responsibilities. Able to work either as part of a management team with the CF or alternatively, somewhat separately, as a planning and management cell these three would be individually and respectively responsible for the process, JFPM operations and studies aspects of the project. Circle managers are already fully committed with planting and regulatory work and three new co-located planning specialists will be optimum in at least the initial, establishment stage of the new activities.

The DCF (Human Resources Development) would assist the CF with the process aspects of staff development,the integration of all project activities within the Circle, the development of a system of institutional monitoring and with training at Circle level. The DCF (Joint Forest Planning and Management) would concentrate on reviewing JFP and JFM achievements and in securing quality assurance for the new joint activities at Divisional and Section levels. He would, for example, make his own confidential reports on those staff in the territorial divisions with JFPM duties. The DCF (Regional Planning) would be responsible for undertaking and/or commissioning necessary planning studies and for subsequent follow-up and the effective use of the results within both the planning and management cell and the territorial divisions.

There would be greater project impact if, in the initial phase, planning cells could be established for both the northern and southern part of the Circle, with one based at Dharwad and another at Sirsi. In the case of JFPM this would allow operations and studies for the Kanara coast and Dharwad District and for the Sirsi area sopina betta lands to both start in the initial months. The establishment of two cells would also facilitate the subsequent redeployment of certain cell members (once project procedures were clearly defined and established) to another Circle or in order to bring field experience of the new procedures to planning and monitoring duties at Headquarters.

5.6 The Organisation of Joint Forest Planning and Management

Joint Forest Planning and Management (JFPM) teams will be charged with establishing joint procedures for need and resource assessments at local levels, for the regulation of forest use in the immediate surrounding area and for coordinating and monitoring the joint management of newly developed silvicultural and silvipastoral aspects.

5.6.1 The JFPM Team

A team of three will organise the joint forest planning consultations in a target area of village and settlements. It is assumed that these target areas can be organised so that each team coordinates and facilitates a microplan exercise in one settlement or village a week and continues to do so for approximately six months. At the end of that period it will review its microplanning achievements and results, examine the potential for joint forest management schemes of various kinds and, in close consultation with the Circle planning and management cell, develop a joint management development strategy for its area. The strategy would identify those settlements or villages where there was greatest priority for further work, select the models most likely to be appropriate and relevant to be offered to the Forest Department's partner associations or groups, and assess the likely social composition and character of the associations most likely to adopt joint forest management patterns of working.

The team will be led by a range Forest Officer (RFO) specially trained to undertake this work. He will have no resposibilities other than those of JFPM. His job will be to balance Forest department and local community views and perspectives on the best way to manage the forest and how to meet local needs within the context of changing forest use.

Another permanent member of the team will be the Community Facilitator. This person will be recruited from outside the department and should have an NGO or community education background. His or her job will be to contribute to the general work of the team and to strengthen the JFPM process by contributing advice on the operation of the process at local levels. Within this context s/he will take responsibility for ensuring that the full range of local user's and other community views are identified and clearly expressed within the planning process.

The third member of the team will be the Forester (Territorial) who is responsible for the Forest Section in which the settlement or village concerned might be expected to find most of its fuelwood, mulch and green manure or other non-wood forest products and within which its cattle might be expected to graze. He will join the team on a temporary basis to be replaced by another appropriate Section Forester when the joint planning exercise moves on to a new site. The Forester (T) will take primary responsibility within the team for accessing information

on the past, present and future operations of the Forest Department in the area. He is also most likely to express, within the planning process, the need for protection of the forest and for the regulation of its use by the Forest department.

5.6.2 Team Supervision

Each of the team members will report to a different supervisor and each of these supervisors has a different primary responsibility. The aim is to maintain creative tension between the team members particularly at the planning stage when contrasted views need to be identified, acknowledged and assessed.

The RFO(JFPM) will report to an ACF(JFPM) who will manage some four or five RFO team leaders within a Zone IV 'corridor' or 'field' - that is, a group of adjacent settlements located at the interface of the forest and human settlement. The Forester(T) will continue to report to his ACF(T) or directly to his DCF(T) if there is no sub- divisional ACF. The Community Facilitator will report to a Link Organisation to be supported by the project and through which he or she will have been recruited.

5.6.3 Coordination and Monitoring of Teams

The participation of Territorial staff and the JFPM staff will be coordinated at Divisional level by the DCF(T). He will be kept fully informed of the JFPM activities and will be able to monitor the extent, if any, to which the planning of alternative forms of forestry management could interfere with the normal, regulatory work of the department in Zones I, II and III and with plantation development in Zone IV for which there is no partner association or institution. The DCF(JFPM) will be responsible for quality assurance and monitoring across the JFPM work of all Divisions within the Circle, for all liaison with the Link Organisation and for researching for the CF the case for changes within the department which will facilitate the development of JFPM as a normal part of departmental working practice.

The DCF(JFPM) will need to focus on the quality of JFP and JFM operations. His work will require judgements about the effectiveness of specific JFP techniques, the quality of microplanning documents, the failures and successes of particular three-person teams and the effectiveness of the ACF(JFPM) postholders. At the policy and strategy level, however, it will require the combined efforts of all the territorial DCFs and the entire planning cell mobilising under the leadership of the CF to establish Joint Forest Planning and Management as an essential process and objective of the department

5.7. Link Arrangements

5.7.1 Introduction

The optimum arrangement for the recruitment and support of the Community Facilitators in the JFPM teams would be through a Link mechanism or organisation to be set up within or parallel to the project. The possible link arrangements considered within the preparation mission have included:

- o an 'umbrella' or 'networking' Non-Governmental Organisation;
- o a newly created or modified Forest Development Corporation;
- o an augmented Planning and Management cell at Circle level which would include one or two NGO sector advisers;
- o a newly created 'Aranya Bank', an informal banking institution based on group-lending support for associations of, typically, peasant and landless silviculturalists and silvipastoralists;

5.7.2 Link NGO

It would be desirable if the Community Facilitators could be supported by, and report to, an NGO which could link the smaller NGOs and educational institutions of the forest areas into a network of information exchange and personnel support. The aim of this network would be to support the overall objectives of JFPM and the field operations needs of the Community Facilitators. The organising NGO would need to operate at least at district-wide levels and preferably at State levels. It would also need to evolve a policy on the type of staff it wished to place as Community Facilitators; in particular it should pay particular attention to the potential for recruiting women in this role and explore how it would support them in post. The Link NGO would itself organise and run management seminars for the benefit of the Community Facilitators and the JFPM teams as a whole. It would access available participatory planning techniques and help develop the joint planning module.

5.7.3 Link Corporation

An existing forest sector corporation would be able to recruit both forestry staff and outside specialists on contracts or on secondment. It could organise some of the materials and seminars identifed as necessary but it would lack the established links with the voluntary sector which will be needed to initiate and sustain JFPM.

5.7.4 Attachments to the Planning and Management Cell

Experienced NGO programme directors could be hired on secondment through the Institute for Forest Research, Training and Education and attached to the Circle's newly established planning and management team. They would need to develop local connections but ought to be experienced in the other skills needed from the Link Organisation.

5.7.5 Informal Banking Institution

The Link Organisation will need to evolve mechanisms to ensure its own local accountability and to assist in the development of local level community management ability. The JFM schemes will need to resolve the dilemma faced by all cooperative and producer/user associations which is how to separate specific institutionalised roles from general personal relationships. The partner association participating in a JFM scheme, and/or initally the three person support team acting on its behalf, will need to combine 'the sense of mutual trust between members and the sense of loyalty to the group' with 'rationalised accounting methods ... and devices of institutionalised suspicion which prevent the abuse of leadership powers'(Dore 1971:58). A 'banking' system of credits for labour and supervision and debits for harvesting held in a passbook or read out at regular public meetings would 'institutionalise suspicion' while also protecting the Forest Department officials from accusations of unfair or illegal discretionary action. It might also allow the easy administration of crop insurance against fire and vandalism and the underwriting of risk from major changes in timber, and other forest product prices.

Certain NGOs have managed to implement community management schemes through institutionalising suspicion in the form of public meetings at which every participant's share is announced and checked. In the case of Sarvodaya Shramadana in Sri Lanka an NGO has managed to set up its own savings and loans wing in order to tap rural savings. The highly successful Grameen Bank in Bangladesh was set up following voluntary activity. There may, therefore, be an opportunity to set up, in the medium term of the project, an informal banking institution which would help implement the JFM schemes. A link NGO could start out with the relatively limited objectives of recruiting and supporting the Community Facilitators and a wider NGO network. It would then develop, with these or subsequent staff, an innovative 'Aranya Bank' dedicated to the funding of joint management forestry and grazing plots.

5.8. Guidelines for joint forest planning

The Forest Department could be expected to take the lead in identifying the range of feasible jointly managed investment schemes. The Link Organisation should be expected to access and organise the range of participatory planning and rapid appraisal techniques which are available from the sociological, development administration and market research literatures. Perceptive use of these techniques will allow planning teams to assess the main social contours of a settlement or group and to map the key patterns of resource use.

A set of joint forest planning guidelines is suggested. These would outline the procedures to be followed at each Gram Sabha or alternative meeting, the information to be collected, the techniques appropriate for specific situations and the way the results are to be recorded and analysed. The guidelines would

give guidance on how to hold discussions with villagers, what to ask them about village social and economic relations and how to record their preferred choice of species, how to provide details of the silvicultural systems and models which could be on offer and examples of simple agreements and their execution.

Information on the village or settlement would include some contextual information for example on its Mandal Panchayat membership, population counts, social composition and the degree of social homogeneity, records of previous areas and species planted, site conditions and estimates of the likely range of yields. Instructions on how to prepare and present maps of the village at a scale of 1:25,000 or larger would be included. Most importantly the 'joint forest microplan' would include a record of all discussions held, and an outline of the range of planting, harvesting and revenue agreements which identifiable social groups or associations might like to enter.

5.9. The pace of planning and development

It is most important that the JFPM teams should act as facilitators and consultants to the local groups rather than as external organisers according to a fixed set of models chosen previously by technical specialists. Local people will need time to assess the new information and the texture and results of consultation. Moreover, they are likely to offer new analyses and solutions which should be taken seriously and reviewed within the planning process both to take advantage of additional insight and to acknowledge the value of local perceptions. Individual JPFM staff may also need time to acquire sensitivity to the range of social variation and familiarity with the techniques of negotiation and participatory planning. At the same time it will be difficult to maintain quality in the planning it is too extended in time.

For these reasons it is proposed that the JFP and JFM phases of consultation and participation are separated. It has been assumed that the first intensive planning period and review of the consultation documents will last for approximately six months and that a single team will complete a plan at individual Gram Sabha level or its equivalent each week during that period. This will allow the JFP exercise to gather momentum and maintain quality and allow the results of planning to be reviewed at Circle level. Priorities for JFM services and investments can then be set. In certain cases the community concerned may prefer that the Forest Department rehabilitate and manage degraded areas on its own account and with their passive acceptance rather than active participation. It has been assumed for initial planning purposes that one in four of the villages or settlements consulted will wish to have further discussions about joint protection services or joint investment schemes.

5.10 Local Government Consultations

Consultation with units of the Panchayati Raj will be required throughout the project. Gram Sabha meetings, extended versions of which are envisaged as the main forum for JFP sessions, are formally convened by the Mandal Pradhan, the Mandal Panchayat's leader and thus there will be a requirement to consult the Mandal. There will also be positive benefits from doing so, especially where, for example, a large cluster of villages is dependent on a single minor forest and consultations are extensive and complex. The DCF(T), DCF(JFPM and ACF(JFPM) should ensure that the Mandal Panchayats and Zilla Parishads are kept fully informed about JFPM activities and are able to facilitate the work of the local planning teams.

5.11 Women's Participation

In some areas, especially near Dharwad, women's groups play a key role in jointly initiated forestry schemes and in craft and trades using forest products - for example, plate making from muthaga leaves. Overexploitation of the forest in other areas means that the predominantly female and child collectors have to walk considerable distances to collect minor forest products. It is predominantly Halliki Gowda women who organise and provide the labour in the headload trade in firewood along the Kanara coast.The planning process should ensure that the needs of women and their significant contribution to forest based production and trade are recognised and that mechanisms for their participation in joint management are specified.

5.12 Joint forest management

5.12.1 Priorities and Alternatives

Following the review of community planning results and documents, priorities will be set for the introduction of Joint Forest Management. Priorities will need to be set for the following: the key services or investments to be jointly managed; the size and nature of the associations proposed for partnership arrangements; the range of allowable revenue sharing models; and the pattern of support and technical advice which the JFPM teams will be able to provide the partner associations. The review will also identify areas where, alternatively, the territorial forestry sections can proceed with conventional Forest Department plantations with local people's acceptance and cooperation but without their active involvment.

5.12.2 Joint Protection Services

Workshops conducted during the project preparation mission with Forest Department staff and with representatives of the voluntary and educational sectors indicated that there could be scope for jointly managed protection services. The co-determination of forest protection services may arise in two ways. First, there is evidence that certain village communities and social groups need the Forest Department's policing services in order to

protect forest assets they themselves use or have developed from exploitation or theft by outsiders to the area. Second, the Forest Department would like the community's cooperation and active assistance in certain aspects of its work, for example firewatching and firefighting and protection against grazing, where there is need for constant vigilance. The creation of a joint planning process will create the social infrastructure within which agreements for paid protection services can be drafted and implemented.

5.12.3 Joint Investment Schemes

The review of existing and potential joint management schemes undertaken during the workshops conducted in the Circles and with NGO and educational sector representatives identified the lack of firm revenue sharing agreements as the principal constraint on progress. A number of joint management schemes had already been started usually with the encouragement and unpaid support of local environmental NGOs. These schemes tended to benefit women's groups, tribal societies and associations of small farmers and the landless. There was active participation but distrust that no binding agreements could be reached on revenue sharing of the jointly developed assets. The nature and quantitity of the inputs contributed by the partner association and the Forest Department varied considerably. A critical indicator of success was when a local group felt sufficiently confident in the arrangements and incentives that they contributed their unpaid labour to plantation security and watchmen services. Most joint schemes involved a range of mixed forest products with thepossibility for benefits from timber, fuelwood, mulch and green manure and grazing or fodder production.

Demands from local groups to be involved in 'species selection' were often displaced demands for a more generalised participation in the planning of forestry assets and in the distribution of forest produce. The opportunity for local people to participate in joint planning and joint management design will help make their species selection wishes more realistic and appropriate to contemporary environmental conditions and economic opportunities.

5.13 Extension Advice and Institutional Support

Potential partner associations will need considerable support from the Forest Department and its Link Organisation in the initial phases of co-determined services or investment schemes. There are indications that resource-poor farmers and landless labourers have most at stake in the regeneration of the forest and may be the most committed and hardworking partners. On the other hand the poor are the least likely to be socially prominent. They may be reluctant to take on innovative roles and are subject to complex social controls when they do so. They will need carefully judged institutional support and advice which should be based on a sociological analysis of the local circumstances. For example, the North Kanara District social

structure is likely to be the most encouraging of any in the Western Ghats to the participation of poorer farmers. The dominant groups in North Kanara are not the dominant social groups of the State and are in all aspects relatively backward compared to the latter; moreover, their land holdings are smaller than those of dominant groups elsewhere (Nadkarni 1987:18n).

5.14 Forest Protection Committees and Services

The Gram Sabha level meetings may lead, in the case of homogeneous villages, to joint managament schemes for the whole village. It is more likely, however, that the village meeting for forest planning will continue as a Village Forest Protection Committee. Agreements for joint protection services may be with this Committee rather than with the hamlet level group. The Committee will meet no less than six times per year.

There is a need for a Divisional Forest Protection Council which should meet at least one a year. It should be chaired by the DCF(T) and include representatives of the relevant local government institutions.

5.15 Training Implications

The training system proposed is a 'cascade system' in which an inital group of social and regional planners are trained to a high level in the planning specialisms and then apply their skills under supervision to generate planning studies needed by the project. These planners, trained to MSc level in their specialisms, would assist in the short-course and in-service training of the JFPM teams and the territorial staff involved in joint management.

It is recommended that a minimum of two complete Circle planning teams are trained to MSc level to assist replicability and to insure against staff loss after training. Two members of each team will specialise in social development and management; one will specialise in regional development planning. It is desirable that they should complete their dissertations on topics of direct benefit to the project planning.

These six or more foresters with MSc level planning skills could, if the sequencing were possible, contribute to the training which will be necessary for the JFPM team leaders and senior territorial staff. A short-course module of 10 to 12 weeks in length should be designed for this second category. The key topics to be covered in their training will include social planning, participation strategies, management and evaluation of social development projects, and team building skills.

6. PROJECT REVIEW AND EVALUATION

6.1 Introduction

A project with process and organisation objectives will need regular review and evaluation to establish independently of the monitoring and management process, the project achievements. An evaluation contractor should be identified and commissioned to undertake the baseline and other studies which will be needed.

6.2 Objective

The evaluation component will enable the project sponsors (that is, GOI, GOK, KFD and ODA) to judge the extent to which the project is meeting its social, economic, ecological and environmental objectives.

It will provide to KFD independent advice on project performance and suggestions regarding possible changes in project strategy to meet the agreed objectives.

The component will undertake special studies to investigate specific issues identified as important in the implementation of the project and the achievement of its objectives.

6.3 Institutional Arrangements

The consultant recommends that an institution in Karnataka is identified which is acceptable to KFD and ODA. The University of Bangalore appears to have a large range of the relevant expertise and experience which is necessary. The sociology department has been designated as a UGC Centre of Excellence and its programme is focused on 'The Dynamics of Rural Change'. The University has the requisite ecological expertise. The Institute of Social and Economic Change which has previously studied forest sector social and economic change grants University of Bangalore degrees.

