Appendix A - Diagnostic checklist

The following is a minimal checklist of factors potentially associated with the success or failure of tree planting efforts. It was used in the initial stage of the present study as a logical framework for the evaluation of species choices revealed in project documents, but it may also be used as a general framework for species selection (the decision algorithm given in Chapter 4 and the supporting material contained in the remaining appendices are essentially an elaboration of this framework).

Table 7. Checklist of factors affecting the appropriateness of tree planting efforts.

1. For each project site or recommendation domain, identify:
   Local land use systems and user groups;
   - Prevailing land use patterns
   - Indicators of land use intensity
   - Socioeconomic context and identity of the land users

2. For each tree recommended for a particular land use system or user group ascertain:
   2.1 Functional role of the tree within the land use system:
       - What is the intended function (include both products and services)?
       - Is the function explicitly or implicitly stated or considered in the project document?
       - How was the function identified (distinguish certain vs. apparent indications)?
         - by survey of needs and preferences
         - by demonstrated behavioural choice of the local people (e.g., traditionally planted, preferences shown when taking trees from the nursery, etc.)
         - by "project bias" (e.g., fuelwood projects forced by their mandate to promote fuelwood trees, etc.)
         - by individual choice other than any of the above (what criteria were used)?
       - What is your overall assessment of the intended function?
       - Is there a problem (or benefit) associated with the function to the tree?
       - Can you ascertain whether the function of the tree...
         - is or is not a locally perceived need?
         - is or is not beneficial (or harmful) to some members of the community?
   2.2 Location of tree planting within the landscape:
       - Spatial niche within the landscape where the tree is planted:
         - land quality of the planting site
         - land tenure of specific tree planting site (see also under "distribution of benefits" below)
       - What is your assessment?
         - Is there a problem (or benefit) associated with the planting site (spatial niche, type of land, tenure of land, distance or access to land, landlessness, gender or caste restrictions, etc.)?
         - Which community members do not have access to such planting sites?
         - Are there any other groups which may use these sites or this type of land on a seasonal or temporary basis (e.g., pastoralists, itinerant labourers, women, "strangers")?
   2.3 Tree planting arrangement:
       - Is the tree planted as a monocrop or in association with other plants?
       - If associated with other plants, what are the other plant species?
       - What is the planting arrangement? — What is your assessment?
       - If associated with other plants, what are the other plant species?
       - What is the planting arrangement? — What is your assessment?
   2.4 Tree management:
       - Source of planting material (government, private nurseries, wildlings, etc.)?
       - Type of planting material (seed, seedlings, vegetative cuttings, etc.)?
       - Pre-treatment requirements of the planting material?
       - Planting out method (direct seeding, seedlings, cuttings; land preparation requirements)?
       - Care required/given during the establishment phase (e.g., watering, weeding, protection from livestock and pests, etc.)?
       - Pollarding, coppicing, lopping, thinning, heading back, other forms of pruning?
       - Harvest methods (timber and general system of harvesting, e.g., thinning, tending at end of rotation, topping or pruning as needed, allowing animals to browse during the dry season, etc.)?
       - What is your assessment?
       - In what way does the recommended management affect people’s willingness to plant particular trees (check labour and skill requirements)?
   2.5 Distribution of costs and benefits:
       - Who has what rights to what produce and services? How does the distribute labour inputs and incentives for tree planting for different community members? (Pay particular attention to evidence of conflicts or contradictions; e.g., observations such as: "women do all the work but men get all the benefits; hence women are slow to plant trees." OR "farmers plant trees but pastoralists allow their animals to browse them because they view tree planting as an encroachment on traditional grazing rights." OR “tenants would be interested in planting more trees except that the benefits accrue to the landlords.” OR "tenants are happy to plant trees because it gives them a legal basis for a claim to the land on which they are planted.”)
       - What is your assessment?
       - How does the existing system of the distribution of benefits relate to the distribution of costs, and how does this effect people’s response?
       - What intrinsic or extrinsic incentives are present and how do they affect tree planting behaviour?