The evaluating institution should establish a link with a UK institution with socio-economic expertise to ensure that specialist advice is available as necessary.

Provision should be made in the project for funds to:

provide UK training and study visits for key actors and analysts.
contracting additional staff who may be research officers or assistants and will add to the disciplinary mix in the institutions.
the involvement of UK researchers in training and special studies.

- the possible attachment of TC or APO assistance.
- the funding of study costs.

6.4 Content

Baseline studies will be required for:

forest dwelling communities and the implications for them of forest enrichment programmes.
the implication for tribal communities, especially in the southern districts.
rehabilitation prospects for the minor forest lands of Uttara Kannada with special reference to the involvement of fuelwood collectors on the Kannara coast.

- rehabilitation prospects for the sopina betta lands
- fuelwood trade and collection in the Dharwad-Hubli transition zone.

social structure and forest protection in the Shimoga district.

Other baseline studies will need to be specified as the project proceeds and moves to other Circles.

There will also be a need to monitor particular project components and moves to other Circles. These include:

- case-studies of joint management arrangements.
- the socio-economic impact of regulation and protection on adjacent communities (Zones III and IV)

the viability of different arrangements for fodder and grazing.
the impact of project activities on different socio-economic groups and categories.

Policy studies of a number of issues will be undertaken. These include:

the impact of subsidies and the relationship of incentives, distribution and consumption - especially to fuelwood supply.
the framework of legislation, case law and legal anthropology.

ANNEX V LIVESTOCK ISSUES

Contents

1. THE GRAZING PROBLEM

Forestry officials view grazing as a problem for one or more of the following reasons:

1. it prevents natural regeneration, depleting growing stock for the future;

2. grazing prevents new plantations from growing as the cattle browze the seedlings and young shoots - it is only after an age of three years that a young tree is safe from cattle damage;

   villagers set fire to obtain better quality grass, preventing regeneration of trees, destroying fire sensitive species and admitting disease organisms through damaging the bark of mature trees;

   grazing cattle compact the soil and prevent seeds from germinating, although it is claimed that ingestion by cattle encourages some seeds to germinate more readily;

5. the movement of cattle damages the bark of trees;

6. villagers who collect fodder often cut trees and lop off branches for fuelwood, and in times of grass scarcity they cut bamboo and young trees such as Bombax; and

   soil erosion increases with loss of grass cover.

2. STRATEGY OBJECTIVES

Any strategy has to solve the following problems:

1. Decrease or stabilisation of the 'scrub'cattle 'Malnadgidha' population. At present stall feeding is not profitable as these cattle are non-productive and the only option for villagers is free-range grazing.

   Stall feeding can be made profitable only by the use of more productive breeds (not necessarily hybrids). It could then become a dominant trend in the Western Ghats.

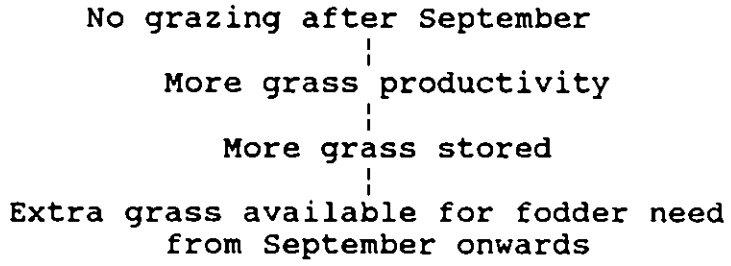
   This would take at least 6 - 8 years to develop and during this time Zone IV should be used for controlled grazing and no denudation of Zones I, II and III should take place.

3. CONTROL OF THE GRAZING PERIOD (1)

At present fresh grass is grazed continuously from the end of June until December. This prevents the flowering stage from being reached and affects the quantity of dry grass available for cutting and storage for the summer.

It should be agreed that no grazing will be allowed after September. How this could be controlled, and whether enough fodder could be collected for stall feeding, should be examined on an area by area basis.

LOGIC:



COSTS:

The plantation cost of a Fodder Farm, as detailed in the 'Red Book', may be considered for land improvement in Yrs 4, 6, etc.

Note (1) from discussions with Mr K.M.Hegde, IIS Field Station, Bhairumbhe, Sirsi Division.

4. OVERALL STRATEGY TO COMBAT THE GRAZING PROBLEM

The first priority is to protect Zones I,II and III from grazing. This would be done for 6 - 8 years by providing fodder and by arranging controlled grazing in Zone IV. If, during this time, stall feeding had not become a common practice, then the grazing pressure would have become too heavy to control.

ACTION TO BE TAKEN

1. Promote controlled rotational grazing in silvopastoral plots, developed on a large scale in Zone IV.

2. Fodder farms would be established as pilot schemes to augment local fodder supply.

   Fencing and strict protection of Zones I, II, and III from grazing. Some of the grass from protected zones should be supplied to villagers as compensation and to promote stall feeding.

   Representation should be made for funds to be set aside for a special scheme of animal husbandry for the Western Ghats. As Forestry and Animal Husbandry are under the same minister it should be easy to have the same policy.

5. Grass production should become an important part of forestry activities. Productivity could be increased by periodic ploughing and the introduction of new grass varieties. A recommended schedule for periodic ploughing is an initial ploughing and, after a 5-year period, repeat ploughing every 3 years.

5. CATTLE POPULATION DEPENDENT ON THE WESTERN GHAT FORESTS

In the 'red book' it is stated that the cattle population in the project area totals 80 lakhs (8 m) and that 10 per cent depend on the forests for grazing. The districtwise population figures indicate this to be an underestimate. In order to obtain a more accurate estimate of the number, one could assume the cattle density is uniform. Hence, if the cattle population in a district is multiplied by the ratio of the cattle population of the district to the total area of the district, then it would be possible to obtain an estimate of the cattle population dwelling in and dependent on the forest. The cattle population of each Circle has been obtained based on this assumption.

To verify this estimate it was compared with the cattle population figures of 1988-89 given by the Statistical Department, Kodagu District. This gives a total population of 3.24 lakhs and, since 30 per cent of the area is forest, the estimate is of 0.972 lakhs cattle dependent on the forest. This compares with a figure of 0.86 lakhs given by the estimate derived by the ratio method. This is slightly on the low side, not an overestimate. Table 1 below shows the estimated numbers.

Table 1. Estimated cattle population dependent on the Western Ghat forests

Circle	District	Cattle population of District (m.)	Project area as % of total area (%)	Cattle population dependent on the forest (m.)
1.Hassan	Hassan	1.074	4	0.043
2.Belgaum	Belgaum	1.840	3	0.055
3.N.Kannada	Dharwar	1.537	3.6	0.055
	Karwar	0.510	100	0.510
	TOTAL			0.565
4.Coorg	Kodagu	0.320	27	0.086
	D.Kannada	0.860	15	0.130
	Mysore	1.480	6.5	0.096
	TOTAL			0.312
5.Shimoga	Shimoga	1.086	20.5	0.270
	Chick-malagur	0.721	14.8	0.100
	TOTAL			0.370
Grand Total		9.428	14.3	1.345

Note: (1) In N.Kannada District there is no public land except forest land; hence all the cattle in this area are dependent upon the forest.

(2) The cattle census of 1988-89 should be published in 6 months time. This would give the most accurate data for the cattle population.

6. A NOTE ON ANIMAL HUSBANDRY IN THE PROJECT AREA

The status of animal husbandry is quite different in each of the 5 project Circles and a strategy which may be successful in one Circle may not prove viable in another.

North Kannara Circle: The main cattle breed is the 'Malnadgidha'. In the Dharwad Division in the plain area there are some improved local breeds with a higher level of milk productivity, but these are few in number. The total number of cattle is 5.2 lakhs and the fact that only 12,000 tons of milk is collected per day from the 82 Milk Centres indicates the low yields being obtained.

The ratio of cattle population to the human rural population is nearly 1:1. Most cattle owners, including the Gowlis, whose only occupation is cattle rearing, have a very low knowledge of good animal husbandry practices. However, in Honnavar and Sirsi Divisions the arecanut farmers are educated and have invested savings in animal husbandry. They have purchased crossbred cows and are managing them well.

Shimoga: Shimoga Dairy has a large crossbred introduction and an AI programme. The arecanut farmers in the western areas, i.e. Thirthalli and Anandapuram Ranges, have already started purchasing crossbred cows in a small way. Although the main breed is Malnadgidha, the introduction of the local breeds from the plains, i.e. Amrithmahal and Allicut, is improving the management level of the milk societies. Farmers are purchasing cattle feed and raising fodder such as Guinea grass, NB-21, etc. on their farms.

Coorg: The cattle population of Kundapur and Mangalore Divisions is high whilst that of Madikera is quite low. Kundapur and Mangalore milk procurement is high and farmers purchase fodder regularly from the nearby areas of Hassan and Coorg. The rich coffee farmers have invested in animal husbandry improvement and are gradually replacing the Malnadgidha by better local breeds and crossbred cows. However, villages outside the coffee belt are quite similar to those in N.Kannara.

Hassan: Although Hassan District has a large cattle population and milk procurement is increasing, the area under the Forest Circle is not very developed. Here the breed is Malnadgidha which is fed on paddy straw and forest grass.

Belgaum: Despite a large cattle population the animal husbandry management level is low and similar to that of N.Kannara.

7. RECOMMENDED ACTION

A STRATEGY FOR NORTH KANNADA CIRCLE

A detailed strategy is required for this Circle since the project is to be started in North Kannada; hence each Division is analysed and the Gowlis are treated separately.

1. Gowlis

Gowlis are spread throughout the Halliyal, Yellapur and Dharwar Divisions. The Government has been trying to work out a settlement scheme for them and it is recommended that this scheme is followed by the Forest Department. The Department has a 16 ha re-settlement plot for them in Honnapur, Dharwar Division. In this model the Gowli families grow fodder individually using irrigation facilities provided by the Forest Department. This model should be studied in greater detail and considered for use elsewhere.

A report on the Gowlis in Halliyal Division could be used as a basis for estimating the total cost of resettlement. A more detailed study of their movements within the forest is required before any policy is adopted.

2. Dharwar Division

Most villages are aligned on the outskirts of the Western Ghats and grazing pressure is acute. Here the Nighadhi model (see Case Study 1) may be adopted in which the Dharwar Dairy could play a major role in a fodder development programme. Wherever there are milk societies there could be pilot schemes involving (a) fodder farms and (b) the promotion of fodder production on farmers' land by guaranteeing a minimum price equivalent to that obtained from growing paddy. This fodder could be marketed in villages at minimum cost. The dairy is already operating a similar scheme for fodder seed multiplication and is also considering such a fodder production scheme. The marketing of such fodder could be linked with the promotion of stall feeding. This would reduce the need for capital expenditure on fodder production by the Forest Department.

3. Karwar Division

The status of animal husbandry is the lowest in this agriculturally poor division. Most villages have minor forest land where they have the privilege to graze. This grazing destroys natural regeneration and prevents the establishment of new plantations. As the minor forest lands are being denuded, the cattle are now grazing in Forest Zones II and III. Villagers have their own betta land in which each individual has 25 - 30 per cent of his land protected from grazing. This land is usually lateritic and unfit for

cultivation but it produces grass which is cut and stored for use during the dry months. Hence in the monsoon months the farmer sends his cattle to graze in the forest.

Recommended strategy

1. Where plantations are to be established rotational grazing should be followed.

   Grass should be planted in new plantations and soil conservation areas.

   . A forest grass supply programme should be initiated to supply grass from Zone II to promote stall feeding. The first priority should be to encourage stall feeding of bullocks as this is easy to have adopted as (a) all farmers in the plains do not send bullocks to the forests to graze; and (b) bullocks have a productive purpose and it can be argued that free-range grazing reduces their draught power.

   . Fodder farms: No fodder farms are feasible during the first two years and should be established only after they have been established in Dharwar Division.

4. Honnavar Division

The area is more prosperous agriculturally and produces arecanuts and summer groundnuts. This has led to some investment in animal husbandry and villages with surplus milk sell this in the nearest town. Farmers make use of the betta land and bullocks are costly. In addition to using fodder grass, some farmers are purchasing cotton seed as cattle feed. In this Division there are two areas of forest land run by village panchayats. Although the Forest Department considers that only one is successful, it is not trying to use this success as a model to motivate others.

Recommended Strategy:

1. Where planting is being carried out in minor forest areas, the rotational planting method, already being practised, should be followed.

   Village panchayats should be shown Halkar Village and encouraged to emulate it. As these panchayats do not have funds to pay salaries, some nominal management support, in the region of Rs.6,000 per year, should be provided to each panchayat cooperating.

   Fodder farms: fodder farms may be viable here and at least one per range could be developed.

5. Sirsi Division

Substantial numbers of prosperous arecanut farmers exist in this Division and there is good development of animal husbandry. However, in the Siddapur area grazing has caused a lot of damage and fires are quite common. The arecanut farmers have sopina betta land which are also used for grazing. A strategy similar to that recommended for Dharwar Division is recommended for farmers in the Siddhapur area but for the articulate and educated arecanut farmers a separate strategy is recommended.

Recommended strategy for the arecanut farmers

1. Jointly managed fodder farms with distribution responsibility in the hands of the farmers.

. They should have an investment in every activity, even though this may be a small amount.

A few farmers are already growing sun hemp, NB-21, etc. after being motivated by a local NGO (IIS - Field Station, Bhairumbe). This NGO could work in a larger area if provided with funds and support by the Forest Department. The NGO could expand activities rapidly as there are already demonstration models at Bhairumbe. By this means the arecanut farmers could be encouraged to adopt stall feeding.

6. Halliyal Division

The same strategy should be followed for this Division as for Karwar, as the status of animal husbandry is only marginally better. As the area of transitional and minor forest, and betta land, is much less, many villages will have to be allocated Zone IV land.

7. Yellapur Division

Except for the Gowlis, this area is similar to Sirsi Division, especially the Siddhapur area. Here, also, fire is a problem and it is recommended that rotational planting and silvopastoral plots should be adopted. This will be relatively easy as there is a large area of minor forest and overall the availability of Zone IV land is the highest.

Summary of overall strategy

1. Fodder farms should be established in the first year, only in the Sirsi, Honnavar and Dharwar Divisions.

2. A fodder production system in which farmers grow fodder should be tried out in Dharwar Division, with the help of the dairy.

   A rotational grazing model should be followed in all divisions.

. Where no plantation is being established, silvopastoral grazing plots should be established on a pilot basis.

5. The Dairy should be actively involved in the Dharwar and Karwar Divisions.

6. Local NGOs such as IIS, Bhairumbe, IDS, Dharwar, etc., could be involved in an extension programme encouraging stall feeding.

. Fodder from protected areas of Zones II and III (534,000 ha) should be used to promote stall feeding, especially where Zone IV land is not available. This programme should receive priority.

8. The rotational model silvopastoral plots should be in Zone IV only.

8. A NOTE ON FODDER GRASSES

Staff of the Forest Department have very little knowledge of fodder grass growing in the forest. 'Karad' grass is found in Shimoga Circle but, so far, the Forest Department has only tried Guinea grass in its fodder farms and Stylosanthes hamata on its micro-watershed plots in Honnavar Division. Many other grasses should be tried out, especially those which can be established by broadcasting seed. Grasses such as CO-1 and Molasses grass are recommended for the fodder plots and Brachiaria, and 'Congosilva' for the silvopastoral plots. In addition to the Dairy Department, which has considerable experience in fodder cultivation, individuals, such as Father Joseph, have a wide experience and could be used as 'resource persons' by the Forestry Department. For example, Father Joseph of Anandapuram,, Sagar Division, Shimoga Division, has been testing a wide range of fodder species in a 24 ha farm and could supply seeds, grass slips, etc.

9. RECOMMENDED MODELS

Model 1. Cutting and collection of grass

Location: On degraded land in all divisions but initially in the divisions of Uttar Kannada Circle. In each village dependent on the forest for grazing land there should be a dialogue to encourage controlled grazing. This would be in degraded Zone V land, e.g. minor forest lands, C and D class lands and, in the case of villages located in Zone III, in Reserved Forest also.

Unit: Each village would be a unit for this model. The Forest Department will be taking up plantation establishment in Zone IV lands and, there, rotational grazing should be adopted (see Statement A below).

Type: Wherever villages have grazing, the surrounding land is degraded. Such lands are reforested by the Forest Department, using fast growing species such as Acacia and Casuarina, and protected by a cattle trench.

In such cases rotational grazing could be adopted. (Described in Statement A).

Where no plantation establishment is taking place villages could adopt a silvopastoral model (Described in Statement B).

In both methods the primary aim is to work out an agreement for the mutual benefit of both the villagers and the Forest Department. As the Department is wary of a written agreement, which may lead to court disputes over land ownership, it is recommended that such agreements are informal and verbal initially. The villagers would agree not to graze in a new plantation, or a silvopastoral plot, and in turn they would be permitted to cut grass from the plots, which would be of a higher productivity. The villagers could be encouraged to set up a protection committee which would establish rules and levy fines on their infringement.

In villages where animal husbandry is better organised, and have a milk society, the Forest Department could establish irrigated fodder farms (Described in Statement C). Priority could be given to those villages with 100 per cent stall feeding, to use the good quality grass from the fodder farm as an incentive.

STATEMENT A:

Controlled rotational grazing where the Forest Department is establishing fuelwood plantations.

The following dialogue would be adopted:

1. It would be verbally agreed that the Department would plant 10 - 15% of the total area in the first year and plan to cover the whole area in 7 - 10 years.

   This 10 - 15% would be protected by a barbed wire fence and villagers would agree to be responsible for protecting it from grazing for 3 - 4 years. They would graze in the remaining area only and not in the forest. In return they would be allowed to cut grass in the protected zone.

   As seen in Table 2 below, by the fourth year 40 - 60% of the area would be under protection and only 60 - 40% be available for grazing. The area for grazing would not get less for from year 5 the first area planted would be opened up and the area planted in year 5 would be protected. By year 7 or 10 all the area would have been planted, with 50% available for grazing and 50% protected.

Table 2: Areas available for grazing in a plantation

Years	1	2	3	4	5	6	7	8
Protected planted area	15%	30%	45%	60%	75%	90%	100%	100%
Grazing area (a) non-planted	85%	70%	55%	40%	25%	10%	0%	0%
(b) planted & opened up					15%	30%	45%	45%
% grazing available	85%	70%	55%	40%	40%	40%	45%	45%

A 10 year model would stabilise at 60% grazing area available.

However, the available grazing would not be of good quality because (a) the canopy at close spacing would affect grass growth, and (b) the increasing cattle population on the decreasing area available for grazing would affect the time the same grass yield could last. Several measures are necessary to prevent this:

(i) Wider spacing (e.g. 4 - 5 m) of fuelwood trees to allow grazing, with enough space for bullock cart/tractor ploughing every five years for opening up soil and increasing productivity.

(ii) Introduction of higher-yielding grasses.(acceptability to the villagers could be tested using small trial plots in years 2-5).

(iii) Encouragement of stall feeding by incentives such as low-cost, good quality fodder,plus a high intensity dairy programme.

Another option, using this model, would be to stop planting after year 4, leaving 50 per cent of the area free for grazing. This would be the better approach where C and D lands are reforested. The option would depend on the fuelwood demand and supply situation.

STATEMENT B: A Silvopastoral model - non-irrigated

Meant for:

Villagers with degraded land and grazing pressure extending onto forest land nearby, and where no major fuelwood plantation scheme is envisaged.

Methodology:

1. After consultation with the villagers the Forest Department would set aside an area for silvopastoral plots - at least 0.1 ha per head of cattle.

   In the plot, grass of high productivity and suitable for grazing would be cultivated and fodder trees grown at wide espacement.

   An agreement of mutual benefit would be made with the villagers.

Cost:

The main costs would be:

1. Protection fencing (as in 'Red Book', Model III).

2. Tree cultivation (ditto).

3. Initial ploughing and application of manure (as in 'Red Book').

STATEMENT C: Irrigated fodder farms

Meant for: villages with a functioning milk society.

Method: The irrigated fodder farm of 5 ha suggested in the 'Red Book' may be adopted. It could be used to promote stall feeding and given only to farmers with 100 per cent stall feeding. Villagers could also be allowed to purchase fodder at a nominal price, provided there was no 'subsidy culture'.

Model 2. Protection from Fire

The model suggested in the 'Red Book' is adequate, however more attention should be paid to fire prevention. A lot of extension work will be necessary including posters, slogans on village walls,audio-visual shows and video tapes giving a message of long term priority. NGOs, village community leaders and religious leaders could be of valuable help also.

There should be staff provision for an extension person and a budget for audio-visual aids, posters and wall slogans. The extension effort should reach a peak in Feb-March before the onset of the fire season.

Note: Suggestions from K.M.Hedge, IIS, Bhairumbe.

Model 3. A Scheme for Communal Pasture Land

The following model could be tried out if there is an NGO or local body which has a good rapport with the people.:

MODEL

1. Each village family has an equal share in the village pasture land available for common grazing.

2. The area of land allotted is obtained by dividing the total pasture area by the number of share holders.

. Villagers who own many cattle can buy shares from villagers who own less, thus there is a value attached to the right to graze.

Protection of the land is by a watchman paid by the shareholders.

5. In time, people with large, but unproductive cattle will prefer to sell them, rather than buy shares, since grazing is no longer free.

6. By making everyone a shareholder, each villager has a stake in the success of the programme and would not like to destroy the scheme.

Only one day can be allowed for the transfer and sale of shares.

8. The monetary value of a share is decided by the market, i.e. the price paid when transactions take place.

10. CASE STUDY I

Village Statistics

Village	Nighadhi/Benagargati
Taluk	Dharwar
Dist.	Dharwar
Population	2,000 (500 landless)
Castes	Linayuths 70%
	Kshathriya 15%
	Others 15%
Cattle population	1,500

What happened

In 1986 the Forest Department wanted to establish a plantation in this village. Afraid that grazing in the initial years would destroy the plantation, they had discussions with the villagers in which the villagers were asked to treat the plantation as their own and restrict grazing there. The villagers agreed and proclaimed that whoever allowed his cattle to graze there would be fined. After 4 or 5 people were fined nobody from the village grazed there. In return the Department allowed the villagers to cut grass in the protected plantation area. For the past 4 years there has been no grazing in the plantation, and village cattle only graze on a 20 ha area of C and D land.

The villagers not only protect their plantations from grazing within the village but they also prevent other villages from grazing their cattle there. Recently, when the Forest Guards were under attack from nearby villagers who were collecting firewood, the Nighadhi villagers came to the rescue. Information about log smuggling is also passed on to the forestry officials. Thus, at the cost of giving grass, twigs and branches from a coupe, the Department obtains the great benefits of protection, support and information. The Department no longer has to ask the Forest Guard to patrol this area, yet the survival rate of this plantation is amongst the best in the Range.

Reasons for the success

1. The DFO and RFO involved the villagers from the beginning.

2. The DFO personally attended two village meetings to explain the issues to the people. Because of this the villagers found the proposal credible.

. The local RFO believes in working with the people. He held 4 to 5 meetings to sort out the details and patiently answered the queries of the villagers.

   The RFO has not been transferred for the past 4 years and has been able to maintain a continuous personal rapport with the villagers.

5. There is an altruistic village leader called Patil who took the initiative on behalf of the villagers and organised the village committee to monitor protection, levy fines, etc. His word is accepted by the rest of the villagers.

6. There was some alternative grazing land available for use by the village cattle.

7. The village has few factions and is a single caste dominated village, although this may not be very important if the village leadership is strong.

8. The Department adopted a flexible approach, even stretching the rules slightly to allow the village to collect twigs and loppings from a nearby coupe.

Suggestions for how this could be replicated

When the villagers were asked whether such a cooperative arrangement between the Department and other villages was possible they thought that it would be if the Department involved the villagers and discussed matters patiently. They thought it would be in the villagers self-interest to cooperate and gave as examples the villages of Maligunadi, Devroopali and Amalikoppa.

The criteria for success are:

1. The DFO adopting a positive attitude towards involving the villagers and if possible he should attend at least one village meeting.

   The same attitude should be held by the RFO and he should have a good knowledge of extension skills.

2. There should be some additional village land for grazing.

3. There should be good village leadership or the presence of a local NGO.

4. The villages which are taken up initially should be single caste dominated to avoid factionalism.

11. CASE STUDY II

Hodlanagaddhe is a small village in Honnavar Division, North Kannada Circle. It has about 200 ha of heavily degraded minor forest. In 1986 the Forest Department decided to establish a fuel plantation on this degraded land. However, the villagers protested and did not allow work to start. Finally a compromise was agreed: the Department would plant only 20 ha a year and allow the cutting of grass in the planted area, the remaining land would be kept open for grazing, and the villagers agreed to help in protecting the area. In this way, every year 25 - 30 ha is being planted and the villagers are happy because the productivity of the grass in the protected plantation is about 2 to 2.5 times that in the open land. This year the 1986 planted area has been opened for grazing as the trees are large enough to withstand grazing damage. In future, as new land is planted the older plantations will be opened to grazing.

This success has led the ACF to adopt this method for many other villages which have minor forest land.

12. POLICY AND ORGANIZATIONAL IMPLICATIONS OF NEW STRATEGY FOR SOLVING THE GRAZING PROBLEM

The current level of knowledge of forest grasses and fodder species (varieties, suitability and productivity) is not high. Since it has not been a high priority of the Forest Department, there is no person specifically in charge of working with fodder. At the RFO level and below, individual officers do take initiative in some places to try out fodder grasses, but there is no information on the results of such trials.

Since the programme suggested for decreasing grazing in Zones I and II involves local people in the management by identifying grazing needs, total fodder needs for the summer period, etc. this will be part of the micro-planning exercise. Hence, the following should be included in the data collected at the village level:

1. Estimate of cattle population, e.g. number of cows, draught animals, bullocks and others, and whether they are grazed or stall fed.

. Grazing period, place, and approximate area of grazing land (distance from village).

Indentification of Zone I and II areas which need protection from grazing.

Identification of compensatory grazing areas and forest grass supplies from Zones I II and III, and potential grazing areas (silvopastoral plots, rotational grazing plots) from Zone IV.

Possibility of fodder farm development or the production of fodder by farmers

Organization

The DCF (Silviculture) will also be the DCF(Grazing) and will produce all the technical inputs and knowhow on the type of grasses to be grown, seed availability, need for ploughing or manuring, etc. Fodder farms will be established under his guidance.

In the Joint Forestry Planning team, the Forester would be the local man involved. He would be placed in charge of implementing the managerial decisions taken and look after work in silvopastoral plots (e.g fencing, ploughing and seeding).

Training

Training would be the most important component of the new strategy. These would of two types: (i) social; and (ii) technical.

(i) The basic attitude that grass is not the Department's business should be changed. Forest Department officials should be trained to understand that their role is wider than mere tree growing and protection: the forest contains a lot of grass and grass should also be considered a forester's responsibility. Since grazing is an activity involving people, it should also be taught as a problem of common property resources (CPR) and the socio-economics of grazing should be included in the training course.

(ii) Technical aspects of training present less problems as there are many local departments, e.g. Dairy Department, BAIF, and the Agricultural Universities, which could provide training on grasses, basic knowledge of cattle diets, etc.

Propose Research Studies - Areas Needing Detailed Study

1. Gowlis - their movement during the grazing months of the monsoon;
harm caused by them to the forest.

. Productivity and variety of forest grasses - the value of various grasses in terms of nutritional value.

. Impact of biogas on fuelwood consumption - the impact to be tested in a village such as Masur Village in the Honnavar Division of North Kannada Circle. This village has 750 families, of whom 400 have biogas plants. It is reported that the number of card holders who collect headloads of fuel in the forest has declined by 70 per cent since the biogas programme assumed such a major proportion in Masur.

'Malnadghidha' - the best alternatives, phase-wise, for improving the breed, especially for small farmers who cannot maintain cross-bred cows.

13 MICROPLANNING - A NOTE ON WEALTH RANKING

One of the worries of the Forest Department is that if a joint management exercise is to be implemented in the villages, then the local elite would corner all the benefits. Since the Department does not know who are the really poor and needy people the chances are higher that the rich and articulate would get labour work, being on the joint management committees.

Before adopting joint management in a village, a micro-planning exercise would be carried out. During this exercise, the team should find out who are the relatively rich and who are the poor villagers. This can be done through a 'wealth ranking exercise'.

This essentially involves villagers ranking themselves on grounds of wealth and classifying themselves into 3 - 5 groups. The process is as follows:

1. At a village meeting people could be asked what would be their criteria for classifying a man as rich, e.g. more land, more implements, more animals, service in a town of a family member, etc. Criteria in different regions may differ, e.g. amongst Gowlis it might be number of cattle whilst this might not be significant amongst the arecanut farmers of Sirsi.

2. The villagers would then be asked to write down the names of all the families of the village - each family's name being written on a separate slip of paper.

. The villagers would then be asked to classify these slips into different groups according to wealth. Initially there would be 2 - 3 groups, then two names can be drawn out of a group and checked by asking the villagers whether they are really in the same wealth group. Usually one or two more groups would be formed, giving 4 - 5 groups.

. To cross-check this classification where, in public, the poor people might not have been very articulate, the exercise could be done with individuals or groups of only two or three people specifically belonging to the poorest class classified earlier.

The final list would be made giving a classification of the villagers into different wealth groups. In most villages, there is a high caste-class correlation, with most Brahmins in Group 1 and Hariyans and Hallihagowdas in Group 5.- but exceptions always exist, so a familywise classification is the best.

14. BIOGAS

The Government of Karnataka and the K.V.I.C.(Khadi and Village Industries Commission) are constructing biogas plants. The Western Ghats regions has a higher subsidy amount for biogas than the rest of the State. Biogas plants would decrease the pressure on fuelwood used for cooking and is the only viable and successfully tried out alternative energy source at the village level.

However, at present there is no coordination between the KVIC and the Forest Department. KVIC officials complain that at the field level they do not get cooperation from lower-level forestry officials, e.g. in the provision of laterite stones for biogas plant construction in areas where bricks are not readily available.

Another cause for concern is that, despite the special subsidy given for the Western Ghats, (1.5 to 1.8 times the normal subsidy) the subsidy does not cover more than 50 - 60 per cent of the cost. Since the total cost is about Rs. 9,000 to Rs. 11,000 per plant for the KVIC design (the only one used at present).a farmer has to contribute about Rs. 4,000 to Rs. 6,000 per plant. This is such a high sum that only the rich arecanut farmers can afford this type of gobar gas plant.

However, two suggestions are made: (i) if the Government switches over to the Deenbandhu design, which is much cheaper, the programme could then spread to the smaller farmers also and start to have an impact on fuelwood demand at the village level, and (ii) expand the programme by keeping the subsidy constant and not decreasing it every year as at present.

In North Kannada about 2,600 plants have been constructed so far, as against a potential of 20,000 plants (even if considering only 25% of rural households).

RECOMMENDED ACTION

1. The Government could be persuaded to keep the subsidy amount constant for the Western Ghats and encourage the use of the Deenbandhu plant (KVIC has already started but it will take time to train the manpower to make the new design). This would make gobar gas a feasible alternative to wood fuel in the Western Ghat region.

   The Central minister of State for Environment, Ms Maneka Gandhi, may take over DNES, the funding agency for biogas plants. This programme enjoys great support amongst local politicians and the State Government may be influenced to pay special subsidies for the Western Ghats region.

   If ODA could fund part of this subsidy, beginning with North Kannada, then the programme would receive a fillip. An additional Rs.500 per plant would cost Rs. 2,500,000

per annum, an amount easily recovered from the saving in fuelwood not used. A normal biogas plant saves a family a minimum of 4 kg wood/day, i.e. 1.2 t/yr. If 500 plants are constructed this amounts to a saving of 6,000 t/yr; at present fuelwood costs of Rs. 400 - 500/t this amounts to between Rs.2,400,00 to 3,000,000 per annum. This is more than the additional subsidy cost.

2. If a subsidy increase is not possible, perhaps the two Departments could work more closely at a lower level. A further option could be to promote the Deenbanchu generator, which is a fixed dome model, in preference to the floating dome model. The fixed dome model costs only 60 per cent of the floating dome generator and is easier to construct as it does not need the manufactured dome, but only locally available bricks, cement and sand. These could be afforded by the local small farmer as they can be made in small sizes, normally 2,3,4 or 6m3, but a model of only 1m3 has been successfully tried.

   Either additional subsidy, or funds for KVIC to use in training masons to construct the Deenbandhu on a large scale, would enable the biogas programme to be successful on a large scale in the Western Ghats.

15. LIST OF PEOPLE WITH WHOM DISCUSSIONS WERE HELD

1.	Dr Ramakrishniah	Manager, Procurement, Dharwad and Animal Husbandry,Dharwad Union.
2.	Dr Annand Kabbur	Coordinator, IDS. Dharwad
3.	Dhondu Kalapte Babu Shinde Thakkar Konde Daku Adulkar Dhaklu Pingle	Gowlis at Honnapur Settlement, Honnapur,Dharwad
4.	Mr S.V.Bhatt	Vice president, Forest Vilage Panchayat, Halakar Village, Kumtata, Honnavar Div.
5.	Mahadev Naya	Farmer, Hollangade Village, Honnavar Division.
6.	Farmer group	Nighadhi/Benagargati Vill. Dharwar
7.	Secretary, watchman and members	Masur-Kallabe-Hosad Village Forest Panchayat Masur, Honnavar Division.
8.	Mr G.G.Bhatt	Farmer, Hostotta Hamlet, Unchalli Village, Sirsi Division
9.	Mr K.M.Hegde	IIS Field Station, Bhairumbe, Sirsi Division
10.	Dr Krishnan	Managing Director, Shimoga Milk Union
11.	Fr Joseph	Anandpuram Fodder and Animal Husbandry Station Anandpuram Village, Shimoga.
12.	Mr Murthy	Asst. Director, KVIC, Bangalore
13.	Mr S.R.Navak	Development Officer,(Biogas) KVIC, Bangalore

ANNEX VI : LEGAL ISSUES

Contents

1 INTRODUCTION

The aim of this Annex is to highlight some legal points related to the design of the project.

Since the project is aiming at enlisting the co-operation of the population in many forestry activities, the way in which people perceive their rights and obligations is of importance as one starting-point, whether that perception is legally sound or not. Over a number of instances there appears to reign considerable uncertainty regarding what the law actually is. This uncertainty seems to have two causes. One is the number of different sources of relevant law; the other is the uncertain way in which the law has been enforced over the years.

The main sources of rights and obligations relevant to the management of the Ghats forests are :

the Constitution

Central legislation

State legislation

Government Orders

Customs, Servitudes and Privileges.

Following its amendment in 1976, the Constitution contains a provision that:

> "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country." (Art.48A)

The same amendment to the Constitution also introduced an addition to the list of fundamental duties incumbent on Indian citizens, to the effect that:

> "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures." (Art.51A(g))

2 FORESTRY LEGISLATION

Central legislation takes precedence over State legislation in the case of a conflict between them. The main pieces of relevant legislation at these respective levels are the following:

Central: Indian Forest Act VII (1878)
with amendments of 1890 and 1927
Cattle Trespass Act (1871)

(The original Acts did not apply to those parts of Karnataka which were in the Madras Presidency, where the Madras Forest Act V (1882) applied, which was closely modelled on the Indian Act of 1878, together with some legislation regarding wildlife.)