Appendix B - The range of options for tree planting

This appendix sets forth a number of complementary perspectives on the range of options that exist at each of the decision points in the planning algorithm given in Table 7 of Chapter 4. It does not provide ready-made solutions or recipes that can be applied unthinkingly to any location. The intention, rather, is to open up thinking about the range of possibilities for a creative and socially sensitive approach to tree planting for a variety of clients. The selection of reference material to aid in this process is deliberately eclectic. Although there is a general consistency in what is presented, no attempt has been made to embrace a rigid uniformity on the perspectives offered here. There are no “magic bullets.” Each and every new situation requires individual consideration. All decisions should be made in consultation with the intended users and tested as working hypotheses until validated by direct experience.

8.1 The user perspective

Rocheleau (1986) has recently focused the effort to develop a "user perspective" in agroforestry. The first question to ask when trying to develop a user perspective on a given locality is: what kinds of land users are there? The following checklist suggests some of the possibilities to consider when developing a list of land users for your area.

Table 9. Defining your clientele: users of land, trees and tree products (adapted from Rocheleau 1986).

<table>
<thead>
<tr>
<th>USER CATEGORIES</th>
<th>PRODUCERS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest producers</td>
<td>professional foresters, private forest owners, etc.</td>
<td></td>
</tr>
<tr>
<td>By tenure/type of forest production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foresters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional forest users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encroachers, poachers, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest labourers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hunters, foragers, shifting cultivators, herders, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>illegal in formal law but may have rights in customary law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>paid for labour, may engage in other exploitative activities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Farmers
By size of landholding
- Medium-large farmers
  exact size limits vary from area to area
- Small farmers
  exact size limits vary from area to area
- Landless & marginal farmers
  dependence on wage labour and gathering

By farming system type
- Long fallow shifting cultivation
  R value S 10 (see note below)
- Bush fallow cultivation
  R value 10-33
- Short fallow cultivation
  R value 33-66
- Permanent arable cropping
  field cropped annually
- Multiple cropping
  more than one crop/year
- Perennial crop plantation
  usually trees crops, often internationally traded commodities

By economic orientation
- Subsistence
  production for own consumption or informal exchange
- Mixed or "subsistence plus"
  most common orientation of small farmers
- Commercial
  production for cash sale

By type of tenure/participation
- Land owner
  freeholder, owner operator, absentee landlord, etc.
- Usufruct right holder
  tenure usually secure but rights limited
- Tenant
  based on informal reciprocity rather than formal exchange
- Borrower
  full or part-time, continuous or temporary
- Farm labourer
  "illegal" occupier but some rights usually recognized
- Squatter
  based on informal reciprocity rather than formal exchange

Livestock producers
- Ranchers
  modern commercial extensive range management
- Pastoralists
  traditional nomadic, semi-nomadic or transhumant herders
- Agropastoralists
  part-time harding in combination with cropping
- Mixed farmers
  limited livestock production closely integrated with cropping

PROCESSORS
Urban industry
- located in cities or large towns
  large-scale, high tech industries like pulp, rayon, chemicals
- Modern, formal sector
  medium/large-scale, adequate working capital & storage facilities
- Traditional, informal sector
  small to medium-scale artisans and workshops

Rural industry located in rural areas, villages or small towns
- Medium-scale
  usually modestly capitalized & labour intensive, e.g. saw mills, furniture making
- Small-scale
  cottage or small-scale group enterprises providing full or part-time employment

VENDORS
- Formal sector
  medium/large-scale, adequate working capital & storage facilities
- Informal sector
  small/trading-scale, lack of capital & storage facilities

CONSUMERS
- Urban
  large, politically influential populations
- Rural
  farmers, rural industry workers, retired persons and members of the remittance economy

Note: The R-value classifications are based on Ruthenberg (1971). R-value = (cropping period + (crop + fallow period)) x 100. Equivalent to % of land in cultivation at any one time.