Wildlife Protection Act (1972)
with amendments of 1982

Constitutional Amendment (1976)

(This Amendment transferred Forests and Wildlife from the State List to the Concurrent List and thereby paved the way for:-)

Forest Conservation Act (1980)
With amendment of 1988

State: Karnataka Forest Act (1963)

Karnataka Preservation of Trees Act (1976)

Trends:

The transfer of Forests and Wildlife to the Concurrent List in 1976 marked the increasing concern of the Centre with environmental matters. The States now share with the Centre responsibility for policy and legislation in these matters.

In Karnataka the trend has been to increase the policing powers of the Forest Department.

3 LAW RELATING TO LAND

The bulk of the project activities will take place in the Forest Reserve. There appear to be few uncertainties over the legal definition of Reserved Forest boundaries. Those that arise tend to concern new reservations transferred from Revenue land, where owing to faulty records the same piece of land may also have either earlier or later been allocated to another body than the Forest Department.

However, owing to lack of demarcation of the boundaries of the Forest Reserve, uncertainties do arise on the ground. The project is designed to reduce the incidence of such uncertainties.

4 LAW RELATING TO PRODUCE

Considerable uncertainty arises, however, with regard to what may or may not be done on Forest Reserves or to what may or may not be taken from them. The main sources of uncertainty are the historical layers of regulation and the fact that in most Districts in the Ghats certain privileges have been granted in the past to people living nearby. Such privileges typically concern the rights to graze animals in the Forest Reserve, to collect firewood and non-wood forest products, to collect "green manure". Privileges may have been granted under any of the previous forms of government (Princely States, the Madras or Bombay Presidencies, etc.) and expressed in different terms with regard to extent or duration. Privileges may have been conferred on members of a community collectively or on the owner or occupier of a given (usually, but not always, adjacent) piece of land. There was variety, too, in the manner in which such privileges were extinguished: whether they died with the first beneficiary, were transmitted to his heirs, and if so to all of them or only to the owner of the original or main property; whether they could be revoked at will, or subject to some conditions, or at all (in which case they ceased to be privileges and became rights), etcetera (for these are but examples).

In addition to this variety, there is the fact that the beneficiaries depend on their privileges in different degrees, ranging from very heavy to almost negligible degrees of economic dependency. The Forest Department has therefore been less than strict in its administration of the system and, in particular, has seldom insisted that the beneficiary should respect any rules of good husbandry that may have been written into the privilege agreement. The result has been in the overwhelming majority of cases severe degradation of the forest resource and often of the soil too. The project is designed to address this problem in a way which is sensitive to the real needs of the beneficiaries. While such socio-economic factors will be prominent, it will still be necessary to determine the legal position in individual cases.

One of the aims of the project is to lead to the orderly access of forest resources in place of the unregulated and therefore

destructive modes of access that obtain at present. Regulated access will imply allowing forest produce from the Reserve Forest and from other (Zone V) lands to be distributed to local people. In the case of the Social Forestry Project a special Government Order was promulgated specifying the terms and conditions for such distribution of produce. Initial analysis of this Government Order suggests that it will not be sufficient for the purposes of the Joint Forest Planning and Management envisaged in the present project and that a new Government Order will therefore be necessary.

5 LEGAL ADVICE FOR THE FOREST DEPARTMENT

At present the Forest Department has no Legal Adviser. The education and training of Forest Department staff include knowledge of the law as it relates to forestry and of the relevant legal procedures. The project will influence the nature of the activity of the Forest Department so that it becomes considerably more interactive with people. The occasions for potential conflicts will thereby multiply and it will be important for the Forest Department to enhance its capacity for avoiding or handling conflicts without, however, walking away from them, which would usually mean allowing the forest resource to be abused.

The need is for a lawyer of imagination who would act principally in two modes:

in handling individual cases, either by advising the terrritorial officers concerned or by taking on certain cases himself

in analysing the state of the law as it relates to forestry and other land management schemes, codifying it where necessary so that it becomes more comprehensible to Department staff andto the people and when occasion arises in proposing amendments to the law or dependent regulations.

ANNEX VII ECONOMIC MODELS

Contents

1. INTRODUCTION

This annex specifies and analyses the models used to estimate the costs and benefits of the forestry models used in the main report. The models are meant to be illustrative rather than prescriptive, in keeping with the approach outlined in the main text. The processes of zonation, forest planning and monitoring and joint planning with local communities which are specified in the project will be used to determine the appropriate model and mix of species in any particular case.

The planting models have been grouped into 3 classes for the purpose of discussion :

- Multi-purpose models
- Artisan and industrial plantations
- Gap filling and enrichment models

Associated with each of these models is one of two trenching sub-models, which are presented in the section preceeding the models.

In the cost benefit analysis for each model, trenching, seedling and planting and subsequent protection costs are linked together with the related benefit streams.

Before introducing the planting models, the mechanism for price determination and the system for distributing produce are discussed.

2. PRICING AND DISTRIBUTION

2.1 Introduction

The pricing and distribution system of the department has evolved over time. In general, there are fewer subsidies than in the past. However, each market is handled differently and therefore a brief description is required for each product.

2.2 Fuelwood

The price of fuelwood is fixed by government on the basis of the following formula for the seinorage rate:

Seinorage rate = Market price - extraction costs

However, over time the market price has not been updated fully, and hence there has been until recently the element of subsidy has been creeping up.

The current seinorage rates in Karnataka are as follows:

Depot supply to:	Rs/tonne
Forest villages	Rs 10.00
Transistion zone	Rs 35.00
Urban/commercial users	Rs 110.00

Users also pay taxes which currently are about 27% of the total. (Refer to Section 2.9 below)

This means that government revenue/subsidy is as follows:

Depot supply to: Rs/tonne	Seinorage rate	Taxes	Extraction costs	Govt Revenue/ subsidy
Forest villages	10.00	2.70	125.00	-112.30
Transistion zone	35.00	9.45	125.00	- 80.55
Urban/commercial	110.00	29.70	125.00	14.50

These figures are gross: extraction costs have been estimated since in practice, the fuelwood is extracted alongside the timber. Timber contractors have to supply fuelwood as a condition of their contracts, and it is therfore difficult to seperate out the cost of fuelwood extraction from timber extraction.

The equivalent market price of fuelwood in Dharwad is Rs 600.00 per tonne. This suggests an economic seinorage rate of:

Market price	Rs 600.00
Extraction costs	Rs 125.00
Adjustment to extraction cost due to linkage with timber	Rs 75.00
Economic price	Rs 400.00

The low price in forest villages reduces the incentive for villagers to go deep into the forest for fuelwood. The higher price elsewhere is still lower than the equivalent supplied from private sources.

The use of low prices in areas near the forest will be more or less effective as a means of forest access management, depending not only on the quantity supplied (through depots, by means of ration cards) but also the ease and transaction costs of collecting from the depot. Further study is proposed within the project to determine the effectiveness of this strategy.

However, where the Forest Department is trying to encourage joint management or joint investment, which involves sharing produce, the strategy of supplying subsidised fuelwood would be counterproductive.

2.3 Sandal wood

Sandal wood is not auctioned in Karnataka, and the regulated price is based to some extent on auction prices in Tamil Nadu. However, sandal is a particularly valuable product, and smuggling is a problem everywhere, being organised on a large scale, and with considerable resources.

Recent sales in Tamil Nadu have exceeded Rs 225,000.00 per tonne, although it is thought that Rs 150,000.00 is a more realistic market price.

The current regulated price to the Govermnet owned sandal oil factory has averaged Rs 125,000.00 per tonne, net of taxes, in the recent past. This has been taken as the basis for the economic price.

	Rs/tonne
Regulated price	125,000.00
Extraction costs	12,500.00
Economic price	112,500.00

Sandal wood is also used for woodcarving. Registered artisans receive sandalwood at 25% of the regulated price, on top of which are the usual taxes. The before tax subsidy is therefore about Rs 93,750.00 per tonne.

Sandalwood is a luxury item used both to extract oil as well as for carvings. The projected price of sandal is difficult to estimate, as there is considerable scope for substitution of sandal oil, at least, with synthetics. However, given it's desireability for religious carvings, future demand has been assumed to continue and present prices have been projected over the life of the project.

2.4 Bamboo

Bamboo is the most subsidised of all products distributed by the Forest Department. Bamboo is distributed through depots at the following rates:

Distributed to:	Rs/tonne
Artisans	400.00
Industries	400.00
Mysore Paper Mills	200.00

In the retail market, the price of bamboo is based on poles, which sell for Rs 25.00 each, making a market price of Rs 10,000.00 per tonne.

In the wholesale market, bamboo is sold at Rs 1,000.00 per tonne. Assuming extraction costs are Rs 400.00 per tonne, the economic price of bamboo is about Rs 600.00 per tonne.

2.5 Timber

Timber prices vary considerably depending on species, size and quality, ranging from Rs 1,000.00 to Rs 5,000.00 per m^3.

There are 3 different distribution mechanisms for timber:

By auction: Variable

To industry: Based on a seinorage rate, which is determined by the average of the last 3 auction sales

By allotment: Based on the Depot Schedule Rate, which is a 3 year weighted average of auction sales

In each case, users have to pay tax.

The alloted price has an inherent subsidy due to differences arising between current prices and the weighted average of prices over a period going back 3 years.

Timber from private sources tends to be higher by 10% - 15%, reflecting some post depot handling, private profit and perhaps a tendency to sell on average higher grades.

Extraction costs are Rs 400.00 per m^3., although this also involves a 'piggy-back' contract for extracting the fuelwood.

The economic price of average timber was estimated as follows:

	Rs/m^3
Market price	2300.00
Extraction costs	300.00
Economic price	2000.00

2.6 Teak

Teak is distributed without concessions, with prices ranging from Rs 10,000.00 to Rs 25,000.00 per m^3. An average figure of Rs 12,400.00 per m^3 has been assumed which, after removing extraction costs of Rs 400.00 m^3, gives an average price of Rs 12,000.00 per m^3.

Teak is internationally traded, and Karnataka has increased imports over the last five years to compensate for reduced supply due to the no-logging policy. The quantity of imported teak, at 50,000 m^3 per annum, is now 7 times that extracted from the Western Ghats.

The import parity price for teak, based on current world market prices, was estimated for teak which passes through Dharwad depot. (Table 7.1) A quality factor of 12 % was included to allow for the superior quality of Indian teak.

Basis for quality premium

Assuming a mixture where 20% is top quality and the remaining 80% is similiar to import quality.

Price of	Rs/cum	Mix (%)
Top quality	17500.00	20.00
Import quality	11000.00	80.00
Average quality	12300.00	
Quality premium (%)		11.82

Preference in India is for Indian teak, afterwhich users prefer imported teak and then Hunsa. Hunsa is valued at about 50% of the equivalent teak quality.

Teak prices have risen over the last few years, at rates exceeding both the commodity wholesale price and labour wage indices. The present 'no-logging' policy is consistent with the shortage of mature teak timber coming onto the market, and new plantations are required to maintain a sustained supply at even current levels.

Table 7.1 : Import parity price for teak

Burma Teak		Unit	Unit Cost	US$	Rupees
FOB Mangalore		Cum		270.00	
Rps/US$	17.00				4590.00
Port handling charges					
		Cuft	5.00		
Cuft/cum	35	Cum	176.57		176.57
Customs duty (%)	15.00		.00		
Transport					
Managlore to Dharwad 250km		Cum	200.00		200.00
Handling/supervision etc		Cum	1200.00		1200.00
Import parity price at Dhawad depot					6166.57
Quality premium		%	11.82		
Quality equivalent		Cum			6895.35
Extraction and other costs					400.00
Supervision/dept overheads					1700.00
Stumpage value					8995.35

2.7 Other products

None of the other products specified in the models are distributed by the department. Estimates have been derived as follows:

Green manure	Same rate as fuelwood, adjusted on basis of biomass, gives Rs 400.00 - Take Rs 100.00
Fodder	Market rate is Rs 2000.00 per tonne Take Rs 1200.00 per tonne. Fodder is only required for 3 months of the year, when all the quantity used for nthe models is harvested.
Grazing	Variable. Guessed at Rs 200.00 per annum
Fruit	Prices in markets are high, but after receiving considerable value added. Take Rs 200.00 per tree for 'farmgate' price
MFP	An unspecified mix, taken at the same value as fruit

2.8 Taxes

The following taxes are payable at the point of sale.

Tax		Industrial	Domestic
Sales tax	(GoK)	8%	8%
Forest development tax	(KFD)	12%	8%
Income tax	(GoI)	8%	8%

There is also a small GOI surcharge of 5% on the element for income tax.

2.9 Planting costs

The prices used to cost the plasnting models are based on market rates in July 1988 (i.e. from the Red Book), which have been adjusted to reflect inflation since then, and therefore equate with July 1990 prices.

Most of the cost is for labour, where the current average market rate of Rs 17.50 is used throughout. In some areas, the rate is higher than this, and in Uttara Kannara, the Forest Department organises annual labour camps. Under these circumstances, the economic rate for labour (or Shadow wage rate) is unlikely to differ significantly from its market value.

Most costs are for locally purchased or produced materials. (The element of tax on these items is considered to be small and no

adjustments have been made.)

Transport costs are likely to contain a higher degree of subsidy or taxation. However, they consist of a relatively small proportion of the total costs of planting, and so no adjustment has been made to remove these distortions. The level of such distortions is certainly well within the margin of error associated with specification of each model.

2.10 Price projections

Constant real prices have been assumed throughout the analysis.

2.11 Conclusion

The prices used to value net benefits are economic rather than financial prices and therefore reflect the value of the produce rather than realisable revenue.

The prices used to cost the establishment and maintenance of the plantations are financial prices. However, it is argued in the section above that these are unlikely to differ greatly from economic prices.

In the models that follow, the economic prices derived above have been used to value benefits. In practice therefore, the models presented below can be considered as economic models.

2.12 Environmentally adjusted or 'green' prices

In the 'Yellow book', a case was put forward for the use of environmentally adjusted planning prices. In Chapter 7 of the main text, an attempt has been made to estimate the economic value of the environmental impacts. Discussion of this issue is therefore left until Chapter 8 of the main text.

3. TRENCHING MODELS

Two protection models have been specified. In each of the planting models discussed below, one of these protection models has been included. Further, these models will form the basis of forest demarcation and fire protection activity.

Model 1: 45 cm deep trenches or CPTs
Model 2: 100 cm deep trenches or EPTs

The costs for these models are provided in Tables 7.2 and 7.3.

Trees will be planted along boundaries - the species or mix of species will depend on local requirements to be determined through the processes described elsewhere in the report.

The costs for protection are estimated on a kiolmetre basis. It is assumed that 100m of trenching is required for 1 ha of planting.

Table 7.2 Costs of establishment of Live hedge strip planting (Unit 1 km.)

	Particulars of works	Rate Rps.	Per	Quantity		--- Breakdown of costs --- Materials	Labour	Transport	Total costs
	1st Year								
	Preparaton of stakes and alignment	35.43	1000	1190.00	Nos.	20.23	37.94	5.06	63.24
2.	Soil preparation								
	a. 0.45mx0.45mx1000 trench	8.40	cmt.	202.50	cmt.	510.30	2143.26	102.06	2755.62
	b. 0.30mx0.30mx0.30m.330 pits	8.40	cmt.	8.91	cmt.	22.45	94.28	4.50	121.24
	c. 0.45mx0.45mx0.45 200 pits	8.40	cmt.	18.23	cmt.	45.92	192.89	9.19	248.00
3	Refilling								
	a. 0.45mx0.45mx1000 trench	1.07	cmt.	112.50	cmt.	36.11	151.67	7.24	195.01
	b. 0.30mx0.30mx0.30m.330 pits	1.07	cmt.	8.91	cmt.	2.86	12.01	.58	15.44
	c. 0.45mx0.45mx0.45 200 pits	1.07	cmt.	18.23	cmt.	5.84	24.57	1.19	31.60
	Transportation of Seedlings								
	a. From Nursery to Plantation site (Approx.15 km distance).	65.00	1000	2628.00	Nos.	20.50	276.73	.00	297.23
	b. To planting site on head loads	40.00	1000	2190.00	Nos.	10.51	141.91	.00	152.42
5	Planting	40.56	1000	2190.00	Nos.	10.66	143.91	.00	154.57
6	Replacement of failures (20%)								
	a. Opening pits (30cmx30cmx30cm)	7.39	cmt.	11.83	cmt.	26.22	110.14	5.26	141.62
	b. Refilling pits	1.07	cmt.	11.83	cmt.	3.79	15.95	.77	20.51
	c. Seedlings to planting site on head loads	40.00	1000	438.00	Nos.	2.10	28.39	.00	30.49
	d. Planting	40.56	1000	438.00	Nos.	2.12	28.80	.00	30.92
7.	Weeding and soil working	60.65	1000	1190.00	Nos.	17.32	90.92	8.68	116.91
8.	Unforseen Expenditure	-	-		L.S.	22.40	67.25	22.40	112.06
	Subtotal					739.10	3522.67	161.86	4423.63
	2nd Year								
	Replacement of failures (10%)								
	a. Opening pits = 219 Nos	7.39	cmt.	5.92	cmt.	13.10	55.06	2.64	70.81
	b. Refilling pits	1.07	cmt.	5.92	cmt.	1.90	7.97	.38	10.25
	c. Trasnportation of seedlings	65.00	1000	219.00	Nos.	1.70	23.08	.00	24.78
	d. To planting site	40.00	1000	219.00	Nos.	1.04	14.20	.00	15.25
	e. Planting	40.56	1000	219.00	Nos.	1.06	14.40	.00	15.46
2.	Weeding and Soil Working	60.65	1000	1190	Nos.	17.32	90.92	8.68	116.91
3.	Unforseen expenditure	-	-		L.S.	13.76	41.35	13.76	68.87
	Sub total					49.88	246.98	25.46	322.33

Table 7.2 Costs of establishment of Live hedge line planting (Unit 1 km)

	Particulars of works	Rate Rps.	Per	Quantity	Cost breakdown Materials	Labour	Transport	Total cost
1.	Soil preparation							
	Elephant proof trench (2.5mx1mx2m)	8.4	cmt.	3500 cmt	8820.00	37044.00	1764.00	47628.00
2.	Transportation of Seedlings							182.70
	(a) Nursery to Plantation site	65	1000	1000 Nos.	7.80	105.30	.00	
	(b) Planting site on head loads	40	1000	1000 Nos.	4.80	64.80	.00	
3	Planting	40.56	1000	1000 Nos.	4.86	65.72	.00	70.58
4	Sowing on the mound							26.66
	(a) Cost of seeds			L.S.	14.40	1.35	2.70	
	(b) Sowing			L.S.	.58	7.06	.58	
5	Unforseen Expenditure			L.S.	10.37	31.10	10.37	51.84
	Subtotal :				8862.80	37319.33	1777.64	47959.78
	2nd Year							
1.	Replacement of casualities							107.45
	(a) Opening 200 pits 30cmx30cmx30cm	7.39	cmt.	5.4 cmt.	11.96	50.27	2.41	
	(b) Refilling pits	0	cmt.	5.4 cmt.	.00	7.27	.36	
	(c) Transportation of seedlings	65	1000	200 Nos.	.00	21.06	.00	
	(d) Planting	40.56	1000	200 Nos.	.97	13.14	.00	
2.	Unforseen Expenditure			L.S.	2.46	7.38	2.46	12.30
	Subtotal				15.40	99.13	5.23	119.75
	3rd Year onwards							
	No investments							

4 PLANTING MODELS

A) Zone IV Multi-purpose models

Introduction

The outcome of the joint planning process described in the main text is expected to be the planting of species whose products will meet local requirements. These are expected to be mixed species/mixed product plantings the exact mix of species being determined by the joint planning process.

For the purpose of analysis and illustration, 4 models have been specified in which the relative proportion of different products has been adjusted as in Table 7.4.

Table 7.4 Composition of species in multi-purpose models

	Composition (% area)				
Model	Fuelwood	Fodder	Green Manure	MFP	Fruit
Fuelwood	50	20	20	5	5
Fodder	20	50	20	5	5
G manure	20	15	50	10	5
MFP/Fruit	20	10	10	30	30

Costs

The detailed costs of field work including the construction of a cattle proof trench (Model 1) are the same for all the models (Table 7.5).

Table 7.5 Costs of establishment of Multi-purpose models (Unit 1 ha.)

Particulars of works	Rate Rps.	Per	Quantity	Cost breakdown Materials	Labour	Transport	Total cost
1st year :							
1. Preparation of stakes/allignment	35.43	1000	1 ha.	36.46	88.72	10.63	135.81
2. Soil preparation							5672.86
(a) Trenches (4.00mx0.45m.x.0.45m)	8.40	cmt.	400 Nos.	816.48	3429.27	163.26	
(b) Pits (60cms.x60cms.x60cms)	8.40	cmt.	87 Nos.	47.35	198.88	9.48	
(c) Pits (45cms.x45cms.x45cms)	8.40	cmt.	813 Nos.	186.68	784.10	37.36	
3. Refilling							722.12
(a) Trenches	1.07	cmt.	400 Nos.	103.91	436.43	20.80	
(b) Pits (60cms.x60cms.x60cms)	1.07	cmt.	87 Nos.	6.02	25.33	1.22	
(c) Pits (45cms.x45cms.x45cms)	1.07	cmt.	813 Nos.	23.83	99.86	4.72	
4. Transportation of Seedlings							513.30
(a) Nursery to site (15km)	63.00	1000	3000 Nos.	23.40	315.90	.00	
(b) To site on head loads	40.00	1000	2500 Nos.	12.00	162.00	.00	
5. Planting	40.56	1000	2500 Nos.	12.17	164.27	.00	176.44
6. Replacements							219.83
(a) Opening pits (30cmsx30cmsx30cms)	7.39	cmt.	500 Nos.	29.94	125.69	5.99	
(b) Refilling (20cmsx20cmsx20cms)	1.07	cmt.	500 Nos.	4.33	18.22	.86	
(c) Transport to site by headload	40.00	1000	500 Nos.	2.40	32.40	.00	
7. Weeding	67.58	ha.	1 ha.	24.32	72.97	8.12	105.42
8. Scraping around plants	56.10	1000	2500 Nos.	33.66	176.71	16.84	227.20
9. Weeding & soil working	60.65	1000	2500 Nos.	36.40	191.14	18.19	245.73
10. Fire protection	218.45	Km.	400 mts.	20.96	125.84	.00	146.80
11. Soil moisture conservation works	400.00	ha.	1 ha.	144.00	360.00	96.00	600.00
13. Watch & Ward 1 man for every (1 man per 25ha, July to March)	9.75	Mandays	240 days	.00	168.48	.00	168.48
14. Application of farm yard manure (1cum/plant for 27 plants)	40.00	cmt.	8.1 cmt.	233.28	165.96	44.88	444.12
15. Unforseen expenses				43.15	129.46	43.15	215.76
Sub total for 1 year :				1840.75	7271.62	481.50	9593.87

Table 7.5 (continued)

Particulars of works	Rate Rps.	Per	Quantity	Cost breakdown Materials	Labour	Transport	Total cost
2nd year							
1. Soil Preparation							90.10
(a) Opening pits (30cmsx30cmsx30cms)	7.39	cmt.	250 Nos.	14.96	62.86	.59	
(b) Refilling pits (30cmsx30cmsx30cms)	1.07	cmt.	250 Nos.	2.17	9.09	.43	
2. Transportation of seedlings							57.47
(a) Nursery to plantation	65.00	1000	250 Nos.	1.94	8.77	11.71	
(b) To planting site on head loads	40.00	1000	250 Nos.	1.20	16.20	.00	
(c) Planting	40.56	1000	250 Nos.	1.21	16.43	.00	
3. Weeding	67.58	ha.	1 ha.	24.32	72.99	8.11	105.43
4. Scraping around plants	56.10	1000	2500 Nos.	33.67	176.71	16.82	227.20
5. Weeding & soil working	60.65	1000	2500 Nos.	36.38	191.05	18.20	245.64
6. Fire protection	218.45	Km.	400 mts.	20.90	125.84	.00	146.74
7. Watch & Ward 1 man for every 25 ha for 365 days	9.75	Mandays	365 days	.00	256.23	.00	256.23
8. Unforseen expenses				20.20	60.59	20.20	100.98
Sub total for II year :				156.97	996.75	76.07	1229.79

The protection costs are continued throughout the life of the plantation, which is assumed to be 30 years for the purpose of analysis.

Table 7.6 Cost flows for Multi-purpose models (Unit 1 ha.)

Rps/ha	Project year									
	1	2	3	4	5	6	7	8	9	10
Field costs										
Materials		1840.75	156.97	135.48	41.10	41.10	41.10	41.10	41.10	41.10
Labour		7271.62	996.75	883.40	442.66	442.66	442.66	442.66	442.66	442.66
Total		9593.87	1229.79	1082.22	503.95	503.95	503.95	503.95	503.95	503.95
Protection costs										
Materials	73.91	4.99								
Labour	352.27	24.70								
Transport	16.19	2.55								
Total	442.36	32.23	10.74	10.74	10.74	10.74	10.74	10.74	10.74	10.74
Nursery costs										
Materials	771.66	77.17								
Labour	1410.65	141.06								
Transport	368.04	36.80								
Total	2550.35	255.03								
Total costs	2992.71	9881.14	1240.53	1092.96	514.70	514.70	514.70	514.70	514.70	514.70

Benefits

The incremental benefit from these models depend both on the expected returns to the investment and on the use and condition of the land before planting takes place.

With project benefits:

The models assume that the fuelwood species initially planted, are harvested in year 9, when the other species begin to cover the area. (The models do not assume coppicing.)

Protection is needed to establish these plantations and this will have implications particularly for village grazing. The consultative and planning processes proposed under the project should ensure that individual plantations are not considered in isolation to other land use options in the village.

This will also affect the rate at which individual villages can take up project activities - and in many instances it is expected that relatively small areas will be taken up each year, thus limiting the economic costs of temporarily putting land out of operation.

Two 'without- project' scenarios were developed under the following set of assumptions.

A. Very degraded land

In most cases, and at least initially, it is anticipated that the land will be highly degraded, reflecting the existing pressure on these Zone IV lands. Here, it is assumed that access to grazing, and poor quality grazing, is foregone by the planting programme. (Table 7.7)

Table 7.7 Benefit cost model for Multi-purpose (Fuelwood) Model

A. Very degraded land

Benefits	Unit Price (Rps.)	Project year 1	2	3	4	5	6	7	8	9	10	11	12-30
With project						Rps '000							
Fuelwood	400.00									17.45			
Poles	40.00									150			
G manure	100.00						.41	.41	.41	.41	.41	.41	.41
Fodder	1200.00						.41	.41	.41	.41	.41	.41	.41
-lopped	850.00						.50	.50	.50	.50	.50	.50	.50
Fruit	200.00										50		50
MFP	200.00										37		37
Total		0	0	0	0	0	958	958	958	13938	18358	958	18358
Without project													
Fuelwood	750.00												
Poles	10.00												
G manure	100.00												
Fodder	100.00												
Fruit	50.00												
MFP	50.00												
Grazing	200.00	1	1	1	1	1	1	1	1	1	1	1	1
Total		200	200	200	200	200	200	200	200	200	200	200	200
Incremental benefits		-200	-200	-200	-200	-200	758	758	758	13738	18158	758	18158
Net benefit flow		-3193	-10081	-1441	-1293	-715	243	243	243	13223	17643	243	17643

Rate of return

Net present value	
DR	30 years
0	193741
5	71621
10	27138
15	8853
20	624
25	-3296
IRR (30 years)	20.59

B. Semi degraded land

In this case, there was more substantial loss, during the period of protection and exclusion necessary to establish the plantation. (Table 7.8)

It was assumed that the 'without project' scenario was on land that was yielding about 75% of the planted fuelwood yield. Further, this yield, in annual terms was assumed for every year, whilst, for new planting the fuelwood would be harvested after year 9.

For green manure and fodder, it was estimated that 30% of the planted yield was foregone as well as 1 tonne of grazing fodder, and 25% of the fruit and other MFP. All of these products would have been available from the start of the year in which new planting commences.

Table 7.8 Benefit cost model for Multi-purpose (Fuelwood) Model

B. Semi-degraded land

Benefits	Unit price	Project year 1	2	3	4	5	6	7	8	9	10	11	12-30
With project	Rps					Rps '000							
Fuelwood	400.00									17.45			
Poles	40.00									150			
G manure	100.00						.41	.41	.41	.41	.41	.41	.41
Fodder	1200.00						.41	.41	.41	.41	.41	.41	.41
-lopped	850.00						.50	.50	.50	.50	.50	.50	.50
Fruit	200.00										50		50
MFP	200.00										37		37
Total		0	0	0	0	0	958	958	958	13938	18358	958	18358
Without project													
Fuelwood	750.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Poles	40.00	25			25			25			25		
G manure	100.00	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14
Fodder	100.00	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14
Fruit	50.00	5	5	5	5	5	5	5	5	5	5	5	5
MFP	50.00	5	5	5	5	5	5	5	5	5	5	5	5
Grazing	200.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total		2477	1477	1477	2477	1477	1477	2477	1477	1477	2477	1477	1477
Incremental benefits		-2477	-1477	-1477	-2477	-1477	-519	-1519	-519	12461	15881	-519	16881
Net benefit flow		-5470	-15611	-2718	-3570	-1992	-1034	-2034	-1034	11946	15366	-1034	16366

Rate of return

DR	Net present value 30 years
0	141168
5	42752
10	8136
15	-5250
20	-10659
25	-12758

IRR (30 years) 12%

Rates of return

Rates of return were estimated for each of the models and for both sets of 'without project' assumptions (Table 7.9)

Table 7.9 Rates of return

	Without project assumptions	
Model	Very degraded	Semi-degraded
Fuelwood	21%	12%
Fodder	24%	18%
G manure	25%	19%
MFP/Fruit	95%	54%

These results suggest fairly high returns to the Zone IV planting programme. In one case, the land is so degraded that almost no benefits are foregone, while in the second case, substantial benefits are foregone until the new planting yields produce. In both cases, no benefit has been assumed from cutting any remaining old trees, since it is assumed that the land is already very degraded.

This suggests that the models are fairly robust even with the stringent assumptions of without project scenario 'B'.

The returns from the predominately fruit model are particularly high and much higher than expected. This is because the value of the fruit has been calculated in terms of the value of the product, which is not normally distributed through the department.

No sensitivity analysis has been carried out on these models beyond specifing two extreme without project scenarios. The critical issue for the success of these models is the ability of the joint planning process to deliver agreements which ensure the protection and maintenance of the forest asset.

The nature of such agreements is discussed elsewhere. However, in some instances this may involve the sharing of the forest product, as a return to communities or other groups for management or provision of other services on behalf of the forest department.

B) **Artisan and industry plantations**

Introduction

Two examples of models representing plantations whose output is for artisans and/or industries are discussed in this section.

Bamboo is an example of an industrial product which is also of value to rural people for construction purposes, while sandalwood is a valuable, but long cycle crop, which requires careful maintenance and protection.

Bamboo plantation model

The bamboo plantation model is to raise stocking levels to 400 climbs per ha from a current average of 223 clumps per ha. in forests having natural bamboo growth and also the potential to support bamboo.

The bamboo would mostly be in the partially open forest areas of Zones II/IV.

Costs

Detailed costs are set out in the table 7.10.

Nursery costs are based on 8 month old nursery raised seedlings in polypots.

Protection costs include the construction of CPT. The CPT is assumed to have a life of 10 years, after which a major reconstruction is required, at roughly the original cost of construction.

Field costs include preparation of the land and the costs of a watchman who will be required through out.

Table 7.10 Bamboo plantations (Unit 1 ha.)

Particulars of works	Rate (Rps)	Per	Quantity	Unit	Cost breakdown Materials	Labour	Transport	Total cost
I. First year :								
1. Alignment & stacking	35.43	1000Nos.	177	Nos.	1.87	7.88	.40	10.15
2.								
3. Soil preparation								586.53
(a) 0.50cmx0.50cmx0.50cm	8.40	cmt.	177	Nos.	96.34	404.64	19.28	
(b) Refilling of pits	1.07	cmt.	177	Nos.	12.26	51.53	2.47	
4. Transportaion of seedlings								33.79
(a) nursery to plantation site	65.00	1000Nos.	212	Nos.	4.13	17.35	.84	
(b) planting site by head loads	40.00	1000Nos.	177	Nos.	2.12	8.91	.43	
5. Planting	40.56	1000Nos.	177	Nos.	.85	11.65	.00	12.50
6. Replacement of failure 20%								17.83
(a) Opening pits 30cmX30cmX30cm	7.39	cmt.	35	Cmt.	2.09	9.59	.43	
(b) Refilling pits	1.07	cmt.	35	Cmt.	.30	.45	.07	
(c) Transport seedlings to site	40.00	1000Nos.	35		.17	2.27	.00	
(d) Planting	40.56	1000Nos.	35		.17	2.29	.00	
7. Application of manure								512.95
(a) Manure (20 plants/cart)	40.00	Cartload 8.85 cl			254.88	191.16	42.48	
(b) Application costs	.10	Plant	177	Nos.	12.74	9.56	2.12	
8. Scraping around plants	56.10	1000Nos.	177	Nos.	2.38	12.51	1.20	16.09
9. Bharav to all plants	433.70	1000Nos.	177	Nos.	18.42	96.71	9.22	124.35
10.Watch & ward (one man for 40 ha)	9.75	Manday	240	days	.00	105.30	.00	105.30
11.Fire protection	218.45	K.m.	400	Mts	20.96	125.84	.00	146.80
12.Unforseen expenditure					49.07	147.20	49.07	245.34
Sub total I year					478.75	1204.85	128.02	1811.62

Table 7.10 (continued)

Sl	Particulars of works	Rate	Per	Qty/No	Cost breakdown Materials	Labour	Transport	Total cost
1	2	4	5	6	8	9	10	11
II year (10 % replacement of casualties)								
1.	Soil preparation							6.28
	(a) Opening pits (30cmx30cmx30cm	7.39	cmt.	17 Nos.	1.01	4.27	.22	
	(b) Refilling pits (30cmx30cmx30	1.07	cmt.	17 Nos.	.14	.61	.04	
2.	Transportaion of seedlings							2.89
	(a) nursery to plantation site	65.00	1000Nos.	17 Nos.	.32	1.39	.08	
	(b) planting site by head loads	40.00	1000Nos.	17 Nos.	.20	.85	.05	
3.	Planting	40.56	1000Nos.	17 Nos.	.07	1.12	.00	1.19
4.	Weeding & soil working	60.65	1000Nos.	177 Nos.	2.57	13.52	1.31	17.39
5.	Bharav	433.70	1000Nos.	177 Nos.	23.22	121.91	11.62	156.75
6.	Watch & ward (one man for 40 ha)	9.75	Manday	365 days.	.00	160.15	.00	160.15
7.	Fire protection works	218.45	Km.	400 Mts.	20.98	125.82	.00	146.80
8.	Unforseen expenditure	-			5.94	17.82	5.94	29.70
	Sub total for II year				54.46	447.44	19.25	521.15
III year								
1.	Weeding & soil working	60.65	1000Nos.	177 Nos.	2.57	13.52	1.31	17.39
2.	Watch & ward	9.75	Manday	365 days.	.00	320.29	.00	320.29
3.	Fire protection works	218.45	Km.	400 "	20.98	125.82	.00	146.80
4.	Unforseen expenditure				4.18	12.56	4.18	20.92
	Sub total for III year				27.72	472.19	5.48	505.40
IV year								
1.	Fire protection works	218.45	Km.	400 Mts.	20.98	125.82	.00	146.80
2.	Unforseen expenditure				3.78	11.38	3.78	18.94
	Sub total				24.76	137.20	3.78	165.73

Incremental yields and benefits

The effect of the project will be to increase yields as follows:

Product	Unit	Yield With	Yield Without
Bamboo	Tonnes	5.0	2.5
Timber	m^3	2.5	2.0
Fuelwood	Tonnes	2.0	2.0

Freshly planted bamboos will be available after 10 years, and will be removed on a 3 year cycle.