Checklists such as the foregoing are useful to stimulate perception of often overlooked user groups and interests, but the main concerns of most projects located in areas of settled agricultural land use can often be handled by much simpler classifications. One such simple, widely applicable classification can be developed from our analysis of the eucalyptus controversy, where there were three main socioeconomic categories of land users (Table 10).

Table 10. Classification of settled land users by ability to participate in tree planting.

<table>
<thead>
<tr>
<th>Category</th>
<th>Landholding</th>
<th>Ability to participate in tree planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Advantaged</td>
<td>Large farmers</td>
<td>More than adequate resources for participation in planting, but generally only interested in practices that offer attractive commercial returns, or that confer other socioeconomic advantages (e.g. security of tenure over large land holdings)</td>
</tr>
<tr>
<td></td>
<td>Small farmers</td>
<td>Adequate resources for participation in a wide range of tree planting practices, both for subsistence and commercial purposes; this is the main client group for the widest range of agroforestry and other multipurpose tree planting practices.</td>
</tr>
<tr>
<td>2) Moderately endowed or capable</td>
<td>Small to medium-scale farmers</td>
<td>Adequate resources for participation in a wide range of tree planting practices, both for subsistence and commercial purposes; this is the main client group for the widest range of agroforestry and other multipurpose tree planting practices.</td>
</tr>
<tr>
<td>3) Disadvantaged</td>
<td>Landless and marginal farmers, minority groups, women in some cases, etc.</td>
<td>Lack of land resources restrict participation in tree planting to a limited range of options (for cash income or partial subsistence); special incentives and infrastructural supports may be needed to enable participation, unless land can be made available, or tree tenure rights given, the processing of tree products may be a more viable option for the landless than direct tree planting.</td>
</tr>
</tbody>
</table>
B.2 Socioeconomic context and development strategy

The eucalyptus debate demonstrated how important the socioeconomic context of the intended user can be in determining whether or not he or she will be able to make effective use of a particular tree planting practice. Factors that are relevant to consider under this broad heading will vary greatly from place to place. Among the most important are: degree of local socioeconomic stratification (by wealth, land holding size, gender, ethnic group, etc.), access to resources (land and tree tenure), overall economic development strategy, general approach of tree planting programmes, opportunity for reallocation of resources, access to credit, processing technology and marketing assistance, etc. The category covers a vast territory. Only the major considerations are highlighted here.

Socioeconomic stratification

The degree of socioeconomic stratification which exists within a locality is an extremely important determinant of the adoption and impact of new technology, particularly if it is tightly coupled to factors which govern access to resources. It is no accident that the Indian communities in Karnataka where the eucalyptus controversy waxed hottest are areas where rates of landlessness are high and where traditional landlord-client relationships based on caste and economic dependency were beginning to break down under the influence of changing capital and labour relationships in agriculture just when eucalyptus farm forestry was introduced.

One of the most important factors in how the pattern of social stratification is expressed in an area is the body of formal and customary law defining land and tree tenure. Several recent publications have expanded our understanding of tenure issues in forestry and agroforestry projects (Fortmann and Riddel 1985, Raintree 1987, Fortmann and Bruce 1988). Much of this recent advance in knowledge has been synthesized by Bruce (1989) in a guide to the rapid appraisal of land and tree tenure issues for project planners and researchers. It will suffice here to highlight a few of the key areas of concern.

Table 11. Who has what rights to which trees? (adapted from Fortmann 1987).

<table>
<thead>
<tr>
<th>Types of trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>The State</td>
</tr>
<tr>
<td>Groups</td>
</tr>
<tr>
<td>geographically defined groups (e.g. village residents vs. strangers)</td>
</tr>
<tr>
<td>kin groups</td>
</tr>
<tr>
<td>non-kin corporate groups</td>
</tr>
<tr>
<td>Households</td>
</tr>
<tr>
<td>Individuals</td>
</tr>
<tr>
<td>tree planters</td>
</tr>
<tr>
<td>landowners</td>
</tr>
<tr>
<td>tenants</td>
</tr>
<tr>
<td>borrowers</td>
</tr>
<tr>
<td>pledges/mortgagees</td>
</tr>
<tr>
<td>Types of tree rights</td>
</tr>
<tr>
<td>Rights exercised by the State</td>
</tr>
<tr>
<td>Ownership of trees on State land</td>
</tr>
<tr>
<td>prohibition of tree use (specific trees or all trees on reserved forest land)</td>
</tr>
<tr>
<td>limited use of trees for specific uses by specific people</td>
</tr>
<tr>
<td>Regulation of the use of trees on others' land</td>
</tr>
<tr>
<td>Rights exercised by individuals or groups</td>
</tr>
<tr>
<td>Right to own or inherit trees</td>
</tr>
<tr>
<td>Right to plant trees</td>
</tr>
<tr>
<td>Right to use trees and tree products</td>
</tr>
<tr>
<td>Right to use the standing tree (e.g. to hang beehives or cure hides)</td>
</tr>
<tr>
<td>Right to use produce under trees</td>
</tr>
<tr>
<td>Right to harvest produce</td>
</tr>
<tr>
<td>Right to cut all or part of a living tree</td>
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<tr>
<td>Right to dispose of trees</td>
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<tr>
<td>Right to destroy the tree</td>
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<tr>
<td>Right to lend the tree</td>
</tr>
<tr>
<td>Right to lease, mortgage or pledge the tree</td>
</tr>
<tr>
<td>Right to give away or sell the tree</td>
</tr>
<tr>
<td>Factors affecting who has what rights to trees</td>
</tr>
<tr>
<td>Origin of the tree</td>
</tr>
<tr>
<td>Planted vs. self-propagated</td>
</tr>
<tr>
<td>Location of the tree</td>
</tr>
<tr>
<td>Private vs. common land</td>
</tr>
<tr>
<td>Nature of the use</td>
</tr>
<tr>
<td>Cash vs. subsistence</td>
</tr>
<tr>
<td>Nature of the land tenure system</td>
</tr>
</tbody>
</table>

Any change in production technology that affects the use of the resource base will send ripples of change throughout the system of customary rights and obligations that regulate the use of those resources. Most projects are launched in near total ignorance of these impacts. Minimally, one needs to check out the likely impact of the proposed technological or organizational change, not only on those who are likely to adopt the innovation but also those who may not be able to adopt it but are nevertheless unable to escape the effects of adoption by others.

The central question is: whose rights are likely to be affected by the introduction of a new tree growing practice or organizational innovation. This checklist may be helpful in troubleshooting the possible tenure impacts of such innovations. See Bruce (1989) for other rapid appraisal survey instruments and guidelines.

Table 12. Trouble-shooting checklist to assess the effects of tree planting on existing land or tree use rights held by selected user groups (adapted from Fortmann 1987).

<table>
<thead>
<tr>
<th>User category</th>
<th>Location, age, etc.</th>
<th>Improved, reduced, lost, etc.</th>
<th>Total, including total</th>
<th>Trees, including trees, and total</th>
<th>Gal or Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>(In general)</td>
<td></td>
<td></td>
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</tbody>
</table>

Conflicting demands on forest resources

The following case study shows how complex the conflicting demands on forest resources can become. Ultimately it is the political process that sorts out who gets what rights in practice and the results may differ markedly from the legal rights accorded in principle.
The following table represents a practical synthesis of several lists of tree functions and the method employed to assess the demand. The hierarchy of power and the order in which the various demands are satisfied is roughly as follows:

### Table 13. Tree growing approaches in social forestry projects (adapted from FAO 1985)

<table>
<thead>
<tr>
<th>RANK</th>
<th>INTEREST GROUPS</th>
<th>MANAGEMENT OF TREE AND LAND RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>government</td>
<td>COMMUNAL AND COMMUNITY-BASED FORESTRY</td>
</tr>
<tr>
<td>2</td>
<td>electricity board, pulp and paper industry, modern wood-based industries, rich traders</td>
<td>PRIVATE FORESTRY</td>
</tr>
<tr>
<td>3</td>
<td>forest land-based public corporations</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>encroachers cultivators, highland planters</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>traditional industries (rich)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>wood users (rich), tourists (rich), traders (middle class)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>traditional wood industries (poor), low income wood users</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>lowland cultivators, tribals</td>
<td></td>
</tr>
</tbody>
</table>