Bamboo is a gregarious flowering species. The species to be planted are not expected to flower before 30 years, and therefore a full cut is allowed for in year 30 before flowering would take place.

In the meantime, the existing yield will be harvested on a more systematic basis, again on a 3 year cycle.

The benefits arise from 2 sources:

(1) Increase in the stocking rate,

(2) Better management of existing stock, by removing dead and other useless stocks.

This is likely to produce an increase in yield of 4 times existing yield per hectare.

At the same time, dead and fallen trees will also be removed, providing timber and fuelwood. This will produce incremental gains only for timber, where only the Forest Department can remove the larger trees.

The price obtainable for each bamboo stick is higher from a well managed plantation. The without project assumption is that the value of bamboo averages 2/3 of the full economic price.

Benefit and cost flows are presented in Table 7.11

Table 7.11 Bamboo plantation

Unit 1 ha.		Project year 1	2	3	4	5	6	7	8	9	10	11
Field costs					Rps '000							
Materials			478.75	54.46	27.72	24.76	24.76	24.76	24.76	24.76	24.76	24.76
Labour			1204.85	447.44	472.19	137.20	137.20	137.20	137.20	137.20	137.20	137.20
Transport			128.02	19.25	5.48	3.78	3.78	3.78	3.78	3.78	3.78	3.78
Total			1811.62	521.15	505.40	165.73	165.73	165.73	165.73	165.73	165.73	165.73
Nursery costs												
Materials		189.78	18.98									
Labour		278.05	27.81									
Transport		114.93	11.49									
Total		582.77	58.28									
Protection costs												
Materials		73.91	4.99									
Labour		352.27	24.70									
Transport		16.19	2.55									
Total		442.36	32.23	.00	.00	32.23	.00	.00	32.23	.00	.00	32.23
Total costs		1025.13	1902.13	521.15	505.40	197.96	165.73	165.73	197.96	165.73	165.73	197.96
Benefits												
With project												
Bamboo	600.00		2.50			2.50			2.50			10.00
Timber	2000.00		2.00			2.00			2.00			2.00
Fuelwood	400.00		2.00			2.00			2.00			2.00
Total			6300.00	.00	.00	6300.00	.00	.00	6300.00	.00	.00	10800.00
Without project												
Bamboo	400.00		2.50			2.50			2.50			2.50
Timber	2000.00		2.00			2.00			2.00			2.00
Fuelwood	300.00		2.00			2.00			2.00			2.00
Total		.00	5600.00	.00	.00	5600.00	.00	.00	5600.00	.00	.00	5600.00
Incremental benefits		.00	700.00	.00	.00	700.00	.00	.00	700.00	.00	.00	5200.00
Net benefit flow		-1025.13	-1202.13	-521.15	-505.40	502.04	-165.73	-165.73	502.04	-165.73	-165.73	5002.04

Rates of return

Using the above estimates of costs and benefits, the incremental rate of return is 17%.

Net present value	
DR	30 years
0	29477.98
5	10151.37
6	8197.07
7	6597.46
8	5282.32
9	4196.47
10	3296.37
15	587.68
20	-566.18
25	-1074.92

IRR (30 years) 17.04

In practice, where the Forest Department are able to control harvesting and ensure sound management through out the life of the project, this rate will be higher.

Sandal plantation model

Sandalwood - or sandal oil - is used both by local industries as an essence and by artisans for religious carvings. Demand for sandal has been increasing. Sandalwood is the main prize of smugglers, and therefore requires considerable protection.

The objective of planting sandal is to ensure a regular and adequate supply of sandalwood to industrial users and for artisans and to provide revenue for the state.

The sandal wood would mostly be planted in the partially open forest areas of Zones II.

At present about 2000 ha of sandalwood is planted per year. However, Uttara Kannara is less well suited to sandalwood and therefore little is planted there.

Costs

Detailed costs are set out in the following Table 7.13 and include the costs of constructing special protection trenchs (Trenching Model 2).

Table 7.13 Sandal plantation (Unit 1 ha.)

	Particulars of works	Rate (Rps)	Per	Quantity	Cost breakdown Material	Labour	Transport	Total cost
	1st year :							
1.	Alignment and stacking	35.43	1000	1000	17.00	30.08	5.46	52.54
2.								
3.	Soil preparation							2931.13
	a.500 trenches (0.45cmx0.45cmx2.00cm)	8.40	cmt	202.50	510.30	2143.26	102.06	
	b.Half refilling of trench	1.07	cmt	101.25	32.50	136.49	6.52	
4.	Transportation of seedlings							371.72
	(a) nursery to plantation site	65.00	1000	1800	14.04	63.18	84.24	
	(b) planting site by headloads	40.00	1000	1500	7.20	97.20	.00	
5.	Planting	40.56	1000	1500	7.30	98.57	.00	
6.	Replacements 20%							153.07
	(a) Opening pits 30cmx30cmx30cm	7.39	cmt	8.10	17.95	75.42	3.60	
	(b) Refilling pits	1.07	cmt	8.10	2.59	10.91	.54	
	(c) Seedlings to site by headload	40.00	1000	300	1.44	19.44	.00	
	(d) Planting	40.56	1000	300	1.45	19.73	.00	
	Seeding on mounds							127.30
	(a) Cost of seeds	-	-	L.S.	43.20	4.05	8.10	
	(b) Cost of sowing	9.75	Manday	6	56.16	5.26	10.54	
8.	Application of manure							1035.00
	(a) Manure (100 plants/cart)	40.00	Cartload	15	504.00	216.00	72.00	
	(b) Application of manure	.10	Plants	1500	36.00	189.00	18.00	
9.	Scraping around plants	56.10	1000	1500	20.20	106.02	10.10	136.32
10.	Bharav to all plants	433.70	1000	1500	156.13	819.68	78.07	1053.89
11.	Fire protection	218.45	km.	400 mts.	31.46	78.64	20.96	131.07
12.	Watch and Ward (1 man for 40 ha)	9.75	Manday	240 days	.00	105.30	.00	105.30
13.	Unforeseen expenditure	-	-	L.S.	40.80	93.26	34.68	168.74
	Subtotal :				1499.72	4311.49	454.87	6266.08
	2nd year :							
	Replacement of casualties (10%)							55.50
	(a) Opening 150 pits 30cmx30cmx30cm	7.39	cmt	4.05	8.98	37.71	1.80	
	(b) Refilling pits	1.07	cmt	4.05	1.30	5.45	.26	
	Transportation of seedlings							23.89
	(a) Nursery to plantation site	65.00	1000	150	1.16	5.26	7.03	
	(b) Planting site on head loads	40.56	1000	150	.72	9.72	.00	
3.	Planting	40.56	1000	150	.83	11.32	.00	12.15
4.	Seeding on mound							63.65
	(a) Cost of seeds			L.S.	21.60	2.02	4.06	
	(b) Cost of sowing	9.75	Manday	3	28.08	2.63	5.27	
5.	Weeding and soil working	60.65	1000	1500	21.83	114.62	10.93	147.38
6.	Bharav	433.70	1000	1500	156.13	819.68	78.07	1053.89
7.	Fire protection works	218.45	km.	400 mts	31.45	78.64	20.98	131.07
8.	Watch and ward (1 man for 40 ha)	9.75	Manday	365 days	.00	160.15	.00	160.15
9.	Unforeseen expenditure		-	L.S.	22.01	66.06	22.01	110.08
	Subtotal :				294.08	1313.26	150.41	1757.75

Table 7.13 (continued)

(Unit 1 ha.)

	Particulars of works	Rate (Rps)	Per	Qty/Nos.	Cost breakdown Material	Labour	Transport	Total cost
	3rd year :							
1.	Weeding and soil working	60.65	1000	1500	21.83	114.62	10.93	147.38
2.	Fire protection works	218.45	km.	400 mts	31.45	78.64	20.98	131.07
3.	Watch and ward	9.75	Manday	365 days	.00	160.15	.00	160.15
4.	Unforeseen expenditure	-	-	L.S.	9.79	29.43	9.79	49.01
	Subtotal :				63.07	382.84	41.70	487.61
	4th year onwards :							
1.	Fire protection works	218.45	km.	100 mts	6.55	19.67	6.55	32.78
2.	Watch and ward (1 man for 40 ha)	9.75	Manday	365 days	.00	64.06	.00	64.06
3.	Unforeseen expenditure	-		L.S.	5.27	15.80	5.27	26.34
	Subtotal :				11.82	99.54	11.82	123.18

Removals and yields

From year 10, host plants will be lopped regularly, providing the following in a 5 year cycle:

Fuelwood	1 tonne per ha.
Green manure	100 kg per ha.

The yield of sandal wood is as follows:

Year 30, 2 tonnes per ha.,
Year 60, 2 tonnes per ha.,
Year 80, 3 tonnes per ha.

Table 7.14 Sandal plantation (Unit 1 ha.)

		Project year										
		1	2	3	4	5	6	7	8	9	10	11-14	15
Field costs													
Materials			1499.72	294.08	63.07	11.82	11.82	11.82	11.82	11.82	11.82	11.82	11.82
Labour			4311.49	1313.26	382.84	99.54	99.54	99.54	99.54	99.54	99.54	99.54	99.54
Transport			454.87	150.41	41.70	11.82	11.82	11.82	11.82	11.82	11.82	11.82	11.82
Total			6626.08	1757.75	487.61	123.18	123.18	123.18	123.18	123.18	123.18	123.18	123.18
Nursery costs													
Materials		564.72	56.47										
Labour		798.30	79.83										
Transport		266.79	26.68										
Total		1629.80	162.98										
Protection costs													
Materials		886.28	1.54										
Labour		3731.93	9.91	50.00	.00	50.00	.00	50.00	.00	50.00	.00	.00	75.00
Transport		177.76	.52										
Total		4795.98	11.98	50.00	.00	50.00	.00	50.00	.00	50.00	.00	.00	75.00
Total costs		6425.78	6441.04	1807.75	487.61	173.18	123.18	173.18	123.18	173.18	123.18	123.18	198.18
Benefits													
With project													
Timber	1000.00	10											
Billets	500.00	10											
Sandal	50000.00												
Sandal	120000.00												
Fuelwood	300.00	3				3					3		3
G Manure	100.00										.1		.1
Total		15900.00	.00	.00	.00	900.00	.00	.00	.00	.00	910.00	.00	910.00
Without project													
Sandal	50000.00												
Timber	1000.00	3				3					3		3
Billets	500.00	1				1					1		1
Fuelwood	300.00	3				3					3		3
Total		4525.00	.00	.00	.00	4525.00	.00	.00	.00	.00	4525.00	.00	4525.00
Incremental benefits		11375.00	.00	.00	.00	-3625.00	.00	.00	.00	.00	-3615.00	.00	-3615.00
Net benefit flow		4949.23	-6441.04	-1807.75	-487.61	-3798.18	-123.18	-173.18	-123.18	-173.18	-3738.18	-123.18	-3813.18

20	21-24	25	26-29	30	31-59	60	61-79	80
11.82	11.82	11.82	11.82	11.82	11.82	11.82	11.82	11.82
99.54	99.54	99.54	99.54	99.54	99.54	99.54	99.54	99.54
11.82	11.82	11.82	11.82	11.82	11.82	11.82	11.82	11.82
123.18	123.18	123.18	123.18	123.18	123.18	123.18	123.18	123.18

.00	75.00		75.00		75.00		500.00		300.00
.00	75.00	.00	75.00	.00	75.00	.00	500.00	.00	300.00
123.18	198.18	123.18	198.18	123.18	198.18	123.18	623.18	123.18	300.00

	3 .1		3 .1		3 1		3 .1		3 1
.00	910.00	.00	910.00	.00	200910.00	.00	480910.00	.00	720910.00

	3 1 3		3 1 3		3 1 3		1 3		3 1 3
.00	4400.00	.00	4400.00	.00	54400.00	.00	54400.00	.00	54400.00
.00	-3490.00	.00	-3490.00	.00	146510.00	.00	426510.00	.00	666510.00
-123.18	-3688.18	-123.18	-3688.18	-123.18	146311.82	-123.18	425886.82	-123.18	666210.00

Rate of return

The rate of return to sandalwood planting, over 80 years, under the assumptions of this model is about 10%.

Net present value	
DR	80 years
0	1212751
5	54695
6	30536
7	16486
8	8057
9	2863
10	-405
15	-5473
20	-5442
25	-4688

IRR (80 years) 10%

C. Gap filling and enrichment models

Introduction

Three gap filling and enrichment models have been specified, appropriate for each of the classes of degradation defined in the main text and Annex III. In each case the models represent mixed species planting.

Model	Land type	Canopy cover
'A'	Degraded	< 20%
'B'	Partially degraded	20% - 40%
'C'	Medium	40% - 100%

The costs and benefits of each of the models are presented separately, before discussing the estimated rates of return

Model 'A'

Costs

Fields costs for model 'A' are set out in Table 7.15.

The initial cost of demarcation and construction of a cattle proof trenching (CPT) was presented earlier (Table 7.2) and the estimated cost of seedling production is presented later in Table 7.20.

Table 7.15 Gap planting 'A' (Unit 1 ha.)

	Particulars of works	Rate (Rps)	Per	Quantity	Cost breakdown Materials	Labour	Transport	Total cost
	1st year :							
1.	Soil preparation							958.84
a.	Pits 0.50cm x 0.50cm x 0.50cm(500 Nos.)	8.40	cmt	62.50 cmt	157.50	661.50	31.50	
b.	Refilling pits (500 Nos.)	1.07	cmt	62.50 cmt	20.06	84.26	4.02	
2.	Transportation of seedlings							79.65
a.	From nursery to plantation site	65.00	1000	500 Nos.	3.90	17.55	23.40	
b.	To planting site by head loads	40.00	1000	500 Nos.	2.40	32.40	.00	
3.	Planting	40.56	1000	500 Nos.	2.50	32.76	.00	35.26
4.	Scraping around plants	56.10	1000	500 Nos.	6.73	35.33	3.37	45.44
5.	Bharav to all plants	433.70	1000	500 Nos.	52.04	273.22	26.03	351.29
6.	Watch and ward (1 man for 40 ha)	9.75	Manday	240 days	.00	105.30	.00	105.30
7.	Unforeseen expenditure				9.58	28.76	9.58	47.92
	Subtotal :				254.71	1271.09	97.90	1623.70
	2nd year :							
1.	Scraping around plants (80% survival)	56.10	1000	400 Nos.	5.38	28.26	2.71	36.35
2.	Bharav to plants (80% survival)	433.70	1000	400 Nos.	41.63	218.57	20.83	281.03
3.	Watch and ward (1 man for 40 ha)	9.75	Manday	365 days	.00	160.15	.00	160.15
4.	Unforeseen expenditure				4.52	13.63	4.52	22.67
	Subtotal :				51.53	420.61	28.07	500.20
	3rd year :							
1.	Bharav to plants (70% survival)	433.70	1000	350 Nos.	36.43	191.27	18.22	245.92
2.	Watch and ward (1 man for 40 ha)	9.75	Manday	365 days	.00	160.15	.00	160.15
3.	Unforeseen expenditure				2.76	8.33	2.76	13.85
	Subtotal :				39.19	359.75	20.98	419.92
	4th year onwards (Nil)							

Benefits

Incremental benefits depend to a large extent on the assumptions taken for the productivity of the land pre-planting.

In Model 'A', the land is badly degraded and it is assumed that only grazing is possible.(Table 7.16) An annual loss of fodder due to effective protection measures has been included in the model.

Further, as a result of the gap filling, there would be a loss of any naturally regenerated growth, which has been replaced by the newly planted trees. This has been assumed to be equivalent to 40% of the final cut from the plantation.

Table 7.16 Gap planting Model 'A'

Unit 1 ha.

	Project year 1	2	3	4	5	6	7	8	9	10	20,	30,	40,50, 60,70	80
Field costs														
Materials		254.71	51.53	39.19										
Labour		1271.09	420.61	359.75										
Transport		97.90	28.07	20.98										
Total		1623.70	500.20	419.92										
Nursery costs														
Materials	156.87	15.69												
Labour	221.75	22.17												
Transport	74.11	7.41												
Total	452.72	45.27												
Protection costs														
Materials	73.91	4.99			4.99			4.99						
Labour	352.27	24.70			24.70			24.70						
Transport	16.19	2.55			2.55			2.55						
Total	442.36	32.23			32.23			32.23		100.00	100.00	100.00	100.00	100.00
Total costs	895.08	1701.20	500.20	419.92	32.23	.00	.00	32.23	.00	100.00	100.00	100.00	100.00	100.00

Benefits	Unit price	Project year 1	2	3	4	5	6	7	8	9	10	20	30	40,50, 60,70	80
With project															
Timber	2000.00	5.00									5.00	5.00	5.00	5.00	60.70
Billets	800.00	2.50									2.50	2.50	2.50	2.50	30.35
Fuelwood	400.00	4.00									4.00	4.00	4.00	4.00	12.14
Planted timber	2000.00													25.00	
Total extraction		13600									13600	13600	13600	13600	
Total replanting														50000	150536
Total		13600	0	0	0	0	0	0	0	0	13600	13600	13600	63600	150536
Without project															
Timber	1000.00														23.30
Billets	500.00														11.65
Fodder	300.00	.50	.50	.50	.50	.50	.50	.50	.50	.50	3.15	3.15	3.15	3.15	
Total		150	150	150	150	150	150	150	150	150	945	945	945	945	29125
Incremental benefits		13450	-150	-150	-150	-150	-150	-150	-150	-150	12655	12655	12655	62655	121411
Only for replanting		-150	-150	-150	-150	-150	-150	-150	-150	-150	-945	-945	-945	49055	121411
Net benefit flow		12555	-1851	-650	-570	-182	-150	-150	-182	-150	12555	12555	12555	62555	121311
Only for replanting		-1045	-1251	-650	-570	-182	-150	-150	-182	-150	-1045	-1045	-1045	48955	121311

Rate of return

The rate of return under a number of different assumptions is discussed after Model 'C' is presented.

Net present value (80 years)			
DR(%)	Assumption		
	I	II	III
0	417865	405310	309065
1	240029	227675	161369
2	145520	133345	85612
3	93510	81496	45756
4	63816	51947	24238
5	46204	34468	12337
6	35345	2373	5610
7	28387	16883	1738
8	23754	12354	-520
9	20555	9252	-1844
10	18268	7055	-2619
15	12821	1999	-3470
20	10748	256	-3205
25	9629	-561	-2887
30	8910	-994	-2616

Model 'B'

Costs

Model 'A' and 'B' are essentially the same, except in terms of planting densities:

Model 'A' has a replanting density of 500 trees/ha
Model 'B' has a replanting density of 750 trees/ha.

The higher planting density in Model 'B' is because in the partially degraded areas, represented in Model 'B', a more rigerous thinning of inferior species is required.

Costs are based on Model 'A', but increased by 50%.

Benefits

In model 'B', where there has been less biotic pressure than in Model 'A', it is assumed that the without project products on a five year cycle would be 40% of timber, 50% of billets and 70% of fuelwood of the with project level. (Table 7.16)

Further, as a result of the filling, there would be a loss of any naturally regenerated growth, which has been replaced by the newly planted trees. This has been assumed to be equivalent to 40% of the final cut from the plantation.

Table 7.16 Gap planting Model 'B'

Benefits

	Unit price	Project year 1	2	3	4	5	6	7	8	9	10	20
With project												
Timber	2000.00	9.00				9.00					9.00	9.00
Billets	800.00	4.00				4.00					4.00	4.00
Fuelwood	400.00	5.00				5.00					5.00	5.00
Extraction		23200.00				23200.00					23200.00	23200.00
Planted timber	2000.00											
Total extraction												
Total		23200.00	.00	.00	.00	23200.00	.00	.00	.00	.00	23200.00	23200.00
Without project												
Timber	1000.00	4.00				4.00					4.00	4.00
Billets	500.00	2.00				2.00					2.00	2.00
Fuelwood	300.00	3.50				3.50					3.50	3.50
Total		6050.00				6050.00					6050.00	6050.00
Incremental benefits		17150.00	.00	.00	.00	17150.00	.00	.00	.00	.00	17150.00	17150.00
Net benefit flow		16028.55	-2535.68	-750.30	-629.87	17117.77	.00	.00	-32.23	.00	17150.00	17050.00

Rate of return

The net present value of this model under a number of assumptions is given below and discussed after Model 'C'

DR(%)	Net present value Assumpton		
	I	II	III
1	280919	265329	139550
2	179604	164406	68770
3	122910	108064	31778
4	89839	75310	11969
5	69684	55441	1127
6	56833	42849	-4911
7	48259	34510	-8309
8	42278	28744	-10219
9	37926	24589	-11272
10	34636	21478	-11821
15	25539	13096	-11831
20	21071	9142	-10894
30	16216	5023	-9220
40	13513	2881	-7987
50	11768	1620	-7057
60	10537	830	-6333
70	9614	314	-5753
80	8887	-32	-5278

Model 'C'

Costs

Model 'C' represents an enrichment model and here the species mix is assumed to have a larger proportion of higher valued species, such as teak. Costs are given in Table 7.17

Incremental benefits

Most of the original stock is left intact, and only the incremental benefits have been accounted for in the model (Table 7.18).

Table 7.17 Enrichment 'C' (Unit 1 ha.)

	Particulars of works	Rate (Rps)	Per	Quantity	Cost breakdown ----- Material	Labour	Transport	Total cost
	1st year:							
1.	Alignment and stacking	35.43	1000	1000.00	17.00	30.08	5.46	52.54
2.								
3.	Soil preparation							1346.21
	(a) 1000pits (0.45mx0.45mx0.45)	8.40	cmt	91.13	275.56	826.69	91.85	
	(b) Refilling of pits	1.07	cmt	91.13	35.10	105.30	11.70	
	Transportation of seedlings							184.08
	(a) Nursery to plantation site	65.00	1000	1200.00	28.08	84.24	9.36	
	(b) Planting site by headloads	40.00	1000	1000.00	14.40	43.20	4.80	
5.	Planting	40.56	1000	1000.00	14.60	43.80	4.87	63.27
6.	Replacements 20%							96.23
	(a) Opening pits 30cmx30cmx30cm	7.39	cmt	5.40	14.37	43.10	4.79	
	(b) Refilling pits	1.07	cmt	5.40	2.08	6.24	.69	
	(c) Seedlings to site by headload	40.00	1000	200.00	2.88	8.64	.96	
	(d) Planting	40.56	1000	200.00	2.88	8.64	.96	
7	Scraping around plants	56.10	1000	1000.00	20.20	60.59	6.73	87.52
8.	Fire protection	218.45	km.	400 mts.	31.46	94.37	10.49	136.31
9.	Watch and Ward (1 man for 40 ha)	9.75	Manday	240 days	21.06	63.18	7.02	91.26
10.	Unforeseen expenditure	-	-	L.S.	37.58	112.74	12.53	162.85
	Subtotal :				517.25	1503.81	172.21	2220.27
	2nd year :							
1.	Replacement of casualties (10%)							37.00
	(a) Opening 100 pits 30cmx30cmx30cm	7.39	cmt	2.70	2.39	25.14	4.79	
	(b) Refilling pits	1.07	cmt	2.70	.35	3.64	.69	
2.	Transportation of seedlings							22.79
	(a) Nursery to plantation site	100.00	1000	100.00	1.20	12.60	2.40	
	(b) Planting site on head loads	40.56	1000	100.00	.49	5.13	.98	
3.	Planting	40.56	1000	100.00	.49	5.12	.97	6.58
4.	Weeding and soil working	60.65	1000	1000.00	7.28	76.42	14.56	98.25
5	Bharav	433.70	1000	1000.00	52.04	546.46	104.09	702.59
6.	Soil and moisture conservation work	-	-	-	30.00	315.00	60.00	405.00
7.	fire protection works	218.45	km.	400 mts	10.49	110.10	20.97	141.56
8.	Watch and ward (1 man for 40 ha)	9.75	Manday	365 days	10.68	112.10	21.35	144.13
9.	Unforeseen expenditure		-	L.S.	4.60	48.30	9.20	62.09
	Subtotal :				120.00	1260.00	240.00	1620.00
	3rd year :							
1.	1st Weeding and soil working	60.65	1000	1500.00	21.83	114.62	10.93	147.38
2.	2nd Weeding and soil working	60.65	1000	1500.00	21.83	114.62	10.93	147.38
3.	Soil and moisture conservation work				.00	16.24	.00	16.24
4.	Fire protection works	218.45	km.	400 mts	31.45	78.64	20.98	131.07
5.	Watch and ward	9.75	Manday	365 days	.00	160.15	.00	160.15
6.	Unforeseen expenditure	-	-	L.S.	9.79	29.43	9.79	49.01
	Subtotal :				84.90	513.70	52.63	651.23
	4th year onwards							
	No expenditure							

Table 7.18 Enrichment Model 'C' (Unit 1 ha.)

	Project year											
	1	2	3	4	5	6	7	8	9	10	11	12
Field costs												
Materials		517.25	120.00	84.90								
Labour		1530.81	1260.00	513.70								
Transport		172.21	240.00	52.63								
Total		2220.27	1620.00	651.23								
Nursery costs												
Materials	1723.52	172.35										
Labour	1093.62	109.36										
Transport	398.60	39.86										
Total	3215.74	321.57										
Protection costs												
Materials	73.91	4.99										
Labour	352.27	24.70										
Transport	16.19	2.55										
Total	442.36	32.23			32.23			32.23			32.23	.00
Total costs	3658.11	2574.07	1620.00	651.23	32.23	.00	.00	32.23	.00	.00	32.23	.00

Benefits

	Unit price	Project year 1	2	3	4	5	6	7	8	9	10	11	12
With project													
Poles	9.00						300						
Poles	11.00												300
Poles	295.00												
Poles	740.00												
Timber	2425.00												
Timber	4850.00												
Timber	8000.00												
Billets	1000.00												
Total							2700.00						3300.00
Without project													
Timber	1000.00												
Billets	500.00												
Fuelwood	300.00												
Grazing	300.00	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
Total		150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Incremental benefits		-150.00	-150.00	-150.00	-150.00	-150.00	2550.00	-150.00	-150.00	-150.00	-150.00	-150.00	3150.00
Net benefit flow		-3808.11	-2724.07	-1770.00	-801.23	-182.23	.00	-150.00	-182.23	-150.00	-150.00	-182.23	3150.00

13-17	18	19-23	24	25-39	40	41-59	60	61-79	80
.00	64.47	.00	64.47	.00	150.00		150.00		150.00
.00	64.47	.00	64.47	.00	150.00	.00	150.00	.00	150.00

13-17	18	19-23	24	25-39	40	41-59	60	61-79	80
	150						50		100
	2		3		10		10		10
	46250.00		43000.00		131250.00		252500.00		810000.00
	20.00 10.00 10.00								
2.50	.50	2.50	.50	7.50	.50	10.00	.50	10.00	.50
750.00	28150.00	750.00	150.00	2250.00	150.00	3000.00	150.00	3000.00	150.00
-750.00	18100.00	-750.00	42850.00	-2250.00	131100.00	-3000.00	252350.00	-3000.00	809850.00
-750.00	18035.53	-750.00	42785.53	-2250.00	130950.00	-3000.00	252200.00	-3000.00	809700.00

Rate of return

The net present value of this model under a number of assumptions is given below and discussed in the next section.

Net present value	
DR (%)	Assumption III
0	1246721
5	59686
6	35454
7	21081
8	12170
9	6411
10	2549
11	-123
12	-2020
13	-3393
14	-4401
15	-5149
20	-6820

IRR (30 years) 11%

Rates of Return to gap planting and enrichment

The rates of return for these models, over an 80 year period, models have been calculated under three different assumptions.

Assumption I

This is the rate of return to the incremental planting. Model 'B' has a lower return compared to model 'A' because of the relatively higher costs, and the higher assumptions about produce foregone in the without project scenario.

Model 'C' is essentially a return to planting higher valued species such as teak.

Assumption II

This is the return to both the incremental planting and the thinning of pre-project planted trees, which will be maintained and thinned with the fresh planting.

Because of the more rigorous thinning during establishment in Model 'B', the rate of return is very high to this model, since it is effectively the combining of enrichment by selecting out superior stands, with replanting of gaps. Further, the benefits of increased protection and systematic working of the plantation leads to increased yield of fuelwood and timber.

Assumption III

This assumption includes the returns from the harvesting of the existing crop, at the time of planting fresh material. In each case, the net incremental benefit flows are positive throughout, with the fresh planting costs being absorbed by the revenue.

Table Rates of return to gap filling models under different assumptions

Assumption		Model		
		A	B	C
Replanted seedlings	I	8%	5%	11%
Replanting and future thinning of existing stock	II	20%	75%	
Replanting, future thinning of existing stock, clearing for replantation	III	all	all	

The models are all sensitive to the discount rate. This can be seen in the following table of NPV's over 80 years.

Model	Discount rate	Assumption I	Assumption II	Assumption III
Gap 'A'	5%	46,200	34,500	12,300
	10%	18,300	7,060	- 2,620
Gap 'B'	5%	69,100	55,400	1,130
	10%	34,600	21,500	-11,800
Enrich 'C'	5%	59,700	-	-
	10%	2,500	-	-

Summary

The different alternatives outlined above reflect different approaches to handling the opportunity costs associated with the proposed investment.

Assumption I assumes that there are alternative uses to the land and that the allocation of fresh investment resources is dependant on a comparison of alternative ventures - consistent with the capital rationing approach.

Assumption III represents the view that consideration of alternative land uses for the present forest area is not permissible. The area is forest.

In this case, the income derived from the forest asset is net of an amount set aside for reproduction and maintaince of the capital value of the stock.

Assumption II represents an approximation to the return on better management, part of which includes replanting where neccessary. This assumption underlies the rationale for the emphasis of the project on management, on processes and understanding. Quantification of these benefits is attempted in Chapter 7 of the main text, where benefits per hectare are built up for different effeciency gains.

(D) Forest Maintenance and Working

The project will fund the regular working of teak and other existing forests. This is already being carried out but the incremental benefits attributable to the project are as follows:

(1) More efficient logging and thinning
(2) Better site selection as a result of improved planning, understanding and GIS
(3) Assured financing of harvesting costs

The revenue and costs of thinning teak plantations was estimated for each age class and averaged over a 3000 ha plantation. (Table 7.19)

Table 7.19

Age class	Area in each class	Poles per ha		Thinning costs Rps each	Cost per ha Rps/ha	Total cost per 3000 ha	Value per pole	Value per 3000 ha	Net revenue Rps per 3000ha per annum
		Balance	Cut						
0		2500							
6	800	1300	1200	1.00	1200.00	960000.00	8.00	8320000.00	1,225,000.00
12	700	650	650	5.00	3250.00	2275000.00	30.00	13650000.00	1,895,000.00
18	600	500	150	20.00	3000.00	1800000.00	400.00	120000000.00	1,970,000.00
24	450	375	125	50.00	6250.00	2812500.00	1500.00	253125000.00	12,515,000.00
40	250	275	100	150.00	15000.00	3750000.00	2500.00	171875000.00	8,405,000.00
60	150	175	100	200.00	20000.00	3000000.00	5000.00	131250000.00	6,410,000.00
80	50	75	100	200.00	20000.00	1000000.00	8000.00	30000000.00	1,450,000.00
100		0	75						
Total	3000					15597500.00		728220000.00	33,870,000.00

Taking an average annual cut from each age class, gives the net revenue from a 3000 ha teak plantation, representing all age classes, to be approximately Rs 34,000,000 per 3000 ha or Rps 11,300 per hectare per annum (Table 7.19).

More typically, given a range of species, most of which are considerably less valuable than teak, the net potential revenue is estimated to average about Rs 6,000 per hectare.

With the improved efficiency resulting from the investment in logging technique training and improved equipment, a 10% gain in logging efficiency is expected.(Annex III) This would amount to Rs 600 per hectare.

With assured financing, it is estimated that thinning will take place earlier than otherwise. This leads to an economic benefit arising from the earlier realisation of income and from the faster growth of the remaining plantation.

The 'economic', rather than financial value, of this revenue depends on the number of years by which the thinning is advanced and the return on subsequent reinvestment. This is estimated for each hectare under a range of interest rates and for a range of time periods. (Table 7.20) (This gain arises from the difference in the present value of the revenue less the discounted future value.)

Table 7.20 Economic value of earlier thinning.

Rs '000 / ha	Years advanced					
Interest rate	10	5	4	3	2	1
10 %	3.7	2.3	1.9	1.5	1.0	0.5
5 %	2.3	1.3	1.1	0.8	0.6	0.2
2 %	0.9	0.6	0.5	0.3	0.2	0.1

Under conservative assumptions, of say 2 years and 10% interest, there is an economic benefit of approximately Rs 1,000 per hectare. With the careful selection of valueable teak areas, this economic benefit would be even more considerable.

The combined benefits of improved logging efficiency and earlier thinning result in an estimated 'economic' gain of Rs 1,600.00 per hectare.

This analysis also shows the importance of regular sustained thinning and maintenance of the existing plantations. The project does not provide for a significant increase in new planting, since it has been argued that this would be at the expense of such maintenance work.

Under the no-logging policy currently in operation, dead and fallen trees are being extracted from a much wider area - at higher cost - than was previously worked. The above analysis tends to support this policy as there appear to be significant economic gains from it.

However, the allocation of resources between working these areas and new plantings requires more detailed analysis than is presented here. The planning and monitoring unit proposed under the project would be entrusted with the task of providing data and analysis in order to quide future policy.

5. GRAZING AND LIVESTOCK MANAGEMENT MODELS

Introduction

The competition between the grazing requirements of local animals and the environmental and economic benefits of forests is perhaps the most difficult to resolve. The project does not attempt to do so, but to provide a mechanism for better management of these conflicts.