In the case of competitive or mutually exclusive demands the groups which stand higher in the hierarchy will have precedence over those below. A weaker group can also secure its demands if they happen to be complimentary to the interests of a powerful group. The demands that will be satisfied first are: revenue to government, forest produce demand of the modern industries, land for electricity board and forest land-based public undertakings, etc. Those that will remain least satisfied are the demand for services from foresters, especially habitat protection, regulation of streamflow--as the groups which require these wield little power.

The table includes direct production roles of trees and indirect service roles (in which the tree itself has no direct output but still has a function instead to enhance the output of other components of the production system).

### B.3 Functions of trees

Fundamentally, even before considerations of physical site matching and immediately following the specification of the intended user, the primary question in the selection of an appropriate tree species is: what function is the tree expected to perform? Of course, one tree may perform multiple functions and, by the same token, more than one tree may be required to fill all of the functional needs of the intended user. In the wake of the “energy crises” of the 1970s, most social forestry projects were planned with fuelwood as the primary objective, yet fuelwood is rarely the first priority of rural people. Fruit trees, fodder, medicinal trees or poles for cash among numerous other uses of trees often take precedence over fuelwood (Rainine and Hoskins 1980).

An unbiased approach to species choice begins with an awareness of the full range of uses at a medium level of detail. The table includes direct production roles of trees and indirect service roles (in which the tree itself has no direct output but functions instead to enhance the output of other components of the production system).

### Table 14. Products and services provided by trees (Sources: Rainine 1987, Scherr 1987, Burley and Wood in press).

#### PRODUCTS

**FOOD (for people)**

- Fruits
- Nuts
- Oils
- Seeds
- Robehes
- Spices
- Starch (e.g. tapioca)
- Sugary sap
- Beverages
- Honey
- Mushrooms, caterpillars & the like
- Stimulants & other ingredietns (e.g. betel, cola nut, amousing materials, etc.)

**FEED (for livestock, fish, bees, silkworms, caterpillars, ants, mushrooms, etc.):**

- Leaves
- Fruits
- Nuts
- Seeds
- Bark
- Roots
- Wood

**FERTILIZER**

- From prunings
- From litter
- From root discard
- From animals attracted to the tree for shade or shelter

**ENERGY**

- Firewood
Charcoal
Wood chips, sawdust briquettes
Pyrolytic oils and gases
Ethanol
Methanol
Oils
Latex
Resins
Augmented windpower

BUILDING MATERIALS
Poles
Posts
Planks, saw-wood, lumber
Thatch, other roofing
Chipboard
Veneers
Flooring
Sleepers

RAW MATERIALS FOR LOCAL INDUSTRY
Wood
- carving, turnery
- furniture
- hand tools
- matches
- musical instruments
- sporting goods (e.g. cricket bats)
- utensils
- weapons
- wheels/spokes

Fiber
- rope
- clothing
- baskets, etc.
- Wrapping material (e.g. palm leaves)

Chemical or industrial substances
- adhesives
- biocides, pest repellents
- cork
- dyes, food colouring
- essences (e.g. for perfumery)
- gums
- lac
- medicinals, botanicals, pharmaceuticals, stimulants, narcotics, etc.
- oils/paints
- pulp (for paper, cardboard, etc.)
- resins
- rubber
- tannins
- varnishes
- water purification agents
- waxes

SERVICES
LIVE FENCING
- Dense hedges
- Stickwood fences
- Posts

SHADE (for people, animals & shade-loving crops)

SOIL MANAGEMENT
- Fertility maintenance & rehabilitation (chemical & physical)
- Soil conservation/erosion control