In Annex V, a number of schemes are put forward as possible options to be considered. These involve the modifications to the multi-purpose models described earlier and include staggered planting, wider spacing, silvi-pastorial plots, rotational grazing and the inter planting of higher yielding varieties.

Other suggestions relating to the management of forest and alternative land uses, include proposals for fire protection and communal pasture land. These issues will need to be considered by the Joint Planning teams.

Fodder farms

In addition to the modifications to the models discussed in earlier sections, the project will introduce fodder farms, initially on an experimental basis, to provide fodder for dry season stall feeding. The costs of an irrigated fodder model are specified in Table 7.21

Economic analysis of these farms is premature at this stage, since they are to be introduced on an experimental basis only. The project will fund studies to evaluate and monitor the progress of the suggestions for livestock management including fodder farms.

Accomodation of grazing with other forest objectives will need to be given priority, since many of the earlier models and the environmental benefits rest on the assumption that the plantings will be protected from severe grazing. However, no ready made solutions are available.

Table 7.21 Fodder farm (Unit 1 ha.)

Particulars of works	Rate (Rps)	Per	Quantity	Cost breakdown Material	Labour	Transport	Total cost
1st Year							
1. Site preparation							1830.00
(a) Levelling	200.00	ha.	1.00ha.	60.00	270.00	.00	
(b) Bunding	50.00	ha.	1.00ha.	.00	90.00	.00	
(c) Ploughing	750.00	ha.	1.00ha.	60.00	180.00	720.00	
(d) Irrigation channels	250.00	ha.	1.00ha.	.00	450.00	.00	
2. Irrigation		1 well/5 ha.					8664.00
(a) Borewell	25000.00		1.00ha.	4800.00	450.00	900.00	
(b) Electrification	1000.00		1.00ha.	180.00	72.00	12.00	
(c) Pump,motor pipe etc	9000.00		1.00ha.	1920.00	270.00	60.00	
3. Fencing -barbed wire approx 180m/km							3802.34
(a) Cost of stone pillars fixing	12.00	one	72Nos.	777.60	270.00	79.20	
(b) Cost of Barbed wire	350.00	tonne	5Tonne	2400.00	45.00	90.00	
(c) Fixing Barbed wire	1.21	2.5m.	180m.	26.54	108.00	6.00	
4. Preparation of stake/alignment	35.43	1000 Nos.	400Nos.	6.79	12.76	1.70	21.26
5. Soil preparation							9180.13
(a) 60 cm.x60cm.x60 cm. (pit 400)	7.39	cmt.	86cmt.	191.56	795.51	38.30	
(b) 45 cm.x45 cm.x60 cm. (Trenches 20)	7.39	cmt.	354cmt.	790.14	3318.59	158.03	
(c) 4mx100m (grass slips in 20 plots)	.30	Sq.m.	3000Sq.m.	720.00	3024.00	144.00	
6. Transportation of Seedlings							
(a) Nursery to plantation site (15km)							827.66
a.1 Seedlings	65.00	1000 Nos.	5280Nos.	41.18	194.35	247.13	
a.2 Grass slips	250.00	-	-	30.00	135.00	180.00	
(b) Planting site on head loads							518.88
b.1 Seedlings	40.00	1000 Nos.	4400Nos.	21.12	95.04	126.72	
b.2 Grass slips	200.00	-		24.00	108.00	144.00	
7. Replacement of failure at 20%							436.34
(a) Opening pits 30Cmx30Cmx30Cm=200No	7.39	cmt.	880Nos.	52.68	221.24	10.54	
(b) Refilling pits (30cmx30cmx30xm)	1.07	cmt.	880Nos.	7.63	32.02	1.52	
(c) Transport to site by headload	40.00	1000 Nos.	880Nos.	4.22	19.03	25.36	
(d) Planting	40.56	1000 Nos.	880Nos.	4.28	57.82	.00	
8. Scraping around plants	56.10	1000 Nos.	4400Nos.	59.24	311.02	29.62	399.88
9. Weeding & Soil working	60.65	1000 Nos.	4400Nos.	64.04	336.24	32.03	432.31
10.Fire protection	218.45	Km.	400Km.	20.98	125.82	.00	146.80
11.Watch & Ward							
1 man per 5 ha.for July to March	9.75	Manday	240days	.00	842.40	.00	842.40
12.Application of Fertilizers							84.96
(a) Fertilizer cost (30 gm/plant)	4.50	Kg.	12Kgs	51.84	.00	12.96	
(b) Application of Fertilizers	30.00	1000 Nos.	400Plants	1.44	17.28	1.44	
13.Cost of Diesel & Electricity	50.00	ha.	1.00ha.	480.00	45.00	90.00	615.00
14.Unforseen expenditure				40.86	122.54	40.86	204.26
Sub total 1st year				12836.16	12018.65	3151.40	28006.22

Table 7.21 Fodder farm continued
(Unit 1 ha.)

Particulars of works	Rate (Rps)	Per	Quantity	Cost breakdown Material	Labour	Transport	Total cost
2nd Year							
1. Soil preparation							428.66
(a) Opening pits (30cmx30cmx30cm)	7.39	cmt.	440Nos.	3.53	15.03	.71	
(b) 4mx100m (Grass slip plots)	30.00	Sq.mtr.	800Sq.m.	72.00	302.40	14.40	
(c) Refilling pits (30cmx30cmx30cm)	1.07	cmt.	440Nos.	3.77	16.02	.80	
2. Transportation of Seedlings							70.09
(a) Nursery to plantation	65.00	1000	440Nos.	3.43	15.44	20.59	
(b) Planting site on head loads	40.00	1000	440Nos.	2.11	28.51	.00	
3. Seeding	50.101	ha.	1.00ha	12.11	113.40	20.41	145.92
4. Scraping around plants	56.10	1000	4400Plants	59.24	311.02	29.62	399.88
5. Weeding and soil working	60.65	1000	400Plants	5.82	30.56	2.92	39.30
6. Fire protection	213.45	Km.	400m.	20.90	125.93	.00	146.83
7. Watch & Ward							
1 man for every 5 ha.	9.75	Manday	365days	.00	1281.15	.00	1281.15
8. Cost of Diesel & Electricity	800.00	ha.	1.00ha.	768.00	72.00	144.00	984.00
9. Unforseen expenditure				.00	.00	.00	.00
Sub Total II year				950.92	2311.47	233.45	3495.83
3rd Year							
1. Scraping around plants	56.10	1000	4400Nos.	59.78	311.02	29.08	399.88
2. Weeding & Soil working	60.65	1000	400Plants	5.82	30.56	2.92	39.30
3. Fire protection	213.45	Km.	400m.	20.96	125.84	.00	146.80
4. Watch & ward	9.75	Manday	365days	.00	1281.15	.00	1281.15
5. Unforseen expenditure				8.93	26.80	8.93	44.66
Sub Total III year				95.50	1775.38	40.92	1911.79
4th year							
1. Fire protection	218.45	Km.	400m.	20.98	125.82	.00	146.80
2. Watch & ward	9.75	Manday	365days	.00	1281.15	.00	1281.15
3. Unforseen expenditure				.00	1.57	.00	1.57
Sub Total IV year				20.98	1408.54	.00	1429.51

6.SEEDLING PRODUCTION

Seedling production costs for 1000 seedlings were used to estimate the cost of seedling production for each planting model (Table 7.22) and for each trenching model (Table 7.23)

Given the planting densities specified for each model and after allowing for casualities, the seedling costs for each model have been estimated. (Table 7.24)

These costs have been incorporated into the benefit cost models discussed in earlier sections of this annex. However seedling production will be organised under a separate division within each Circle. (See Chapter 5 of the main text)

Table 7.22 Unit costs of seedling production. Plantation models

Model / Activity	Unit	Cost per unit: Materials	Labour	Transport	Total cost
Gap planting 'A'					
Seedbed	1000	28.40	56.25	23.44	108.09
Seedlings (8mts polypot)	1000	256.81	346.93	111.30	715.04
Total	1000	285.21	403.18	134.74	823.13
Gap planting 'B'					
Seedbed	1000	28.40	56.25	23.44	108.09
Seedlings (8mts polypot)	1000	256.81	346.93	111.30	715.04
Total	1000	285.21	403.18	134.74	823.13
Teak plantations 'C'					
Pre-spruted seedlings	1000	1305.70	828.50	301.97	2436.17
Bamboo plantations					
	1000	812.29	1190.09	491.92	2494.30
Sandal plantations					
Seedbed	1000	28.40	56.25	23.44	108.09
Seedlings (8mts polypot)	1000	256.81	346.93	111.30	715.04
Total	1000	285.21	403.18	134.74	823.13
Multiple purpose planting					
(a) Seedbed	1000	28.40	56.25	23.44	108.09
Seedlings (8mts naked)	1000	72.98	151.79	35.82	260.59
Total	1000	101.38	208.04	59.26	368.68
(b) Seedbed	1000	28.40	56.25	23.44	108.09
Seedlings (8mts polypot)	1000	256.81	346.93	111.30	715.04
Total	1000	285.21	403.18	134.74	823.13
(c)	1000				
Seedlings (24 mts grafte	1000	2189.72	4689.92	855.86	7735.50
Total	1000	2189.72	4689.92	855.86	7735.50
Multiple purpose planting					
Seedbed	1000	28.40	56.25	23.44	108.09
Seedlings (8 mts polypot	1000	256.81	346.93	111.30	715.04
Year 1 costs	1000	285.21	403.18	134.74	823.13
Year 2 costs	1000	1016.39	1617.30	517.69	3151.38

Table 7.23 Unit costs of seedling production. Trenching models

Model / Activity	Unit	Cost per unit: Materials	Labour	Transport	Total cost
Live hedge strip planting					
Year 1 seedlings					
8 mts naked	1000	101.38	208.04	59.26	368.68
8 mts polypot	1000	285.21	403.18	134.74	823.13
24 mts polypot	1000	285.21	403.18	134.74	823.13
Agave	1000	144.39	402.12	97.54	644.05
Year 2 seedlings					
24 mts polypot	1000	1016.39	1617.30	517.69	3151.38
Live hedge line planting					
Agave	1000	144.39	402.12	97.54	644.05

Table 7.24 Costs of seedling production per hectare

Model	Unit	Costs per unit planted			Total initial cost
		Materials	Labour	Transport	
Plantation models					
Gap planting 'A'	ha	156.87	221.75	74.11	452.72
Gap planting 'B'	ha	235.30	332.62	111.16	679.08
Teak plantation	ha	1723.52	1093.62	398.60	3215.74
Bamboo plantation	ha	189.78	278.05	114.93	582.77
Sandal plantation	ha	564.72	798.30	266.79	1629.80
Multiple purpose planting					
Type 1	ha	214.11	439.38	125.16	778.65
Type 2	ha	306.08	432.68	144.60	883.35
Type 3	ha	251.47	538.59	98.29	888.34
Total	ha	771.66	1410.65	368.04	2550.35
Multiple purpose planting					
Year 1	ha	403.96	571.05	190.84	1165.85
Year 2	ha	1090.75	1735.62	555.56	3381.93
Trenching models					
Live hedge strip planting					
Year 1	km	502.54	1028.17	286.03	1816.74
Year 2	km	268.33	426.97	136.67	831.96
Live hedge line planting	km	190.59	530.80	128.75	850.15

7. LABOUR REQUIREMENTS

For each of the models, the labour requirements for seedling production, protection and field work have been estimated.

The labour profile for each model is presented for a 10 year cycle. (Table 7.25) Assuming, that after some time the forests can be worked on a sustained yield basis, then this level of labour is effectively required on a regular and indefinite basis.

The demand for labour by the project will be seasonal.

Gap planting and enrichment

The gap planting models require about 250 mandays of labour per hectare. Every 3000 ha planted generates demand for 750,000 mandays of labour, costing at current rates of Rs 17.50 per day about Rs 13 million.

Assuming the seasonal distribution of labour requires the labour over about 3 months - say 100 days - employment is provided for about 7,500 people, with each person earning on average Rs 1,750.00 per season/year. This is a sizeable contribution to incomes in an area where average per capita income is about Rs. 800 per annum.

Multi product planting

These models, by definition, are located near to populated areas, and because there are shorter cycle crops require higher labour inputs per hectare both for the establishment of the plantation and for subsequent maintenance and protection.

Assuming an average labour requirement of 1000 mandays per hectare, each village plantation, of say 25 ha, would generate 25,000 mandays of work. Again using the assumption that an individual might obtain work for about 150 days per year this would provide labour for 170 people.

Over a 10 year cycle, with the accumulated size of the different village plantations building up to say 250 ha, these people would be in almost permanent employment for about 1700 people during the year. On this basis, the average earnings per individual from the project might provide an income of about Rs 2600 per year.

Table 7.25 Labour requirements for each model per hectare planted.

Wage rate Rps/day 17.50

Model		Project year 1	2	3	4	5	6	7	8	9	10
Gap 'A'	Field		73	24	21						
	Seeds	13	1								
	Protection	201	14								
	Total	214	88	24	21	0	0	0	0	0	0
Gap 'B'	Field		73	24	21						
	Seeds	19	2								
	Protection	201	14								
	Total	220	89	24	21	0	0	0	0	0	0
Gap 'C'	Field		87	72	29						
	Seeds	62	6								
	Protection	201	14								
	Total	264	108	72	29	0	0	0	0	0	0
Bamboo	Field		69	26	27	8	8	8	8	8	8
	Seeds	16	1								
	Protection	201	14								
	Total	217	84	26	27	8	8	8	8	8	8
Sandal	Field		246	75	22	6	6	6	6	6	6
	Seeds	59	24								
	Protection	2133	6								
	Total	2191	276	75	22	6	6	6	6	6	6
Multiple products planting	Field		416	57	50	25	25	25	25	25	25
	Seeds	33	102	10							
	Protection	201	14								
	Total	234	532	67	50	25	25	25	25	25	25

ANNEX VIII EARLY CONSULTANCIES AND TERMS OF REFERENCE

Contents

1. SUMMARY OF EARLY CONSULTANCIES AND TRAINING ACTIVITIES

For administrative ease, these consultancies are here collected:

1. Training in sociology and regional planning.
   8 KSED staff to the UK
   Academic Year 1990/1991
   Pre-appraisal activity
   Ref. Annex IV.

2. Survey of literature of the Western Ghats
   Terms of Reference in Annex II
   UK consultancy
   Pre-apraisal activity

   Geographical Information Systems
   Terms of Reference in this Annex
   UK consultancy
   Post-appraisal activity
   Ref. Ch. 4.3.4

   Initial Training Programmes
   UK consultancy
   Project start activity
   Ref Ch. 4.5

5. Review of draft Implementation Manuals
   UK consultancy
   Project start activity
   Ref. Ch. 4.6

   Selection of sites for environmental studies
   UK consultancy
   Post-appraisal activity
   Ref. Annex II

   Information Management Design
   UK and Indian consultancy
   Project start activity
   Ref. Ch. 4.3.2 etcetera

8. Improvement of Working Plans Design
   Indian consultancy
   Start of project activity
   Ref. Ch. 4.3.2

   Identification of Link Organisations
   UK consultancy
   Pre-appraisal activity
   Ref. Annex IV

2. TERMS OF REFERENCE FOR SELECTION OF SITES FOR ENVIRONMENTAL STUDIES (Item 6 above).

It is recommended that a mission for site identification and selection be carried out before the start of the main project. This would finalize the locations for the 4 main environmental sites for process studies and the locations of the 5 catchment experiments. This would enable detailed planning of the experiments to commence and clearances to be obtained for the use of the sites before the main project begins. It would also allow more detailed costing of the projects to be obtained. The mission members would include an Ecologist-vegetation, Ecologist-animals, Envirronmentalist (process studies) and a Catchment Hydrologist. The mission would be completed within a period of three weeks.

3. TERMS OF REFERENCE FOR COMMISSIONING OF A GEOGRAPHICAL INFORMATION SYSTEMS (Item 3 above).

ODA Consultancy, Western Ghats Project, beginning Oct/Nov 1990

1. To assess the requirements for the establishment and support of a new remote sensing centre under the auspices of the Karnataka Forest Department.

   To advise on the methods and procedures for:

   (a) the regular surveillance of changes in the forest areas, and the preparation of Forest Type Maps at 1:50 000 scale.
   (b) partial or complete updating of land use maps at 1:50 000 or 1:25 000 scale.
   (c) identification of the potential of a GIS, both for regular planning purposes, and for specialised studies.

   To identify the appropriate software and hardware required for the project and to estimate the cost of the purchase and maintenance of equipment for the interpretation of different data and for the production of hard copy.

   To estimate the cost of acquisition of satellite imagery and aerial photography.

   To investigate the means by which final cartographic maps will be prepared.

   To investigate how the centre will liaise with other organisations, such as Indian Space Research Organisation (I.S.R.O, Bangalore) National Remote Sensing Agency (NRSA, Bangalore), and the French Institute for Ecological Research (Pondicherry). This will require visits to each organisation.

   To assess the availability of auxiliary data (eg topographic/meteorological) and the cost of relevant data to be obtained.

8. To specify a list of duties/requirements of the employees of the remote sensing centre.

   To advise on training of the employees of the remote sensing centre.

10. To visit with the officers and technicians of KFD the Sri Lanka Survey Dept, Colombo, and/or Dept of Geography, Univ of Zurich, to discuss with personnel involved in establishing a similar centre in Colombo as part of Sri Lanka/Swiss Remote Sensing Project. Visit Freiburg University for discussion with Prof. G. Hildbrandt.

11. To recommend how the remote sensing and GIS facility will

The first consultancy mission for a period of a month, during the pre-project period. Follow up mission of 3 months after the start of the project for a specialist with knowledge of the particular software purchased, for installing the equipment, training the personnel and adapting the software as necessary.