WATER MANAGEMENT
- Water absorption/retention (in soil or vegetation)
- Improved drainage (e.g. with phreatophytic trees)
- Flood control (e.g. riverbank measures)

WIND SHELTER (including control of wind erosion & crop dessication)
- Shelterbelts
- Windbreaks

A somewhat different perspective is suggested by looking at the potential of trees to supply the basic needs of the household economy (Table 15). This “basic needs” approach provides a convenient entry point for diagnosis of tree-related supply problems and identification of relevant tree planting interventions. Used as a tool in the analysis of land use systems, the assumption behind this approach is that land use systems, whatever else they might do, are organized so as to satisfy these universal human needs in one way or another. In subsistence economies these needs are met directly from household production, while in commercial economies basic needs are generally met by purchases.

Table 15. Potential role of trees and shrubs in satisfying basic human needs (Raintree 1987, 1989).

FOOD
1. Human food from trees (fruits, nuts, leaves, cereal substitutes, mushrooms, etc.)
2. Livestock feed from trees (moving down the trophic chain)
3. Fertilizer from trees for improving the nutritional status of associated food and feed crops through a) nitrogen fixation, b) access to greater volume of soil nutrients through deep rooting trees, c) improved availability of nutrients associated with higher CEC and organic matter levels, d) mycorrhizal associations, e) feedstock for lignicolous mushrooms
4. Soil and water conservation effected by runoff and erosion controlling arrangements of trees in farming systems (indirect benefits through enhanced sustainability of cropping systems)
5. Microclimate amelioration associated with properly designed arrangements of trees (e.g., shelterbelts, dispersed shade trees) in crop and grazing lands (indirect production benefits)

WATER
1. Improvement of soil moisture retention in rainfed cropping systems and pastures through improved soil structure and microclimatic effects of trees
2. Regulation of streamflow for reduction of flood hazard and more even supply of water through reduction of runoff and improvement of interception and storage in infiltration galleries through various watershed protection practices involving trees
3. Protection of irrigation works by hedgerows of trees
4. Improvement of drainage from waterlogged or saline soils by phreatophytic trees
5. Increased biomass storage of water for animal consumption in forage and fodder trees
6. Purification of drinking water

ENERGY
1. Firewood for direct combustion
2. Pyrolytic conversion products (charcoal, oil, gas)
3. Producer gas from wood or charcoal feedstocks
4. Ethanol from fermentation of high carbohydrate fruits
5. Methanol from destructive distillation or catalytic synthesis processes using woody feedstocks
6. Oils, tars, other combustible saps and resins
7. Augmentation of wind power using tree arrangements to create venturi effects

SHELTER
1. Building materials for shelter construction
2. Shade trees for humans, livestock and shade-loving crops
3. Windbreaks and shelterbelts for protection of settlements, croplands, pastures and roadways
4. Fencing (living fences, fence posts, cut brush fences, etc.)

RAW MATERIALS (for local industries)
1. Wood for a variety of craft purposes
2. Fiber for weaving industries
3. Fruits, nuts, etc. for drying or other food processing industries
4. Tannin, essential oil, medicinal ingredients, etc.

CASH
1. Direct cash benefits from sale of tree products
2. Indirect cash benefits from productivity increases (or input savings)

SAVINGS/INVESTMENT (as insurance against contingencies for future goals)
1. Addition of a savings/investment enterprise to farms lacking one
2. Improvement of existing savings/investment enterprises (e.g., increased fodder for cattle kept as savings on the hoof)

SOCIAL PRODUCTION
1. Production of any of the above goods for socially motivated exchange (e.g., bride price or dowry, funeral and other ceremonial occasions, political expenses, etc.)
2. Increased cash for social expenses (ritual expenses, development levies, political contributions, etc.)

To achieve specific objectives, interventions need to be carefully planned to address specifically defined needs. No amount of "income generation" will solve staple food or fuelwood shortages if there is an absolute scarcity of these commodities in an area.